



# Shelter from the storm

## Liz Nickels

**Tragic natural disasters such as the Tibet earthquake, Texas floods and Colombian landslide and their aftermath have highlighted the need for temporary shelters for those who have lost their homes. Liz Nickels looks at some recent developments in composite housing.**

Exel Composites is a leading company that designs, manufactures and markets composite profiles and tubes for demanding industrial applications. The company has eight production units in seven countries: Finland, Germany, England, Austria, Belgium, Australia and China.

Besides shelters, it also manufactures windsurf masts, antenna tubes and train and tram parts using a variety of techniques including prepreg molding and pullwinding.

Recently, Exel Composites was selected to provide 10,000 lightweight, durable, composite shelters to refugee families around the world by the UN Refugee Agency. The agency is mandated to lead and co-ordinate international action to protect refugees and resolve refugee problems worldwide. While its primary purpose is to safeguard the rights and well-being of refugees, it also has a mandate to help stateless people. Through a new collaboration with the IKEA Foundation, it commissioned Better Shelter, a design and innovation project based in Hällefors, Sweden, to design the houses. Better Shelter was started by the Housing for All Foundation, a non-profit foundation established by the IKEA Foundation. The aim is to bring dignity and safety to the millions of refugees fleeing violence, armed conflict, persecution and natural disasters.

The shelter is composed of a lightweight composite-reinforced steel frame, roof and wall panels, floor covering and a photovoltaic solar energy system. Special attention has been given to transport volume, weight, easy assembly, price, safety, and comfort. The expected lifespan of the shelter is three years. Prototypes were field-tested by refugees in Ethiopia and Iraq.

### On site assembly

According to Better Shelter, the housing has been designed with special attention to transport volume, weight, price, safety, health

and comfort. The expected lifespan is three years and the house can be disassembled and reused when needed. While the house is composed of three individual parts – frame, panels and photovoltaic system, all components can be assembled on site without additional tools and equipment. The photovoltaic system provides energy for the supplied LED light or for charging a mobile phone.

The agency also required the shelters to:

- have a standing height and lockable door to increase security
- take four hours to assemble without tools
- withstand all harsh climate conditions: extreme cold, extreme heat, sandstorms, rain and powerful winds
- be well insulated but also well ventilated
- withstand an impact, flooding and heavy weight
- comprise parts that can be used for other purposes once the shelter is disassembled
- weigh less than 100 kilograms.

‘Around 10,000 families will be provided with Better Shelter this upcoming year and that is just the beginning,’ said founder Johan Karlsson.

‘At Exel Composites we are honored and humble to be part of this important project, addressing one of the most difficult situations facing humanity today,’ added Kari Loukola, SVP sales and marketing at Exel.

Austrian company GHS Global Housing Solutions, a spin off from the Greiner Group, based in Ried im Traunkreis, Germany, plans, designs and delivers complete manufacturing plants for the production of walls, doors, windows and roof panels. GHS also notably manufactures a mobile house system of lightweight panels that is suitable as emergency shelter following catastrophes.

In March, GHS received orders from Qatar for its own temporary composite house system.

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## Short term use

The GHS Temporary Home is designed specifically for use in disaster areas and industrial camps and is for short term use. It consists of sandwich panels that can be assembled modularly into a house size of 16 to 32 m<sup>2</sup>. The construction material is a PUR foam with good thermal insulation properties. On the outside, the panels are protected from wind and weather by galvanized sheeting.

The design engineers developed a system that ensures assembly within just 40 minutes, and neither tools nor specific knowledge are required for erecting them on site, the company says. All parts are supplied prefabricated. 'When designing the houses, we paid particular attention to making them simple to erect with no need for tools,' said Alexander Khinast, CEO of GHS. 'This is extremely important for the predestined deployment areas of relief missions.'

Production of the individually configurable house made of sandwich panels has begun in Upper Austria, and initial samples of the houses have already been ordered for the Red Crescent charity and the state railway company in Qatar.

Another type of temporary housing is supplied by Canadian company Innovative Composites International Inc (ICI), based in Toronto.

ICI uses environmentally-friendly materials and designs such as prefab modular homes, cargo containers and structural insulated panel for a variety of industries. Its flagship product, Structure-Lite composite panels, forms the base for many of its homes. Using recycled materials such as plastic water bottles, the panels are environmentally friendly with low cost, readily available raw materials. The composite panels won't rust, rot or warp and each one is insect, water and UV resistant, ICI claims.

