By Don Talend

Safe Havens

Top: A five-bedroom concrete home featuring a concrete safe room was a highlight of the International Builders' Show 2001 in Atlanta last February. Though not intended for the middle-income home buyer, it showed how a safe room blends into a home's interior. Bottom: The "Safe Haven" home's safe room looks like anything but a tornado shelter.

PHOTOS: PORTLAND CEMENT ASSOCIATION

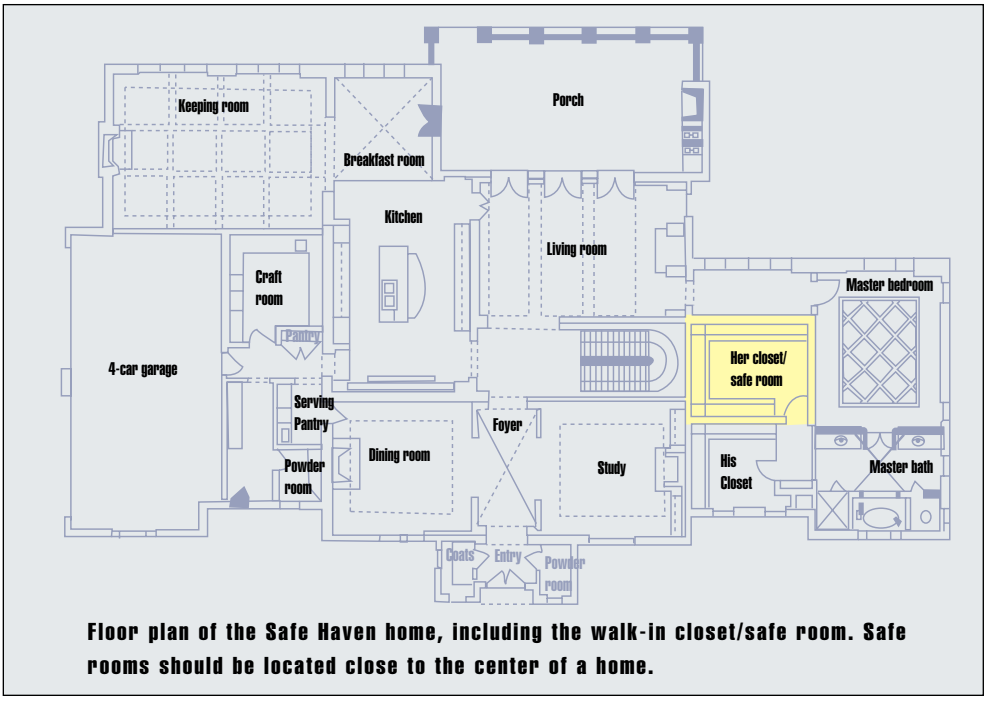
Concrete safe rooms save lives when nature's fury is at its deadliest.

If someone had "built a better mousetrap" than the traditional underground tornado shelter, the only loss to mankind might have been the inspiration for the great children's book *The Wizard of Oz*. Dorothy and Toto might never have spun off to the Land of Oz before they could reach their underground shelter. Perhaps there never would have been a Scarecrow, Tin Man, or Cowardly Lion. Perhaps there never would have been a Yellow Brick Road—and certainly no need to utter "There's no place like home."

If the two had just stayed in Dorothy's bedroom/concrete safe room as their entire Kansas town collapsed all around them, it might not have made much of a story, admittedly.

Concrete homes aren't suitable for all homeowners who live in tornado- or hurricane-prone regions, but concrete promoters still can lay down a path to their Emerald City with above-grade concrete residential walls. You might say this path will be made not of yellow bricks but of insulating concrete forms (ICFs), ready-mixed concrete, and concrete masonry units (CMUs). Instead of going for the whole home, in some cases promoters can increase the market share of concrete by capturing one room per residence. A complete concrete home will reduce damage costs and save lives, but a less expensive safe room serves the more basic of the two needs, and it offers the room the supplemental benefits of

The producer can increase the market share of concrete for above-grade walls by promoting free-standing safe rooms as protection for an existing stick-frame home.



