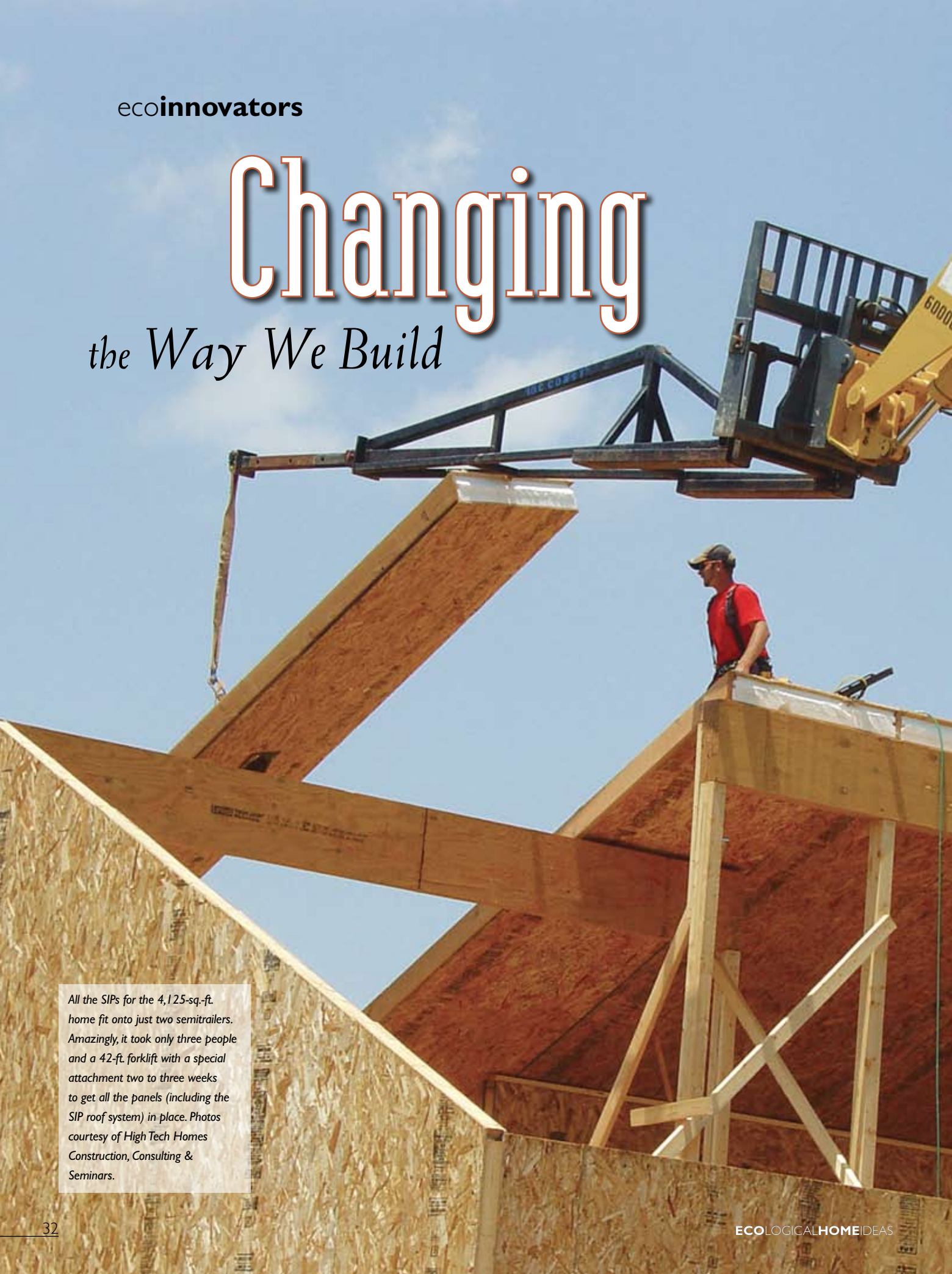
# Changing the Way We Build



*All the SIPs for the 4,125-sq.-ft. home fit onto just two semitrailers. Amazingly, it took only three people and a 42-ft. forklift with a special attachment two to three weeks to get all the panels (including the SIP roof system) in place. Photos courtesy of High Tech Homes Construction, Consulting & Seminars.*

# Contractor teaches herself how to build affordable, energy-efficient housing.

*McKee-Bartholomew built up the basement elevation and chipped into the rock to create a 6-ft. crawlspace. She had every part of the foundation that comes in contact with earth sprayed with Rubber Wall, a sealant that guarantees that the foundation won't take on water.*

Structural insulated panels (SIPs) are one of many new building system technologies that are becoming more popular as energy prices soar. Energy efficient and easy to erect, these panels sandwich a layer of expanded polystyrene (EPS) insulation between two layers of plywood or oriented strand board (OSB).

Gemma McKee-Bartholomew of High Tech Homes Construction, Consulting & Seminars in Kimberling City, Mo., is testing this relatively new technology to see if it's the right system to create her ultimate goal — building communities of "workforce housing." Her company's tag line, "Affordable Housing Redefined," states this aspiration but doesn't fully express her absolute commitment to energy efficiency.

