

RECRAFT:

An Environmentally-Friendly House

It was three years ago that builder Steve Loken first showed us his plans for the "ReCraft House" he wanted to build in Missoula, Mont. The plans looked fairly conventional; the materials were anything but. He showed us paving material made from recycled tires; tile made from old windshields; carpet from recycled plastic; and, most eye-catching of all, floor panels that in cross section looked like oversized cardboard. Using these materials, he said, he could build a conventional-looking American house.

After two years of research, Loken broke ground on the house in the fall of 1991. He finished and moved in last spring. What follows is a description of some of the materials he used and some of the adjustments he had to make to use them.

—The Editors

Stick building is a wonderful way to build. It's how I've made my living for almost 20 years, and it produces some of the best houses in the world. But it is getting increasingly difficult to ignore the environmental impact of this wood-intensive approach to building. As our forests are harvested on shorter cycles, lumber quality has dropped. Every builder has had to cast aside some of the lumber taken from trees too young to harvest. A shrinking supply has also forced us to pay more for quality lumber, particularly in the larger dimensions, which have reached record prices several times in the last two years.

Despite these problems, our home building practices have changed little. Over 90% of our homes are still framed with wood, and wood is used for many other building components as well, from flooring to trim.

Home building accounts for

roughly one third of all the wood used in the U.S. This heavy wood use is apparent in the mountains where I hike and ski. It isn't rare, when you reach a high overlook, to see a patchwork of clearcuts stretching into the distance. Seeing this, I could no longer ignore the consequences of my work — the clearcuts I saw while hiking on Saturday might have supplied the studs and rafters I nailed on Friday.

To correct this situation, I tried to build the "ReCraft House" using as few raw resources, particularly wood, as possible. The 2,400-square-foot house uses about one fifth of the wood used in a conventional house its size — probably less than 3,000 board feet, as opposed to the usual 13,000 or 14,000. Yet it looks quite conventional. To build it, I had to learn how to fit together some rather unconventional materials with the materials I'm used to.

I'm not suggesting that every house should be built like this one or that builders should stop using wood. I love working with wood. I like to think that, by improving our forestry practices and using products that use wood fiber more efficiently, we can continue to use wood in those places where substitutes are a serious compromise. The "ReCraft House" shows that you can, by using well-chosen alternatives and learning some new techniques, build a truly resource-efficient house without compromising the product.

Laying the Foundation

The house is bermed into a hill, with the basement below grade on the back side and a walkout basement on the front.

Keeping the radon out. Our radon mitigation system consisted of 3 inches of Baseclad (Fiberglass Canada, 4100 Yonge St., Willowdale, ON M2P 2B6 Canada; 416/733-1600) laid over the sand beneath the concrete slab. Baseclad is mineral-based and uses no ozone-depleting CFC gases. The material is similar to fiberglass batts that have been compressed. It gives us R-3.2 per inch, for a total of R-9.6. It also gives us a capillary break against ground moisture, as well as a radon collection area. This collection area is evacuated by a 4-inch PVC pipe stuck through the slab and vented to the roof to exhaust any radon.

Ashes. For the basement slab and walls, we used a concrete with a 20% fly-ash content — that is, fly ash taken from coal-burning power plants. The fly ash strengthens the concrete, giving it a compressive strength of 3,400 psi as opposed to the standard 3,000 psi. The fly ash's round particles also make the concrete flow better and reduce air bubbles and pockets in the mix. The fly-ash mix also leaves denser material on the surface, making the flatwork go more smoothly. Our concrete sub said it was a smoother, leaner mix to work with.