Floor plan of the Safe Haven home, including the walk-in closet/safe room. Safe rooms should be located close to the center of a home.

fireproofing, soundproofing, and insulation found in a full concrete home.

No place like a safe room

Tornadoes are a simple fact of life for non-fictional Kansans. Despite this awareness, a particularly lethal occurrence of this weather phenomenon on May 3, 1999 killed six people in the Wichita area and a total of 48 in Kansas and Oklahoma, causing more than $1 billion in damage. It was a wake-up call to many homeowners to upgrade their tornado protection.

Even before this the Federal Emergency Management Agency (FEMA) was developing its pilot "Project Impact" program, which later went nationwide. Project Impact includes homeowner subsidies for disaster mitigation strategies of which safe rooms are a fundamental component.

The major concept behind the in-home safe room is the fact that residents who need to escape flying debris, referred to as missiles (the primary cause of death and injury in windstorms), never have to leave the home. In regions where basements are not common, safe rooms are a relatively minor alteration to stick-frame home plans and appear no different from any other room. Key considerations are a footing of enough strength to support the added weight; adequate fasteners for roof-to-wall, wall-to-wall, and wall-to-floor connections; a central location for accessibility from any location in the home; a missile-resistant door; and wall and roof material strong enough to resist missile penetration. Reinforced concrete has performed well in missile impact testing (see related article, page 34).

However, in-home safe rooms are impractical for existing homes because the rooms must be constructed close to the center of the home. A freestanding safe room in the backyard provides easier storage and slightly better flood protection than a below-ground shelter, although the homeowner loses the benefit of not having to leave the home during a windstorm. "A lot of them have been built for existing homes right in the backyard," says Wichita concrete producer and ICF manufacturer Steve Ruud. "They're freestanding; they look like a little backyard shed, but they're solid concrete. You side 'em and put trim on 'em and put on a good solid steel door.

"There's a thickened slab about a foot thick, probably a foot to the outside of the actual dimensions, with the steel coming up into the walls, and you stack the walls. There are 6 inches of concrete ceiling for the roof, and the walls and the roof are poured all at the same time."

Producers such as Ruud and subsidized homeowners are benefiting from nearly 30 years of research on reduction of tornado and hurricane damage at Texas Tech University's Wind Engineering Research Center. Using in-depth testing of windstorms and their effects on structures, researchers developed the safe room idea.

The safe room prototype was designed to resist wind speeds of up to 250 mph, which is essentially the theoretical limit of all recorded U.S. windstorms. The region subject to windstorms of 200 mph and higher covers roughly the Texas and Florida coasts to Canada and the eastern edge of the Rocky Mountains to the Carolina coast. Two of the three safe room wall materials Texas Tech researchers recommend for resistance to these high winds are ICF-concrete and concrete masonry.

In Wichita, R.A. Ruud & Sons supplied the ICFs and the concrete for about 25 federally subsidized safe rooms in the wake of the 1999 disaster. "We discounted

A Promotional Silver Bullet

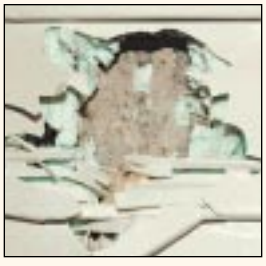
Recent research reveals just how well concrete walls protect humans against bullet-like debris during a tornado or hurricane, giving concrete producers a silver bullet in promoting concrete for safe rooms.

Thinking back to fifth-grade science class you may remember images of telephone poles or trees impaled by pieces of wood propelled by tornadoes or hurricanes. Such images illustrate the fact that wind-borne debris—not structural failure—is responsible for most fatalities that occur during a weather catastrophe.

