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HOUSE OF STRAW

This storybook house outside Mosinee is made of lumber from culled city trees and straw bale walls encased in local clay



(above) Clay plaster smoothed over the straw and framing covers the interior walls with a design element similar to adobe.

(top) For the first floor walls, straw bales were wired into place within the traditional 2x6 framing. The heavy ceiling beams support a green roof that will grow hardy sedum plants.

(left) This energy efficient house in rural Mosinee is made almost entirely from local materials such as straw, clay, on-site trees and city trees from Wausau that had been damaged or culled. It's the first house in the area built with "tree-cycled" urban lumber.

HOUSE OF STRAW

This storybook house outside Mosinee is made of lumber from culled city trees and straw bale walls encased in local clay

With the current economic climate, Americans are paying more attention to the economy, jobs and the origin of the products they buy.

Consider, for example, the buy-local food movement, based on the idea of a healthy product raised locally with minimal environmental impact, rather than food trucked in from far-off distances. The natural home movement has similar goals of using as much local material as possible in the construction.

Both support local business, require less transportation cost, pass along local historical skills and decrease environmental poisoning.

Using local materials whenever possible is a key theme of "sustainable architecture," a general term that describes environmentally conscious building and design. Broadly, this approach seeks to minimize the negative environmental impact of buildings by enhancing efficiency and moderating the use of materials, energy and development space.

A great example of this natural home/sustainable building approach can be found in a small, two-story straw bale home

I helped construct last year near the town of Knowlton, southeast of Mosinee.

This 24'-by-36' energy efficient "green" house for Anne Dyken and her son is constructed of a timber frame with straw-bale core walls and other local materials such as recycled urban white pine trees and clay.

The straw bale building technique was first developed in the U.S. in Nebraska during the early 20th century when mechanized baling technology was first developed. Straw bale houses still stand today in Nebraska, including a 100-year-old municipal courthouse and an 83-year-old church. These buildings are a testament to the durability of straw bale construction.

Environmentally, there is much to be said for bale construction. The materials are local, rapidly renewable and have an incredibly low embodied energy cost. The incredible thermal performance reduces the home's dependence on fossil fuels for heating, often requiring little or no supplemental heat.

Straw bale houses are known for their 20-inch-thick monolithic plastered walls reminiscent of Southwest-style adobe houses, with curved window returns and deep window bays.

For the Dyken house, we used local barley straw and a local team of baling experts to fit bales between the studs and timber posts. We literally sewed them together with mesh and twine, and covered the walls with several coats of a clay-plaster-stucco mix to create gently undulating wall planes with a beautiful textured surface.

Another wonderful aspect of straw bale walls is that they are 100% natural and non-toxic. There is no off-gassing of VOCs (volatile organic compounds), particulates or formaldehyde as found in too many conventional construction materials. The Dyken house is built with primal elements: wood, straw and earth.

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ABODE

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This house was a joint venture

with general contractor Alex Greene of Red Beard Woodworks in Spring Green. I provided the logs and lumber sourced from recycled urban trees from Wausau and its park system; these trees that had died or come down in storms were given a second life in this structure.

Trees cut on the property also went into the construction. Greene managed the general construction and I manufactured the wood, paneling, stairs, trim, moldings and kitchen cabinets.

There were a few things to work out with the building inspector, but nothing major. Both Greene and Dyken say the inspector was skeptical at first, but open-minded. There are, after all, non-standard components — straw bales and lumber that was not commercially graded. But enough straw bale homes have been constructed and documented in the U.S., Canada and Europe that Greene had the necessary, authoritative information on fire code and insulation quality — straw bale construction fulfills both requirements well, he says.

Greene also showed the inspector provisions within the state building code for the lumber from small sawyers instead of a big building supply chain. The sawyer submits a specification sheet on the lumber, including measurements of moisture content. The main concern is structural strength and consistency in dimensions. In most cases, the lumber used was true to size rather

than “nominal” lumber (that is, labeled 2x4 when it’s really 1.5 x 3.5 inches). The extra size strengthens the final product.

Dyken says the inspector was favorably impressed with the finished house and passed it with flying colors.

A straw bale house is both warm and quiet. Straw is, Greene points out, hollow tubes. When finished, the walls provide an insulation factor of about R40, he says, thanks to its mass, continuous, monolithic nature, and almost no air leakage because of the clay-plaster skin.

