MODERN GREEN HOMES

Sanctuary

16 MODULAR & PREFAB HOMES

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ISSUE 42 • AUTUMN 2018
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INSIDE ISSUE 42 Courtyard basics; build without skip bins; PCM cost-benefit; stairs with flair; easy home automation; reinvent your garden

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MODERN GREEN HOMES
Sanctuary

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HOUSE PROFILES

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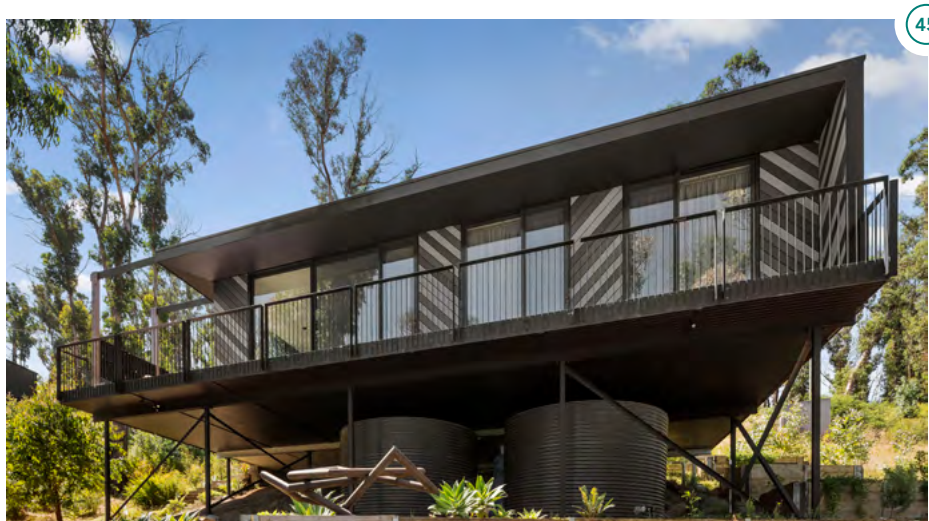
MODULAR AND PREFAB SPECIAL



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PowerPlay

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'Prefabricated wall and roof panels have proved to be a cost effective, time efficient solution on numerous projects including our Suntrap House'
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Letter from the editor

—Issue 42

Prefabrication is proving to be important in the pursuit of more environmentally sustainable homes. Top performing businesses are producing designs with high building energy star ratings and Passivhaus certification, making this one of the most innovative branches of the building industry. International experience shows factory construction lends itself well to efficiencies, transparency in building quality and reduction in waste streams, and this is playing out here too.

Just five years ago a few modular products dominated this market, but now there is more diversity including growth in 'flat-pack' or panelised systems. The increased activity within this sector is certainly good for consumers – our prefab special starts on page 45 – and heralds a much-needed shift in the way we do housing in Australia. And with prices for some architecturally designed prefab systems now dipping below $2000 per square metre, off-site construction appears to be our best hope yet for delivering high-quality houses at scale (page 64).

While in this *Sanctuary* we focus on 16 stand-out prefab companies, we also feature five beautiful passive solar designed homes built in more traditional ways – and even explore the owner-builder experience which is capturing the imagination of a new generation keen to get hands-on and creative (page 66).

ALSO IN THIS ISSUE ...

We see how technology can augment passive solar design (page 86) and interconnect your passive and active solar systems (page 34); Anna Cumming presents a suite of spectacular stair ideas and Marie Carrel explains how best to use courtyards. We continue to see people experimenting with phase change materials (page 22) and in this issue, we assess whether it's providing bang for buck for thermal performance (page 72). Outdoors, Michael Tanner explains the correct way to protect plants and soil during the building process.

Thank you to everyone who completed our *Sanctuary* readers survey. We've been overwhelmed with the number of responses. Your feedback and insights are invaluable, keep them coming!

– *Kulja*

PS. Congratulations to Vanessa Tallon, winner of the Stiebel Eltron hot water heat pump in our recent subscriber prize draw. We hear the system is providing hot showers for the extended family at a shared home on the Hawkesbury River.

Sanctuary is published by the Alternative Technology Association (ATA), a not-for-profit environmental organisation promoting renewable energy, sustainable building and water conservation since 1980. ATA's advisory service, advocacy, events, research and publications aid over 250,000 Australia wide.

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Products

01

RETROFIT CONCRETE PANELS

A concrete slab needs to be planned from the beginning of any building project, but there is one retrofit option that can store some passive heat from the sun in winter. Concreate's floor panels are lightweight and able to be retrofitted to any stable sub-floor or glued-in during construction. You'll need a pro to fit them but the tongue and groove interlocking system should streamline the process, and the panels come oiled and polished saving time and money on finishing, with occasional re-oiling required. As well as retaining some natural warmth from the sun – more than floorboards, though of course not as much as a full slab as the stone component is just 4mm thick – these floor panels could work with floor-based heating as they transmit underfloor heat into the room. They're made from specially formulated cement mixed with recycled fibres, with lower CO_2 emissions than standard Portland cement. The floor panels cost $129 plus GST per square metre, and also come as wall panels at $85 plus GST per square metre.

www.royaloakfloors.com.au/concreate

02

BRASS TAPS

Not every tapware business is able to operate its own foundry, so it's special to come across one that does have a local manufacturing process. Sussex Taps has switched to more energy efficient manufacturing in recent years, converting to LED lighting and installing a more efficient cooling system at the foundry so it can still manufacture on really hot days. They've also been recycling brass shavings, a by-product of their manufacturing process, into even more taps by melting the shavings at the foundry. Its broad range includes Suba, a bit minimalist in nature with bold shapes and finishes, and Scala (exclusive to Reece), incorporating a more contemporary design. Taps can also be custom-designed. Prices start at $700.

www.sussextaps.com.au

03

WATER SAVING AIR SHOWER

Some people like to feel completely drenched in the shower, but not all modern water-saving showers feel the same. Technology is now helping to deliver a 'fuller' shower experience so that people can get that soaked feeling while still saving water. The Multi Spray Air Shower mixes the droplets of water with air to create the feeling of a fuller spray while using six litres of water per minute. The showerhead also comes on a height-adjustable rail that can be modified for all shower users, and extends up to 300mm from the wall, making it feel like a ceiling shower without the pipework and expense of installation. It is easy to install onto the existing shower thread, with no drilling involved. The Multi Spray costs $215 from EzyFix, with discounts available if replacing two showerheads; they are also available at Bunnings.

www.ezyfix.com.au

04

PLYWOOD BEDSIDE TABLE

A furniture designer by the name of No Goat for Jack would be a bit approachable don't you think, to have a chat about some unique pieces for the home? The No Goat team works out of Yarraville and Brooklyn in Melbourne's inner west and makes a beautiful range of coffee tables, dining tables, sideboards, entertainment units and more from plantation plywood, one of the more sustainable timber choices around. Plywood is an engineered wood made from sheets of timber glued together, that's incredibly strong but also versatile enough to make modern furniture. Working with a sheet of plywood also ensures less waste than other cuts of timber. The Rocket range of bedside tables is made from Birch plywood and can be ordered in various configurations with and without shelves, as well as with a rounded door, known as the 'round peg square hole' option. Prices start at $355 for a single or $665 for a pair, with vintage laminated detail available from time to time.

www.nogoatforjack.com.au

05
RECYCLED PLASTIC MATS

Sometimes we want a mat made from a soft cotton or wool, but other times we need a functional mat made from a durable material such as plastic, especially outdoors or where children play and make a mess. Recycled Mats make a range of indoor and outdoor mats from polypropylene, which is the polymer found in food containers, plastic bags and some other plastics that we urgently need to divert from landfill and the oceans. Their range of contemporary recycled plastic mats recently caught our eye, but their speciality is Aboriginal and Maori designs, commissioning unique works by Indigenous artists. The mats are reversible, washable and UV treated so work well in the sun to some extent, although prolonged exposure to sun and rain will cause deterioration. The Garrima recycled mat (pictured) features a design by Aboriginal artist Christine Slaab, inspired by Joongarrabah, a peak in her local Tweed and Gold Coast area. The three-metre wide mat costs $169.95, with many more designs on the website.
www.recycledmats.com.au

06
MORE BEESWAX FOOD WRAPS

The modern kitchen is home to a lot of plastic waste, be it plastic bags, food containers or cling wrap. Fortunately there are new food wraps hitting the market, including these organic ones handmade in the Hobart CBD. Sustomi makes food wraps using a combination of local Tasmanian beeswax, jojoba oil and natural tree resin applied to pieces of 100 per cent cotton or hemp material. The oil, wax and resin give the wrap just the right adhesiveness to stick to itself or to glass and ceramic, and breathability to keep food fresh. The cotton wraps come in bright designs while the hemp wraps resemble brown paper. There are four sizes, from small to extra large depending on the purpose. The starter four-pack contains each size and retails at $49. Sustomi also sells DIY blocks of the wax/oil/resin combination for $19.50 to make your own wraps at home; they come complete with instructions.
www.sustomi.com.au

07
WATER SAVING PLANTER

Wicking garden beds are one of the more efficient ways to water plants, delivering water straight to the roots from a reservoir at the base of the bed and cutting evaporation at the same time. Orto Urban Gardens have smartened up this old DIY garden method with a range of self-watering planter boxes made from plantation timber, with castors if you choose, so the box can be moved around the garden or home for the best year-round sun position. The reservoir at the base holds 33 litres, which is handy if you're going away, with an outlet pipe to prevent over-filling the wicking bed. The soil depth is 25cm to 30cm, enough to support a range of vegetables, and the plants tend to thrive thanks to less disease caused by wet leaves and being able to control their own water intake. The Orto Rustic Planter can come pre-planted with your choice of herbs and vegies (the Pro model), or empty and ready for you to fill (the Gardener model). Prices range from $269 to $419.
www.orto.com.au

08

THERMAL COOKER

Slow cooking often makes a more delicious meal and can be a more energy efficient way to cook as well. One cooker on the market, the Billyboil, incorporates an inner pot like a saucepan and an insulated outer pot, much like a thermos, to help cook food after it has been brought up to temperature on the stove. The meal can cook for up to eight hours in retained heat, with no energy used in that time. The cooker obviously appeals to campers and caravaners, but it's just as useful in the home. The inner pot capacity is 3.5 litres, enough to make a meal with plenty of leftovers. It is suitable for use on any stove top (gas, electric or induction) and costs $99.

www.billyboil.com.au

09

SMART SMOKE ALARM

Every home must have a smoke alarm by law these days, so it was only a matter of time before this household essential was made more reliable via smart home automation. The Nest Protect is a smart smoke alarm that issues its alert via a human-like voice along with a message to the phones of all householders, in case no one is home. If it's just a case of burnt toast the alert can be switched off via the phone. While a well-maintained beeping smoke alarm will do the job, a smart smoke alarm reduces the chance of human error preventing the alarm from working, say if the batteries aren't changed or the alarm is never tested. The Nest Protect checks its batteries and sensors over 400 times a day and runs its own regular sound check. The split sensor detects both fast- and slow-moving fires, and has a built-in carbon monoxide monitor to detect dangerous gases in the home from appliances such as heaters. It can even control compatible devices, for example it can flash lights if it detects smoke, or shut down a heater if it detects carbon monoxide. The sensors last 10 years and the device is powered by six long-lasting AA lithium batteries. The alarm retails for around $189.

www.nest.com/au

Reviews

—Books, websites, films and other interesting stuff

If you have recommendations for films, books, smartphone apps, blogs, websites or anything else you think would be of interest we'd love to hear from you. Email us at sanctuary@ata.org.au

BOOKS

THE APARTMENT HOUSE: REFRAMING THE AUSTRALIAN DREAM

Edited by Katelin Butler and Cameron Bruhn
Thames and Hudson 2017
RRP $70

The Apartment House could not be released at a better time. With the advent of the Nightingale model, the recent release of apartment design guidelines in Victoria and New South Wales and renewed passion within the design profession for producing quality over quantity, there's growing interest in the possibilities for apartment living. Replete with thorough reviews of 26 apartments and town houses, it takes readers on a journey through the alternative Australian (and New Zealand) dream – where we live closer together but still in functional, and often spacious, homes. The book includes apartments from 27m² to 319m² and showcases old and new residences built or renovated to perfection. Experienced editors Katelin Butler and Cameron Bruhn also explore the huge diversity that characterises this housing type: some buildings are high-rise and have hundreds of homes, while unit developments can offer as few as three.

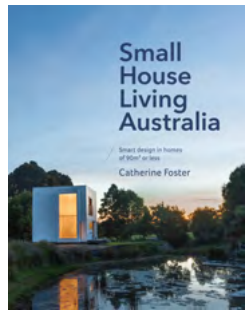
For those who love floor plans and demographic details, you'll love the information provided to contextualise each dwelling, including distance from the CBD, public transport, the density of the suburb and typical car use.

CONNECT: PRACTICAL WAYS TO GROW AND PREPARE SUSTAINABLE FOOD

Kylie Treble
Self published, The Place of Wonder 2017
RRP $60

Many families have recipes and even recipe books that pass down through the generations. This practice not only maintains culinary culture but connects people with their food and gardens. Kylie Treble, a passionate advocate of sustainable food, has created such a book for her own family and local community, and also for the rest of us! Self-published under the name of her farm The Place of Wonder, *Connect* is structured around 20 temperate and cool-climate crops with at least five delicious recipes per section, inter-dispersed with edited notes from her diary and cooking and gardening journals.

What sets this book apart from others is her thoughtful, often thrifty, guide to the how each crop can be connected to social eating, resourceful gardening and sustainable cooking. For example, the apple section highlights the ease in which this crop can be shared with others, how pruned branches can be used to shade lettuces and seedlings and ways to use the seeds as a natural source of jam-setting pectin. Filled with innovative gardening tips and tricks and unique food combinations, even the experienced gardener or cook will be surprised and inspired by this book.