Before McKee-Bartholomew started her career as a developer and general contractor (GC), she was, and still is, considered one of the nation's leading experts in the geothermal heating/cooling industry. Experience has taught her that today's more efficient building envelope materials such as SIPs and insulating concrete forms (ICFs) dramatically reduce the size or "load" of the structure's heating, ventilation and air conditioning (HVAC) system.

She developed a formula that expands on the HVAC industry's Manual J load calculation, which should *always* be used to determine the home's precise system size. McKee-Bartholomew claims her formula demonstrates that it is frequently possible to reduce a home's HVAC system size by 40 to 70%. This significantly reduces the up-front cost of the system and, of course, the use of energy for operation. (See sidebar for more information on Manual J calculation.)

She developed her formula while tracking and verifying the dramatic effect highly energy-efficient building technologies have on the HVAC system sizing and operation. To illustrate the difference, she asks, "Is the home comparable to paper cup or a Styrofoam cup? Any coffee drinker can quickly tell you the difference."

## Standardized Testing

During her GC career McKee-Bartholomew has already tested, and continues to test, green products and technologies that will become standard in her future homes, such as ground-source heat pump systems (AKA geothermal systems) for heating, cooling and hot water production; passive heating and cooling design; whole house water filtration systems and gray-water systems that reclaim condensation from air conditioning units.

She always installs bathroom fixtures designed according to the Americans with Disabilities Act and encourages the use of low-flow toilets, high-efficiency indoor and outdoor fireplaces, high-performance metal roof systems such as Titan Cool Roof, and a nontraditional, ultra-decorative Minka Aire ceiling fan. It comes with, not just one, but two oscillating fans that also rotate 360° to maximize air flow. These fans are one of the signature products included in every home she builds, and she says they're always a great talking-point to open further discussions about all kinds of energy savings. Another element she recently added to the growing list of "must-haves" are the fully insulated, cedar garage doors by Classic Industries, Lebanon, Mo. "Classic's products and customer service are incredible," says McKee-Bartholomew.

McKee-Bartholomew's newest project is right across the street from her current home and first test project, an ICF home. In this home she installed two separate geothermal heating and cooling systems. One system is dedicated to providing forced-air cooling and heating for emergency backup to the radiant in-floor heating system. The second system's only duty is to produce hot water for the in-floor radiant system and domestic hot water usage for bathing, laundry, dishwasher, etc. McKee-Bartholomew now works closely with a leading manufacturer of geothermal heat pumps, Oklahoma City-based ClimateMaster Inc.

## Preplanning Pays Off

Although every construction project demands careful preplanning, this project faced a few unique challenges to this project. The 150' x 100' site is located on a steep incline of solid rock that butts up against Army Corps of Engineers-controlled Tablerock Dam. The site is also part of an existing subdivision with established covenants.

*The home's interior walls are built of traditional 2" x 4" studs with the addition of value-engineered structural beams, called glulam beams. These beams are small strips of wood no more than 2-in. thick (called lams) that are glued together in layers to form a beam stronger and longer than natural timbers.*

Most surrounding homes have basements or crawlspaces that required blasting the solid bedrock. However, because of the existing neighbors, the steep incline and the nearby dam, dynamite was out of the question. Instead McKee-Bartholomew built up the basement elevation and chipped into the rock to create a 6ft.-high high crawlspace. Every part of the foundation that comes in contact with earth was sprayed with Rub-R-Wall, a sealant that guarantees that the foundation won't take on water. It's sprayed inside the foundation as well, because a portion of the basement also serves as a storm shelter.

The bedrock also created a couple of opportunities for unique land management. Through careful research and planning, McKee-Bartholomew rerouted and saved a wet weather spring, which allows excess ground water to drain out of the rock instead of collecting near the foundation. An existing rock formation that can be used as a natural fish pond.

Two dozen cedar trees were saved, which will help shade the home, reducing solar gain from direct sunlight in the summer. The home faces northeast, so the back southwest exposure is designed to take full advantage of passive heating and cooling possibilities.

## The Home Arrives

Staging a project on a tight site like this can be tricky given the many waves of materials to be managed. It was acheived with help from the SIP manufacturer, Energy Panel Structures of Graettinger, Iowa. The SIPs and the fantastic erection crew arrived the night before, stayed overnight and unloaded everything in the morning.

All the SIPs for the 4,125-sq.-ft. home fit onto just two semitrailers. Amazingly, it took only three people and a 42-ft. forklift with a special attachment two to three weeks to get all the panels (including the SIP roof system) in place.

The panels that make up the exterior envelope of the home are 4-ft. wide and vary in length depending upon the wall's height for that portion of the home. Some were as long as 24-ft. at the north- and south-facing elevations of this home.


*The erection process was fast and methodical.*

McKee-Bartholomew was very happy with the experienced erection crew's skills and dedication, saying, "When it started raining they didn't run to leave, they ran to put on rain slickers and kept going until the rain was too heavy to continue." She credits their 20 years of experience in construction — 10 of which were entirely erecting SIPs — for easing her learning curve.

