Sustainability - More than just Straw Bales

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According to Webster's online dictionary, sustainability is defined as...

Main Entry: sus·tain·able
Pronunciation: s&s-'stA-n&-b&l
Function: adjective
Date: circa 1727
1 : capable of being sustained
2 a : of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged <sustainable techniques> <sustainable agriculture> b : of or relating to a lifestyle involving the use of sustainable methods <sustainable society>
- sus·tain·abil·i·ty  /-ˈstA-nə-ˌbi-lə/ noun

What sustainability means to me is to have the ability to create something without harming the local environment, and to accomplish what you have set out to do in such a way that future generations will also be able to create exactly the same things, in perpetuity.

The question is, can we, as builders, architects, engineers and building officials, take an honest and open look at how we currently construct straw bale homes and truly find the methods and materials we use to be sustainable?
I think the answer to that loaded question, is that it depends on how we build and what we choose to build with.

First off, a few facts.

- The production of concrete/Portland cement is responsible for 8-10% of the Earth's greenhouse gas emissions according to reports published by Greenpeace.
- The current rate that forest companies are harvesting the timber in the forests of North America today, far outweighs the production capabilities of those same forests.
- In the North America, and most likely worldwide, the construction industry uses an incredibly large percentage of water, second only to the food production industry.

Based on these facts, the most common building materials of stucco cement and timber framing, which are the current "industry standard" being used in the construction of straw bale homes are not necessarily "sustainable" materials.

Building Materials.

In North America, building officials want to see a stamp from an architect or an engineer (sometimes both) on a SB house plan which absolves them from responsibility should anything fail in the structure throughout its lifespan. This has led to the use of cement and timber frames being the most common ways to provide a platform, framework and finish for the bales, of concrete, wood and steel. Since the properties have been measured, quantified and standardized the architects and engineers have numbers associated with the materials so they can design a building to withstand the foreseeable forces that the structure will be subjected to during its lifespan.

Many architects, engineers and contractors in the industry are aware of the impacts on the environment caused by deforestation and cement production, and are turning to other methods and materials in attempts to lessen the ecological footprint of the homes they build.
Cement Render Alternatives.

Earthen plasters are a far more common alternative to cement stucco today than even a few years ago. Instead of a cement render, a simple mixture of local soil from your building site or local quarry, unwashed plaster sand of varying size and well chopped straw form the basic recipe for a plaster which will seal and protect a bale home from insects, fire and weather. Add a small amount of linseed oil to the mix and you have a fairly water resistant plaster, which could be left as an exterior finish with a proper overhang. Other exterior alternatives to cement are a lime plaster with a lime wash for color. A lime plaster is more water resistant than earth and less hydrophilic than cement, and when properly applied, over a long period of time will cure back to its original form - limestone. Both lime and earth are more vapor permeable than cement, and provide a softer finish as well.

For the interior, after you have brought the wall surface to its desired level of plane, instead of a store bought paint, drywall or gypsum plaster, an alis (pronounced alize) finish plaster can be used instead. Wheat paste, Kaolin clay and fine plaster sand are the ingredients needed to make this fine, smooth finish. A pigment is added to the mix to achieve the color of your choice. It is less water resistant than a cement plaster and should not be used in a place where the walls will get wet. Another option could be Papercrete or "ClayPercrete", a mixture of shredded newspaper and water with a touch of cement or clay or both. This slurry is not as sticky as an earthen plaster, but with a little diligence can be applied to wired bales. It is very soft, and even when dry and needs a good, durable finish applied over it to be a good long term plaster.

The benefits of plastering walls with materials other than cement lie in the permeability of the plaster "skin" and also the amount of embodied energy going into your walls. A "breathing" set of walls with natural plasters will shed the moisture they gather during wet times of the year more easily than walls that have been plastered with cement. In terms of energy, because the production, transportation and sheer cost of cement is exponentially higher than digging the soil from your own house site, it only makes sense to use an earth based plaster if your aim is sustainability.

Poured Foundation Alternatives.

