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- Subscription Center
- House Plans Book
- Home Builders Directory
- Concrete Forum
- Benefits of Concrete
- Magazine Archives
- Industry Events
- Contact Us
- Search

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Written by Carole McMichael
Solarcrete shines in Illinois



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The news about the cost of this country's energy consumption is not good. Currently, high gasoline prices are grabbing headlines, but they are just a small part of a burgeoning energy crunch. In recent years, the Energy Star program and green movement have increased pressure on builders to use materials and techniques that conserve resources and produce energy-efficient homes. The fact that more concrete wall systems are on the market than ever before is a sure sign that the message is getting through.

It was with the future in mind that Steve and Jackie Smith, of Prairie Grove, Illinois, turned to sustainable design specialists at Farr Associates Architecture in Chicago to create a home to take advantage of solar energy and use insulating concrete wall systems. Then, the Smiths chose National Solarcrete Inc. to construct the home that would be prepared to deal with energy demands far into the future.

National Solarcrete, and its subsidiaries throughout the United States, manufactures and distributes a concrete panel system designed to cut energy use and expense. Don Oberlin, president of Payne, Ohio, distributor Tri-State Solarcrete LLC, worked with Solarcrete Energy Efficient Building of Union, Illinois, to construct the Smiths' custom home.

"One of the key things in this wall system is sustainability," says Oberlin. "In a sustainable design, you use as much recycled content as possible." All of Solarcrete's materials contain recycled content; the expanded polystyrene contains approximately 10 percent post-manufactured recycled content.

Solarcrete

The Solarcrete wall system consists of a sandwich panel made up of a core of 7 1/4-inch-thick expanded polystyrene, which carries an R-36 insulation value. Every 2 feet, on each side of the panel, No. 3, Grade 60 rebar studs are fastened into a treated wood top plate. The sandwich is held together first by plastic ties that pass through the panel. These are positioned every 2 feet vertically on the stud. Second, the sandwich is fused by the concrete—pneumatically dispensed 4,000-psi shotcrete (fiber-reinforced concrete)—which is applied on both sides of the foam after the panels are erected and the window and door bucks are installed. The result is 2 3/8 inches of concrete on each side with the rebar in the center—an inch of concrete on both sides of 3/8-inch rebar.

"There are two types of shotcrete, wet and dry," says Oberlin. "Dry is often known as gunnite; Solarcrete is the wet shotcrete, using a very precise mix, prepared in a Reddi-Mix plant close to the job site. It is delivered to our shotcrete crews or a local one that is experienced with our process. We have training done on an as-needed basis on the job because you can only train when you have shotcrete in progress."

Every component that goes into the panels is prefabricated. Using AutoCAD, Oberlin's engineering department creates detailed shop drawings that are accurate to 1/16 inch. When the foam is delivered from the manufacturer it is cut for the particular job. As a matter of economy, every component that goes into one panel goes in one bundle and workers lay it out on a jig table to install the foam and set the panels.

According to Oberlin, panels are 10 feet wide and as tall as the distance from the footer to the top plate. "The highest panel we have done is 45 feet—but it could go higher," he says. "We can put 5,000 square feet of paneling on one truck because there is no concrete."

Oberlin says the amount of assembly his team does onsite depends on the site's distance from his headquarters. He frequently works on out-of-state projects, including 39 units in Alaska and a YMCA in Oklahoma City. Total, he has worked in 19 different states: Alaska to Maine, the

Carolinas, Oklahoma and Nevada. His largest custom Solarcrete project was a 15,000-square-foot home in Toledo, Ohio.

The Smith residence

The Smith home sits on 5 acres of land, set back approximately 200 feet from one of Prairie Grove's quiet roads.

The site is sloped, which suits the home's modern style and rambling layout. Designed to maximize southern exposure; some areas of the residence are four stories high. Taking advantage of the slope, the walkout basement fits nicely under the garage. It contains a spacious workshop, a gym, a swim spa, a gardening room and greenhouse, a recreation room, a root cellar, and a number of specialized storage rooms. The main floor, level with the garage, contains: a master suite with sleeping porch; a kitchen with a breakfast area and large pantry; a formal living room; a dining room and great room that opens to a sun room; an office; a guest bath; and a mud room and laundry just off the garage entrance. The top floor, which has three bedrooms and two baths, offers a peaceful haven apart from the main activities of the shared spaces below.