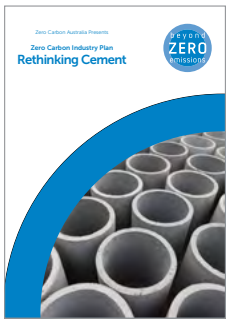
SMALL HOUSE LIVING AUSTRALIA: SMART DESIGN IN HOMES OF 90M² OR LESS

Catherine Foster
Viking 2017
RRP $40

Sanctuary has long been enthusiastic about smaller-scale living, and houses that can support sustainable lifestyles using a fraction of the materials required for an average-sized home. *Small house living Australia* celebrates good design and modest tastes, and gets a huge tick from us when it comes to curating projects – many of which have strong green credentials including some we've featured ourselves over the years! Familiar designers include Day Bukh Architects, Ben Giles, Small Change Design and Takt; readers will also be enthusiastic about the projects included from the studios of David Weir and Peter Stutchbury.

The 21 projects featured here are all detached residences where the liveable space is under 90m². There is a good selection of floor plans and materials on show, and a mixture of permanent houses built on tight sites and weekenders designed for occasional use. For anyone wishing to build a small abode, studio, granny flat or country getaway, or even if you are searching out ideas for ways to make a small space work better using clever layout or storage ideas, this could prove to be a valuable design-book investment.

REPORT



RETHINKING CEMENT

Beyond Zero Emissions, 2017

Free PDF or $30 print

bze.org.au/rethinking-cement-plan

How much do you know about concrete? Used by the ancient Egyptians, Greeks, Chinese and Romans, it's a material with a long history – and its strength, durability and ease of use ensure that it's still vital to our construction industry today. However, production of cement, the key ingredient in concrete, is the single biggest industrial producer of carbon emissions, responsible for a huge eight per cent of global emissions – more than the world's car fleet. It's an area of concern for those aiming to build a truly sustainable home: concrete slab floors can offer excellent thermal mass benefits and contribute to the energy efficiency of the home, but at a cost of high embodied energy and emissions.

Climate change think tank Beyond Zero Emissions produces independent research in a range of areas. In 2017 they released *Rethinking Cement*, the first part of their Zero Carbon Industry Plan. It's available for free in PDF format or in hard copy for $30 from BZE's online shop. At 98 pages it's long, but very readable and informative and lays out the main problem (the use of limestone-based Portland cement for concrete production) and five strategies for making and using our concrete differently and more sustainably. Even if you didn't think you were interested in the ins and outs of making concrete, this fascinating and inspiring report might change your mind.

ONLINE CALCULATOR

BASIC SOLAR ADVICE SERVICE ONLINE TOOL

ATA 2018 - Free

www.ata.org.au/ata-solar-advice

The not-for-profit Alternative Technology Association (*Sanctuary's* publisher) has recently launched Australia's first free, independent and comprehensive solar and battery calculator that gives you the information you need to properly size your solar and/or battery system.

The Basic Solar Advice online tool asks you a few simple questions about your location, electricity consumption, tariff, any existing solar system, and budget; they are generally easy to answer with the help of your latest electricity bill. The calculator then emails a report with a range of options for different solar system and battery sizes to suit your situation, with estimates of bill reductions and payback times for each.

An old jacaranda tree – the only non-native presence in the yard – is a striking focal point.

Photosynthesis house

A tiny beach cottage in Sydney's Manly Vale is sensitively renovated to bring all-day sunlight and year-round comfort to a family of five.

WORDS Fiona Negrin
PHOTOGRAPHY Simon Whitbread

PERVASIVE MILDEW, A SCANT 90M² OF floor space and just two bedrooms weren't providing the best environment for Ruth and Keith to raise their three young boys. On the other hand, the couple loved their modest 1950s beach shack in Manly Vale, Sydney; it had a 'nice feel' and loads of natural light. When their architect Matt Elkan shared their reservations about demolishing it to rebuild from scratch, the decision was made to renovate and extend.

The compact cottage, although dilapidated, had a humble character that they wanted to preserve. They kept its frame but stripped away the fibro cladding and interior walls to leave just "a skeleton of the old home on its foundations". The new external cladding is 8.5mm fibro with painted batten joints to provide a more robust, "slightly more thought-through" riff on the original version. The foundation, as it happened, was a sandstone rock shelf. Rather than excavate it, the couple have allowed the rock to govern the levels of their extension and to become a feature in its own right.

The new house takes advantage of excellent orientation with full-length, low-e glass windows along the north face. In the central area of the house, where the old part joins the new, light pours in through an expansive skylight strip made of high-spec, double-glazed, low-e glass. It's Ruth's favourite space: "I find myself spending hours in the central zone of the house when I have the chance. With the louvres and the big skylight, it's a good feel." In fact, the house's incredible solar access has led the couple to dub it the Photosynthesis House.

While the light is welcome, the heat that accompanies it is not. The area's sandstone rock shelf acts as a heat sink and with minimal vegetation to offset it, summers in Manly Vale can be stifling. To shade the house and open it to cooling sea breezes there are "vast areas of louvres – we probably kept the louvre industry in business," jokes Matt. External sensor-operated, smart Venetian blinds shade the northern and western sides of the house, and Keith and Ruth have already noticed the comfort these bring on hot days.

Locally sourced timber features inside and out, and this consistent material palette does an excellent job of integrating the old part of the house with the new. Hardwoods are used extensively, including on windows, with tallowwood on the decking because "it doesn't splinter or warp," says Matt. Internal floors are all blackbutt and there's extensive use of imported melamine board, made by TZ Austria. "It has VOC emissions one-fifth of what would classify as e0 in Australia; the standards in Europe are more stringent," says Matt.

He says the joinery was blackbutt veneer because of the more varied texture and lower waste. Matt credits Fine Earth Joinery and builder Greg Lofhjelm for their attention to detail on the custom build. "A

Ruth and Keith enjoy gardening but rarely find time for it. Their garden caters to this by being planted out with indigenous species that need little to no watering, and is watered from the 5000L rainwater storage tank. A green wall covers the south boundary and a green roof (passively watered by run-off from the old roof) provides welcome shade over the skylight during summer.

Rooftop PV "makes loads of sense on a place like this with great orientation", says Matt, but the couple have deferred buying a battery, judging the technology to still be approaching its peak. Meanwhile, the electric hot water unit functions as a de facto battery for their 5kW PV system.

project like this is nothing without a good builder to bring it to life."

Cleverly, all clear-finished doors and windows are at ground level where they're easy to reach and oil, and the painted timbers are positioned higher up where less maintenance is required. The timber used for these parts was a mix of clear-finished blackbutt and Accoya pine, which Matt describes as a more durable alternative to Western Red Cedar. "Western Red Cedar takes 50 years to grow and windows made from it will last 20 to 30 years; Accoya takes 20 to 30 years to grow but will last 50 years as windows." Perhaps that's why it's finding favour among bespoke joiners.

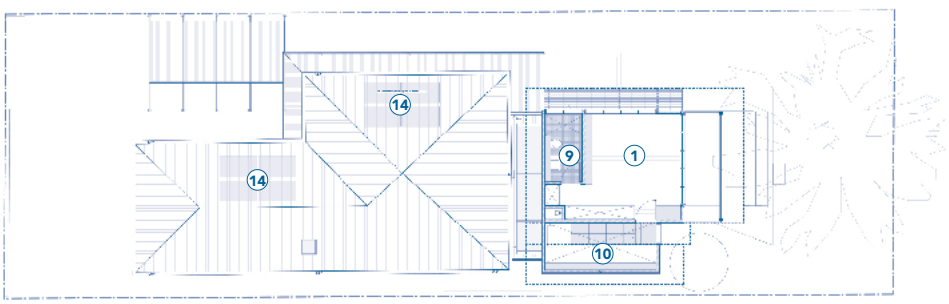
With their original 90m² cottage now expanded to 163m² over two light-filled levels, the family are "sickeningly positive" about the renovation. Ruth speaks proudly of her sons' newfound knowledge of solar power and environmentally sustainable design as a result of observing the 12-month build. Matt's take on ESD encompasses those solutions but goes beyond them: "Water tanks and orientation are relatively easy to achieve." His goal is to use beautiful materials to create spaces that are "really joyful", because that's what inspires people to look after their houses through the years, even centuries.

If that's the measure of sustainability, then Photosynthesis House is set for a very long life.

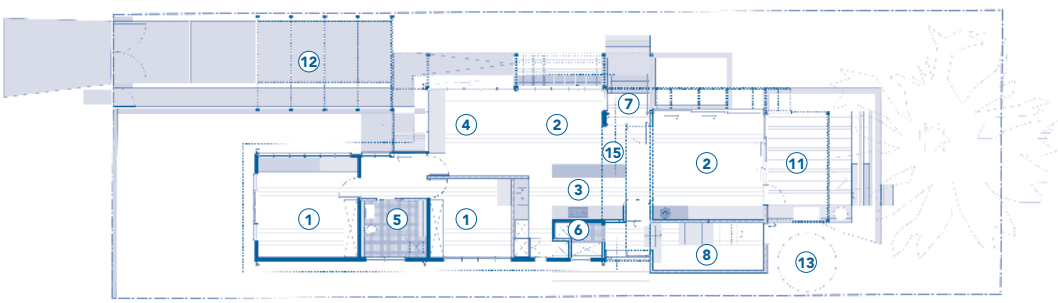
A custom-made glazed-skylight strip delineates the new part of the house from the old, and brings plentiful light into the heart of the house. It's double glazed and low-e coated.

Large banks of Breezway louvres upstairs and down keep the home naturally ventilated through the area's hot summers.

FIRST FLOOR PLAN



GROUND FLOOR PLAN



LEGEND

1. Bedroom
2. Living
3. Kitchen
4. Dining
5. Bathroom
6. Laundry
7. Entry
8. Study
9. Ensuite
10. Void
11. Deck
12. Carport
13. Water tank
14. Solar panels
15. Skylight strip

Photosynthesis House

—Specifications

Credits

DESIGNER
Matt Elkan Architect

BUILDER
Bangalley Building,
Greg Lofhjelm

PROJECT TYPE
Renovation

PROJECT LOCATION
Manly Vale, NSW

SIZE
Land 464.5 m²;
House 163 m²
(original 90m²)

BUILDING STAR RATING
5.5 Stars (whole house)

Sustainable Features

HOT WATER
– 315L electric hot water, installed in conjunction with rooftop PV array.

RENEWABLE ENERGY
– 5kW PV array (Jinko 260W Panels) with SolaX Wifi monitoring, installed by SolarPro.

WATER SAVING
– 5000L Zincalume above ground tank connected to garden taps and laundry.

PASSIVE DESIGN / HEATING & COOLING
– North orientation to all living spaces and majority of bedrooms
– North-, east- and west-facing decks to be used according to time of day
– Cross ventilation from all orientations
– Large eaves to the north to prevent overheating in summer
– External Venetian blinds on north-, east- and west-facing windows.

ACTIVE HEATING & COOLING
– Hunter Pacific Concept 2 ceiling fans in living, dining and bedrooms
– Morso 7648 wood-burning heating.

BUILDING MATERIALS
– External cladding: 8.5mm James Hardie Easy Lap with 40mm TP batten joints painted in Colorbond 'Monument'
– Roof: BlueScope corrugated custom orb in Colorbond 'Windspray'
– Insulation: roof 55mm Autex foil-backed insulation blanket and R3.0 polyester ceiling batts; internal walls R2.5 polyester acoustic batts; external walls breathable sarking and R2.0 polyester batts
– Internal acoustic feature ceilings achieved with 19 x 42mm Blackbutt battens spaced 19mm apart for acoustic absorption
– Recycled demolition sandstone used for wall footings, stairs and landscape features.

WINDOWS & GLAZING
– Blackbutt and Accoya windows and doors by H2 Custom Joinery
– Breezway louvres
– Single-glazed low-e toughened 6mm and 8mm glass throughout
– Custom skylight strip with double-glazed low-e glass.

LIGHTING
– LED lighting throughout, by Tovo lighting
– Pendant lights made from recycled Venetian blinds by Adrian Lawson.

PAINTS, FINISHES & FLOOR COVERINGS
– All internal timber finished in Organoil
– 130mm blackbutt tongue and groove flooring with Synteko Natural Oil
– All external hardwood (doors/windows/decking) finished in Cutek CD40 Grey Mist.

OTHER ESD FEATURES
– Green walls and self-watering green roof planting by The Greenwall Company
– Low water use native planting designed by Lindy Hulton Larson
– Small footprint.

Acoustic feature ceilings upstairs were formed using Blackbutt battens, spaced 19mm apart to aid sound absorption. Ceiling fans provide the only active cooling in the house.

Playtime front and centre

When it came to extending their house to fit their family, creating kid-friendly spaces with playful details was just as important to this Melbourne couple as achieving an energy efficient, light-filled home.

WORDS Anna Cumming
PHOTOGRAPHY Jack Lovel

THE MOTIVATION FOR CAROL AND Andrew's renovation and second-storey extension to their 1920s Californian bungalow in the Melbourne suburb of Northcote is a common one – having moved in with one small baby, several years later they were a family of five and needed more space. However, the priorities and the rigorous commitment to energy efficiency and passive thermal performance they brought to the project set it apart from most.

"The brief focused on the house being a bit fun and quirky for the kids, as well as on sustainability and improving the existing envelope as much as possible," explains their designer Penny Guild of Guild Architects. "Often, an upper level extension houses a parents' retreat, but here it was all about a family home with three new bedrooms and an extra play area for the kids upstairs – with a walkway above the stair void and hidden hatches connecting the bedrooms via the roof space. It made it a fun project."

Another important driver for the design was the need to admit more light into the existing living space, without making drastic changes to the structure. Penny removed the central study that is a common feature of bungalows of this era, and opened up the hallway into a double-height void; cleverly located windows, the open treads of the staircase and deliberate spaces between floor boards on the landing all help admit winter sun deep into the dark south side of the house. "We used heat shifters and ceiling fans to offset the heating stratification you can get with voids like this," says Penny: the warm air is directed into the tiny laundry where clothes airers hang from the ceiling.

It was a challenge to design the upper level extension to minimise its bulk when viewed from the street while still maintaining the original home's three-metre ceilings, and the concept went through several iterations. The original ridgeline was retained at the front of the house, behind which a small flat section of roof sets the main height of the second storey back a little further. "I tapered the new roof in a little at the sides to reduce bulk," says Penny. "It made the internal spaces more fun for kids' bedrooms too. You can create interesting spaces with angles."