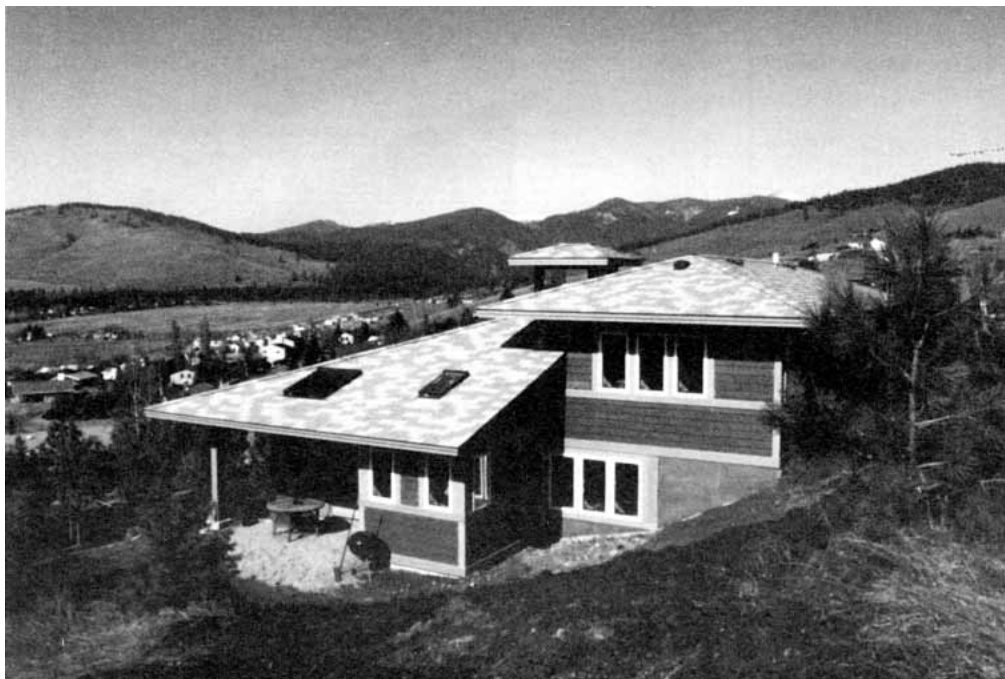
The concrete costs about 15% more than the standard variety, running about \$57 per ton instead of the usual \$50 we pay around here. But this cost was more than recovered by using thinner walls (we poured 6-inch walls instead of 8-inch), which was possible because of the concrete's higher strength.

Inside the Slab

For heat, we installed a radiant-

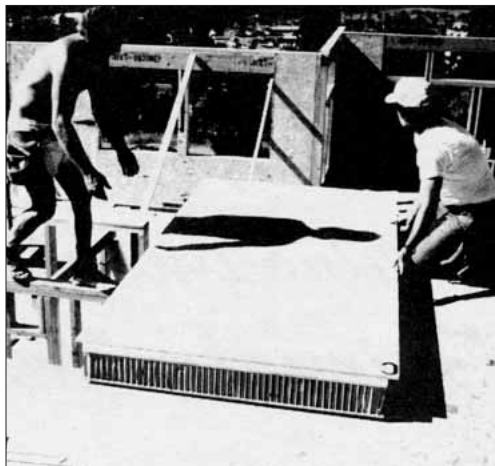
To lessen the impact on the environment, this innovative house makes efficient use of recycled and alternative materials

by Steve Loken & Walter Spurling



The "ReCraft House" doesn't look terribly unconventional. Yet, unlike most American homes, it uses very little sawn lumber and few products made from raw resources.

Structural floor panels. Honeycombed cellulose panels, which resemble cardboard in section, make up structural floor panels capable of spanning up to 14 feet (top). Splines (bottom) tie one panel to the next.



JOHN CARSON

A paneled shell. R-26 stress-skin panels formed the exterior walls.



BRENDAN MOLES

New connections. Special connectors from Simpson were used to join the TJI I-beams to the Parallam hip rafters.



JOHN CARSON

floor hydronic system made by Wirsbo, laying it down so the slab could be poured over and around it. We tied the flexible heating tubes to wire mesh laid on top of the Base-clad, then poured 4 inches of concrete over that. As we poured, we pulled this arrangement gently and evenly up into the forming slab.

This system adequately heats the basement space and helps warm the main living floor. We currently have no heat in the main or second floors (it's not winter yet), but we know we can easily add that later. The upper floor radiant tubes will attach to the underside of the main floor subfloor, between the TJI joists, with foil insulation below.