Interestingly enough, it was the aesthetic features that resonated most with Dyken in her decision to pursue this kind of a home.

“I have always wanted to live in a small cottage style house since I was a little girl and saw the European Village in the Milwaukee Public Museum,” Dyken says. “I remember wanting to crawl into the cottages and live there. Something about the wood, plaster and stone just resonated with me. When I first stepped into a straw bale house seven years ago in California, I saw it was possible to achieve that Old World enchantment today.”

When Dyken inquired about financing a timber framed straw bale house, she says the first banker flat-out asked, “What makes you think you can do this?” The second banker never got back to her. The third approved the loan, but with some hesitation.

“I came very close to giving up on this project several times,” Dyken says. “Banks will be more willing to finance these projects as time goes by, but they won’t until

Local materials on the outside

Local clay went into the plaster mix that covers the straw. The second floor siding features pine board and batten siding typically used on farm buildings



there are more of them out there. I hope the risk I took will pay off when the next person in this area pursues the alternative, sustainable option. If so, it will be worth it.”

Based on this February and March (the first full months after all construction was complete), Dyken estimates her monthly heating costs, using the in-floor hydronic heat, was about \$30 a month.

“With the thermostat set on 60 degrees, this house feels warmer than most houses feel at 70 because the floor is warm and there are no drafts,” Dyken says.

Other “green” features of this home include a living roof over the one-story southern portion of the home. This roof of large timber rafters, visible as the kitchen ceiling, supports 4 inches of sand and compost for growing a low-maintenance but colorful sedum plant roof.

Besides having natural aesthetic appeal, living roofs having many practical benefits: Water evaporation in summer is a natural cooling mechanism; the green cover and soil bed conceal the rubber membrane from damaging UV rays, giving this roof

system an expected lifetime of over 100 years with normal maintenance; and snow-fall gripping on the low-pitched roof and vegetated surface providing extra insulation during winter.

Another green and economical choice was to use a poured concrete slab as the finished floor for the lower level. Instead of building the home on a traditional basement or on 4-foot frost walls, the building employs what’s known as a Shallow Frost Protected Foundation. This monolithic 4-inch concrete slab with 16-inch footings sits over an insulated drainage bed with skirt insulation around the perimeter to keep frost from penetrating under the slab and heaving the foundation.

This system was developed in the 1950s in Scandinavia as a more cost-effective means of pouring frost-protected slabs. Over 1 million homes have been built there using this kind of foundation and the concept is taking off in the U.S. for cost-saving and environmental reasons. Concrete production represents a major component of carbon emissions worldwide, so green builders are conscious of minimizing its use.

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White pine cabinets and other woodwork was custom-made by Duginske from the lumber of urban trees

In-floor radiant heat tubing was installed in the slab, and the pour was colored with dye as it was mixed at the concrete plant. In the final stage of the house, we polished the colored slab to a high luster, creating a permanent finish without additional materials.

Recycled wood The first floor walls are made with traditional 2x6 framing and then in-filled with straw bales wired into place between the studs, covered with chicken wire and then coated entirely, on the interior and exterior, with earthen plaster.

Local "tree-cycled" pine was used for the framing material, floor joists, beams, flooring, ceiling, siding and exterior trim. Lumber for the cabinets and stairs was dried with a solar kiln and then placed in a dehumidification kiln for final drying.

The floor of the second story is made of tongue and groove 1-1/2" thick pine I created on a four-side planer. The floor also functions as the ceiling for the first floor.

This home features an open floor plan with the kitchen and living space on the first level, and two bedrooms in a second-story loft.

The bedrooms are on the east and west sides with an open space for the staircase and catwalk between the bedrooms. Three windows in the middle of the second floor provide light for the floor-to-ceiling space between the bedrooms.

The second-floor exterior siding is traditional board and batten made from white pine. This type of siding was typically used on farm buildings as it's easy to make and install. The 2-inch batten strips — which seal the seams between the vertical boards — make good use of waste material. Beveled siding covers the bottom of the first floor, set off by some exposed adobe-like clay plaster above.

The white pine kitchen cabinets are a simple frame and panel design. The staircase was made from an oak tree harvested in Wausau after it was damaged in a storm.

The structural timber frame, which is the load-bearing exposed beam in the middle of the building, came from aspen harvested from the building site. Aspen has a beautiful grain, often with curly figure and is a soft wood that radiates warmth. It's readily available at a very cheap price and is underused as a building material.