Another favourite feature of the house is the large integrated fish tank in the wall between the hallway and the dining room. "It started as a joke," laughs Penny. "We were conscious of the fact that there was no thermal mass in the house, and it's difficult and expensive to retrofit. As Andrew is a marine biology teacher and has always kept fish, I suggested we install an aquarium because water can be excellent thermal mass." Although the aquarium is currently heated to house tropical fish and thus doesn't function as thermal mass, it could

Instead of creating an upstairs parents' retreat, Andrew and Carol designed the new second storey for their kids, now aged eight, six and four. Hidden in the upstairs ceilings, BioPCM phase change material will help stabilise internal temperatures, particularly in summer.

If indoor greenery is Carol's passion, the fish tank is Andrew's. Integrated into the wall between the hallway and the dining room, it provides interest and a sense of connection – and the large volume of water could also be used as thermal mass if Andrew decided to convert it to a cold-water ecosystem.

The above-ground recycled shipping container pool is, of course, one of the kids' favourite features of the house. Supplied as a self-contained unit complete with access steps, pump and filter, it was chosen for the minimal groundwork required to install it, avoiding the unknown cost of excavation needed for a conventional pool. Homeowners' photo.

be adapted to do so in the future – and in the meantime, it's a striking design element and helps bring light into the dining area.

Upstairs, the problem of lack of thermal mass was addressed through the use of phase change material (PCM) in the ceilings to help moderate the internal temperature. "I'd been reading about it, and it seemed too good not to include, though it's expensive," says Carol. It was something of a leap of faith, as it's a relatively new product for residential use and they were unable to experience it 'in situ'. But Penny was supportive, explaining that "one of the good things about PCM is that unlike insulation, it doesn't matter if there are gaps between the pieces of phase change blanket. The supplier calculates the optimal amount of material, and you just squeeze it in wherever it will fit above the ceiling and in the upper walls." [See page 72 for the phase change material product review.]

Andrew and Carol's quest for a "really energy efficient, passive thermal house" also involved careful attention to cross ventilation, shading and insulation. The existing house was retrofitted with underfloor and blow-in wall insulation. Upstairs, a variety of fixed and adjustable shading including fixed louvres, eaves, and roof windows with integrated honeycomb and blockout blinds ensures optimum summer shading and winter sunlight. Downstairs, an existing pergola to the north was extended and is fitted with Vergola adjustable roof louvres. Closed, the roof provides an outdoor living space protected from the rain; the louvres can be adjusted to regulate solar access to the interior as needed.

And while the family has not gone off gas yet, they put in a circuit for the induction cooktop they plan to install, and a full energy transition is very much on the cards for the future. "Carol and Andrew opted to retain the existing gas-boosted solar hot water system, as it wasn't that old and had plenty of life left," explains Penny.

"However, they took the opportunity to install the larger hydronic heating panels that they'll need when they upgrade from gas to a heat pump for their hydronic heating down the track." Air-to-water heat pumps operate at a lower temperature than a boiler and consequently larger panels are required to provide correct comfort.

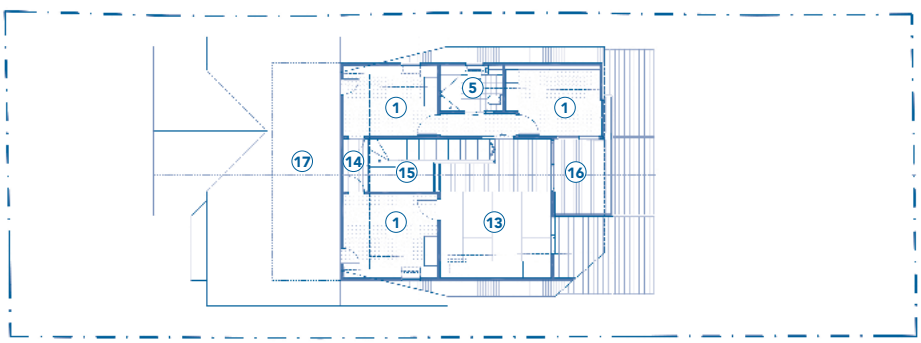
The result of the clients' and the designer's commitment to the project is a collection of practical, inviting spaces in which Carol's cherished indoor plants now have sufficient light to thrive everywhere.

Perhaps most importantly, "the kids love it", she says. "We wanted them to enjoy it and be part of caring for the house, learning to 'sail' it for its best performance."

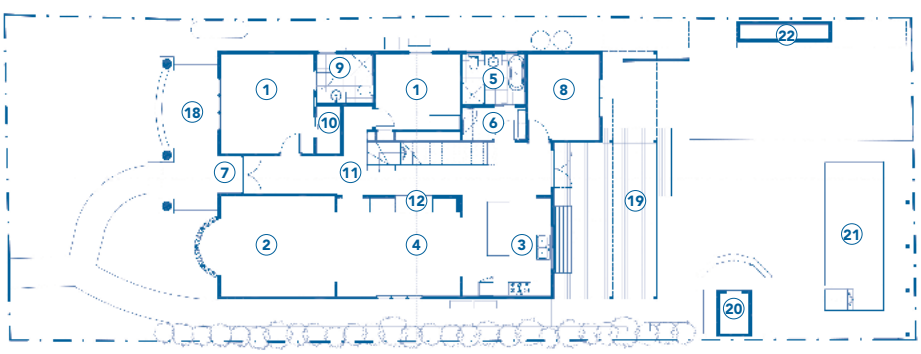
"The stairs that let the light in sum up what we wanted for the house: plenty of north light into the dark south side," says homeowner Andrew. The double-height void accommodating the hallway and stairs is Penny's core design strategy for natural light and ventilation. Open treads and lightweight balustrades help let light filter through, as do the spaces left between floor boards on the landing. This space also supports family life: a large corkboard wall for displaying the kids' artwork surrounds the built-in aquarium, and deep drawers under the stairs provide storage for shoes and school bags. Recycled Baltic pine floorboards were sourced to match the existing floors.

The back of the house faces north, so a variety of strategies was employed to ensure sunlight can be admitted when it's desired and excluded when it's not. A large pergola with adjustable Vergola louvre roofing covers the deck, while upstairs a carefully designed eave, fixed louvres and blinds provide shading when needed.

FIRST FLOOR PLAN



GROUND FLOOR PLAN



LEGEND

1. Bedroom
2. Living
3. Kitchen
4. Dining
5. Bathroom
6. Laundry
7. Entry
8. Study/playroom
9. Ensuite
10. Walk-in robe
11. Hallway
12. Aquarium
13. Playroom
14. Walkway
15. Void
16. Balcony
17. Roof storage
18. Verandah
19. Deck with roof louvres over
20. Cubby
21. Pool
22. Shed

Playtime House

—Specifications

Credits

DESIGNER
Guild Architects

BUILDER
CRD Developments

PROJECT TYPE
Renovation

PROJECT LOCATION
Northcote VIC

SIZE
Land 479 m²
House 242 m²

BUILDING STAR RATING
5.3 Star (whole house)

Sustainable Features

HOT WATER
– Reused existing gas-boosted solar hot water system.

RENEWABLE ENERGY
– Reused existing 1.25kW solar system and upgraded to Enphase microinverters, so in future when PFiT expires more panels can be added easily.

WATER SAVING
– All bathrooms and laundry connected to the existing EcoBowser greywater system which waters the non-edible garden
– All new and existing roofs plumbed to existing 7500L water tanks.

PASSIVE DESIGN / HEATING & COOLING
– Extension designed to maximise north light to existing ground areas and new first floor areas
– South-facing operable clerestory windows to bedrooms and void, for cross and displacement ventilation
– All new habitable rooms have windows on multiple sides for cross ventilation
– Vergola operable roof louvres to deck maximise winter sun and protect windows and deck from summer sun
– Fixed louvres and eave to first floor north-facing windows, designed for optimal summer shading and winter sunlight
– Fully adjustable blind to north-facing bedroom window
– East- and west-facing roof windows/skylights all with integrated honeycomb or blockout blinds.

ACTIVE HEATING & COOLING
– Hydronic heating throughout by Skyline Energy, with high efficiency Baxi Luna Duo-Tec GA 1.24 condensing boiler. System sized/designed to be adapted to a heat pump system in the future allowing clients to transition off gas completely
– Daikin 5kW high efficiency reverse-cycle air conditioner on first floor
– Heat shifter moves stratified first floor heat to lower level laundry for clothes drying
– Big Ass Haiku fans in new bedrooms and living area.

BUILDING MATERIALS
– BioPCM Mat Q23 phase change material to first floor ceiling aids in temperature stability, particularly in summer
– High levels of insulation throughout: Supafill R2.3 blow in insulation from Enviroflex retrofitted to all existing walls; R2.0 polyester batts retrofitted to existing floor; all new ceilings and walls use a combination of R2.7 batts and Aircell, with ceilings achieving R5.4
– Cladding: Cemintel barestone and Colorbond to first floor for low maintenance exterior
– Blackbutt hardwood ply used for upper level flooring, stair treads and joinery, supplied by Big River Timbers
– Recycled Baltic pine flooring used downstairs.

WINDOWS & GLAZING
– Miglas high performance composite timber and aluminium windows to first floor; high performance double glazing to east and west windows
– Velux skylights with integrated solar honeycomb blind and NEAT photocatalytic coating.

LIGHTING
– Energy efficient LED lighting from Richmond lighting.

PAINTS, FINISHES & FLOOR COVERINGS
– Natural sisal flooring from Floorspace for first floor bedrooms
– Dulux low-VOC paints to walls and ceilings
– Bona Traffic water-based two-component non-toxic finish to timber flooring.

OTHER ESD FEATURES
– Maximised retention of existing building structure to reduce embodied energy
– Lightweight building – minimal high embodied energy materials such as concrete and brick
– Pulley operated clothes hangers in laundry together with heat shifter from first floor, to aid low-energy winter clothes drying
– Above-ground recycled shipping container pool, from Shipping Container Pools, minimises excavation and allows for re-use
– Integrated 1000L aquarium has the potential to be converted to a cold water system in future to aid in temperature stability
– Deliberate choice of separate hot and cold water taps in upstairs bathroom to prevent unnecessary/accidental use of hot water.

ATA update

—Alternative Technology Association: www.ata.org.au

The ATA, publisher of *Sanctuary* magazine, is a not-for-profit organisation that exists to enable, represent and inspire people to live sustainably in their homes and communities. Stay up-to-date with ATA news: sign up to updates online at www.ata.org.au.

ATA NEWS

GIFT OF LIGHT GEARS UP FOR 2018

Thanks to everyone who supported the Christmas Gift of Light campaign, the ATA can support the installation of hundreds of solar lighting and USB charging systems in villages across East Timor in 2018. The Gift of Light program also enables the training of local technicians to install and maintain the systems, empowering local organisations and people to manage their systems into the future without us.

Learn more about this amazing program: www.ata.org.au/what-we-do/ipg

50 CHARITIES SIGN UP FOR SOLAR

The ATA, with support from the Lord Mayor's Charitable Foundation, is helping over 50 not-for-profit organisations save money by installing energy efficiency and renewable energy systems. Aged care, transitional housing and animal welfare charities as well as sports clubs, church groups and youth camps have already registered with the Sustainable Energy in Not for Profits program.

For more details visit: www.ata.org.au/sustainable-energy-in-not-for-profits

SPEED DATE A SUSTAINABILITY EXPERT

ATA's popular Speed Date a Sustainability Expert series is back in 2018 with two new events and more to be announced soon. The Boroondara event will focus on water efficiency, with experts in greywater, irrigation, water recycling, water storage, stormwater management, low water gardens, wicking beds, and green roofs, walls and facades. So bring your plans and questions to get free advice from leading sustainability experts.

Register here: sdse.ata.org.au

NOMINATE YOUR HOUSE FOR SHD 2018

Sustainable House Day 2018 will be on September 16. Invest in your neighbourhood by opening your home and sharing your passion and knowledge of sustainable living. Let your house inspire and educate others as you share your journey of what worked, what didn't and how it has changed your way of living. By opening your home you can upcycle your knowledge and encourage the continued growth of sustainable houses.

Learn more: sustainablehouseday.com

ATA SHOP – SHOP.ATA.ORG.AU

SOLAR FOR ALL

Traditionally, solar energy has been hard to access for tenants and apartment dwellers, but happily a range of options is emerging to enable them to join the solar revolution. *ReNew* 142 shines a light on what landlords and tenants can do to implement solar and energy efficiency technologies. In addition this issue includes the latest solar panel buyers guide, an induction cooktop mini guide and an update on the electric vehicle market in Australia.

Price: $9.90 for print version or PDF.
shop.ata.org.au/shop/renew-issue-142

GAS OR ELECTRICITY?

When your gas heater or hot water system needs replacing, are you better off getting another gas one, or switching to an electrically powered one? A heat pump system may cost more than a gas one, but what about the running costs? Does having solar make a difference? The ATA has done the maths, looking at appliance change scenarios for five different household types across Australia and our report on the economics of fuel choice is coming out in March 2018. Sign up to the ATA enews to find out more at www.ata.org.au

In the saddle

The result of a mutual understanding between architect and client, Saddle Hill House is a comfortable and well-insulated family home, achieved through passive solar design and renewable energy.

A colourful interior was an important part of the brief for Anya and Richard's home – they opted for Resene paints and stains, and their colour choices won them an interior design award.

North-facing double-glazed windows – well shaded with eaves to block summer sun – are a feature of all three bedrooms and the open plan living area. The concrete slab floor is laid with porcelain tiles throughout the house.

WORDS Rebecca Gross
PHOTOGRAPHY Jason Mann

RICHARD AND ANYA MOWLL LIVED IN Tawa, a suburb of Wellington, New Zealand, for eight years with their two children, now aged 12 and 14, before deciding to buy. They looked at houses for sale, but finding none that met their requirements they purchased a 1.36-hectare site to build one that would: affordable, comfortable, well-insulated and energy efficient.

After writing a detailed two-page brief, Richard and Anya met with four local architects they found online, including Richard Wright, principal of Aonui Architecture. The Mowlls say Wright was the only architect who listened and understood what they wanted – an important component of their brief.

