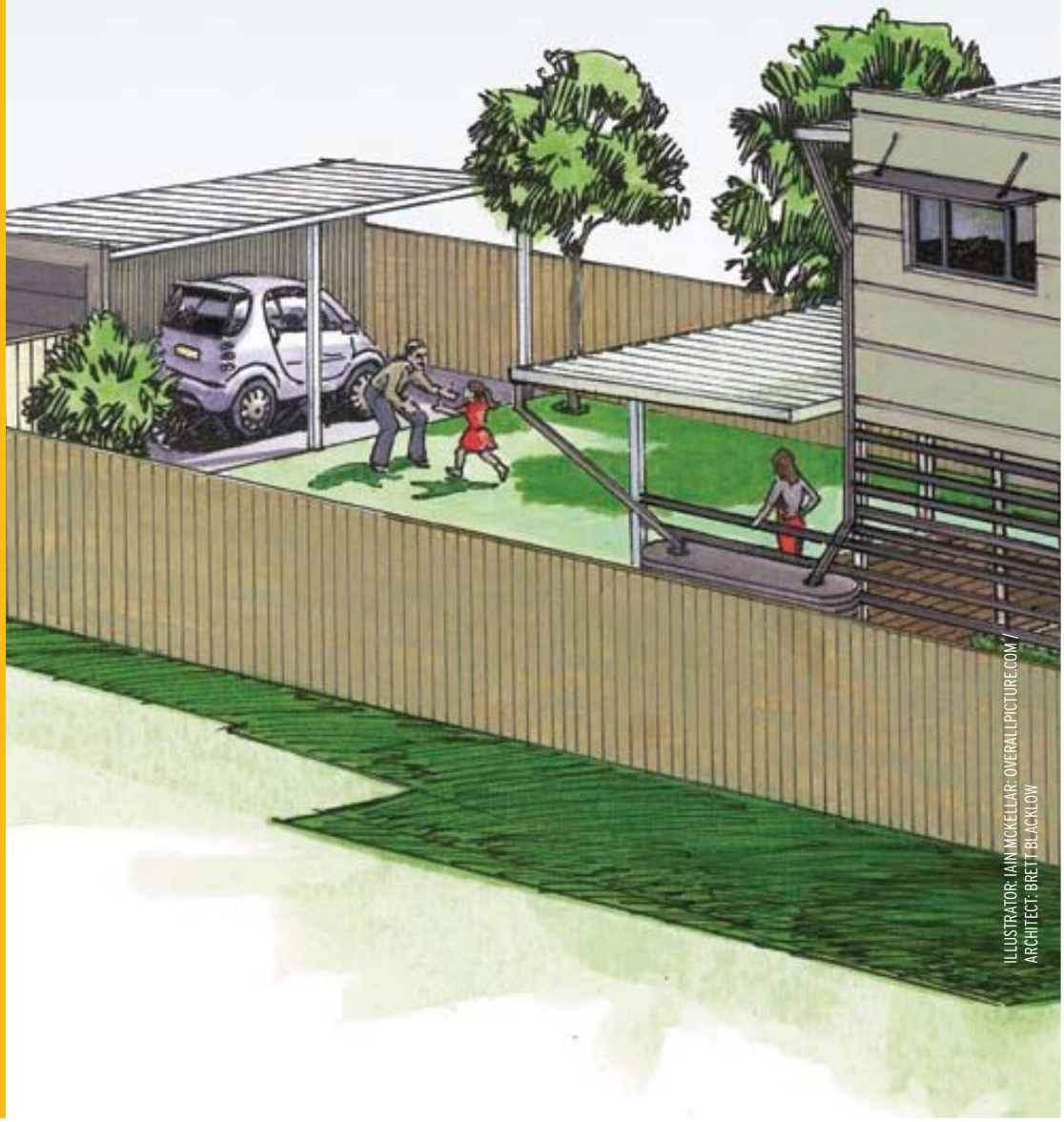
The Solution

WORDS AMANDA FALCONER

INTRODUCING ... **THE SMARTER SMALL HOME**

A small lot, small house, smart choice of materials and an efficient construction method are the key ingredients in delivering a home that stylish, sustainable – and **very** affordable.