The Shell

For all exterior walls we used 5 1/2-inch structural stress-skin panels made by R-Control (Excelsior, MN; 612/474-0809) with an R-value of about R-26. These were difficult to work with because they were so large. We ordered 12- to 24-foot-long sections 8 feet tall. It took four to six people to move them around and tip them into place. These were tiring days! Either a crane or smaller panels would have been nice. In this case, the sloped site made crane access difficult. If I were doing it over, I'd probably order smaller panels.

Another problem was that the beam saw, a 14-inch Makita, would not saw completely through the panels for door and window cutouts. As a result, we had to flip the large panels over, measure again, and saw through the other side. Having small panels would have made this easier. But an even neater solution might have been to use one of those Prazi saw attachments — the chainsaw-like gizmo that attaches to your worm-drive saw (Prazi USA, 11812 Western Ave., Stanton, CA 90680; 800/262-0211). That would have allowed us to cut through from one side.

Roof Framing

We framed the roof with a variety of materials. Over attic spaces, we used conventional trusses made with 2x4s and 2x3s. We wanted to use finger-jointed members in these, but the truss engineer's computer software had no calculation provisions for finger-jointed members. The 2,400 board feet of 2x4s and 2x3s in the trusses represent the single most wood-intensive set of materials we used in the house. Even so, they were an improvement on standard rafter construction, which requires larger dimension wood cut from larger trees.

In the cathedral ceiling sections, we used a mix of resource-efficient products. For the hip rafters, we used the parallel-strand product called Parallam, which was a lifesaver. It was the only material we found that

could both carry the load and span and match the 14-inch-deep TJI I-joists that served as jack rafters.

We needed the I-joists for the 24-foot spans. TJIs have been around for awhile, but it bears repeating that they use wood quite efficiently (requiring only 50% as much wood fiber as equivalent dimensional lumber), are straight and true, and never require crowning. The Parallam timbers were dense, quite heavy, prone to slivers, and hard on saw blades; but they were straight, clean, and true to work with.

Most of the connections between these different members were pretty straightforward. We used finger-jointed top plates in walls and Simpson connectors (1450 Doolittle Dr., San Leandro, CA 94577; 510/562-7775) to tie the TJIs to the walls and to the Parallam hip rafters.

Roof Insulation

The attic sections were filled with blown-in recycled cellulose to R-49. For baffles to keep the cellulose out of the soffit vents, we used roof sheathing scraps installed vertically between the raised-heel trusses, on the same plane as the exterior panels would have been nice.

We framed the cathedral ceiling sections with 14-inch TJI I-joists, 24 inches on-center, and filled the space with blown-in-batt (BIB) fiberglass insulation. We used BIB to maximize R-value for the limited space, reduce the potential for settling, ease the installation, and decrease the weight on the span. OSB sheathing went over both roofs.

Floor Systems

Among the more unusual products we used was a floor system made of honeycombed cellulose panels (Bellcomb Technologies, 70 No. 22nd Ave., Minneapolis, MN 55411; 612/521-2425) that in section resemble thick sheets of cardboard. We used these panels, which have cores consisting of 95% air and 5% honeycombed paper fiber sandwiched between OSB sheathing, as our floor system on the second floor. The load-carrying capacity of these lightweight panels is astounding — no joists are required for spans up to 16 feet. The biggest ones we worked with were 4x12 feet and 6 1/2 inches thick. Most were precut to exactly fit the spaces we had specced. They were delivered on a flatbed and fork-lifted up to us.

The floor panels required different thinking by the crew. Once we got familiar with them, however, they went together easily. You had to handle the panels carefully so as not to ding the edges. You sometimes had to join them with splines supplied by the manufacturer; these went in easily and were glued with PL premium adhesive. All in all, they were a real pleasure to work with. We just laid the finish floor on

them and we were done. The tile setter loved them, for they were perfectly true and equally supported throughout.

In some rooms, we had to fur beneath the floor panels to accommodate wiring runs in the ceilings below. We used 2x2s or scraps. (We tried throughout to conserve and reuse wood scraps.)

