

Cast & Character

A well-traveled homeowner lends personality to a home built using the cutting-edge technology known as cast earth.



ABOVE: Contractor J. W. McShane etched a dark, wave-like pattern into the curved, exterior cast earth wall using a high-pressure hose. Jan went over the design with iron oxide and a wet sponge to add color.

OPPOSITE: McShane riveted copper pieces to the insulated metal front door following Jan's design. The darker sections oxidized naturally, while the lighter pieces, coated with polyurethane, retain more of the copper's original color. The result is energy efficient as well as artistic.

When Jan Johnson saw a newspaper article on earth houses and decided she wanted one, little did she know that she would end up owning a home in the forefront of sustainable building technology. Jan, a pediatric occupational therapist, cut out the article and tacked it up in her office. Twelve years later, she moved into her dream home, a 2,000-square-foot cast earth house with a 400-square-foot attached guesthouse in Prescott, Arizona.

Having spent time in Africa, Jan is familiar and comfortable with earth structures. She bought property in Prescott in 1997 and told her real estate agent that she wanted to build an alternative home there. The agent referred her to Michael Frerking, owner of Prescott-based Living Systems Architecture and Construction, who has been designing and building earth homes and buildings since 1975.

Cast Earth Construction

When Frerking suggested cast earth, a relatively new building material made with earth and calcined gypsum that requires less hand labor than adobe or rammed earth, only a couple of houses had been built with it. But Jan was drawn to cast earth for several reasons. She liked the rich colors and beautiful patterns that can be created by adding pigments to naturally light-colored cast earth walls. Second, earth for the house could be “harvested” from a local lake that collects runoff sediment. And third, the energy efficiency of cast earth homes can make them less costly to live in than conventional homes.



Frerking's wife, Joanne, a fabric and watercolor artist, consulted with Jan on color before adding pigments to the cast earth mix that resulted in the rich earth tones in these walls. The windows were set into openings in the cast earth walls and anchored with drywall covered with similarly pigmented earth plaster.



The design process began in fall 1997. Construction started in April 1998, and the home was completed in November 1998. Some of the design challenges included minimizing destruction of the site's natural environment, situating the house to take maximum advantage of passive solar gain, and orienting the windows toward peaceful views of nature, not neighbors. The result intrigues and invites visitors without giving away its size or its secrets.

“My house reflects who I am,” Jan says. “I wanted it not to attract a lot of attention on the outside, but to be interesting looking, and then, as you come inside, it gets more interesting the farther you get into it.”

Three striking, curvilinear walls give a sense of peace, stability, and positive energy flow to the one-story floor plan that includes a living room, a dining room, a kitchen, three bedrooms, two bathrooms, and an office.



This breakfast bar, above, is Jan's favorite place to read the paper and get ready for work. Jan's grandmother's 1932 Wedgewood stove was restored by Gentleman Jim's of Sheridan, Oregon. The flooring is wood recycled from warehouses along the Columbia River in Oregon.



The head of Jan's bed rests against a cast earth Trombe wall, which acts as a passive solar heating device to stabilize the room's temperature. Above the Trombe wall sit hats that belonged to Jan's family, including a top hat that Jan's great great grandfather wore as a pallbearer at President Abraham Lincoln's funeral.

Cost Efficient

Jan's house was built to vary an average of seven degrees between day and night and to vary throughout the year between sixty-two degrees Fahrenheit and seventy-eight degrees Fahrenheit without backup heating or cooling. According to Jan, the temperature in the house stays around sixty-six degrees Fahrenheit most of the time and never dips below sixty. Jan's utility bills average between \$80 and \$90 per month for electricity and gas.

Minimization of heat loss and gain is the key. Although the twenty-four-inch-thick cast earth walls contain an integral insulation layer, it's the inherent ability of the mass walls to retain and release solar energy that maintains the comfortable indoor environment. All the non-cast earth interior walls and the ceiling are insulated with blown-in cellulose insulation made from recycled newspapers. Concrete In-steel 3-D Wall Panels provide extra insulation. They also enhance the exterior walls' structural integrity and function as a moisture barrier for the interior walls. A passive solar Trombe wall that looks like a large window is actually part of the energy efficient design. Behind the glass, a cast earth wall eight feet

high and twelve inches thick absorbs the sun's heat as it passes through the glass during the day and slowly releases it into Jan's bedroom on the other side of the wall at night.

Maximization of natural light is another important design feature. Just below the roofline on the south-facing exterior wall is a light shelf, a passive solar feature that takes direct light from outside and diffuses it inside the living room, dining room, and kitchen, to make these rooms more comfortable and to help light them naturally. The light shelf, constructed of conventional wood framing, extends three feet outside the house from the exterior wall and also extends three feet inside the home's living room and kitchen from the interior wall. Outside, it is covered with a bright white exterior roof coating and inside with bright white interior paint so that sunlight reflects off it and onto the living room and kitchen ceilings.

Currently, the cost to build a cast earth home is comparable to that of adobe and rammed earth. According to Frerking, building a 2,000-square-foot cast earth house costs about 15 percent more than a comparable stick-built house. Jan's house cost \$120 per square foot to build, and the cost rose to \$133 per square foot when specialty light fixtures and appliances were included; the total cost was approximately \$320,000. As the technology advances and multiple cast earth homes are built at one time, however, Frerking expects to see the costs come down.

Despite the cost, Jan recommends cast earth. "I wanted to have a house that didn't use much wood and that I could retire in," she says. She paid more up front for cast earth, but she's recouping those costs in lower utility bills. "Now, no matter whether it's good times or poor times, I'm comfortable," she adds. ☐

Architect and builder Michael Frerking used a power saw to cut these nooks into the cast earth wall, but he says that putting removable inserts into the wall when it is poured would be easier. The small books in the nook on the right have been passed down through Jan's family.

Building with Cast Earth

Harris Lowenhaupt, a Phoenix-based metallurgist looking for a way to make earth construction a competitive alternative to wood framing, invented cast earth in 1993. Because the tricks of the trade are closely guarded, the only way to build a cast earth house is through a licensed, certified professional (for more information, visit www.michaelfrerking.com). It's made by combining dirt (with less than 20 percent clay content), calcined gypsum (a hardener and stabilizer), water, and a retarding agent that Lowenhaupt, who has applied for a process patent on the technology, considers a trade secret. Under normal circumstances, dirt and calcined gypsum harden almost immediately when mixed with water. Lowenhaupt's proprietary retarding agent keeps the cast earth material in a liquid slurry state for anywhere from fifteen minutes to eight hours, enabling building contractors to pour it like concrete. The cast earth is poured into wall forms, which also contain electrical conduits, plumbing, block-outs for window and door openings, and insulation. After the mix has set, a reinforced concrete bond beam is usually poured in the top six inches of the wall, and after it has set the forms are stripped for reuse.

Michael Frerking, a cast earth affiliate in Prescott, suggests using the following criteria to decide whether a cast earth home is right for you. Your region should have at least 40 percent sunny days during winter; daily temperature swings should not vary between more than twenty and thirty degrees Fahrenheit; and annual rainfall should be thirty inches or less.



To create the feel of a cast earth without the cost for the low interior wall, above, drywall was soaked in water until uniformly damp, drip-dried, wrapped around a curved frame of wood studs, and, when dry, nailed in place. Earth plaster, a form of cast earth, was then applied to the wall to create a rough, earthy look. The wall is topped by a piece of flagstone from a local quarry. Above the wall, dancing figures suspended on wires hold small lights. One of Jan's current creative projects is to enhance the shadows that the figures cast by painting them on the white wall in subtle shades of white and champagne.