A poured cement slab foundation is the common means of providing a foundation to build a house on today. Depending on the type of soil you are building on and the type of structure you build, there are some other alternatives to the cement slab. A low tech method is to use large boulders or stone to raise your bales off the ground, away from rising damp and splashback. The boulders can be leveled with a combination of earth filled bags and cob to provide a good, flat surface to raise your bale walls on. Another way is the Gabion cage, a wire "basket" filled with rubble or drain rock sunk down into the earth and raised above ground to the desired level. The cage is formed into a rectangle wide enough to hold your bales, filled with rock and tamped down, then tied with wire across the center and top to hold it together. Sometimes a wire lid will be put on top to help hold everything together. This provides a stable foundation to lay your bales on that will also drain any moisture that may come in, back to the ground. One more option is rammed earth tires. A standard used automobile tire is laid on the ground and filled with soil. Using a sledgehammer, the earth is pounded towards the tread of the tire, and eventually filled completely and leveled, creating an extremely dense and stable building block. Stack several layers of tires on top of one another in the shape you intend the house to be, cover the top layer with a waterproof layer to deter rising damp, and voila, a recycled foundation for your bales that diverts waste from the landfill.

Underneath each one of the above foundation options, be sure to include a drainage system such as the "French drain" for times of heavy rainfall.

Once your bales are up and plastered, poured adobe(with radiant tubing if desired) can finish the interior floor of the structure. Other flooring options could be clay or glass tile, bamboo tongue & groove, flagstone or many other alternatives to concrete.
Wood Alternatives.

The most obvious alternative to a wooden framework to support your roof is to not use one at all! Straw bale walls have proven load supporting capabilities as well as excellent shear values once rendered. Multi story bale structures have been built with great success and do away with the need for any framework whatsoever. The only wood needed in a load bearing structure is in the window and door buck framing, and other means such as steel or even cob (in the case of windows) can do away with the use of wood altogether. Unfortunately, engineers and building officials are generally not as comfortable with the load bearing option at this point. As further research is done to generate hard numbers proving the effectiveness of straw as a load carrier, the options for architects and builders to use this technique will expand. Hats off to Bruce King of the EBN and many others around the world who have been working towards creating consistent data in this area.

Other options when a frame is a must are bamboo, steel, cinder blocks, rastra blocks, sustainably harvested "certified" wood, and/or recycled/reclaimed wood. Alternative choices to wood are out there, and many more will surface in the future.

A note on bamboo. There are over 1000 varieties of bamboo available today, and some of these have structural capabilities that far surpass wood or steel. A piece of bamboo mimics the shape of a human bone, each node being of similar design to the carpal bones in our hands. Each node is sealed by a circular and concave disk, making them extremely strong. Bamboo, when used correctly can span amazing distances, far more than wood, and is exceptionally unique in its beauty as well.

In terms of sustainability, some varieties of building grade bamboo reach full maturity in three years (most wood in North America takes between 30 and 80 years to grow before it's ready for harvest) and is harvested by cutting above the roots. The same stand of bamboo will regrow from its "stumps", in another 3 years. They can grow almost anywhere, and are a vast source of potential building material for those who are willing to learn how to use it properly. Simon Voulez of Columbia has created some incredible structures using bamboo, see the book "Grow your own house" for some examples of his work and the potential of bamboo.

Roofs.

A basic conventional roof design in North America is built with 2 by 4 trusses, spaced according to the load they will need to carry, crossed with 1 by 4 purloins, covered with a moisture barrier such as roofing felt, then sheathed with shingles of aluminum. The space between the trusses is stuffed with fiberglass batt insulation and then drywall is hung below to seal it off. Add some vents and soffits and you're done. This is a very resource intensive way to build a roof.

Why not design a roof with bamboo trusses and purloins, a recycled or salvaged metal or clay tile roof, insulated with blown in cellulose, recycled blue jean or papercrete, and finished with reed matt soffits. The embodied energy and cost of this type of roof is far lower than the conventional model.

To take it to another level, design a living roof with bamboo truss-work adequate to carry the extra loads. A "green" roof is a benefit to your homes performance and the environment as well. Not only is it beautiful, but it also insulates your roof, provides a rooftop garden where you can grow wild strawberries, squash or decorative plants and flowers. It catches rainwater and percolates it slowly through the soil, delaying its trip to the sewer system, thus lowering the impact on your towns drainage facilities during times of high rainfall. Finally, it provides green-space, effectively giving your home greenhouse gas "credit" potential. Kyoto, here we come!