The first floor system consists of I-joists with a new sheathing laid over them, a product called *Comply* made by Oregon Strand Board Company (34363 Lake Creek Dr., Brownsville, OR 97327; 503/466-5177). *Comply* is three layers of plywood surrounding two layers of sawdust. This made quite a strong subfloor; it is denser and much stiffer than OSB. And unlike OSB, it produces no swelling at the joints.

Interior Framing And Woodwork

For walls, we used finger-jointed studs throughout. These are available from Champion International (P.O. Box 1593, Tacoma, WA 98401; 206/572-8300). They behaved pretty much like standard studs, but they were straighter, without the bows and twists that show up more and more frequently in standard lumber. We had no nailing, screwing, or splitting problems.

There is very little sawn lumber in the house. We used 2x6s for a few headers and a few standard studs in the garage because we ran out of finger-jointed stock. We used TJI Micro-Lams for most of the headers in the house.

The door jamb stock was also made of finger-jointed wood and covered with a hemlock veneer. This too worked just like normal lumber.

Exterior

For siding, we used fiber-cement clapboards from FibreCem (P.O. Box 411368, Charlotte, NC 28241; 800/346-6147). These cementitious boards are made from cement leavened with wood fiber. As you might expect, they are heavier than wood, by about 50%. They also had to be primed with an alkaline-resistant primer on both sides. Handling took extra time because the 9x3/8-inch stock was moderately brittle. It nails up very well, however, with ring-shanked nails. And once primed and nailed up, it is fireproof, warranted for 50 years, and takes paint very well.

We also used FibreCem roofing slates. Though they are denser than the siding boards and we had to hand nail them (as pneumatic hammers can crack the relatively brittle slates), they come predrilled, cut well, do a good job of imitating slate, and carry a 50-year warranty.

Floor and Wall Finishes

The finish flooring materials, though taken from a variety of recycled sources, look and install like

standard products.

From tires to glass. We used several types of tile. Stoneware Tile (1650 Progress Ave., Richmond, IN 47374; 317/935-4760) makes one from auto windshield glass. We also used some *Prominence* ceramic floor tiles from GTE (1 Jackson St., Wellsboro, PA 16901; 717/724-8322), made primarily from waste glass from their light bulb manufacturing division. Still more tile came from Summitville Tile (P.O. Box 73, Summitville, OH 43962; 216/223-1511), which manufactures four styles of glazed porcelain pavers made from a byproduct of feldspar mining operations.

The flooring we used on the main floor was remilled from wood salvaged from other buildings. Several companies reclaim wood in this way, including Albany Woodworks (P.O. Box 729, Albany, LA 70711; 504/567-1155), Coastal Millworks (1335 Marietta Blvd., Atlanta, GA 30318; 404/351-8400), and Conklin's Barnwood (RD1, Box 70, Susquehanna, PA 18847; 717/465-3832).

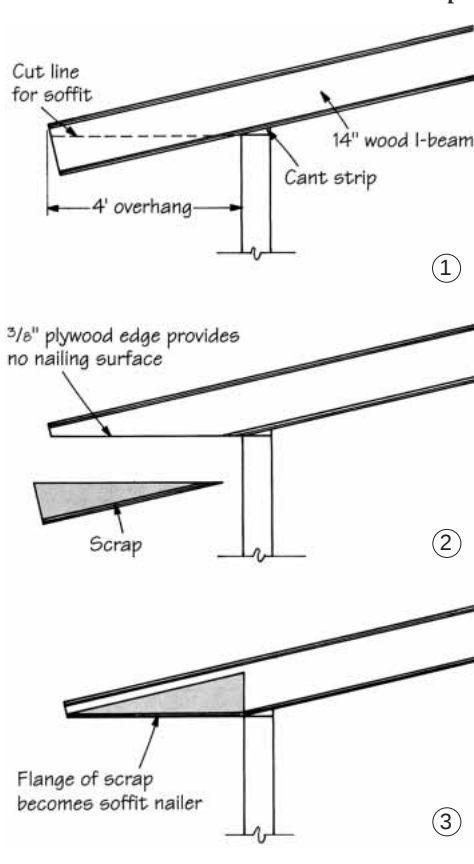
In the closets and kitchen, we used a linoleum product made by Forbo North America (P.O. Box 667, Humboldt Industrial Park, Hazelton, PA 18201; 800/233-0475) from softwood powder, linseed oil, pine tree resins, cork, and chalk. This is a high quality linoleum made the old fashioned way.