Anya and Richard wanted to achieve an energy efficient home through solar design and renewable energy, to be very hands-on and build in stages. "This would allow us to match the build with budget as it becomes available over the years," the couple explain. Wright designed a modest, flexible house with elemental and sophisticated solutions for energy efficiency, and forward planning in mind.

Stage one, completed in 2015, is a long and narrow single-storey house that sits in a saddle between two hills. It has deep eaves and north-facing windows to maximise heat gain in Wellington's temperate maritime climate. "It's a very simple design that means we get sun in the winter and shade in the summer," says Richard. Three bedrooms are at one end of the house and an open-plan kitchen, living and dining area at the other; utility and wet rooms are configured along the southern side with Anya's pottery workshop behind. At 177 square metres, the house is smaller than the New Zealand average (205 square metres plus). "Size is a real area of differentiation between the people who understand sustainable design and the people who want to tack it on. Don't build any more house than you need," Wright advises.

Natural materials for low toxicity and a colourful interior were also priorities for Richard and Anya. The exterior is clad in stained, untreated macrocarpa weatherboards – "an alternative to CCA-treated pinus radiata," says Wright – and gabion basket pillars use locally quarried stone. Both Anya and Wright have a penchant for colour and their bold, bright choices won the Resene Total Colour Residential Interior Award 2016.

The hilltop site receives its fair share of Wellington's notorious wind, but it also enjoys all-day sun. The Mowlls can progressively affix MiaSole photovoltaic laminates to the single-plane ribbed metal

The house is heated by an in-slab hydronic heating system, the water for which is warmed by a combination of solar water heating panels, a wetback on the wood-burning stove, and an electrical backup element. Further heating and ventilation is provided by an automated system that can open windows as needed, and transfer the fire's warmth from the lounge to the bedrooms.

roof (as funds allow), eliminating the wind noise and extra load on the roof structure of traditional rail-mounted panels.

Having lived in cold, draughty houses, Richard and Anya wanted a properly insulated home for year-round thermal comfort and to reduce their energy bills long term. They undertook their own research into energy-saving features to know "what questions to ask about potential designs".

Wright incorporated three energy sources – solar water heating panels, a woodburner wetback and an electrical backup element – to warm the water for the hydronic in-slab heating system. In addition, the natural heating and ventilation system, Soho Ventpac Winsum, releases and regulates heat by automatically opening window sashes, and transfers woodfire warmth from the lounge to the bedrooms via fans and air circulation ducts. "In active solar houses in Wellington, natural forces, especially wind, do the work. Over a sunny day the energy to open and occasionally adjust a window with a small auto actuator can in some cases be as little as 1/400th of that needed to run a heat pump on cooling mode to achieve the same ambient temperature," Wright explains.

Richard and Anya describe the house as having even warmth and coolness, rather than it being isolated to certain spaces or varying over planes of a room. "Because of the design of the house and our low bills, we never feel guilty about having a warm house in winter or cool house in summer."

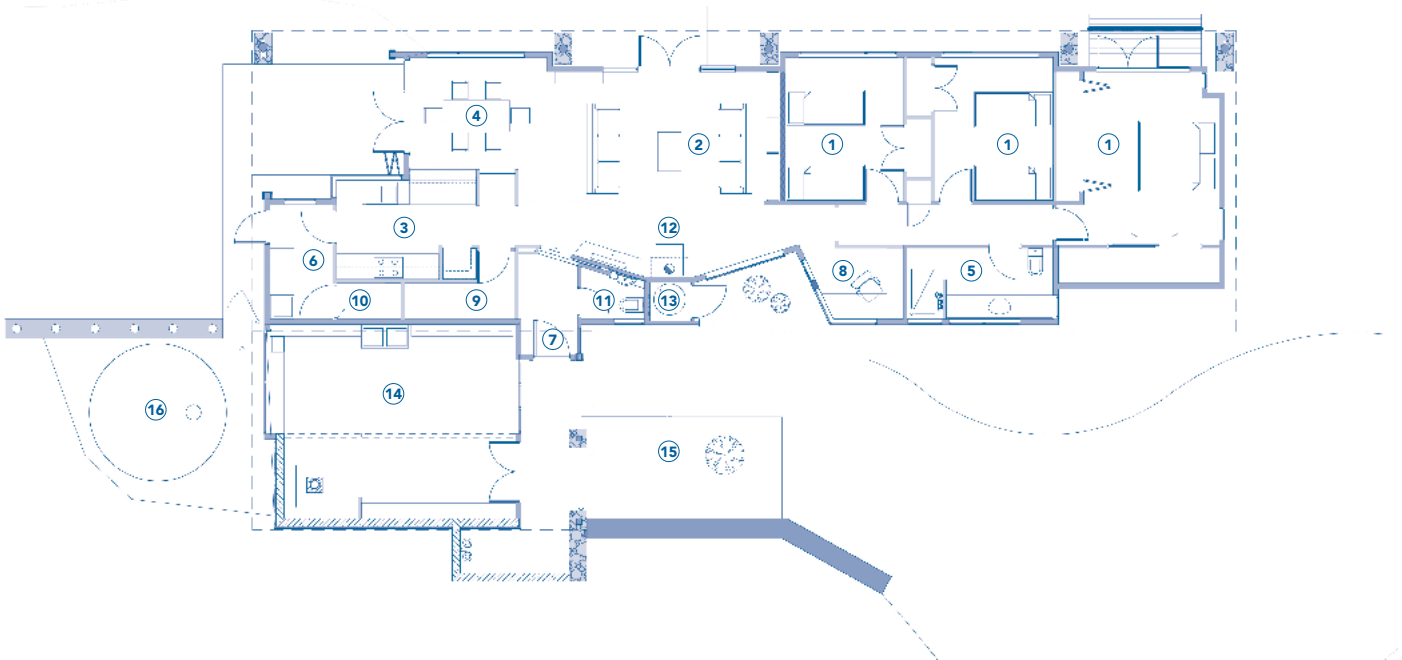
Stage two will add a double garage and second storey with master bedroom, ensuite and guest bedroom, and Richard and Anya's current bedroom downstairs will become a rumpus room for their teenage children. "Do we absolutely need stage two?" says Richard. "We could do without it, but we feel it would complete the house and the additional renewable energy will be very nice to have."

Other energy efficient solutions being considered for the future include transferring warmth from the pottery kiln to the house and installing a wind turbine on the hilltop. Both require special application: a heat exchanger will be needed to eliminate toxic fumes from the pottery glazes, and the protected skyline will influence the positioning of the turbine.

Both the architect and clients attribute the success of the house to their mutual understanding of what they want to achieve. "It's not a complicated house, but the owners and ourselves are on the same page in almost every respect," says Wright.

Richard and Anya asked their architect for a design that could be built in stages as their budget allowed. The first stage is simple: a long, narrow single-storey house with three bedrooms at one end, a living space and kitchen at the other and a pottery studio tucked behind. A future second stage will see an upper storey added, with a new master bedroom and guest room.

FLOOR PLAN



LEGEND

1. Bedroom
2. Living
3. Kitchen
4. Dining
5. Bathroom
6. Laundry
7. Entry
8. Study nook
9. Store room/ future stairs
10. Utility room
11. Toilet
12. Wood stove
13. Hot water service
14. Pottery studio
15. Sculpture garden
16. Water tank

Saddle Hill House

—Specifications

Credits

DESIGNER
Aonui Architecture,
Richard Wright

BUILDER
Richbuilt Construction,
Richard Lillyston

PROJECT TYPE
New build

PROJECT LOCATION
Tawa, New Zealand

COST
NZD$750,000 approx

SIZE
177 m^2

BUILDING STAR RATING
GBC Homestar rating
(pending)

Sustainable Features

HOT WATER
- Hydronic system by Eco Heating and Plumbing comprising: 4 x TopSon F3-Q high performance flat panel collectors and 500 litre stainless steel heat exchanger to supply domestic hot water, with electric boost
- Gerco GD8 Select free-standing woodfire with Brazilian slate cover and wetback connection to storage tank.

RENEWABLE ENERGY
- Photovoltaic generation via MiaSole amorphous silicon peel-and-stick laminate strips.

WATER SAVING
- 22,500 litre polypropylene rainwater storage tank providing potable water through a UV treatment system
- Untreated rainwater to toilets and hose taps
- Swale beside driveway lined with 'riprap' rock; designed to absorb surface water and planted with filtering rushes.

PASSIVE DESIGN / HEATING & COOLING
- Site nestles into southern hillock to minimise exposure to cold southerly wind and shading from northern hillock
- Elongated east-west axis provides optimal orientation for glazed north facade and high thermal mass concrete floor; dark grey tiles moderate hot and cold extremes; tile bedding mortar activated with shredded copper granules for enhanced thermal conduction
- Open plan living area allowing simple cross flow ventilation
- Front door lobby airlock.

ACTIVE HEATING & COOLING
- In-slab hydronic heating system with 6 hot water pipe circuits controlled by 4 room thermostats
- Customised Solarhomes low energy automated comfort control system
- Cross-flow ventilation managed by Soho Ventpac Winsum automatic opening windows
- Active solar heat harvesting and duct heat transfer to cooler rooms controlled by Soho Ventpac Winsum automatic fan and damper system; a signal from Soho weather station on roof closes windows in rain and high wind events.

BUILDING MATERIALS
- Floor slab: concrete on closed cell EPS insulation
- External walls: 140mm pinus radiata framing with ply rigid air barrier
- Cladding: heart macrocarpa (cupressus macrocarpa) bevel back weatherboards and 12mm CHH Shadowclad plywood (both on cavity battens and stain finished)
- Roofing: Calder Stewart Solar Rib 400mm tray longrun colour coated steel roofing
- Pillars: Horokiwi quarry rocks in Soho 75mm grid galv steel gabion baskets over cantilevered tanapoles
- Insulation: Knauf Earthwool 210mm R5.1 glass fibre ceiling insulation; Knauf Earthwool 140mm R3.2 glass fibre wall insulation; Poly Palace 200mm reconstituted polystyrene under slab.

LIGHTING
- Low energy LED downlights.

WINDOWS & GLAZING
- APL Metro ThermalHEART windows with thermally broken double glazing with argon and low-e glass
- APL Vantage external doors with double glazing with argon and low-e glass
- Actuated windows with coordinated opening.

PAINTS, FINISHES & FLOOR COVERINGS
- Colourful Resene stains and paints used throughout, including clear polyurethane satin on pinus radiata plywood; Rough N Tumble used in kitchen and feature wall
- Floor tiles: full-bodied porcelain tiles throughout house, from Jacobsens Keope.

OTHER ESD FEATURES
- Flexible design to be built in stages: a large storage cupboard off the living room can convert to a stairway for planned Stage 2 development
- A ceiling duct is in place in the workshop ready to harvest heat from the electric kiln so it can be gathered through a heat exchanger to help warm the house in winter
- Monopitch roof form is designed to mirror the hill profile and deflect the northerly wind with minimum resistance and therefore reduce noise
- Vegetable gardens and Muscovy ducks
- 1 hectare planted with 5000 native trees
- Space available for a firewood woodlot
- Minimised commuting – both owners work from home thanks to the ceramics workshop and the nook/office.

Small footprint, smart ideas

A renovated worker's cottage in Melbourne's inner west marries age-old passive solar principles with bleeding-edge technology.

WORDS Fiona Negrin
PHOTOGRAPHY Nikole Ramsay

LEANNE AND SCOTT'S PAINSTAKING renovation of a 100-year-old, lean-to cottage in Melbourne's Yarraville held enough painful lessons to defeat a less resilient couple. Instead, it converted these two from sustainability stalwarts to environmentally sustainable development evangelists. At Sustainable House Day 2017 the couple was humbled by the level of interest in their small home and have responded by opening the house to the public on scheduled dates to offer "some great ideas, useful contacts and the confidence to get going on your own sustainability project".

At their first open house event in January this year, Leanne and Scott shared their philosophy of 'abundant sustainability'. They aspire to make sustainable design so irresistible ("it's not always about giving up something") that the unconverted are inspired to adopt its principles. "If we can't get the masses on board, we can't solve the climate crisis," notes Scott, who says they want "to do for houses what the Tesla Model S does for vehicles."

The couple spent a year laboriously partially demolishing the small house by themselves and "uncovering its history", says Leanne, who salvaged and hand-cleaned 800 Melbourne red brick pavers from the courtyard as part of this endeavour. With the help of local building designer James Goodlet at Altereco, they mindfully designed the renovation to "be here in another 100 years, for whoever comes after us."

At a mere 100m^2, the footprint is "nothing ambitious in scale," says James, "but Scott and Leanne were happy to work with the space they had. It's rare to get clients with that much passion about being sustainable."

The house's passive solar properties are impressive by any yardstick, but what makes it more Tesla S than GM EV1 is the couple's meticulous attention to detail.

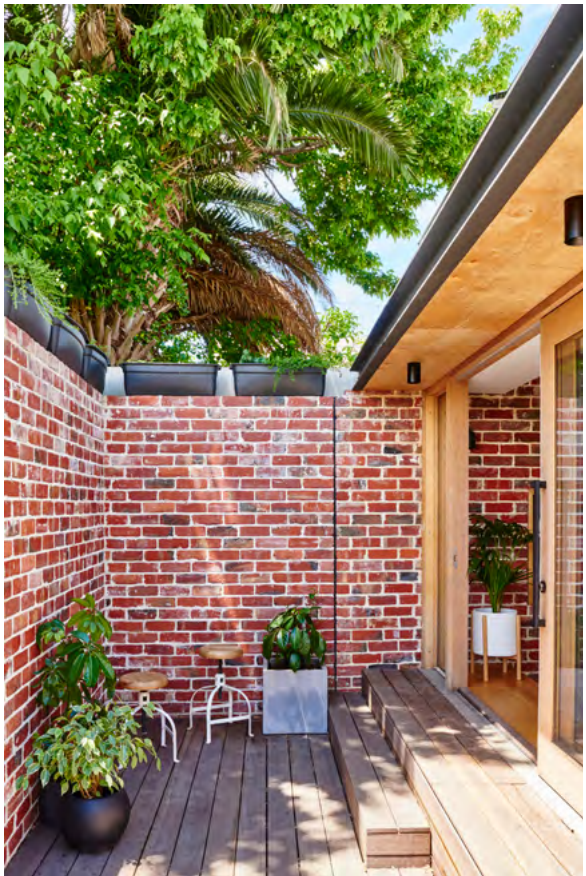
Their green roof was universally admired at January's open house. Planted above the kitchen/living area with water-wise native plants, it creates outdoor space on the tight site and offers surprising glimpses of greenery through highlight windows. It also insulates the kitchen

The compact but appealing living space sits at the back of the house, with large sliding glazed doors to the north. For the kitchen, Leanne and Scott chose benchtops made from 75 per cent recycled glass, mirror, porcelain and earthenware.

