Home buyers and builders benefit from composite-based storm shelters

PLASTICS IN NATURAL DISASTERS

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Storm shelters of various designs protect homeowners and their families from tornados and hurricanes. Underground shelters are the most common, but these can be hard to enter and difficult (if not impossible) to install in some areas. So in places often hit by destructive wind storms, more and more people are turning to an equally effective but less troublesome option: aboveground shelters.

Installed by builders in new homes, aboveground shelters can be made of several different material and component combinations. But many builders prefer the features and benefits offered by a new storm shelter system featuring panels made of fiberglass-based thermoset composite material that is strong enough to meet stringent storm shelter guidelines.

Unlike shelters that rely on concrete and steel, the wall sheathing of the composite-based system is relatively thin and easy to cut to the exact size specified by a floor plan. What is more, the composite-based system can be fabricated using common construction tools, eliminating the need for special equipment and subcontractors that boost the cost of other aboveground shelters.

Solving underground problems

Underground shelters, though used in various places across the country, cannot protect people in many areas that are regularly ravaged by tornados and hurricanes. For example, underground shelters cannot be built in areas with a high water table. In other locations, underground shelters are impractical due to unfavorable soil conditions, such as very hard ground (which makes it difficult to install a shelter) and expansive soil (which can damage a shelter buried in it).

Even when soil conditions are favorable, underground shelters can be problematic because of their location and construction. These shelters are usually small structures with an even smaller entry and a steep staircase. Therefore, they can be difficult to enter — especially for elderly or disabled people who have only seconds to seek safety from a fast-approaching tornado.

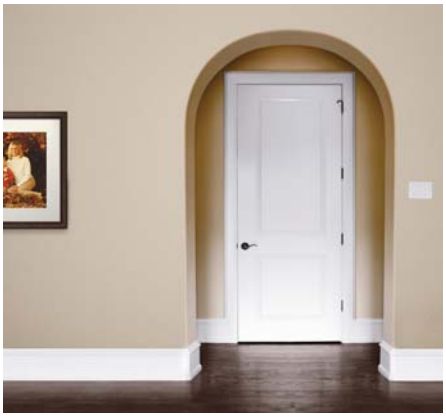
Fortunately, for the millions who need storm protection, an aboveground shelter eliminates these ground and access problems. Located inside a house, this type of shelter is a small room specially constructed to provide a safe haven during wind storms that can severely damage or even destroy the rest of the house. During the construction of a house, the shelter is the first room built on the foundation. Except for the foundation, the shelter does not depend on other parts of the house for support or structural integrity. Thus, it can be thought of as a lifeboat inside the house.

Historically, this room is not used for any other purpose than a shelter; however, aboveground shelters come in many different forms. One increasingly popular option consists of a new technologically-advanced composite-based system. This new shelter offers builders an easier installation solution, and homeowners greater flexibility and security.

Unlike shelters that rely on concrete and steel, the wall sheathing of the Norplex-Micarta StormBlocker™ *composite-based system is relatively thin and easy to cut.*

Composite characteristics

A composite-based storm shelter consists of a reinforced wood framing system covered with high strength thermoset composite material on the outside (walls and ceiling) and 3/4" plywood on the inside.



Within the storm shelter, walls are covered with drywall and painted so that the shelter looks like a typical room in the house.

The structure also includes a steel door with several deadbolts. Standard plans accommodate shelters as large as 8' x 12' x 8' high. A structure this size is classified by the Federal Emergency Management Agency (FEMA) as an "intermediate" sized safe room, but larger shelters can be constructed as well.

Meeting guidelines issued by FEMA and the National Storm Shelter Association, the composite-based shelter survives exposure to F5 tornados and Category 5 hurricanes without penetration or structural damage. In testing at the Texas Tech Wind Science and Engineering Research Center, the shelter was not damaged by 15 lb. two-by-fours striking the outer walls at 100-mph. And at the Clemson University Wind Load Test Facility, the shelter held up to 250-mph panel-suction forces and wind shear.

A key to the strength of the composite-based system is the wall sheathing material, consisting of a woven glass substrate treated with phenolic resin and pressed into a hard sheet measuring 4' x 8' and weighing about 80 lbs. Though they are extremely strong, the thermoset sheets are just 5/16" thick.

The thin sheets help to minimize the overall thickness of the shelter walls. This is important because the thicker the walls, the less space there will be inside the shelter. The walls of the composite-based shelter (including a thermoset outer wall sheathing, two-by-four framing, a plywood inner wall sheathing and drywall) are approximately 6" thick, making them only about 1-1/2" thicker than normal house walls. Thus, the thin composite panels offer minimal loss of wall space, allowing shelters to be constructed into rooms that serve other purposes.