In the bedrooms, we used *Wearlon* carpets (Image Carpets, P.O. Box 5555, Armuchee, GA 30105; 404/235-8444) made from plastic fibers from recycled soft drink bottles. The pads beneath were made by Dura International (8525 Delmeade Rd., Montreal, Quebec H4T 1M1 Canada; 514/737-6561) from tire scrap rubber bonded with latex.

Recycled wallboard. For wallboard we used *Gypsonite*, which has since gone into Chapter 11 reorganization. It's unclear at this point whether the product will reemerge on the market, but Louisiana-Pacific's *Fibrebond* is a similar product (see "On Site with Gypsonite," 10/91). Both are made from a mixture of fresh gypsum and cellulose recycled from old newspapers. The *Gypsonite* is dense, hard to cut, and a bit of a hassle to finish, requiring two coats of mud rather than the advertised one. Nailing was normal, but cutting or routing was difficult and it ate blades. We were pleased with the final appearance and strength, however, and with the uniformity of the paint coating.

Windows and doors. Windows and doors were also straightforward. Hurd Millwork Company custom-made the windows for this project, using *SuperGlass* from Southwall Technologies assembled in Owens Corning *Fibron* frames. These casement windows have a center-of-glass R-value of 6 and are excellent quali-

Soffit Nailer from Wood I-Beam Scraps



Using scraps. When cutting I-beam joists level for soffits, the author found that the cutoffs could be turned around, flipped over, and sistered to the joist to provide a nailer (the flange of the cutoff) for the soffit.

ty. Since they were easy to install and look good, I am convinced that fiberglass frames are the way to go. I don't know, however, whether the companies plan to put this product into standard production.

The interior doors are made of the solid hardboard familiar to most of us. They represent a highly efficient use of the small wood pieces that might otherwise be wasted or burned.

Energy-efficiency. The house will also be resource-efficient in day-to-day living. All plumbing fixtures are low-flow, and most of the lighting fixtures are low-voltage fluorescent. We also installed the most efficient standard appliances we could find to keep electric consumption low.

As for heat, our 87 percent efficient boiler (from Weil-McLain, 500 Blaine St., Michigan City, IN 46360; 219/279-6561), along with the well-insulated shell, should keep heating costs quite low. The building shell turned out pretty tight. We had it blower-door tested and found two air changes per hour at the standard 50 pascals of pressure — and this was before we had sealed the door threshold and the recessed lights, gasketed the attic hatch, and done all the caulking. A VanEE air-to-air heat exchanger will ensure fresh air.

All in all, we were quite pleased with how the house turned out. We built the house for a total of \$160,000 — that's hard costs in labor

and materials, and it includes about \$20,000 in transportation that I had to pay to get materials shipped from distant places. We were given about \$22,000 worth of materials, so figure \$182,000 for the cost of the house. That works out to about \$76 per square foot of finished, above-grade living space. That's about what a custom house of this size and finish would cost to build using standard materials. This was actually a bit better than I had expected, and I think I could do even better the second time around, as we would have less head-scratching time working with the new materials.

Obviously, we can't yet build every house like this. But the "ReCraft House" shows that there are many readily available ways to reduce the use of raw resources, especially wood, without compromising the cost, appearance, or design of our homes. ■

Steve Loken is a contractor in Missoula, Mont. He also directs the Center for Resourceful Building Technology, which researches, collects, and disseminates information about resource-efficient building products and techniques. Walter Spurling, the Center's research coordinator, assisted in the research and writing of this story. The Center's Guide to Resource-Efficient Building Elements is available for \$20 from the CRBT, P.O. Box 3413, Missoula, MT 59806; 406/549-7678.