A ladder provides access to the green roof above the kitchen and dining area. Planted with water-wise natives, it offers surprising green glimpses through the clerestory windows, and also boosts the insulative effect of the roof. A 4.5kW solar system helps power the house; timers turn on appliances to make the most efficient use of the solar electricity.

and living area from above, although, says James, it created a design challenge because "it needed a fair bit of loading, but we also wanted to expose the structure and beams in the lounge room beneath it. The green roof was a feat of engineering!"

In a 21st-century twist on the adage that a passive solar home requires active participation, Leanne and Scott's house is run (in part) on auto-pilot. Electronic timers turn on the dishwasher, sprinklers, washing machine and water heater to take advantage of solar energy. Their thermostat is voice- and sensor-enabled, and the couple has set up geofencing which uses GPS to automatically respond to their movements. Scott and Leanne have also embraced off-the-shelf smart tech from some of the world's best-known tech brands. Apple's virtual assistant Siri turns on the hydronic radiator panels at different times in specific rooms. On a recent trip to the United States, the couple picked up Amazon's virtual



Small houses demand clever solutions for storage; here, the designer took advantage of the high ceiling to include an overhead bookshelf.

assistant Alexa which integrates with their smart LED lights and air con. Via a discreet monitor on the kitchen bench, "you can say 'turn on light in kids room', but you can also ask it to call Uber, or convert Fahrenheit to Celsius," says Scott. Another gadget the couple picked up in the US "monitors VOCs in the house, and lets us know when we should ventilate".

Disconnecting from gas and living in an all-electric house was always on Leanne and Scott's agenda. But the high electricity draw of their heat pump (which supplies heat for hydronic heating and potable water) caused unplanned headaches when they were advised that the local power supply wouldn't meet their needs. Reeling from the distributor's quote of $10,000 to rewire the house to bring in three-phase power underground, the couple "did our own research and found out you can have overhead wires," says Scott. Eventually, after daily phone calls and "stalking the director on LinkedIn", the utility company agreed to connect overhead lines for just $1000. While most houses won't require three-phase power, the experience provided Scott and Leanne with another key

The living room's brick feature wall, rich in thermal mass, was created from the pavers that Leanne and Scott had salvaged from the house's original courtyard. The 40 or more indoor plants are an important part of the interior design strategy.

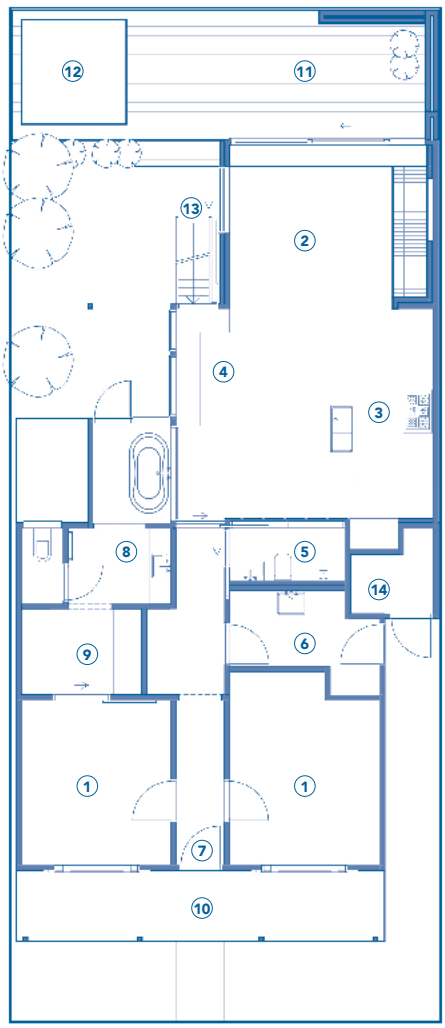
The plants were selected for their air filtering capacities, and the house is even equipped with a gadget that monitors VOCs and lets the residents know when they should ventilate.

learning: “Do your own research and be resilient in the face of setbacks”.

Scott and Leanne are admirably transparent about “the tough stuff – we want people to be aware so they can approach their renovation with a realistic mindset.” They have disclosed the cost of their build (including professional fees) at $470,000, and share their energy consumption data to demonstrate that their ‘abundant’ lifestyle is both environmentally sustainable and cost effective (summer utility bills $45, winter bills $203). Their project website (melbournevernacular.com.au) offers kudos to tradespeople and suppliers who “worked with us to find solutions”, and is notably discreet about the builders they hired who, sadly, were sustainable “only in name”.

Shortly after they bought the house, an astonishing coincidence occurred. The couple learned that the house had once been the family home of a woman who was now caring for Scott’s ageing grandmother. The woman came to visit during Sustainable House Day last year. In spite of the house’s transformation, she immediately recognised the provenance of the brick wall in the living room. “I used to play on those bricks when I was a little girl”, she cried. The time invested by Leanne and Scott in endowing the house with a new life could hardly have had a more rewarding pay-off.

FLOOR PLAN



LEGEND

1. Bedroom
2. Living
3. Kitchen
4. Dining
5. Bathroom
6. Laundry
7. Entry
8. Ensuite
9. Walk-in robe
10. Verandah
11. Deck
12. Pool
13. Ladder to green roof
14. Store

SUMMER ELECTRICITY CONSUMPTION (DAILY AVERAGES)

Produced: 23.83 kWh
Exported: 17.86 kWh
Imported from the grid: 5.13 kWh
Max daily power production 31 kWh

WINTER ELECTRICITY CONSUMPTION

Produced: 9.22 kWh
Exported: nil
Imported from the grid 19.20 kWh
Max daily power production 18 kWh

MONTHLY UTILITY BILL

December/Summer: $45
July/Winter: $203
Compared to a home run on gas we have seen energy savings of approximately $1500 a year

Melbourne Vernacular

—Specifications

Credits

DESIGN
Altereco Design

PROJECT TYPE
Renovation and extension

PROJECT LOCATION
Yarraville, Melbourne

COST
$470,000

SIZE
House 100 m²
Land 187 m²

Sustainable Features

HOT WATER / ACTIVE HEATING & COOLING

- EcoBee Smart Thermostat with four room sensors; enabled for voice control plus geolocation monitoring
- Tivok heat pump with 415L storage tank supplies hot water and hydronic heating
- Wall radiators with Elgato Eve Thermo smart radiator valves; fully programmable and voice controlled through Apple Homekit
- Daikin 5kW reverse-cycle air conditioning unit; wi-fi controlled/voice enabled using If This, Then That (IFTTT) so web-connected devices work together with Amazon Alexa
- Haiku L Series smart ceiling fans, voice activated with senseME technology.

RENEWABLE ENERGY

- LG Neon 2 4.5kW (14 x 320 watt) solar panels; 14 Enphase microinverters allow live energy monitoring through the Enlighten iPhone application.

WATER SAVING

- 3000L Melro Slimline water tank connected to green roof, garden, toilet and laundry
- Otis timber and brass shower head by Wood Melbourne
- Water-wise plants native to the western plains of Melbourne
- Rachio smart sprinkler controller; automated water scheduling, smart phone and voice controlled.

PASSIVE DESIGN

- Eaves protect north-facing windows from summer sun and allow passive solar gain in winter
- Passive cooling/cross ventilation from south to north, promoting air movement when there are cool evening breezes; high-level windows allow warm air to purge naturally
- Green roof by FytoGreen serves as insulation over kitchen and living area
- Polished concrete and recycled brick for thermal mass in north-facing living areas
- Living spaces orientated north; sleeping quarters to the south
- 'Pocket' doors zone living and sleeping areas.

LIGHTING

- Brightgreen canister LEDs (ensures no insulation gaps), from Lighting Matters
- Philips Hue LED smart lighting for night time trafficable areas.

BUILDING MATERIALS

- Roofing: light-coloured Colorbond for low level summer heat absorption
- Recycled materials used where possible: red brick paving reclaimed as an internal feature wall and external brick wall; bluestone foundations reused as front paving; timber rafters reused in addition; stumps reused for green roof paving; 120-year-old framing retained
- ECO by Consentino benchtops manufactured from 75 per cent recycled glass, mirror, porcelain and earthenware
- Recycled carpet with cradle-to-cradle certification from Shaw Group carpets
- Autex GreenStuf R2.5 or Earth Wool R2.5 HD combined with Kingspan Kooltherm insulation board and a breathable membrane. In total the walls are insulated to R3.5 +
- Autex GreenStuf R5.0 in the front of the house and GreenStuf R3.0 to ceilings plus insulating roof blanket
- Autex GreenStuf R2.5 for under-floor insulation with all gaps and penetrations sealed with Sealey's spray foam; the concrete slab is insulated on all perimeters and below with Kingspan insulation board.

WINDOWS & GLAZING

- Double-glazed, argon-filled, low-e films in Victorian ash frames from Steptoes Renovation Supplies
- Thermally broken aluminium glass door in wet room by Autex Windows & Doors.

PAINTS, FINISHES & FLOOR COVERINGS

- Pandomo FloorPlus cement finish to concrete slab supplied by Concrete Resurfacing Systems
- eColour zero-VOC paints used internally and externally
- Windows finished in Cutek cd50 low-VOC in 'grey mist'.

OTHER ESD FEATURES

- Fully electric home with no gas connection
- Efficient appliances such as dishwasher, washing machine and heat pump all placed on timers to take advantage of solar energy
- UseThings internal clothes drying pulley system
- High ceilings and clever joinery allow for ample storage in surprising locations
- Edible garden from the Little Veggie Patch Co.
- Composting system by Composta and Compost Revolution
- 40+ indoor plants selected for air filtering supplied by Mosey
- Timber floorboards from Urban Salvage.

Take two

The second renovation of this South Fremantle house has strengthened the owners' connection to their home of over 40 years.

Architect Joe Chindarsi reworked the upstairs mezzanine bedroom as part of the renovation, enclosing it and adding an ensuite and a balcony. Facing west, the balcony helps shade the downstairs glazing from the hot afternoon sun. Motorised aluminium Venetian blinds with sun and wind sensors also moderate sun access.

WORDS Rachael Bernstone
PHOTOGRAPHY Robert Frith

FOR 43 YEARS JOHN AND ERICA Harvey have lived in their South Fremantle house. Originally constructed in 1923 as a four-room workers cottage, they are just the third owners. The Harveys have undertaken two major renovations – the first in the 1980s, the most recent one in 2016 – both of them reworking the rear section.

Erica says they weren't committed to any one outcome but wanted the whole house to work better now that it's just the two of them at home, with regular visits from their adult children and young grandchildren. For their latest project, they approached architect Joe Chindarsi after visiting his own home on Sustainable House Day three years ago (see *Sanctuary* 31).

Joe opted to retain the earlier extension designed by John's architect-brother in the 1980s, when the couple had young children. That decision had helped to reduce renovation costs while improving functionality and flow in the main living spaces.

Joe relocated the kitchen into a new section that extends three metres beyond the old perimeter, creating space in the existing rooms to separate the dining and sitting areas. The fireplace was moved into the centre of this reconfigured space and the adjacent service zone was reworked, creating a slightly larger bathroom and a sunny combined laundry and sewing room. The installation of new windows – at floor level and up high near the roofline – introduces natural light from various directions throughout the day.

As part of the first renovation, the couple had moved upstairs to a mezzanine bedroom that was open to the living area below, which worked well enough when their children were small, but wasn't as conducive to having family and friends to stay. Also, the low-pitched roof reduced the useable floor space and there was no bathroom upstairs.

Joe addressed these problems by raising the southern side of the roof slightly, enclosing the bedroom and adding an ensuite, dressing room and protected balcony. Now, the upper floor is a serene and generous retreat that takes full advantage of the outlook to the distant Indian Ocean, with the added bonus of capturing prevailing breezes.

The project also included new insulation and photovoltaic panels, which boost sustainability credentials and will reduce their heating and cooling costs. These works didn't add much in the way of additional space, but they have made a dramatic difference to how much they enjoy their home, Erica says.

"We wanted to go more minimal, and we've really achieved that," she explains. "It has a calming effect on us and other people who visit. Everyone walks in and feels relaxed, because the flow is much better. And because it's so open now, we borrow views of the trees in the surrounding yards and feel like we are sitting up in the canopy."

In keeping with the modest ambitions of the project, the material selection was kept deliberately simple. Timber was used for exterior detailing in locations where it

has protection thanks to wide eaves, with a combination of low maintenance materials – self-finished and painted fibre-cement cladding, vertical boards and corrugated steel cladding – adding texture and interest to the facade.

From the rear, it's easy to discern the changes to the original roofline, with the new volumes arranged around and projecting outwards from an enlarged deck. Large banks of glazing on the south-western and western elevations are protected by louvred aluminium shutters that open automatically when the prevailing breeze picks up, as it does most afternoons, naturally cooling the house from back to front.

The Harveys have an extensive collection of indigenous and modern art, built up over decades. Inspired by this, Joe developed a colour palette that appears throughout the house in various guises, including: steel-framed and coloured-glass privacy screen beside the rear deck; steel and glass front gate; and painted sections of fibre-cement sheet that frame selected windows.

Internally, the palette is more subdued and takes its cues from the existing fabric. Where new floors were required, they were matched to the original jarrah boards; the kitchen cabinetry mimics the 1970s joinery the couple lived with for many years; and the original staircase and handrail remain in place, albeit with a new negative rebate detail that ties in nicely with the mid-century modern furniture in the adjacent living area.