Because Dyken was very conscious of keeping toxic emission in the house at a very low level, we finished the woodwork, floor and ceiling with Land Ark, a penetrating oil with all natural ingredients from sustainable resources. The cabinets and stairs are finished with a Waterlox-brand tung oil product that is plant-based and can be easily repaired if scratched.

For years my wife and I lived in Wausau in a beautiful one-and-a-half story 1933 bungalow. The entire house was made in Wausau including the cabinets, doors and windows. It was easy to work on because it was all solid wood.

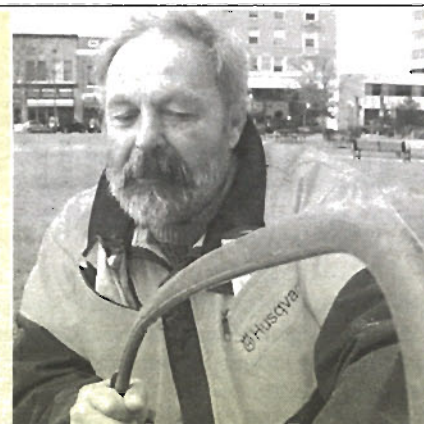
About the author

Mark Duginske is a fourth-generation woodworker, inventor, designer and writer, whose work has been featured in many national magazines, including *Architectural Digest* and *Fine Home Building*. He has authored 10 books and created several DVDs about woodworking and woodworking machines.

Since 2008, Duginske has been buying all of the urban trees from Wausau and the park system. Harvesting urban timber is becoming a big "green" issue. For many years, urban trees have been considered waste. Because of nails and concrete imbedded in them, traditional log buyers and sawmills have avoided urban trees. Without a market for the logs, municipalities hauled them to local landfills as waste. With landfill space at a premium, states such as Wisconsin have outlawed the dumping of trees in landfills.

Some of the pine used in Anne Dyken's straw bale house was sawn and dried by Duginske the previous year. Other logs were transported to the site southeast of Mosinee from a storage lot in Wausau and sawn on site. This is the first house Duginske knows of locally that was built from urban trees.

Both Duginske and general contractor Alex



Greene are state-certified to produce structural materials for one- or two-family homes. The lumber for the Dyken house was dried in a makeshift solar kiln made from 2x4s and clear plastic.

Duginske is teaching building and woodworking classes starting this July at his shop located between Wausau and Merrill. Call 715-536-7449 or e-mail markduginske@gmail.com. For information on urban trees, go to HarvestingUrbanTimber.com. **CP**

The Mosinee house is a prototype for the kind of sustainable housing that could easily be made in Wausau in the future at a reasonable cost, especially if a group of people worked together the way the Habitat for Humanity group does.

Building a house takes a lot of work but it is not a mystery. Just like growing local food, it helps the community in many positive ways.

Dyken herself participated and learned from the process. "I helped with the plastering and finishing work, so I took part in the creation of my own home," she says.

"I did a bit of reading the winter before we got started on the project and I was inspired by projects whose aim was to get

women and children more involved in the process of building their own homes."

She says that the building crew also "really opened my eyes to the importance of using local materials... how much sense it makes for political, economical and environmental reasons."

With standardized lumber and design, a couple of houses could be built each year with the trees harvested in Wausau. The last houses in Wausau constructed with all local materials were built during the 1930s. But there are many excellent examples in northern Wisconsin of structures built with local materials. Dyken's beautiful new home is one of the latest. **CP**

Resources:

- Alex Greene's website: redbeardwoodworks.com
- StawBale.com offers many free, online resources provided by Andrew Morrison, a designer and builder of straw bale homes who now does teaching and consulting. The site comprehensively covers this building technique, including common concerns about mold and decay (short answers: water leakage causes problems, as with conventional building; and don't do straw bale houses in hot, humid climates), fire safety (good resistance because of the compressed quality of bales, like trying to start a phone book on fire) and pests.
- The Midwest Renewable Energy Association, located east of Stevens Point in Custer, has a summary of straw bale construction online at The-MREA.org/download/StrawbaleFactSheet.pdf.
- This year the MREA's annual Renewable Energy and Sustainable Living Fair in Custer will offer two straw bale construction workshops. The three-day fair will have one workshop at 10 am Friday, June 17, with a demonstration afterward, and a second workshop at noon Saturday, June 18, also with a demonstration immediately afterward. See MidwestRenew.org

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