Born in response to a natural disaster, an inventive steel emergency housing solution by Carterwilliamson Architects also brims with potential as permanent low-cost housing. Words **Rob Gillam**

Photography **Paul Bradshaw; Brett Boardman**

FIRST AID KIT

ARCHITECT Carterwilliamson Architects
PROJECT Grid Shelter
LOCATION South Nowra, New South Wales (manufactured)

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the structure. “In emergency situations the ground isn’t going to be properly prepared so the ability to adjust the height of each acrow-prop leg makes them ideally suited to uneven terrain,” Carter says.

The building is relatively lightweight and needed minimal support, so even an unintended device such as an acrow-prop proved suitable as a vertical column.

“It also allows for ‘on-the-fly’ fine adjustment to account for settlement. We can deal with a one-in-five slope. So we’ve got a one metre adjustment over five metres, which is pretty steep. Even with the weight of the whole building it’s quite easy. You just turn a nut.”

Depending on the size of a construction team and their experience, Grid can literally be built in a few hours, as was demonstrated in Martin Place as part of the Sydney Architecture Festival in 2012. Carter says that with a team of seven people it took 3.5 hours to erect and the same to disassemble. “With more people and more experience it could be an hour less,” he adds.

A single experienced ‘leader’ can guide a team of inexperienced labourers but in an emergency situation he foresees a ‘leader’ training a wider group to exponentially grow the amount of labour skilled in the construction. “Labour isn’t short in a disaster. Most people survive and need something to do. With a team leader you can train a group. With 10 groups of 10 people, each putting up two Grids per day, you can build 20 houses daily.”

Carter likens Grid’s modular assembly to that of an oversized Ikea project. “It’s prefabricated so it arrives as a flat-pack. Everything’s pre-drilled and there’s no need for any specialist equipment or tools. It comes with two cordless drills, four charged batteries and a pack of screws.

“At about 1.7 tonnes the building’s not very heavy, but the wall panels weigh around 150 kilograms, which requires a couple of people to hold them in place for fixing. Once you get the plate down and the legs up, you basically just screw everything together.”

Boxing Day, 2004: a 9.0 magnitude earthquake – the highest reading on the richter scale – struck near the Indonesian island of Sumatra, unleashing one of history’s deadliest natural disasters.

Some of the worst damage from the resulting Indian Ocean tsunami happened in the northern Sumatran province of Aceh, in which the United Nations reported over 130,000 fatalities. Half-a-million people were displaced from homes destroyed by the surging sea.

Watching the disaster from afar, architect Shaun Carter was dismayed by the devastation left in the tsunami’s wake. “Neighbourhoods in coastal areas were swept away, leaving behind extensive rubble,” says Carter. “I watched the tents go down for emergency relief but the troubling thing was that there didn’t seem to be a long-term plan.

“The problem with tents, especially in post tsunami-affected areas, is that you’re already off to a bad start with the debris and water on the ground. It collects around them, they deteriorate and water-borne disease sets in.

“My thoughts turned to a better emergency housing solution. I thought about it broadly, in a loose way. It’s a process we apply to every project we take on: you have constraints and you design around them. In this instance, the key questions were: ‘How can we get it out of the ground? How can we get it down quickly, and cheaply?’.”

A cornerstone of Carter’s design is the ingenious adaption of a device conventionally used in concrete form working.

“A solution for getting it quickly off the ground was paramount. I was on a construction site one day, leaning on an acrow-prop and I thought: ‘If I turned this upside-down, it would be perfect’.”

The telescopic steel tubes traditionally used to support scaffolding act as vertical columns at each corner of

“Steel’s impenetrability adds to the sense of security and shelter”