Erica says that while they initially had some misgivings about renovating again, the project ran smoothly and to budget (despite the addition of a few splurge items, such as Louis Poulsen light-fittings). "You have to really want to renovate, because it is hard and a bit scary, but we've just been so happy with the results," she says. "Yes, we love it, every day," John adds.

They credit that outcome to their architect, who they met almost by chance. "We weren't even looking for an architect, we'd had plans drawn up but we were interested in learning more about sustainability, and we established a good rapport with Joe," Erica says. "He was very quick to understand what we wanted, and he gave us plenty of room to discuss the details as the project progressed. I remember saying to him: 'I just want to be surprised', and his response was: 'This will be so much better than you can imagine'. And he's right, it is!"

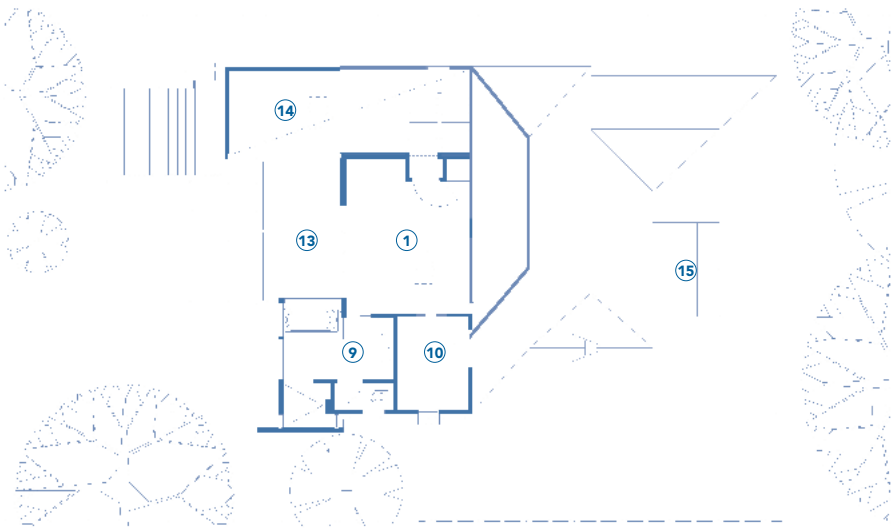
And there aren't many people who can say that about a house they've lived in for more than 40 years.

A small addition to the 1980s extension houses the new kitchen. The new design allows for a separation of the dining and sitting areas, and improves connections between the spaces.

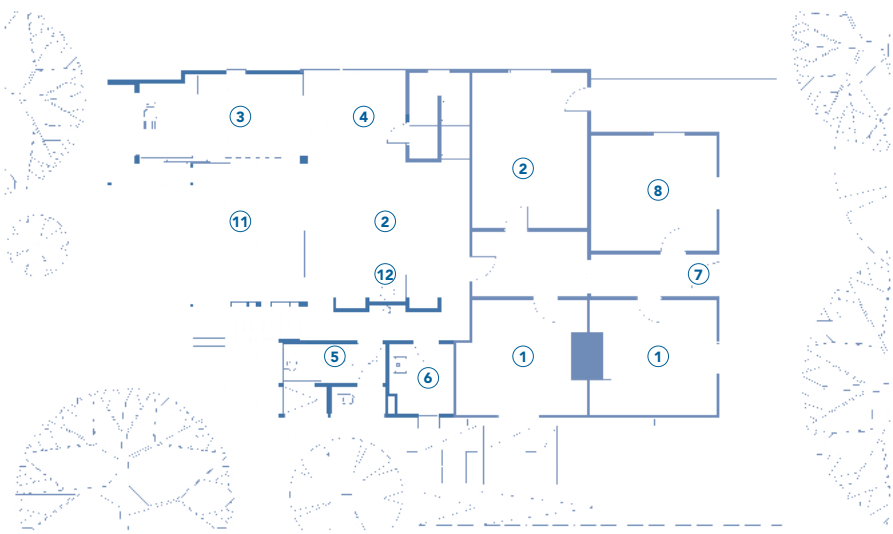
There is almost no hint of the rear addition from the front, but part of the 4.9kW solar system mounted on the verandah provides a clue to this home's environmental credentials.

Highlight colours inspired by Erica and John's extensive art collection appear here and there throughout the house, including the steel and glass privacy screen at the southern end of the deck.

FIRST FLOOR PLAN



GROUND FLOOR PLAN



LEGEND

1. Bedroom
2. Living
3. Kitchen
4. Dining
5. Bathroom
6. Laundry
7. Entry
8. Study
9. Ensuite
10. Walk-in robe
11. Deck
12. Wood stove
13. Balcony
14. Void
15. Solar panels

Harvey Residence

—Specifications

Credits

DESIGNER
Chindarsi Architects

BUILDER
Cassari Group – Daniel Chiari

PROJECT TYPE
Renovation

PROJECT LOCATION
Beaconsfield, WA

COST
$480,000

SIZE
House 252 m²
(includes verandah)
Land 748 m²

Sustainable Features

HOT WATER
– Rheem Loline solar hot water system with gas boost.

RENEWABLE ENERGY
– 4.94kW grid-connected solar system with 26 x 190W Suntech panels; Sunny Boy 5000TL inverter.

WATER SAVING
– Sub-soil irrigation systems to garden
– Underfloor zone ready for connection of water tanks.

PASSIVE DESIGN / HEATING & COOLING
– Optimised northern glazing with considered shading design
– Generous overhangs to western side to protect from setting sun; balcony placed this side to assist with shading and to provide views
– Operable Hella Ecoline Blind AR080 external Venetian blinds (aluminium blades to minimise maintenance) with sun and wind sensors from Modular Shades
– Natural cross ventilation paths designed for effective night purging of heat in summer.

ACTIVE HEATING AND COOLING
– Daikin reverse-cycle air conditioning system from Ford and Doonan
– Radiant Heating heated towel rail RTR02
– Morso 7644 freestanding slow combustion wood heater from Castworks.

BUILDING MATERIALS
– Existing timber structure maintained and salvaged where possible, integrated with new materials
– Recycled WA jarrah flooring (existing lifted and re-laid plus sourced externally to match)
– BlueScope Colorbond custom orb cladding to roof and walls with Zincalume finish; Spandek to flat roof sections
– Cladding: WA jarrah hardwood panel battens to some joint lines, CSR Cemintel Barestone, James Hardie Axon Scyon, James Hardie HardiFlex cladding painted various colours, James Hardie Versilux eave linings
– Insulation: combination of CSR Bradford Anticon building blanket reflective foil/glasswool insulation R-value 1.3 used for roof; CSR Bradford Gold Ceiling Batts glasswool R4.1 used in existing ceilings, walls and underfloor (supported by mesh); CSR Bradford Gold Wall Batts R2.5 in lightweight walls.

WINDOWS & GLAZING
– Low-e glazing (Viridian 'Smartglass' SP30 Neutral Panoramic), cedar windows and doors supplied by Cedar West
– High level windows and skylights, for cross ventilation, light and to encourage stack-effect
– Double-glazed solar-powered skylight units from Velux
– Coloured glass – various colours and textures to windows/screens from Perth Art Glass.

LIGHTING
– LED lighting throughout.

PAINTS, FINISHES & FLOOR COVERINGS
– Interior timber floor stained Feast Watson Japan Black and sealed with Feast Watson Floorseal Oil (hardened tung oil) satin finish
– Exterior decking oil Feast Watson
– Dulux paint systems internally and externally
– External timber/hardwood – Sikkens Cetol.

OTHER ESD FEATURES
– With induction cooking, transition to an all-solar-electric house is almost complete
– Existing re-used/salvaged vintage light fittings used for laundry pendant
– Food garden with fruit trees and wild garden, including native planting
– Owners use public transport and share a car to reduce vehicle ownership.

Prefab performers

If you still think prefab is code for 'cookie cutter' you'd be wrong. Led by countries such as Sweden where over 80 per cent of houses are now built in factories, there has been a widespread architectural revolution when it comes to prefabricated construction. Now, almost any design is possible.

In this special feature, we speak with 16 companies offering what can be called 'prefabricated', 'factory' or 'off-site' construction services. We have selected those with a focus on the residential sector and which provide options for high building energy star ratings, renewable materials and cost-effective production. Their approaches fall into two main construction categories – modular and panelised – but within these is a huge range of different products on offer.

Since *Sanctuary* last looked at this sector in issue 31, modular construction remains the predominant approach. The change has been in the number of companies offering panelised systems which, on our count, has doubled in three years.

Considered the 'European' approach, many are airtight, interlocking systems that can achieve passivhaus standard. The panels range from structural insulated panels (SIPs) using high-density foam insulation, to timber wall panels filled with glasswool and many other combinations.

Efficiencies of prefab/off-site construction can be brought to any design, though it helps if the design is done with the capabilities of the construction method in mind. 'De-risking' the building process by disclosing costs and timeframes to clients up front is also a feature of this industry.

Some prefab companies now offer partnerships with recommended architects and local trades, but a surprising number are architecturally driven and have full design/build teams in-house. Melbourne appears to be the hotbed of action when it comes to innovating with prefabrication, but the rest of Australia (and New Zealand) has growing businesses too – although with this building method geared for transportation, location is little barrier.

WORDS
Kulja Coulston, Anna Cumming and Sasha Shtargot

PHOTOGRAPH
John Madden

ARKit is a design and build group specialising in high quality, customised prefabricated building solutions.

As an architect led practice, ARKit collaborates with its clients to develop sustainable; hand-crafted prefabricated buildings for a variety of residential and commercial applications. We offer the most comprehensive range of integrated consultancy and construction services available for prefabrication.

Our residential services include:

- Full in-house architectural design services
- New builds, studios, additions and renovations
- Complete design and build service
- Infinite design possibilities through our panelised and modular building systems
- Highly sustainable timber framed construction with no/ low VOC materials
- Designed and built in Melbourne for locations Australia wide

Advanced Prefabricated Architecture

—

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ARKit

STRINE
ENVIRONMENTS

SUSTAINABLE LIVING IN THE AUSTRALIAN CLIMATE

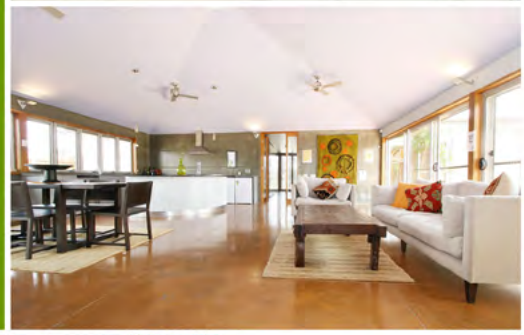
Strine Environments in Canberra are providers of architect designed, low energy buildings and modular homes. We are industry leaders in sustainable living for over 35 years and specialize in innovative solutions based on our unique model that integrates architectural design with high thermal mass, using prefabricated precast concrete and environmental construction.

We offer modular, portfolio and custom designs.

Our homes are energy efficient, with significantly lower running and maintenance costs over the lifetime of the house. Our homes maintain an average temperature of 22C without the need for costly heating or cooling.

Our principles are
- Design Excellence
- Sustainability
- Buildability

What Strine achieves for you is "Balanced Living" – the creation of a beautiful living space within an environmentally sustainable design.



Balanced Living
Unit 4, 33 Lorn Road
Queanbeyan NSW 2620

T 02 6282 4877
E mail@strineenvironments.com.au
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Design ABN 31 109 594 541 ACN 109 594 541
Homes ABN 45 083 169 153 ACN 083 169 153
Architects Licence ACT 654 NSW 4802
Builders Licence ACT 199811469 NSW 100225C

STRINE DESIGN STRINE PRECAST STRINE CONSTRUCTION

Each module is constructed from SIPs using expanded polystyrene foam between two sheets of Colorbond. Colorbond Diversaclad is used as cladding, which contrasts beautifully with the original brick cottage.

BUILDING TYPE:
Modular construction, steel frame

PROJECT LOCATION:
Brunswick, Victoria

SIZE:
113 m2

MATERIALS:
SIPs (structural insulated panels) used for floor, wall and ceiling components, steel frame, black powder-coated double-glazed windows

COST PER SQUARE METRE:
$2700 to $3200, includes full architectural design services and manufacture

BUILDING ENERGY STAR RATING:
7 Star (min)

TIME TO LOCKUP:
1 to 2 weeks on-site works post-installation

PHOTOGRAPHY:
Jack Lovel and John Madden

Modscape

Since it was established over a decade ago, Modscape has seen its business shift from servicing remote and holiday locations with prefabricated modular homes, to delivering the majority of its projects to inner city sites. In fact, these latter can have more complex site access issues than remote areas, such as parking restrictions and prolonged and expensive traffic control, which prefabrication can ameliorate.

"We installed 20 modules (10 apartments) atop the eighth floor of a hotel in St Kilda and they didn't lose one day of operation," says Modscape managing director Jan Gyrn. The crane work required the closure of a major tramway for less than 24 hours. "It's a good example of when modular comes into its own; it provided a 15 per cent cost saving but also avoided 12 months of having personnel coming and going."

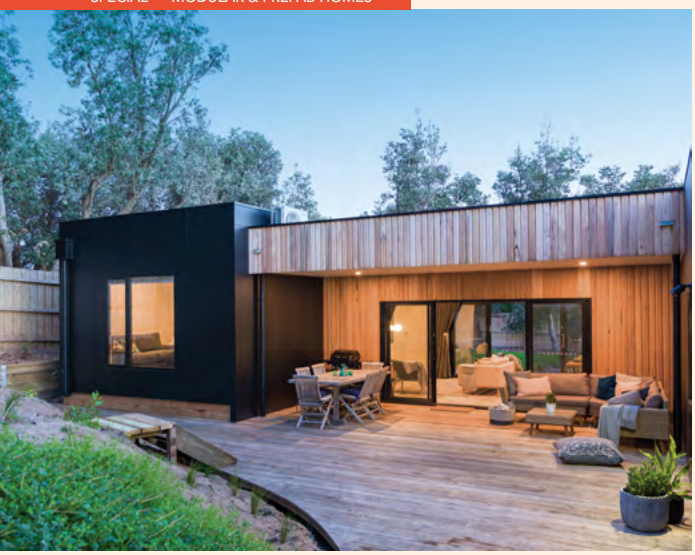
Modscape has grown to over 40 staff in its Brooklyn studio in Victoria and has residential as well as commercial clients. "Modular solutions are now a legitimate alternative approach," says Jan. "We find time and cost certainty are the main attractors for our clients, as well as the aesthetics and materials we offer." Modscape can provide structural modules only, through to a "one stop shop" that includes full internal fit-out, landscaping, solar + battery systems and waste water treatment, among other services.