As reported on a History Channel *Modern Marvels* program about disaster-prevention technology, Texas Tech University recently conducted research on walls built with wood, steel, and concrete. The research at the Wind Engineering Research Center is part of the Portland Cement Association's involvement in the Federal Emergency Management Agency's "Project Impact," designed to reduce the personal and economic costs of disasters.

Predictably ICF walls have performed well in testing for the Portland Cement Association (PCA) at the Texas Tech lab. Missile testing consisted of 10 wall specimens impacted with 15-pound 2x4 wood studs traveling at 50.9 mph to 119.9 mph. (In a tornado with 250-mph winds, projectiles are said to travel at roughly 100 mph, although travel along their axes, as in the testing, rarely would occur.) Testing of tornado-like wind propulsion represents extreme conditions, since the appropriate criteria for hurricane-propelled missiles are 9 pounds and 34 mph.

Missiles completely penetrated the interiors of a wood stud wall with gypsum board, a wood stud wall with brick veneer, a steel stud wall with vinyl siding, and a steel stud wall with polystyrene insulation board. Concrete walls and concrete walls formed with block, panel, and waffle ICFs revealed no cracking, front face scabbing, or back face spalling.



Left: Apparatus for missile impact testing at the Texas Tech University Wind Engineering Research Center. The 2x4 wood missiles splintered into pieces upon impact with concrete walls. Right: Although they penetrated insulating concrete forms and trim, missiles did not damage the ICF walls' concrete.

the ICFs, so we didn't make much money on them, but we gave people something that they really needed, and it created an awareness out there," says Ruud. In all, Ruud Building Systems has supplied ICFs and concrete to roughly 60 in-home and freestanding safe rooms, which serve a growing market segment in a booming residential and commercial business. "Every month just keeps outgrowing the last one," Ruud said last August. "We're looking at 47,000 ICF blocks this month. We're gonna come close to selling 600,000 blocks here this year."

Safety on display

Last February the home building world got a look at the safe room concept when a 6383-square-foot, $3.1 million concrete home called the "Safe Haven" was featured at the International Builders' Show 2001 in Atlanta. The home has above-grade ICF-concrete walls as well as a concrete safe room, so it appears to possess unnecessarily high windstorm protection for the middle- or low-income home buyer—not to mention a price that's out of reach. But from the interior the home does reveal how a safe room fits into its surroundings regardless of which wall material was used.

The 15x12-foot room, which primarily serves as a walk-in closet adjoining the master bedroom on the first level, has walls that extend to the basement floor. It also has a concrete ceiling, a concrete floor, and an in-swing steel door. A look at the room from the exterior or interior reveals a feature that looks like anything but a tornado shelter.

Online promotional resources

Shortly after the 1999 disaster, FEMA released *Taking Shelter from the Storm: Building a Safe Room Inside Your Home*. The publication is designed to help homeowners assess their risks of damage and injury from a weather catastrophe, plot the location of a safe room, and store necessities for dealing with such an event. It also includes safe room building plans.

The FEMA publication is available on the Internet, which also includes a wealth of other information about safe rooms. Additional Web links are listed below.

- More information on safe rooms, including state loans, from the Texas Tech Wind Engineering Research Center: *www.wind.ttu.edu/index.html*
- FEMA's *Taking Shelter from the Storm: Building a Safe Room Inside Your Home* publication in Adobe Acrobat Reader format: *www.fema.gov/mit/tsfs02.htm*
- Risk assessment and consumer information: *http://tornadoproject.com/safety/shelters.htm#top*
- Information on becoming a Project Impact community: *www.fema.gov/impact/impact00.htm*
- National performance criteria for tornado shelters from FEMA (Word file): *www.fema.gov/library/npc_ts.htm*
- Report on the Texas Tech wind testing of ICF-concrete walls and links to *Concrete Homes: Built-in Safety* video and *Investigation of Wind Projectile Resistance of Insulating Concrete Form Homes* publication: *www.concretehomes.com/brief7.htm*.