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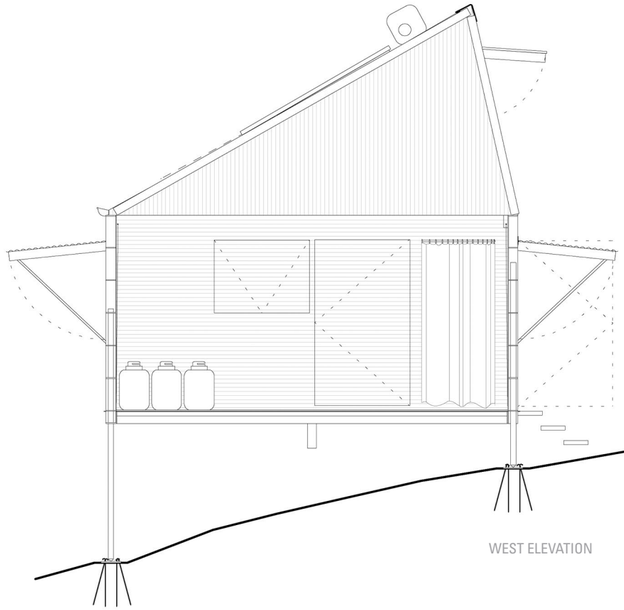

WEST ELEVATION

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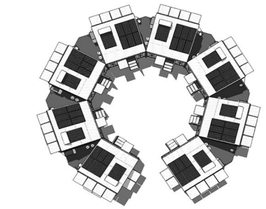
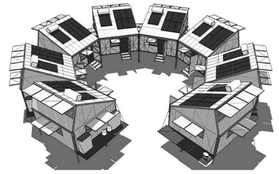
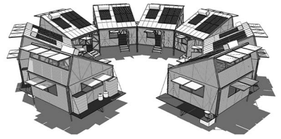
ABOVE: Although pragmatic by design, the architects achieved a resolved design for Grid through material singularity and the homely imagery of a pitched roof

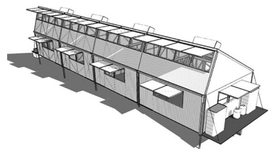
FAR LEFT: Avoiding potential interior compromise in case of failure, ancillaries including rainwater tanks, PV cell, gas bottles, shower and toilet are housed on external ‘outriggers’

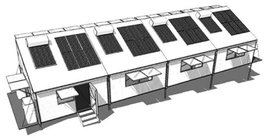
LEFT: Mezzanine sleeping quarters provide spacial differentiation in the plywood-lined interior. Inverted acrow-props serve as vertical columns and adjust easily over uneven terrain











PANEL SAYS

This “caravan without wheels” is an extremely worthy type of disaster shelter, which can be deployed in a remarkably short timeframe to provide housing after an emergency. While it presents as a very utilitarian object, it has plenty of architectural merit and provides maximum amenity in a minimal footprint. The architects have carefully considered the associated issues of fabrication, transportation and assembly, making this a very well-resolved solution. We can also see applications in the temporary accommodation sector, where the Grid could provide a cost-effective but much more advanced housing option than the standard modular unit or “donga” found at many remote locations.

“We’re quite likely to be the only people to have slept in their own house in Martin Place”

BELOW: Echoing the Ikea model, Grid’s pre-drilled prefabricated panels are flat-packed for transporation and later assembled using drills and screws. Seven people can erect it in 3.5 hours

Envisaging that its occupants would be mostly self-reliant, Carter designed Grid to be comprehensible in case of failure. “We wanted to keep the design simple so that the construction method would also be simple. If a wall panel fell out, you would realise it uses standard construction. None of the members span very far before they have another connection, so even someone without structural experience could diagnose and repair it quite easily.”

The Grid ‘flat-pack’ comprises 11 prefabricated panels based on a 2.4 by 4.8-metre module.

Each component – whether as wall, roof or floor – is an interconnecting structural member comprised of corrugated steel cladding, insulation and interior plywood bracing.

“It’s essentially made up of cold-formed steel sections which are put together to make a box section. It has a simple horizontal ring of steel angles in the corners and four vertical struts to receive the acrow-props, and then there’s a .55mm rolled steel stud, which gets rollformed into a 90mm stud section

“At the genesis of our idea for Grid, it was apparent that steel was the ideal solution. When our engineer showed us the rolled extruded steel it ticked the economy and ‘buildability’ boxes. It’s a tenth of the weight of timber for the same strength and when you put it together it’s super-strong.”

A full-length central beam takes up load at the Grid’s middle connection and is also a support for the ‘outriggers’. Around 40 people were inside it while on display in Martin Place and Carter noticed some minimal vibration. His engineer advised simple cross-bracing between the acrow-prop struts to fortify Grid for atypical occupancy.