It has always used sustainable materials and now takes a 'closed loop' approach that has seen it move to using recyclable steel frames for 90 per cent of its projects. Jan says steel has other benefits too: it allows modules to be stacked up to six storeys, reduces the number of footings and provides design flexibility as "modules should not affect the architecture."

Modscape designs are all bespoke – this double-storey addition to a period home in Brunswick uses two modules that were crane lifted into the backyard. The clients moved in two weeks later.

Every second client of Modscape enquires about solar + battery systems. This house in the middle of a 40 hectare site in Franklinford, Victoria, is where this technology is ideally applied.

In less than 24 hours, 20 modules were lifted onto the roof of an eight-storey building in St Kilda. With limited disruption to traffic and trams, modular construction proved an efficient way of adding 10 apartments to the building.



BUILDING TYPE:
Modular construction, timber frame

PROJECT DETAILS:
Phillip Island off-grid project

PROJECT LOCATION:
Ventnor, Victoria

SIZE:
Living 114 m²; deck 37 m²

MATERIALS:
Timber frame, Weathertex cladding, Earthwool insulation, steel roofing, AWS double-glazed windows

COST PER SQUARE METRE:
$2700 ex GST

BUILDING ENERGY STAR RATING:
7 Star

TIME TO LOCKUP:
18 weeks factory construction time; 2 to 3 weeks on-site works

PHOTOGRAPHY:
Warren Reed

Ecoliv Buildings

Running for over 10 years, Ecoliv Buildings is based in the regional Victorian town of Wonthaggi, and delivers projects around Australia. Its approach is based squarely in sustainability. The company says each of its homes is resource-efficient and combines passive solar design, construction waste reduction and systems integration. Its process focuses on optimising operational performance using modular prefabricated construction.

"Our naturally lightweight construction methods use locally sourced plantation timber frames and high levels of insulation to achieve the highest possible energy rating without relying on high embodied energy materials," says Ecoliv's Ashley Beaumont. He notes that sourcing materials from overseas and using those high in embodied energy such as steel framing can negate the advantages of factory-based fabrication in terms of emissions.

Solar electricity and hot water, efficient lighting and 10,000 litres of rainwater storage also come standard with Ecoliv homes to reduce environmental impact. The two-module Ventnor home pictured is off-grid, with a 5.13kW solar system plus batteries, an A&A Worm Farm waste water treatment system and upgraded 50,000 litres of water storage. Ecoliv Buildings' modular approach worked well for this build due to its rural location and lightweight site-adaptive footing system.

Prebuilt and Pleysier Perkins

Starting out 15 years ago, Prebuilt is a veteran in the Australian modular and prefab industry. These days, while about 60 per cent of its work is in the commercial sector, Prebuilt completes about 18 residential projects each year around Australia, offering predesigned houses and custom designs, usually in partnership with architects Pleysier Perkins. "Custom designs are more and more in demand, especially in Sydney where there are often difficult sites and tight planning restrictions," says Prebuilt's Laura Batch.

The company uses a modular system: engineered for the specific site and design requirements of the project, the modules consist of steel structural members with traditional timber frame infill. Insulation, cladding, utilities and the entire internal fit-out is also completed in their Kilsyth factory in Victoria. "Around 95 per cent of the work is done prior to transportation to site," says Laura. "Because of the steel frames, the modules are very rigid, so it's safe to transport them with the interiors fully fitted out." This approach minimises time on site – generally, craning into position and finishing of joins takes about two weeks.

It was this factor that made Prebuilt the right choice for the owners of the Bondi Custom House. Both professionals in demanding jobs, they appreciated the very short time – about two months – between demolition of their old house and moving into the new one. In addition, Prebuilt oversaw the entire design and planning process. The two-storey, 170 square metre house was built as five modules, three for the ground floor level and two for upstairs. "It's a narrow site, with houses built close to the boundaries on the north and south," Laura says. "The biggest challenge was to get light into the living spaces."

The total cost for the Bondi Custom House was around $4200 per square metre. Laura explains that trucking escort requirements and staff accommodation for the construction and finishing phase push the price up for Sydney builds; she estimates that a similar house in Melbourne would cost around $3000 to $3200 per square metre.

BUILDING TYPE:
Modular construction, steel frame

PROJECT DETAILS:
Bondi Custom House

PROJECT LOCATION:
Bondi, NSW

SIZE:
170 m²

MATERIALS:
Steel structure, infill timber stud framing, timber roof trusses, Colorbond roof

COST PER SQUARE METRE:
$3000 to $4200 including all design, project management, transport, fitout, staff accommodation

BUILDING ENERGY STAR RATING:
6 Star

TIME TO LOCKUP:
3 weeks on site

PHOTOGRAPHY:
Tom Ferguson

Based on Archiblox's Orlo 03 smart design, this Portsea getaway was designed to create relaxing spaces.

Archiblox

Archiblox opened shop in 2012 and already has the capacity to complete 40 to 60 modular housing projects per year, depending on the balance of bespoke and 'smart' designs on the books. "We encourage people to consider our smart designs because we can achieve greater efficiencies with cost and coordination of the build," says Archiblox founder Bill McCorkell, who's both an architect and builder.

The company has 40 staff in its Melbourne facilities, and then works with local trades and contractors to deliver projects across Australia's southern states. "We remotely manage the product but don't 'drop and run'," says Bill. "We might be on site for one day with the modules, and our local partners build the decks, provide electrical, maintenance and other services. This provides better serviceability for our clients."

There are at least 11 Archiblox 'smart designs' to work from, and each modular building can be modified to suit the client and site; special care is taken with regard to orienting for passive solar design and to capture views without affecting thermal performance. Green roofs can be added to some modules, which Bill encourages for their ability to improve building performance: "I love them, and the idea that from the air our city could be a sea of green."

While the company has delivered commercial projects, its focus is residential. "We're at our core a green business. We want to make cost-effective products that become spaces people can be themselves in. Where they can slow down and be mindful."

BUILDING TYPE:
Modular construction, timber frame

PROJECT DETAILS:
Orlo 03 smart design

PROJECT LOCATION:
Portsea, Victoria

SIZE:
110 m^2

MATERIALS:
Colorbond, Silvertop ash, natural wool insulation, double-glazed windows, certified renewable materials for fittings and fixtures

Designs can be modified to vary window location and size in order to suit specific sites and achieve optimal passive solar design.

COST PER SQUARE METRE:
$3800 (although smart designs range from $2800 to $4500), including full architectural design, services, and internal fit-out

BUILDING ENERGY STAR RATING:
6 Star (can achieve 8 Star+)

TIME TO LOCKUP:
4 weeks, including decks and awnings

PHOTOGRAPHY:
Tatjana Plitt

A modular addition sits behind an Edwardian house in Richmond, Victoria.

This house, built using Arkit's panelised system, is located on a steep slope, allowing space for the water tanks underneath. This project uses fibre cement cladding but FSC-certified timber and other cladding options are available.

BUILDING TYPE:
Modular and panelised construction systems

PROJECT NAME:
Arkit's Wye River House

PROJECT LOCATION:
Wye River, Victoria

SIZE:
130 m^2

MATERIALS:
Timber framing, Equitone fibre cement cladding, low-formaldehyde oriented strand board (OSB) bracing and structural flooring, ProClima external waterproof membrane, well-sealed double glazing, high-density recycled polyester insulation

COST PER SQUARE METRE:
$3000 to $3500, including full architectural design services, site works, fit-out , delivery, warranties and insurance

BUILDING ENERGY STAR RATING:
6.2 Star

TIME TO LOCKUP:
6 to 8 weeks in factory; 2 weeks onsite

PHOTOGRAPHY:
Alessandro Cerutti

On Christmas Day 2015, 98 houses in the coastal hamlet of Wye River were destroyed in a bushfire, including the original Arkit-built house on this site: "It was built just a year earlier and it was quite devastating," says Craig Chatman. "After some contemplation, the clients decided to rebuild exactly the same house on the same footprint and using the same design (and BAL rating). So while sad, it was also very affirming."

Arkit

Arkit designs and uses modular and panelised construction. The approach used is determined by which will achieve the best outcome, based on the site. For instance, the Wye River project (pictured) used prefabricated panels so it could be delivered flat-packed; for this site, modules would have been a challenge to transport along the winding, single-lane Great Ocean Road. The site topography also made the use of cranes a challenge. "We have found approximately 70 per cent of our projects are still modular," says architect and Arkit founder Craig Chatman. "But with the panelised approach we are not constrained with what can be transported. Sometimes height and volume is important and if a client needs 4m or 5m ceilings, with panels, we can do that."

The company uses similar materials regardless of the approach taken; timber frames, well-sealed double-glazed windows, Passivhaus certified ProClima building wrap, formaldehyde-free OSB and high-density insulation are features of each system. As much of the build as possible is prefabricated within the factory environment, with internal wall linings, footings and services connected on site.

Chatman established Arkit in 2010 as an architecture-driven prefabrication business. Based in Sunshine, Victoria, the studio has grown steadily to complete up to 20 projects each year and employs 30 staff, including seven architects and 15 carpenters. While the majority of projects are in Melbourne and greater Victoria, Arkit is beginning to work outside the state. "We are attracting clients highly educated about prefab," says Chatman, who is currently involved in a project to the Passivhaus standard in Richmond, and several in New South Wales.

Habitech has developed a network of building partners to deliver projects in Australia and New Zealand.

Habitech Systems

Habitech Systems has developed its own sustainable building components based on an integrated wall and roof panel system. Founded in 2008 by architect Chris Barnett, the company offers full architectural design services, with a strong focus on thermal performance and healthy interiors. Using its own SIPs (structural insulated panels) which include an integrated cladding system, Habitech uses a growing network of local builders to deliver its projects.

"We work hard to continually improve our system and keep benchmarking it," says Chris. Monitoring of completed Habitech houses shows they are outperforming the calculted energy star ratings, and some produce more energy than they use from their 6kW solar systems. "We can guarantee thermal performance, and can also produce accurate labour and material costs so our projects don't blow out." Habitech uses flat-pack delivery, and its services include heat recovery ventilation and solar + battery systems, if required.

The Melbourne-based company has delivered 35 houses to date, and is scheduled to construct another 30 in 2018 as the company scales up its design and manufacturing capabilities. The science behind the building system aligns with the Passivhaus standard, and Habitech also works collaboratively with other architects.

The majority of Habitech's clients are in Australia's southern states, but it has also partnered with builders in New Zealand to distribute its product and services there. "In Christchurch there are earthquake construction challenges," says Chris. "The strength and bracing of our SIPs based system responds well to the design requirements there."

NZ builders LiteGreen constructed the Concept House, using Habitech's wall and roof system. Since this project, Habitech has delivered a further eight custom-designed houses to the New Zealand market.

BUILDING TYPE:
Panelised construction system, using SIPs

PROJECT NAME:
Concept House

PROJECT LOCATION:
Christchurch, NZ (majority of Habitech projects are in Australia)

SIZE:
202 m²

MATERIALS:
Habitech SIPs, Thermacraft SIPs roof, recycled Australian hardwood and concrete foundations, double- and triple-glazed windows, hydronic underfloor heating in a screed slab

COST PER SQUARE METRE:
$3100 (base rate $2600)

BUILDING ENERGY STAR RATING:
8 Star (min)

TIME TO LOCKUP:
6 weeks, build time 5 months

PHOTOGRAPHY:
Danny Nelson

Carbonlite

Panellite is a prefabricated timber wall, floor and roof system from Australian company Carbonlite. Carbonlite director Burkhard Hansen is a certified Passivhaus builder with international experience in prefabrication. He launched Panellite in 2015 to provide a flexible panelised system that can be used for any design to achieve the Passivhaus performance standard, and the company routinely provides blower door and pressure testing for completed projects. “The product is the the first and only Passivhaus certified construction system in the southern hemisphere,” says Burkhard.

While Carbonlite can provide design and construction services, its primary business is supplying high-quality building shells for builders and homeowners. “We provide the building envelope, fully constructed offsite, and assemble it ourselves,” he says. The company has off-site and on-site crews, and works across Australia from its three factories in Thomastown, Victoria. In order to work with clients’ preferred designs, ‘prefab software’ is used to provide quick cost estimates; then, once full quotations are established the software is used to analyse architectural drawings to detail wall and corner connections, allowing precision machine cutting in the factory.

The clients for the high-performance house in Canberra wanted a cost-effective 9+ Star design. They engaged F2 Design, selected a local builder and then specified Panellite as their preferred material for the entire building envelope. “This project has achieved results beyond our expectations, with no heating needed during Canberra’s bitter winter,” says F2 Design’s Tim Adams. “The interlocking system makes it reasonably easy to create a leak-proof envelope based on our design.”