The panels arrived without holes cut for doors and windows. "It makes sense because on-site application is rarely dead-on from CAD design," McKee-Bartholomew states. "The very first panel standing on the north side of the house was for a bathroom. I ended up changing the standard 3' x 5' window to a smaller, more stylish, horizontal window to reduce the heating and cooling load and allow the Jacuzzi user to enjoy the beautiful wooded view without being seen from outside."

The lack of precut door and window openings also means less waste from design changes. "I hate waste," says McKee-Bartholomew. "I designed and built a deck in Nebraska a few years ago and we had such a small waste pile at the end of the job that we were able to put it in a 55-gal. drum and burn it."

Once the panels were erected and secured, the SIP roof was installed. Getting the roof on quickly reduces the chance of excess moisture harming the building materials. Titan Veil Metal Cool Roof was chosen for its fast and easy installation, stylish profile, fire safety, weather resistance and incredible energy efficiency. Installed by Midwest Metal Roofing of Corning, Ark., the Titan metal roof is designed to look like shake shingle, adding a touch of class. The "Cool Roof" reflects both solar and

UV rays, which reduces the amount of heat entering the home and contributes dramatically to the home's overall energy savings.

"It *is* a little pricey, a premium product, "says McKee-Bartholomew, "but we can easily demonstrate the long-term savings to the homeowner." This home is so energy efficient that it only requires a four-ton HVAC system, while the same home constructed of traditional "stick" framing would have required a seven- to eight-ton HVAC system. In that region, the cost of even three tons of high efficiency HVAC equipment (with installation) represents up-front savings of approximately $9,600 — not to mention the energy savings of up to an additional $150 per month. "These kind of savings are why I stay passionate about what I do and how I choose to do it," says McKee-Bartholomew.

The home's interior walls are built of traditional 2" x 4" studs with the addition of value-engineered structural beams, called glulam beams. These beams are small strips of wood no more than 2-in. thick (called lams) that are glued together in layers to form a beam stronger and longer than natural timbers. The glue makes each beam waterproof, yet it won't affect indoor air quality. Best of all, these beams use scrap lumber instead of virgin lumber, helping to preserve forests.

## Award-winning Ingenuity

What's next for this inspired contractor? While finishing the SIP home, McKee-Bartholomew purchased a foreclosure property brought to her by a local bank. They called her first for the project because they were familiar with her past green building experience. The home is a geodesic dome. "Many contractors wouldn't know where to start rehabbing the structure," says McKee. Look for a story on the challenges this project provided in an upcoming issue.

Even more urgent to McKee-Bartholomew is the issue of replacing Katrina-destroyed housing with ultra-efficient, green, structurally enhanced homes that are able to withstand Mother Nature's fury.

Also in the planning stage is a green, high-tech development of nearly 250 "workforce homes" to be built in the Branson, Mo., area to meet the needs of the local housing markets. "After all, I do live in the *Show Me State*," says McKee-Bartholomew, "so the least I can do is show how it's accomplished!"

She also continues to test products and technologies, and is in the final stages of creating a basic textbook to educate consumers looking to buy, build, remodel or simply increase their current home's efficiency. She has high hopes that educated homeowners will demand the greenest home possible from their builders, and is uniquely qualified to empower the homeowner in realizing their green dreams. Until then, we eagerly look forward to all the positive changes this contractor has put in motion.

*By Monica Marsicek*

## Manual What?

An improperly sized HVAC system can lead to a whole host of problems after installation. For example, run cycles that are too long or too short can impact dehumidification, loss of operating efficiency and unnecessary wear and tear on the system's components, which may shorten the overall lifespan of the system.

According to Air Conditioning Contractors of America (ACCA), the *Eighth Edition of Manual J* (MJ8 - ACCA/ANSI) was adopted by the American National Standards Institute (ANSI) as the American standard for residential heating and cooling load calculations.

The *Manual J 8th Edition* load calculation is used to determine the home's peak heating and cooling requirements by gathering and processing data specific to the subject residential structure being evaluated. Room size is one example of the data needed to ensure indoor comfort and airflow.

Once a home's peak heating and cooling loads are identified, the load calculation establishes the home's heating, ventilation and air conditioning (HVAC) system size requirements.

Today's technology offers many energy-efficient systems to meet the home's HVAC needs. The Manual J load calculation assists in the selection process by ensuring that the desired system will meet the home's HVAC needs. When combined with other approved calculations, it can even project the system's estimated operating costs (both current and future) and payback period.

RESOURCES

Classic Industries, **www.classic-ind.com**

ClimateMaster, Inc., **www.climatemaster.com**

Energy Panel Structures, **www.epsbuildings.com**

High Tech Homes Construction, 417.739.2185, **www.hthconstruction.com** *(launching April 2008)*

Midwest Metal Roofing, **www.midwestmetalroofing.com**

Minka Group, **www.minkagroup.com**

Rub-R-Wall, **www.rubrwallwaterproofing.com**

Titan Cool Roof, **www.custombiltmetals.com**