ILLUSTRATOR: IAIN MCKELLAR: OVERALLPICTURE.COM / ARCHITECT: BRETT BLACKLOW

WHEN DESIGNER BRETT BLACKLOW sat down with project instigator Kevin Doodney to try to create the archetypal affordable home, he didn't begin with the home itself. Instead, it was the size of the lot that was his first consideration. As the cost of land is often at least half the cost of a total house and land package, both Blacklow and Doodney knew that to deliver an affordable housing product, they needed to make the land size small.

The decision to create a lot 10 metres wide by 30 metres long set up a series of design constraints; they became a design problem that Blacklow and his team needed to solve. For example, having the smallest block of land meant that the home really had to be a two-storey house.

"Generally doing a three-bedroom, two-storey house isn't a wise decision," ⇨

SHOW ME THE MONEY

Blacklow is well qualified to assess the real costs of construction. When he added up the bill to construct The Smarter Small Home™, the total was about $127,583 excluding the GST. With GST, the cost was just over $140,000.

Blacklow then calculated the cost to build the home substituting the James Hardie products with timber weatherboards and flat sheet ply cladding. He then did another calculation, substituting the piers with an 'M'class concrete slab on flat ground, brick veneer walls instead of lightweight cladding, and a pitched concrete tiled roof using standard roof trusses. The total costs were $150,808 and $166,261 respectively, including GST.

Of course, as with any costing analysis of this kind, the primary intent is to illustrate in broad terms relative costs between different construction methods. Actual costs would depend on many factors, including individual building firms' designs, locations and supply agreements.

Blacklow outlined these drivers of cost variances:

- **Quick and efficient installation with screw-in footings.** The slab on ground requires a level pad, whereas the raised house can be built over a small fall without

CONTINUED OPPOSITE ⇨

Blacklow says. "There's more surface area on the outside of the house, so there's more scaffolding and it will take longer and cost more money [than a single-storey home]." However the land saving is so significant, Blacklow and Doodney felt that with some thoughtful design, the additional costs would be offset.

SMARTER PRODUCT SELECTION – THE ROOF

Blacklow says that careful product selection helped claw back costs – particularly when running and maintenance costs were thrown into the mix. While the actual sale price of the home was the first key thing to get right, it was also important to ensure lower life cycle costs as well.

Often, time is money, so the speed of construction also drove product decisions. The team was always thinking of products that could be installed and simply finished; ones that involved the least number of construction layers. For example, Blacklow chose an all-in-one Bondor sandwich panel for the roof, which meant the roof was fully installed in half a day.

"One product turns up to site," he says. "When it's finished we have our roof structure, insulation, sheeting, ceiling structure and finished ceiling. Instead of having a scaffold up for two or three weeks, it's all done in half a day."

Using the Bondor panel didn't inhibit design options either. While there are some span constraints to consider, the panel can be used on anything from an almost flat roof to one with a steep pitch.

SMARTER PRODUCT SELECTION – THE SUB-FLOOR

At the opposite end of the building – the ground – another smart product choice was made. Twenty-two steel screw-in piers were used instead of brick piers and joists or the traditional slab on ground. These screw-in piers are typically installed in just half a day and, at this point, the foundations are finished. No bulk earthworks are needed.

Blacklow says the type of land available in developers' land banks was a consideration when choosing the way the sub-floor would be constructed. Much of the land in many areas of south-east Queensland and some parts of Sydney and NSW is sloping. In other places, like Perth, for example, the soil on land available for development is considered reactive.

A senior project designer with Land and Housing Development in the Western Australian Department of Housing and Works says that more difficult sites are now over-represented relative to the flat sandy sites that are traditionally preferred for development.

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As a result, site costs for fill and retaining are anywhere from $15,000 to $20,000 per lot and "will play an increasing part in the future," he says. Elsewhere in the country, builders frequently tell developers and consumers that to build on sloping sites will cost 'thirty grand extra'. They arrive at this cost very roughly with an approach based on using a concrete slab.