The architects estimate Grid can house up to eight people. Sleeping quarters are provided in the 2.4 by 4.8-metre mezzanine level, which could accommodate a pair of king-size beds or a horizontal series of submarine-style fold-down bunks.

The mezzanine level, typified by its raked ceiling, also provides spatial differentiation. “Even though it’s this very basic, pragmatic structure, we wanted to put spirit in our building – to create a nice space; a sense of joy.

“This project was born out of the idea of helping people, en masse. It’s not bespoke architecture for the few. It’s simple architecture for the many, but that doesn’t mean it can’t be resolved.

“We wanted the design to have a purity about it; to have a single material on the outside and another on the inside. When you open the skin, it has this lovely warmth. We also wanted the form to be instantly recognisable. The pitched roof form plugged into the idea of the universal imagery of a home – it’s like a picture that a kid draws.”

The shelter is self-sufficient, incorporating a 160 watt-hour photovoltaic (PV) cell for heating. ‘Barn-door’ windows and doors cut into each of Grid’s four facades allow for cross-ventilation and can be locked flush, securing the building.

Carter and the practice’s Linda Matthews spent the night in the Grid while it was installed in Martin Place as part of the Sydney Architecture Festival. Apart from some noisy skateboarders, they had a comfortable stay. “You feel really safe, stowed away up there, sealed off from the outside. Steel’s impenetrability adds to the sense of security and shelter,” says Matthews. She also points out that “we’re quite likely to be the only people to have slept in their own house in Martin Place”.

The PV cell, rainwater tanks, a composting toilet system, shower and gas bottles are housed outside the main structure to avoid any failures compromising the interior. “It’s particularly important for people in disaster situations to have consistency. They certainly don’t need a battery, toilet or tank failing, so we came up with the idea of external outriggers for all ancillaries.”

The adaptability of the Grid shelter lends itself to other forms of housing. “As a modular space they can be configured to adapt to different requirements. You could leave walls out and tack them together as a long building. Put them back-to-back, stagger them, cluster them – they’re highly versatile.”

Carterwilliamson is also developing a residential version of Grid, called Pavilion, which will feature covered outriggers and a more refined interior.

The architects unsuccessfully shopped the Grid concept to the Federal Government before concluding that a prototype needed to be built. “We realised that the more real we made this thing, the more interest we’d get in it. And that’s proving the case. It’s been seven years from idea to model, to prototype, but we’re now getting initial sales.”

The cost of Grid is dependent on order volume but Carter was able to throw around some ballpark figures.

“This thing has to be fundamentally economical because we have to satisfy that humanitarian need. If we’re dealing with emergency applications we’ll be selling not one but thousands of them. With that kind of volume we think we can get the price down to somewhere around $5000 to $10,000 per unit, to flat-pack. Transport and construction costs would be extra.”

The architects are already in discussion with national aid organisations AusAID and Austrade, and have longer-term plans with the United Nations Mission. In the meantime they are considering a basic-specification residential version.

“When you say to someone ‘we can give you about 35 metres of habitable space for around $40 grand’, it’s a pretty attractive proposition,” Carter rightly concludes. SP

PROJECT Grid Shelter **ARCHITECT** Carterwilliamson Architects **PROJECT TEAM** Shaun Carter, Linda Matthews, Lindsey Chandler **STRUCTURAL & CIVIL ENGINEER** O’Hearn Consultants **BUILDER** Go-Steel Building Products **SHOP DRAWING AND ASSEMBLY CONTRACTOR** Go-Steel Building Products **PRINCIPAL STEEL COMPONENTS** Roofing, wall cladding, capping and flashing: metallic coated steel; Structural steel: acrow prop size 0 (1.07-1.82m), perforated steel decking, 125 x 125 x 5mm columns, 50 x 150 x 5mm bearers, 250 x 50 x 1.6mm joists, 90 x 35mm cold-rolled studs (0.75 BMT); Interior: 7mm structural plywood wall lining, 19mm particle board floor lining **AWARDS** Shortlisted for 2013 Australian Institute of Architects Small Projects Award **BUILDING SIZE** 35m² **TOTAL PROJECT COST** POA