Straw Bale Basics

According to US Department of Energy our buildings consume:

- 37% of all energy used in the United States
- 68% of all electricity
- 12% of freshwater supplies
- 88% of potable water supplies
- 40% of all raw materials!!

According to US DOE our buildings generate:

- More than 1/3 of municipal solid waste
- 36% of human generated CO₂ emissions
- 46% of SO₂ emissions
- 19% of Nox emissions
- 10% of fine particulate emissions
- Indoor air contaminants affecting human health
The ‘green building’ and ‘natural building’ movements are a response to this need to create homes that are not toxic!

We also take this a step farther:

CULTURALLY BASED AND REGENERATIVE DESIGN.

Homes should be designed not only based on the environment they exist in, but also to reflect our needs and cultures.
What is Straw Bale Building?

Straw bales were first used to construct homes in the Sand Hills of Nebraska in the late 1800s. Faced with no trees to mill and soil too sandy to use for sod homes, they turned to the abundant supply of prairie grasses and their recently invented baling machines. Many of these turn-of-the-century homes, schools and churches are still standing!

Modern straw bale construction uses the same basic principles applied by the Nebraskan pioneers, but updated to meet current building code requirements.

Straw bale homes offer insulation values of R-40 to R-45, more than double that of standard frame homes. Straw bale walls are also less expensive than wood-frame ("stud") walls. Environmentally, the use of straw bales replaces the majority of the framing lumber, manufactured insulation and plastic barriers with an annually renewable, agricultural waste product.

**Straw bale homes consistently use less than one half of the heating and cooling energy required by standard frame homes.**

Any type of straw can be used, including wheat, oats, barley, rye and rice. Bales used for building must be dry (less than 20% moisture) and tight.

Straw bale buildings use the same foundation, flooring and roofing technologies familiar to builders of frame homes. Basements, slabs and pier foundations can all be easily adapted to straw bale construction. Similarly, prefabricated trusses can be used to provide the roof structure.

The straw bales in the walls are stacked in a manner similar to bricks or concrete blocks, in running bond. Window and door openings are created using wide, rough frame wooden bucks inserted into the walls during construction. The first course of bales is always started on a 2x4 curb, to lift the bales higher than the interior floor level, in case of flooding or spills.

There are two basic styles of straw bale construction. Post and beam style uses a structural framework to support roof loads, and the bales are either wrapped outside the framework or in filled between the framing members.
While wooden post and beam systems are the most common, concrete and steel frames would also be suitable.

Load-bearing (or Nebraska) style bale buildings use the bale walls themselves to support the roof. Various systems have been used to "pre-compress" load-bearing bale walls to eliminate any "sponginess" from the bale walls and level them. A structural roof plate is placed on top of the walls, and the precompression system draws this roof plate down toward the foundation. The simplest and most effective system devised to date is a series of 9-gauge wires looped through the foundation and over the top plate, and tensioned using a come-along.

There are building code approved examples of both load-bearing and post and beam straw bale homes all over the United States and Canada. Many have received bank mortgages and regular home insurance. Much testing has been done on straw bale wall systems, and all tests to date show that they outperform the standard 2x6 frame wall. Fire tests show a burn time more than double that of a frame wall, and structural tests show similar advantages.
What about mice & other pests?

Mice aren't in fact a problem with bale houses; at least, no more so than with standard houses. If mice are found in a bale house, they are more apt to burrow into fiberglass attic insulation or stud walls (easier to get into). Mice and other pests aren't attracted to straw as a food, since there is no nutritive value left in the straw.

What about fire?

Straw bale houses get a far better fire rating than standard homes do. They pass a 2 hour fire test. However, loose straw is very flammable, so great care must be taken to avoid activities producing sparks near loose straw. Good building practice includes carefully cleaning up the loose straw on the site at the end of each work day.


What if the bales get wet?

It is problematic in any type of building if the building materials get wet; at a bale raising, be scrupulous, and reject any wet or even slightly damp bales. If the bale wall gets wet during the construction phase, it does have the capacity to dry out through capillary action, but if it is soaked, occasionally you may have to replace a portion of the wall during construction. Proper building techniques must be strictly adhered to when building with bales, including having large overhangs around the building, and the placement of the windows flush to the outside of the building. The Canada Mortgage and Housing Commission has done several tests on moisture in straw bale buildings, and the conclusions are that moisture damage occurs with improper building practises.

What is the cost?

This is one of the first questions people ask. The cost of building a straw bale building varies greatly depending on design, size, and amount of hired labor. The price of a straw bale home is comparable, and sometimes less, than a custom, conventional home. However, when comparing, remember
that a straw bale wall has at least double the insulation of a standard framed house, so the comparison isn't really accurate. If you were to ask a conventional builder to quote on building an R-40 wall, the square foot cost would be significantly higher. Some folks will have you believe that you can build a straw bale home for $10/sq. ft. Somewhere out there, perhaps several decades ago, some owner/builders succeeded in building small buildings with no hired labor, and with reclaimed materials, for that cost, but would be near impossible to do today. Some owner/builders have been fortunate enough to build for as little as $60-$80/sq. ft. (that is with LOTS of donated labor), reclaimed materials, wood off their own lot, etc. With the tremendous increase in materials costs today, the average home, with hired labor, falls in closer to $130-$150/sq. ft., and of course, depending on the design and finish, the cost can go much higher than that. To keep costs down, start out with a simple design, if it suits your purposes. Try to keep the building as small as manageable for your needs. And if you are able/interested, try to schedule in some volunteer labor if possible.

