Building a Safe House

Safety doesn't have to come at a high price

Panel exterior faces were cast with brick-patterned formliners.

When the Joseph Corp., Aurora, Ill.—a nonprofit organization that helps people with limited means find housing—was demolishing some homes that were too run down, it was suggested that they build a concrete home.
Brian Bock, vice president for Dukane Precast, working with the American Red Cross and the Portland Cement Association (PCA), persuaded the Joseph Corp. to build a concrete home using Dukane's precast double-wall panel system at one of the sites. Together they enlisted an army of volunteers and organizations to help with the project.

The organizations involved include the PCA, the American Red Cross of Greater Chicago, the Illinois Emergency Management Agency (IEMA), The Pre-cast/Prestressed Concrete Institute (PCI), the Institute for Business and Home Safety (IBHS), and the construction vocational trade programs of three high schools in the area. The Red Cross and IEMA are involved through their “Safe Home Illinois” initiative. The IBHS is involved through its “*Fortified...for safer living*” program.

Together, their goal was to build a reasonably priced 1500-square-foot home that would keep its new owners safe in the event of a natural disaster, significantly reduce heating and cooling bills, ensure low maintenance cost, and be fire resistant.

Life safety, sustainability, and energy efficiency

Life safety issues focus on construction methods and materials that will prevent the collapse of a building in the event of a disaster.

The fundamental concept of sustainability is simple: to use products made with recycled materials, and build structures with long-service lives that also can withstand disasters.

Energy-efficiency goals are achieved when there are few air leaks in a building envelope and when insulation with high R-values is installed. Sometimes the ability of a structure to store energy in its thermal mass, which concrete does well, and to release it at times when it is needed, can reduce energy bills.

Building a disaster-resistant home

Bock says this house was originally going to be a wood-frame house. For the student's educational and training purposes, it was decided to keep the breezeway and the garage as wood-frame structures with brick as the finished surface. To more easily achieve the fortified designation and provide an energy-efficient sustainable home, Dukane decided to make their precast concrete double-wall panels with a brick formliner pattern the same size as the bricks.

The house has cast-in-place footings and foundation walls except for one wall. “We left the foundation wall out for the area closest to the street for crane access to the back of the house,” says Bock. “Afterward, we installed a precast foundation wall and then placed the first story wall on top of that.”

These high school students will finish the home construction for their vocational program.

The 6000 psi precast panels are made with 38% recycled material including fly ash, ground granulated blast furnace slag (GGBFS), and expanded slag lightweight aggregate. The lightweight aggregate is trucked dry to reduce transportation costs and then saturated with water in a vacuum saturation tank just before it is used. A typical wall panel is 8 inches thick consisting of two concrete panels joined together by a wire truss. Each concrete panel is 2½ inches thick with the 3-inch section in the center used for insulation, rough electrical, and plumbing. Bock says they use a biobased foam insulation product made from soybean and castor oil that provides R-7 insulation per inch of foam or R-21 for the panel. Though they still place steel rebar in the panels, Dukane also uses prestressing strands set every 2 feet.
This project uses Dukane's concrete floor panels consisting of 3-inch-thick concrete slabs with steel trusses below the concrete. The top chord of the trusses is embedded

into the concrete floor panels. The open truss area on the bottom of the floor panels will make it easy for the high school workers to install heating and cooling ducts and lighting. Clips on the bottom of the trusses will serve as the attachment points for hanging drywall.

Covering openings

For concrete, openings and the roof represent the weakest link. Companies such as Andersen Windows, Bayport, Minn., and Therma-Tru Doors, Maumee, Ohio, provided debris-resistant products. Aside from the storm-resistant glass, these windows and doors are made with more-secure attachments to the walls. (See the Details column on page 20 for information on attaching windows to concrete openings.) The same attention to detail is present with the garage door. And true to current thinking, the top roof rafter has a continuous load path connection to the house footings.

Important inspections

In this region, the "*Fortified...for safer living*" program requires inspections to ensure that a home can withstand 110-mph winds. Key inspection points include the following:

- Foundations before concrete placement. Check for rebar size, quantity, location, and proper overlap.
- Accurate installation of concrete wall panels. Check welded connections to the foundation.
- Proper installation of Simpson Strong Tie tie-down straps and hardware (hurricane straps).
- Framing details.
- Correct roof installation: sheeting, sheeting nailing details, placing ice and watershield, the nailing pattern, and type of shingles.
- Final inspection and approval.

The Aurora house

Few people have the opportunity to live in such a safe house, regardless of their income level. But the message related to this construction is directed to all of us. If we are informed, we can build better housing—safer, better as an investment, and better for the country in times of disaster.

Business Partners

Allstate Insurance, Andersen Windows, Bricks Inc., Buzzi Cement, Dukane Precast, Illinois Truck & Equipment, Kendall Concrete, LaFarge, Owens Corning, Sika Paint, Symons Forms, Simpson Strong-Tie, Saint Marys Cement, Therma-Tru Doors, and WR Grace.