Blacklow believes that the industry has been building the same way for two or three hundred years and that it's really hard to change people's thinking. "While screw-in piers have been around for ages, hardly anyone uses them," he says. "The beauty of them is that we don't have to come out and make a flat area and we don't have to dig or pour footings and box up the slab. We just screw these things into the ground, we put the posts on that afternoon, and on day two we start installing the floor framing." ⇨

ARCHITECT: BRETT BLACKLOW

The first Smarter Small Home has been built in a hangar in QLD. It has achieved a 5.5 star rating, modelled with the BERS Pro 4.1 in Climate Zone 2.

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incurring any real extra cost. That's because the screw-in footings don't require excavation and don't produce a big pile of excess soil that needs to be dumped or spread over the remainder of the site. In addition, installing the screw-in footings means two people are there over a half day, whereas a slab uses seven or more subcontractor teams and happens over a one to two week period.

- **Cheaper plumbing costs.** Typically the plumber's charge is slightly cheaper when plumbing suspended pipework under a timber framed floor than it is buried under a slab.
- **No cost requirements for termite protection.** The slab on ground requires termite protection to the slab penetrations (at the very minimum) whereas the raised house has no cost requirements for termite protection.
- **Greater cost-effectiveness in using lightweight products than brick veneer with steel support.** The costs of the brick veneer skin and the requirement for steel support bars over openings makes it a more costly solution than using lightweight sheet products. It would be costly to reproduce the overhangs and window sizes that are in this house if brickwork were used. In addition, the heavyweight brickwork requires a metal scaffold, not an aluminium one, which is more expensive to hire. The labour time required for brick installation is typically longer than sheet cladding so, again, the scaffold stays up for a much longer period of time and therefore incurs more cost.
- **Reduced scaffolding costs.** Building a traditional roof is more time consuming and costly as it also requires a scaffold in place for a longer period of time. The sandwich panel roof solution is installed in half a day using two carpenters where the traditional trussed roof and ceiling system uses up to five different subcontractor teams and typically occurs over a two-week period.

SMARTER PRODUCT SELECTION – FLOORS

When it comes to floor framing Blacklow chose timber joists. But not just any joists. He designed the home around the most cost-effective joists he could find – 245mm by 90mm Hyne ply I Beams. The retail cost of these is about $8 per lineal metre compared with two or three times that amount for hardwood or laminated veneer lumber (LVLs).

The maximum span of the joists this size is 4.2m. "So we tried to design the structure of our house and our floor plate around the limitations of our economical materials," Blacklow says.

"Typically no-one approaches it like that. The builder or designer comes up with a floor plan and then he works out how to make it stand up."

Blacklow feels this is a recipe for adding all sorts of costs that aren't immediately obvious into a building, because the designer or builder has to make the structure work. He says that with his approach "you can pare down the costs". For example, the number of bearers (the chunkier, heavier supporting timbers) is reduced and the cost-effective joists selected are used to their maximum capacity.

With the floor framing nailed, the design team began to think about the type of material that would go on top of the frame. The most inexpensive flooring is particleboard and on top of that, tiling can be a good option, particularly when the finished price of between $110 and $140 a square metre for timber flooring is factored in.

Blacklow felt that he could source "a good tile for around $15 a square metre that could be laid for around $45 a square metre". Instead of particleboard, the substrate could be a flooring product that's made from the Scyon™ material, a lightweight cement composite. Unlike particleboard, Scyon™ won't swell when wet. When water penetrates materials like particleboard, it causes it to swell. Then tiles can crack, bulge and pop off.

SMARTER PRODUCTS – WALLS

For the wall frames the team chose prefabricated timber frames. Again, this means the frames turn up on the day they're needed and it speeds up construction. Timber is also easier than metal for carpenters to adjust if a mistake has been made.

However, as the designers began to consider the cladding materials that would go on the frame, Blacklow felt he needed to set some ground rules about product usage with project partner James Hardie.

You are working with the "grain" of the street to create identity ... Making frontages "active" creates life, and gives vitality to the public realm.

Above: Speed of construction and designing for minimal waste keep costs down in The Smarter Small Home.