**What is the difference between straw & hay?**

Straw is the left-over stalk after grain has been harvested. Chemically straw is composed mostly of cellulose and lignin, the same major components of wood. It contains no nutrition, and is used as bedding for livestock. Hay is field grass that has been cut and baled while still quite green. Hay has a high nutritive value (it is fed to livestock). People often confuse straw and hay; houses are made with STRAW. Some folks also confuse the spontaneous combustibility of hay with straw. It is the moist hay bales, heated under the right conditions, that can self-combust, not straw bales.

**How strong is a bale wall?**

There has been a lot of testing on the compressive strength of bale walls, in addition to the lateral & sheer strength. Bale walls surpass many other building materials in this regard. In addition, the bale wall, once the plaster has been keyed into it, becomes a solid unit which acts as a stress skin panel.

**What about building codes?**

In general, building officials will want to see a set of finished plans that have been stamped by a structural engineer. There are currently straw bale building codes in many states in the U.S. as well as in Canada. Tribal
building projects sometimes have codes in place, sometimes not, and it is good to approach building officials with lots of literature and any other publications you have on hand that explain and legitimate building with bales.

**What about wiring & plumbing in the wall?**

As with conventional building, you want to keep plumbing out of the exterior walls of the house. Plumbing fits into bale houses either in interior stud walls, run along baseboards, or coming up through the foundation.

Electrical wiring can be done in several ways. Some folks run conduit through their straw bale walls, and then feed the electrical wire through that. Although this is perfectly acceptable practice, it is unnecessary. Some people prefer to build (or buy) a base board 'box' to house any electrical wiring at the base of the bale wall. This allows easy access for updates, computer wiring changes in the household, etc. A less expensive, but common way to run wire through a bale wall is to have your electrician come prior to the bale raising and install the electrical wire around the house, leaving ample wire for snaking up between the bales to reach the height of switches & plugs. As the bales are being stacked, the electrical wires are embedded 8"-9" into the bale wall, to be set at the appropriate height. (The electrical boxes can be attached to wood scraps that act as spikes, to set them in place until they are plastered). We recommend a gas-tight type of electrical box, 11 10 utility box, or masonry box which has a flange on it. The gas-tight box is sealed to air leaks, and you won't have to fool around making vapour barrier 'hats' behind each box.

**How do you hang things on a bale wall (cabinets, pictures, etc.)?**

Easy! All you need is a drill & a masonry bit of the appropriate size. Drill in through the plaster with the drill bit, and then you can put your screw right into the wall. Actually, we've used a cordless drill & have driven screws directly through a finish plaster and into the masonry below without pre-drilling for hanging pictures, and that worked fine.

For hanging cabinets and heavier items, it is best to plan this out ahead of time and imbed a piece of lumber into the bale wall, and plaster up to or over it. You can leave a couple of screws sticking out of the piece of wood for ease of finding it after you have plastered.
Is it possible to get house insurance for a bale building?

Yes. In fact, the insurance companies are mainly interested in the fire rating of straw bales, and once they have seen the research, some families have even been issued better insurance rates than a conventional house.

What about bugs?

Once a bale building is properly sealed in, there shouldn't be any problems with pests, since there isn't any nutritive value in the straw itself. That being said, a select few owners of bale homes have, in the first year of the house, been annoyed by tiny beetles (either plaster beetles or collimba, not sure which)...these tiny bugs seem to lay their eggs on certain types of straw, and it seems that straw that has been harvested the same year as building is more likely to have the pests. Although harmless, the bugs are annoying. However, the good news is that after the first year, they die off, and you don't tend to ever see them again (by the way, in doing a search of plaster beetles, I discovered that this is not unique to bale buildings only; new construction, with lots of moisture & humidity caused by plastering, is susceptible to them).

What kind of foundation do you need?

A regular foundation...it can be a pier foundation, slab on grade, footing and frost wall, whatever suits the site. Rubble trench below the frost line with a grade beam of stone, earthbags, recycled materials is an excellent option for minimizing environmental impact.

What finishes can you put onto bale walls?

You can apply lime, gypsum, or earthen plasters on bale walls. It is important to use materials of similar permeability on the inside and outside walls. Some folks opt to paint the interior bale walls once they are plastered; it is important to use a water-based paint, and not an oil-based one. NO LATEX!!! The best option would be to paint on a tinted lime-wash, natural clay paint, potassium silicate paint, or tint your finish coat of plaster as a finish as these have no negative effect on wall permeability.