A key component of ICI's composite panels is their thermoplastic fiber reinforced composite skin material. This skin, owned and manufactured by ICI, forms the outer layer of the panels and offers improved durability and strength. The special manufacturing process ensures the bonds between the fibers and the thermoplastic material are nearly impenetrable. They are also impact resistant, impervious to water and made with 100% recyclable materials, according to the company. Unlike most fiber-reinforced materials, the thermoplastic skin can also be formed into various shapes, making it suitable to use in the transportation and marine industries.

## Hurricane resistant

ICI also supplies EcoScape houses, which have been specially designed for easy, fast assembly, able to be completed in only a few days. The strength and durability of the panels make them suitable for disaster prone areas, being both earthquake and hurricane resistant. Once the panels are delivered on site, they can be quickly assembled by non-skilled labor due to the modular design.

Another temporary shelter manufactured by ICI is ECO:Shield, an emergency shelter that can be assembled in a few hours after being delivered to nearly anywhere in the world. The shelter uses the same design components as the EcoScape houses and unlike some other temporary shelters, these can be used for up to five years or put away in storage with no degradation, ICI says.

ECO:Shield houses can be built on a slab or incorporate a lightweight, durable flooring system. They can also be elevated to meet the needs of the local environment. Structures can be assembled on-site in a matter of hours using unskilled labor and conventional tools.

The shelters can be customized to fit a wide range of size and floor plan requirements. For instance, ICI's 8 × 16 ft ECO:Shield house has 128 ft<sup>2</sup> of living area, yet can be easily folded to a height of only 17 inches and assembled in less than 45 minutes.

ECO:Shield housing is also suitable for stressed regions of the world where affordable permanent housing is needed in a hurry. They can also be used for schools, hospitals, offices and elderly care facilities.

In 2010, WebCore Technologies was selected by the US Air Force to develop rapid assembly, energy efficient composite shelters under the Small Business Innovation Research (SBIR) program. WebCore's TYCOR G fiber reinforced composite cores, incorporating three-dimensional fiber architecture, and automated manufacturing processes, can be used to produce lightweight, high strength, robust sandwich structures suitable for composite shelters.

French company Touten-kamion has also developed a shelter made out of composite materials for use as a command post by armed forces. The building has a workspace of 76 m<sup>2</sup> and can be transported by land, sea or air. It can be set-up in less than two hours by four people. In 2005, Toutenkamion provided around 28 shelters to the French army.

In 2010 US designer Peter Anthony set out a number of innovative designs for a collapsible, lightweight mobile composite housing platform intended primarily for rapid housing response in emergency situations.

'This design was conceptual and is still in development,' Anthony tells *Reinforced Plastics*. 'The material makeup for the panels was originally a PUR foam core with a resin coated cellulose/glass reinforcing. My research however has taken me to a slightly different direction with the application of reinforced plastics.'

The design features a self-contained 8 ft × 8 ft × 8 ft living space constructed of composite material, weighing less than 200 lb (90.7 kg), which folds flat. Reportedly, it can be assembled with a single spanner by two people in less than 30 minutes.

## Collapsible structure

The design can also be configured as long as 48 ft (14.6 m). The transport trailer can be modified to carry up to four shelters along with off-grid support systems that tether with the shelters. 'The unit was designed and best optimized as a collapsible structure within a specific size limit to allow for multiple unit storage and ease of transport by truck, rail or ship,' he says.

The composite panels are made from a sandwiched cellulose skin with a foam core that contains transverse ribbing within the core to provide lateral strength and great reduction in weight. The materials are readily available, allowing for local assembly on site in remote locations with some minor training.

The composite panel material is waterproof and carries an aged thermal resistance value of 6–6.5 per inch. The structural integrity of the wall system is integral with the composite panel material and method of fabrication with extruded aluminum edges that fit over the front and rear wall panel edges.

According to Anthony, everything is 'pieced' and/or 'sectioned' to fit inside the floor cavity. 'All of the loose parts within the unit are stored within the base under the floor. This includes the front and rear wall sections as well as the bedding panels miscellaneous bedding items. Once assembled, the space under the floor is best used for personal storage of the occupants.'

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