"I didn't want this to be the James Hardie affordable house," he says. "Obviously the prototype house is built in James Hardie's empty factory space, but I didn't want any pressure to use James Hardie® products without me arriving independently at that decision. I thought we'd use three products, but at the end of the day we've used eight or nine – Scyon™ Stria™ and Axon™ cladding, Axent™ trim, Linea™ weatherboard and Secura™ interior flooring, as well as HardiFlex® sheets, HardiColor®, compressed for sunhoods and PineRidge® lining in the walk-in robes!"

After researching exterior cladding materials, Blacklow and the team concluded that there is "nothing that can touch a few of the James Hardie products price-wise". He says that then when he found that paint companies Wattyl and Taubmans provide 15-year paint warranties for certain paints used ⇨

ARCHITECT: BRETT BLACKLOW

LOOKING GOOD FROM EVERY ANGLE

▼ FRONT & REAR ELEVATION

▼ SIDE ELEVATIONS

▼ FROM ABOVE

ARE WE BACK TO FRONT?

In its most compact form, The Smarter Small Home has been designed for a rear-loaded lot with the house at the front. Instead of having a front yard and backyard, there is one sizeable yard. "We haven't got a big driveway and wasted 120 square metres," Blacklow says. "Instead we've just used 30 square metres for the front."

If the home is to be used on lots that aren't rear loaded, they'll probably be slightly bigger blocks. For example, a large Queensland developer has already commissioned five Smarter Small Homes after seeing a sneak preview. They will be built on 15 metre wide lots.

Urban designer Sharni Howe says the combination of building height, massing and scale, built form elements, and the interface between uses are fundamental to creating a sense of identity and place. She explains that at this level, you are working with the "grain" of the street to create identity.

Some aspects deserve more attention than others. Making frontages "active" creates life, and gives vitality to the public realm. Howe says that the rule of thumb is that the more frontages on the street, the more active it will be. In areas where frontages have tended to be dominated by garages, rear access lanes can create a more active and safer streetscape environment.

Instead of choosing products that need detailed flashings and jointings, products like HardiFlex® sheets have been used.

on products like Scyon™ Linea weatherboard and Scyon™ Stria cladding, he thought: "This is sensational."

Time saved in construction was another plus. "Many of James Hardie's products are sheet products and so a carpenter can cover an area of three square metres in 10 minutes. So we've chosen products that cover a big bit of area when they go on," Blacklow says.

In addition, instead of choosing products that need detailed flashings and jointings, products like HardiFlex® sheets have been used. "We have this detail that we've used that puts a little bit of a snakeskin (damp-proof membrane) flashing behind the joint in the sheets with a batten [Scyon™ Axent trim] on top. You've got a finished joint and we can put on as many battens as we like." This is a cheaper way to make a weather-tight joint than using folded metal flashings .

In addition, using the Axent trim with its 15-year paint warranty also creates a saving over the life of the building. "Typically we couldn't put on a pine timber batten and not have a drama in under 10 years," Blacklow says.

REPETITION IS THE DEVELOPER'S FRIEND

A key driver of the affordability of a development versus that of a single home is building the exact same floor plan. "When we're doing this we want to make the outside of these homes look as different as possible, while still being essentially the same," says Blacklow. It's this approach that helps ensure a vibrant community instead of the homogeneity that planners, developers and consumers are moving away from.

"The thing I'd say about these products is that you can give me one standard flat sheet like HardiFlex and I can give ⇨

ARCHITECT: BRETT BLACKLOW

FLOOR PLANS AT A GLANCE

GROUND FLOOR

FIRST FLOOR

The floor plan of The Smarter Small Home has been reproduced with the permission of architect Brett Blacklow, Earth Spirit Home Pty Ltd. As the plans, sketches, computer images and models of The Smarter Small Home are protected by copyright they cannot be reproduced without permission.

ILLUSTRATOR: IAIN MCKELLAR: OVERALLPICTURE.COM

SHINING THE LIGHT ON RUNNING COSTS

Running costs were a key consideration for the design team. According to the Chairman of the National Appliance and Equipment Energy Efficiency Committee, Dr Tony Marker, one watt consumed in stand-by is, as a general rule, approximately equal to $1 per year. A single appliance using eight watts of power in stand-by will add approximately $8 per year to your electricity bill.