The Smith home includes many unique design features: a high, vaulted roof with a flying fascia that protrudes beyond the regular fascia; an airlock-style entry to minimize the escape of conditioned air; a two-story vestibule with a large planter to grow tall plants; a bridge that crosses to a second-floor bedroom hallway and another bridge leading to a secluded roof deck; and a dining room that opens into an adjacent room to create a larger space for entertaining.

Aside from design amenities, the owners were most concerned with energy conservation and healthy indoor air. The heating and cooling systems rely on geothermal heat pumps to transfer heat to and from the ground. The house is equipped with a series of green aluminum fins attached to the walls outside of most of the eastern and southern windows. They are angled to maximize heat gain through the windows in winter and reduce it in the summer. Because Solarcrete's thermal-mass properties are so effective at preventing heat loss, the couple also had three energy-recovery ventilators installed to provide preconditioned fresh air throughout the home.

Steve Smith estimates that the average monthly cost to heat and cool the new home is \$100. He and his wife heat close to 11,000 square feet (not all at 72 degrees—the garage is kept in the 40s) and cool only 3,500 square feet of primary living area. The heating and cooling savings amount to at least 50 percent when compared to similarly sized wood-frame residences.

Building with Solarcrete

Solarcrete footers are formed as they are in conventional housing, except that the system has dowel bars that protrude from the footer to tie into the walls. The drainage is also conventional. The builder begins 3 feet below grade regardless of climate to help with the cooling. The system requires 3 feet of clearance for a crew member to hold the nozzle when applying the shotcrete.

"Once the panels are wire-tied and stood up, the horizontal rebar goes in," says Oberlin. "You can only shoot one side at a time, so we brace the opposite side with walers and stiff backs. The walers are attached to the rebar with cam clamps.

"When we shoot the shotcrete, the concrete is kind of lumpy. Specially made expansion joints are periodically set through the walls, and at the corners of all openings, in the vertical position. These joints are the depth gauges to help screed the concrete." Instead of steel trowels, Oberlin's team uses sponge floats, a plastering tool, to finish the surface. The floors are poured after walls are finished, just as in a conventional building.

"If we are putting in a wood floor, we do the entire wall from the basement on up," says Oberlin. "We prefer to have walkout basements where we can get a man-lift inside. But if it is totally

impossible to use a man-lift, we will go ahead and put the wood floor in before the shotcreting. If it is a concrete floor, we set that floor before we go on up because of the way it ties into the walls.”

In the Smith house, the first floor was concrete instead of wood. According to Steve Smith, who acted as general contractor of the project, Spancrete of Illinois Inc., located in Crystal Lake, Illinois, manufactured and installed the precast, prestressed concrete panels used for the floor structure. These panels are the structural members for the floor and take the place of the joists and subflooring found in the upper floors.

“We covered the precast panels with a product called Airfloor,” says Smith. “Airfloor isn’t a panel system, but rather stamped steel pieces, 1 foot by 1 foot square. The pieces are assembled and locked together to cover the entire floor area. After they were laid, concrete was poured over them. They were hand troweled, then chemically stained in a pattern that the architect came up with, then sealed. We have since put on another coat of sealer. This system is a means of distributing conditioned air between layers of concrete. It can be installed on top of any solid floor surface, such as a poured slab.”

Time-saving efficiency

One of the advantages of the shotcrete system, according to Oberlin, is the time it saves the builders in labor and preparation. The integrated nature of the system’s components offers structure, insulation and a finished wall surface in one package. Flexible design features are achievable at lower cost because panels are pre-engineered and prefabricated to a job’s specifications. The shotcrete sandwich produces a monolithic surface at the rate of 200 to 250 square meters of wall area per day, per crew.

“We have such efficiencies in our process that it helps builders to be more efficient as well,” Oberlin says. “Erection goes very quickly, as well. We set walls with window and door bucks and brace them in a day. The shotcrete sets fast, so you can go on to the next floor the next day.”

The final say

Builder advantages are important, but in the end, the owners’ word of mouth is gold in the marketplace.

“The house is very nice to live in,” says Steve Smith. “Obviously it is structurally superior to conventional homes and is very quiet inside. The only way to know if the wind is blowing is to look out the window and see if the trees are swaying. With the very large thermal mass of the home, temperature swings are nonexistent. Even without the heat pumps running, temperature change is very slow.”

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