There are many ways to build a roof, it is up to all of us as designers and builders to provide our clients with alternatives to the conventional model.

Water

Have you ever thought twice when dumping wash water from cleaning tools at the end of a long day? Or when turning the key in you cars ignition, or perhaps in the bobcat or tractor? When flying to this conference
here in Australia, did you ever consider the impacts of all that jet fuel going up in ozone depleting smoke? I have, and though I am not a purist by any standards, I have come to realise that we can also make some choices along the way towards conservation and using alternative means of transportation and fuels when we build or travel.

Recently in California I had the pleasure and the challenge of running an earthen plaster job on a small, owner built straw bale home with a very finite amount of water at our disposal. Less than 1000 gallons of water was all we had to work with to apply the base coat of plaster while we waited for the well to be dug and producing water. As our first day of plastering was coming to a close, I was cleaning out the mixer and washing tools as I normally would, running the hose into the drum and scrubbing the mud off the blades, then pouring the muddy water to the ground. I was thinking more about a nice cold beer than what I was doing. It wasn't until later that the realization came that I could have been reusing all that wasted water to slake our next days earth and clay! Each day following we reused the washwater with great results. At the end of the first stage of the job there were still a little under 200 gallons of water left in the tank, due to our intelligent use of a precious resource. Conservation had paid off, and when stage 2 was ready to begin the well was ready to give us all the water we needed.

In a day and age when aquifers around the world are being depleted and reaching dangerously low levels, when drought and global warming are a reality, not a what if, we could all stand to do more conserving when it comes to water.

The Means to Our Ends

Biodiesel

Then there are our vehicles and construction equipment, some of which are powered by diesel fuel. Not only is diesel fuel expensive to buy but it also is the heaviest polluter of our available fossil fuels. The diesel engine was originally designed for farm vehicles, to run straight vegetable oil from the production of grain. Today it will still burn straight vegetable oil providing that it is filtered and viscous enough. All you need is a separate tank with a heater coil on your vehicle or machinery and a stitch to change tanks from regular diesel or Biodiesel to the vegy oil. Biodiesel is made by combining waste vegetable oil and a mixture of blended methanol and lye. The chemical reaction creates glycerin which congeals at the bottom of your barrel, and biodiesel which can be siphoned off the top. It can be made in your backyard for about 1/3 of the cost of buying regular diesel and will run your diesel vehicles without any modifications. The emissions from biodiesel are far lower than regular diesel fuel, there is slightly more available power (due to more of the fuel being combusted - hence the lowered emissions, and slightly lower mileage) and you become independent of the “Oiligarchy”.

Many thanks to people in the industry like Keith Robertson and Jessica Jahns who are making the biodiesel transition right now.

Living Simply

"Live simply so that others may simply live" is an old saying from I do not know where. It is a wise one.

The choices that we make in where we spend our hard earned dollars, how we get from A to B, how grandiose we choose to build our houses and where we get our energy from all contribute to the overall impact each of us have on the planet.

Some time in the future I hope to travel in a boat instead of a plane, one that can grow its food, make its energy and clean its water. The home that I'll build for myself will be small and well thought out, attempting to incorporate permaculture theory with each part of the home serving three purposes instead of only one, and working in harmony with the environment instead of imposing itself on it. Buying organic food and supporting community supported agriculture farms (CSAs), supporting local artisans and craftspeople within my community, spreading the wealth amongst those that are closest to you, building that community up.
In Closing

This short introduction to my views on sustainability has been a pleasure to write. For houses built with straw I have focused on the shell of the house and only skimmed the surface of available alternatives. There are thousands of products out there to choose from to help provide our clients with a myriad of "green" choices for their homes. The more we as a community of baleheads can raise our level of awareness around these choices, and provide our services to implement these products and techniques safely and effectively, the more we are doing a service not only to them, but also to our planet, our future generations and ultimately, ourselves.

It's up to all of us to make responsible choices.

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