Stand-by power consumption accounts for up to 10% or more of Australia's household electricity usage. This costs Australian households more than $5 billion and generates more than 5 million tonnes of carbon dioxide per annum.

To help reduce stand-by power use, Blacklow and the team added an override switch at the front door that can turn off the circuit that has attached to it all the discretionary appliances like televisions, stereos and the like. When you come home you just flip the switch back on.

In addition, off-peak power will be connected to the house, and power points that indicate when off-peak power is available will be installed in areas, such as laundries, that have significant energy-using appliances.

MEASURING WASTE

One of the key elements of the design approach was to design rooms, heights and walls to the size of materials available. "When I buy timber, it has to be in 300mm increments," says Blacklow. "Plasterboard is two different widths. If I'm not thinking of those things when I'm designing, then I'm potentially buying more than I need and I'm also paying someone to cut it down to the right size."

In addition, the team has developed the design to incorporate a number of the offcuts that may be generated. For example, they use HardiFlex sheets in certain places, and then also use the 600mm offcuts in another. That's instead of using full sheets and throwing the offcuts away.

"For example, plasterers often line the inside walls by sheeting straight over a window or door and then cutting it out," Blacklow says. Then half an hour later they need the same size as that or smaller and so they cut off a new piece of plaster."

Because all the waste on a building site is paid for, it makes sense to minimise it. Typically, skips have to be hired and then transported to a transfer station or recycler and then fees paid on that. On this house, the team aims to reduce the total waste produced by up to 50%.

"I'm very comfortable we'll achieve that," Blacklow says.

Smart innovation: sliding doors stack on the outside to maximise the opening, linking the home to its outdoor room.

ARCHITECT: BRETT BLACKLOW

you five or six different finishes. It can be done without texturing or anything like that, but through using vertical or horizontal battens, or smooth ones or really protruding ones. These products just have a bucketload of flexibility at a really affordable price," he says.

WINDOWS AREN'T JUST A HOLE IN THE WALL

Blacklow knew that the typical length of plasterboard and other lining materials is 2,400mm, so he set ceiling heights at a standard 2.4m high. Windows wouldn't just be a "hole in the wall" either. When considering where to locate them, some key questions would need to be answered first.

Is the window for access, ventilation, view or daylight – or a combination of those factors? How can enough of them be used while at the same time minimising the number of them?

Glazing is a building component that contributes disproportionately to a building's energy ratings. In an unpublished study ratings appeared to be directly related to the overall proportion of glazing and none achieved a 5 star rating if its glazing ratio was in excess of approximately 26% of its floor area. (This study and the factors that contribute to energy efficiency are covered in more detail in *The Smarter Green Book*, available at http://www.jameshardie.com.au/smarter/green.html.)

If windows are poorly chosen, sized, oriented or protected, it can allow too much solar radiation into the building causing overheating in summer. In addition, overglazing causes excessive heat losses in winter.

With these factors in mind, Blacklow decided that instead of putting a window in every wall, they would break it down to determine the function of the specific

window. "This wall is the one we get our light through; this opening is for access; this is for ventilation – and when we get to one for ventilation, we make it a louvre." Louvres allow the wall to be opened in percentages. When it's a view window, it has been made a fixed window, because Blacklow claims that's five times cheaper than having an openable one. The western wall of The Smarter Small Home has no windows at all, but it does use Makrolon® Multiwall sheets.

At less than half the price of normal glazing, this polycarbonate product floods the house with natural light while reflecting 91% of the western heat load. Its stylish and unique look also adds to the aesthetic appeal of the project.

Blacklow says this approach means that the total window bill is 65% to 70% that of a normal volume builder, because they don't usually approach the design of windows in this way. "They put double-hungs here, sliders there, and they haven't saved money where they could," he says.

HARDWORKING SPACES

In a house as small as this one, in total about 120 square metres, no space can be wasted. As a consequence, there are no hallways. Blacklow says they've also tried to use a lot of combined rooms and, in some ways, they've reverted back to features popular in the 1950s, like eat-in kitchens.

Instead of separate kitchen, dining and living rooms that aren't all necessarily well used, the designers have created a large room with a kitchen at one end with space for a large table that can be used for food preparation and dining. Alternatively, a mobile kitchen preparation bench and a smaller dining table can be used.