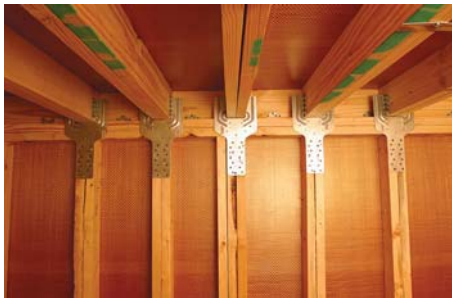
Within the storm shelter, walls are covered with drywall and painted so that the shelter looks like a typical room in the house. Under normal circumstances, the shelter can serve as a closet, pantry, bathroom or utility room. But when a severe storm approaches, residents can seek refuge in the room, knowing that it will survive even if the rest of the house does not.

Walls with a downside

While composite-based systems offer minimal loss of wall space, that is not the case when the walls of an aboveground shelter are made of cinder block. Common in some parts of the country, cinder block shelter walls contain rebar and concrete. This combination provides great strength, but the cinder block alone is 8" thick, not including the drywall that must be added to the inner walls. Drywall can be glued directly onto cinder block, but the resulting inner surface is not strong enough to support shelving. So in many cases, the drywall is attached to two-by-four wood framing constructed next to the cinder block. This brings the total wall thickness to about a foot, which significantly reduces the usable floor space inside the shelter.

Another wall option for aboveground shelters is insulated concrete foam (ICF), which is lighter than cinder block. Including drywall layers, ICF walls are about 9" thick — thinner than cinder block walls but still considerably thicker than the walls of a thermoset composite shelter. ICF construction is also more expensive than thermoset composite sheets.

Besides providing high strength in a thin and relatively inexpensive package, thermoset wall systems give builders greater flexibility in sizing shelters. Builders can cut the material to the exact size they need to fit a shelter into a floor plan. Not so with cinder blocks or ICF. These blocks come in limited lengths, so walls made of the blocks can only be sized in 6" increments. If a floor plan calls for a shelter wall measuring 7'3", for example, the wall length would have to be increased or decreased by 3", reducing the floor space of either the shelter or an adjacent room.



Located inside a house, the StormBlocker™ shelter is a small room specially constructed to provide a safe haven during wind storms that can severely damage or even destroy the rest of the house.

A shelter option that provides greater size flexibility than cinder block or ICF is a system consisting of wood framing covered with a steel outer layer and a plywood inner layer. Like thermoset composite material, steel can be cut to the exact dimensions required by the floor plan of a house. But the cutting is usually done off-site by a steel fabricator. Then, back at the building site, the steel is attached to the framing system. This could require screw holes to be drilled through the steel, or workers could be supplied with powder-actuated nailer guns to drive nails through the steel, a process that can be both expensive and time-consuming.

By contrast, thermoset composite wall material is easily cut to the desired shape and nailed or screwed to the framing system. The entire job can be done at the building site by workers using standard construction equipment.

Aramid-based options

Like steel and thermoset composite material, aramid-based ballistic resistant materials can be attached to wood framing to form shelter walls. But aramid-based material is roughly three times more expensive than glass-based materials. As a result, shelters made with aramid-based materials cost up to 40 percent more than shelters with thermoset composite wall panels.

Aramid-based material has other downsides, as well. Unlike customizable thermoset composite panels, aramid walls come in only a few standard sizes. In addition, it lacks the rigidity of its thermoset counterpart. Aramid-based material is flexible, so it stretches and recovers when force is applied to it. When hit by flying debris, thin aramid walls flex a good distance into a shelter before snapping back to their original shape, so these shelter walls must be significantly thicker than thermoset walls in order to absorb impact energy without extreme deformation that would endanger people inside the room. Additionally, aramid walls alone cannot function as a storm shelter; rather, a separate two-by-four wall must be built around the aramid walls. These two walls combined take up a 12" footprint around the room.

Since aramid lacks rigidity, shelters made with this type of material rely on layers of plywood to serve as shear walls. These shelters also include a number of steel plates to connect the wall sections and ceiling together and also to provide additional structural strength. In contrast, the thermoset-based shelter system requires no steel reinforcement. And though it does include an interior plywood layer for extra debris protection, the system passed shear and other structural tests without help from any plywood elements.

Though the thermoset composite shelter system is relatively new, hundreds have already been installed in areas of the United States endangered by tornados and hurricanes. Besides including them in homes for their customers, some builders are installing the shelters in their own homes.

If people decide to leave their homes rather than ride out a hurricane, they can still use the shelter as a place to store valuable property. Inside the shelter, valuables will be protected both from destructive weather and looters on the prowl in the aftermath of such events.

Conclusion

Aboveground shelters featuring thermoset composite walls provide effective protection for people and property during destructive windstorms. Besides meeting stringent strength and safety requirements, thermoset-based shelters are less expensive, easier to install, and occupy less floor space than other shelter options. For builders who install them in new homes, the shelters are also an effective way to differentiate their service and products from those of the competition in areas where people live with the risk of tornados and hurricanes. ■

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