Blacklow says flexibility is the key. "While we've been designing a house that's affordable, we know that in creating this we're taking people a few steps beyond everything else they're seeing now on the market," he says. "As a result, every decision we've made has been with the goal of creating a space that feels large even though it's small. And we're not decorating it with things that aren't needed.

"We've been intent on getting the architecture to do the work. We've been trying to make a great cake, not squirt a whole lot of pretty icing on it."

You be the judge. The Smarter Small Home is available for tours from April 2, 2009. Check at www.smartersmallhome.com.au for details. ⇨

Smart shading and window placements are important.

James Hardie has offset the carbon produced in the construction of The Smarter Small Home by supporting wind farms in India.

COUNTING THE CARBON

Analyse, reduce and offset: that should be the recipe for designers and builders who are serious about their carbon footprint.

You can't manage what you can't measure, and there is energy used in lots of ways that you may not have even thought of. When it comes to houses, Climate Friendly Managing Director Joel Fleming says that the carbon emissions from buildings are actually one of the greatest contributors to Australia's greenhouse gas emissions.

Climate Friendly's approach is to help organisations understand and measure their carbon footprint by working out how many tonnes of carbon they produce. They then look at ways to reduce it, like using green energy from a wind farm, for example. To offset other unavoidable emissions they might suggest purchasing renewable energy carbon credits from independently Kyoto-compliant projects.

James Hardie asked Climate Friendly to measure the carbon footprint of The Smarter Small Home™. It found that about 139 tonnes of CO_2 were used to manufacture the materials used in the home as well as to actually construct it. That works out at about 1.16 tonnes of CO_2 per square metre. This compares to almost 195 tonnes, or 1.62 tonnes per square metre, of CO_2 for a traditionally built home (we modelled the Smarter Small Home design but with a concrete slab, brick veneer and concrete roof tiles). See graph below.

WHERE THE CARBON COMES FROM

Climate Friendly reports that, based on its analysis ,most of the emissions from The Smarter Small Home come from steel, aluminium and plastics; together these account for 60% of its total emissions. In the case of the traditionally built home, most of its emissions come from concrete, clay bricks, steel and plasterboard, which together account for 58.6% of its total emissions.

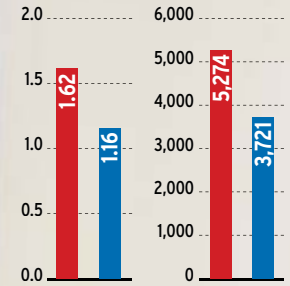
They also quote CSIRO data indicating that the average energy intensity for a high energy intensive house is approximately 5,500 megajoules per square metre (MJ/m²) while the average energy intensity for a low energy intensive house is approximately 4,500MJ/m².

Climate Friendly's analysis demonstrates that the energy intensity for both The Smarter Small Home (3,721MJ/m²) and the traditionally built home (5,274MJ/m²) are less energy intensive than the average low and high energy intensive houses. The Smarter Small Home is significantly less than any of them.

James Hardie has offset the carbon produced in the construction of The Smarter Small Home by supporting the GFL wind farm in Gudhepanchgani in the state of Maharashtra, India. Operational since April 2007, the 23.1MW wind farm is made up of 14 wind turbines each capable of generating 1.65MW of energy and displacing 51,618 tonnes of greenhouse gas emissions caused by the burning of fossil fuels.

Climate Friendly often supports projects in developing countries like China and India. "In part, this is because Australian projects don't currently reduce emissions over and above the cuts already required by regulation," Joel Fleming says. LH

WHICH IS GREENER?



[1] The 120 square metre home is built on a 300 square metre 'lot' inside an empty factory hangar belonging to James Hardie. This approach was taken to speed construction and remove the need for planning permits. It also meant that the prototype home could be used as a display for nine to 12 months. However, The Smarter Small Home is designed and intended to be built on actual sites.

[2] In the relevant James Hardie technical manual, James Hardie recommends the use of folded corrosion-resistant flashings as best practice. Designers and builders are responsible for ensuring the appropriateness and adequacy of the weather-tight details used on each particular project.