BUILDING TYPE:
Panelised construction system; supplies building envelopes to builders/homeowners

PROJECT DETAILS:
8x8 house, designed by F2 Design

PROJECT LOCATION:
Yarralumla, ACT

SIZE:
169 m² addition to a strawbale house

MATERIALS:
Panellite system, comprising locally sourced timber, OSB bracing, glasswool insulation, ProClima membrane, imported triple-glazed windows, LVL (laminated veneer lumber) engineered timber, plus timber batten grid to allow use of any cladding

COST PER SQUARE METRE:
$2750 to $4000 for turn-key projects (lock up shell $900 to $1200 fully fabricated and assembled on site)

BUILDING ENERGY STAR RATING:
9 Star

TIME TO LOCKUP:
2.5 weeks production, 2.5 days onsite, current lead-time 3 months

BUILDING TYPE:
Panelised construction system, deconstructable

PROJECT NAME:
Warrander Studio

PROJECT LOCATION:
Governors Bay, New Zealand

SIZE:
65 m²

MATERIALS:
Structural cross laminated timber (CLT) panels, cladding 'cassettes' containing insulation, building wrap and cavity, exterior fibre cement sheet cladding, Douglas Fir rain screen

COST PER SQUARE METRE:
NZ$3400 (AU$3100) including foundations and fit-out (at 2014 prices)

BUILDING ENERGY STAR RATING:
Unavailable

TIME TO LOCKUP:
2 weeks on site

PHOTOGRAPHY:
Andrew Cameron & Makers of Architecture

Makers of Architecture

Wellington-based Makers of Architecture and construction company Makers Fabrication work together and collaboratively with other designers, using digital technology and CNC (computer numerical control) capabilities to create custom designs efficiently. "Design is our focus," explains director Beth Cameron. "We work closely with the build teams in an iterative design-build process." The company also has sustainable design considerations front and centre. "Our homes are designed specifically to respond to site and the local environment, with natural ventilation and passive solar gain allowing them to perform with minimal assisted systems."

The company also considers the future life of the building, designing with future flexibility in response to the changing needs of the occupants: their design system allows components to be unclipped, disassembled, altered, added to, moved, reconstructed or recycled if needed.

While Makers can work with a variety of construction systems, the Warrander Studio is a great example of the 'CLT with cladding cassette' system developed specifically to make the most of their design and fabrication technology. CNC-cut cross laminated timber (CLT) panels provide the structure and interior lining; prefabricated plywood cassettes containing insulation, service runs and external fibre cement sheet cladding are fitted to the exterior CLT panels using pre-routed slots. A timber 'rain screen' connects to the exterior of the cladding cassettes, providing the final skin.

The system worked well for this tiny two-storey home on a tricky site overlooking Governor's Bay near Christchurch. "It allowed for a custom site and client specific design, and came together rapidly on site," says Beth.

Ehabitat

Ehabitat has offices in Hobart and Melbourne and is a firm of five staff and a small factory. There are no off-the-shelf plans, with each building custom-designed to suit both client needs and the site. Passive solar design is embedded in the system, with low embodied energy materials chosen throughout.

The prefab approach "allows quick construction, reducing on-site labour costs by up to 40 per cent," says Ehabitat's Giles Newstead. "Our modular system uses low-cost, off-the-shelf materials which can be used with no cutting. This means all internal and external cladding (including glass) just 'plugs' straight into the frame." The system is deliberately space-efficient, and there are many clever built-in storage and space saving options included.

BUILDING TYPE:
Modular construction

PROJECT NAME:
Glaziers Bay House

PROJECT LOCATION:
Glaziers Bay, Tasmania

SIZE:
120 m²

MATERIALS:
Tasmanian oak, cement sheet, glass

COST PER SQUARE METRE:
$2500

BUILDING ENERGY STAR RATING:
7 Star

TIME TO LOCKUP:
3 weeks

PHOTOGRAPHY:
Adam Gibson Photography

Ecoshelta

BUILDING TYPE:
Modular and panelised construction systems, aluminium alloy

PROJECT NAME:
Hobart Hideaway Pods, 30 m² (each pod)

PROJECT LOCATION:
Kingston, Tasmania

MATERIALS:
Aluminium alloy frame with composite panel foam/concentrate cement system for floors, zincalume EPS core composite panels for walls/roof, FSC-certified hardwood timber doors, windows and details, bamboo floors

COST PER SQUARE METRE:
$2870

BUILDING ENERGY STAR RATING:
6+ Star

TIME TO LOCKUP:
2 weeks on site

PHOTOGRAPHY:
Clare Glade-Wright

Ecoshelta runs a small architecture-oriented prefabricated modular building practice with workshops in Sydney and Hobart. It has made small, prefabricated buildings for over 30 years, and has experience using solid timber frames, manufactured timber elements, steel and now marine grade structural aluminium alloy.

The company has a strong focus on technology, and uses a combination of natural and manufactured products, composite panel elements and 3D-printed materials. It also uses the proprietary 'EcoCost' environmental costing system to provide clients with a full life cycle assessment of the raw materials.

With expertise in remote and challenging sites, Ecoshelta can integrate its buildings with off-grid solar PV and battery systems, rainwater catchment and waste water management systems.

For these pods, the brief was for "highest achievable aesthetic quality for the lowest achievable ecological impact."

BUILDING TYPE:
Panelised construction system, timber frame

PROJECT NAME:
The Sapkota House

PROJECT LOCATION:
Tarneit, Victoria

SIZE:
220 m²

MATERIALS:
Timber frame, OSB bracing, mix of timber cladding and render, panelised Colorbond-clad roof, concrete slab

COST PER SQUARE METRE:
$1300

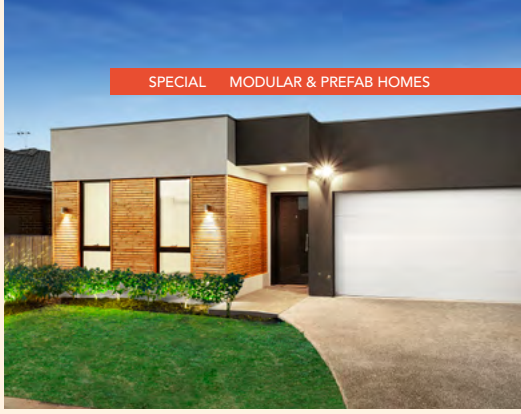
BUILDING ENERGY STAR RATING:
7.4 Star

TIME TO LOCKUP:
Factory manufacture 4 days; on-site construction time to lockup 2.5 days

Impresa House

Impresa House opened its Derrimut factory in Victoria in October 2016, offering precision-cut panelised prefab homes in Melbourne and surrounds. It works to a client's existing design, and also offers a full design, project management and fitout service as required. The company's system consists of timber-framed panels braced with oriented strand board (OSB), which are fitted with insulation, external cladding, and electrical and plumbing runs in the factory.

"We use traditional, familiar materials, but everything is precision cut using automated CNC machinery," explains CEO Sean Morley. "The very precise way that it all goes together means greater energy efficiency, fewer air changes per hour, and reduced heating and cooling needs." Where possible, Impresa homes are designed to achieve a minimum 8 Star energy rating, helped by the thermally broken aluminium-framed double-glazed tilt-and-turn windows the company builds in-house.



The automation also speeds up the fabrication process; Sean says they generally quote about six weeks for the adaptation of an existing design, but once that's done the manufacture of the house's components happens in just days. And further efficiencies can be achieved by designing specifically for their system. Recently, Impresa completed a four-bedroom house in Tarneit, Victoria, handling the entire process from design to fitout. With component sizes designed to optimise the flow through the factory, the fabrication took four days and the on-site construction to lockup was quicker at just two and a half days.

MAAP House

MAAP House has been developed with sustainability and attainability as its primary objective. The firm has a factory at Tomago NSW, a suburb of Newcastle, and produces one house every two weeks. It is looking to move to a bigger factory to double its output.

MAAP House aims to provide contemporary, high quality finished houses that can be built on any Australian house site. It uses a hybrid flat-pack modular system which it says is able to satisfy the broadest range of needs and accommodate aspect, budget and flexibility in floor plan designs and options.

The main benefits of this hybrid system is that house designs can remain flexible during the initial design process.

BUILDING TYPE:
Hybrid modular/panelised construction system

PROJECT NAME:
MAAP House, Merewether

PROJECT LOCATION:
Woodberry, NSW

SIZE:
Internal 144 m² including decks: 171 m²

MATERIALS:
Steel frame; Ubiq wall board cladding on internal and external walls; painted with Dulux Luxafloor ECO2 water-borne epoxy paint on all internal walls

COST PER SQUARE METRE:
$1700, including site costs

BUILDING ENERGY STAR RATING:
Unavailable

TIME TO LOCKUP:
5 weeks work onsite

PHOTOGRAPHY:
Mote

MODE Homes

with Matthew Dynon Architect

Established by architect Matthew Dynon in 2014, MODE builds its homes at a factory in Blacktown, Sydney. Its current capacity is up to 10 unique projects a year.

MODE uses a patented folding assembly system so homes are largely constructed in the factory, folded down for cost-effective transport and then folded back out when they reach site. The system was developed to reduce the prohibitive delivery costs associated with conventional modular construction.

Double glazing is standard in the homes MODE builds and there is a high level of insulation in walls, roofs and floors, considered orientation and sun protection. Waste is reduced on site and in the factory. Products are selected based on sustainability credentials.

BUILDING TYPE:
Modular construction, folding assembly system

PROJECT NAME:
Modular home addition

PROJECT LOCATION:
West Ryde, NSW

SIZE:
100 m² of living space added to existing residence

MATERIALS:
Steel frame, Weathertex cladding, extra height double glazing, feature spotted gum hardwood cladding, spotted gum decking, powder-coated aluminium sun shading

COST PER SQUARE METRE:
Complete module $2500; full project $2850

BUILDING ENERGY STAR RATING:
7 Star

TIME TO LOCKUP:
14 weeks, five on site.

PHOTOGRAPHY:
David Curzon, Matthew Dynon

BUILDING TYPE:
Modular and panelised construction system

PROJECT DETAILS:
Macleod House

PROJECT LOCATION:
Macleod, Victoria

SIZE:
144 m²

MATERIALS:
Polished concrete waffle pod (insulated) slab on ground, timber frame construction, timber floor joists, timber roof trusses, insulated walls/floors/roof, Shadowclad (plywood) and natural timber cladding, cedar double-glazed windows and plasterboard interior lining

COST PER SQUARE METRE:
$2200

BUILDING ENERGY STAR RATING:
6.6 Star

TIME TO LOCKUP:
7 days from slab to roof

Fairweather homes

Fairweather Homes has been delivering modular homes in Australia and overseas since 1982 and has constructed 400 houses to date. Its focus is architect-designed sustainable buildings using a “sophisticated” low-risk approach to affordable construction. “We allow owners to take control of finishing trades and manage their budget and construction timeframes,” says director Paul Adams.

Fairweather’s component-based, off-site fabrication uses locally sourced, low embodied energy materials. Although based in Melbourne, the company works across Australia, including regional and remote areas where there is a limited supply of architects and experienced builders.

This urban infill project on a subdivided block allows a multigenerational living arrangement to prosper. The new two-storey house has a flexible floor plan adaptable to a variety of potential future living arrangements. The durable timber-based cladding allows a contemporary and changeable colour scheme for the life of the building.

Strine Environments

BUILDING TYPE:
Modular construction, precast concrete

PROJECT LOCATION:
Dickson, ACT

SIZE:
Three-bedroom version is 143 m²

MATERIALS:
Precast concrete sandwich panel walls, precast concrete floor, metal SIPs roof, aluminium-framed single and double glazing

COST PER SQUARE METRE:
$2500

BUILDING ENERGY STAR RATING:
9 Star

TIME TO LOCKUP:
3 days

Architect Ric Butt of Strine Environments has developed over 30 years a new style of off-site prefabricated modular housing. The model integrates architectural design with precast concrete and environmentally sensitive construction to achieve climate-proof homes that provide an alternative to the usual lightweight, thermally poor-performing kit home products.

The prefabricated modules have been designed to fit on a truck and can be delivered anywhere. The E-Cubed system uses Utility Modules and Space Modules to achieve flexibility. Ric Butt says: "Utility Modules are the 'wet area' parts of a house including bathrooms, ensuites, laundries and kitchens. Space Modules are flat-packed, with fully completed elements including floors and walls with all windows, doors, services and painting included. Space Modules are assembled on site during the erection process." Strine is based in Dickson, ACT.

Valley Workshop

Valley Workshop is a father-and-daughter team run by Penelope Haley with her father Warren French, the company's principal architect. They employ a number of staff at their factory in Westbury in northern Tasmania and deliver across the state.

The firm's approach is bespoke and unique, manufacturing their own structural insulated panels free of polystyrene. The skin of the SIP and internal grillage system is made from Tasmanian hardwood structural ply, and wall modules are a stud frame built in the horizontal plane in the workshop. Every build is designed by an architect. Haley says: "SIPs reduce thermal leakage, so our R values are double that of conventional building methods."

The dramatic images show a prefabricated building designed for the state's Parks and Wildlife Service being helicoptered to a remote site under Frenchman's Cap in Southwest National Park. The project was built by Valley Workshop and designed by Green Design and Warren French architect.

BUILDING TYPE:
Panelised construction system, polystyrene-free SIPs

PROJECT DETAILS:
Lake Tahune Frenchmans Cap

PROJECT LOCATION:
Lake Tahune Frenchmans Cap, Southwest World Heritage National Park, Tasmania

SIZE:
Building 67 m², deck 14 m² , toilet and workshop 11 m²

MATERIALS:
Custom SIPs wall modules and roof

TIME TO LOCKUP:
20 days in the workshop, 35 days on-site working in an alpine area 1000 m above sea level and accessed by helicopter.

BUILDING ENERGY STAR RATING:
8.6 Star

PHOTOGRAPHY:
Penelope Haley

Towards off-site construction

Many leaders in sustainable building see factory construction as the future of housing. Verity Campbell investigates whether consumers and the building industry are ready to fully embrace the change prefabrication will bring.

WORDS Verity Campbell **PHOTOGRAPHY** Andrew Cameron & Makers of Architecture

DESPITE THE INITIAL SLOW UPTAKE, Australia's interest in modular and prefabricated design and construction is gaining momentum. With the promise of providing cheaper, faster, more efficient and environmentally sustainable solutions, prefab construction in Australia looks like it could be the game-changer triggering the industry's 'Ford' moment.

Led by current research drawing attention to the industry's potential, Melbourne School of Engineering and the Centre for Advanced Manufacturing of Prefabricated Housing wants to grow the prefab market share within the Australian construction industry from five per cent to 15 per cent by 2025.

This impetus is already being felt by a number of designers. Jan Gyrn, managing director of leading modular design and prefabrication firm Modscape, has seen significant growth over the past five years. When the company started 11 years ago, Modscape built predominantly holiday homes in rural, coastal or difficult to access areas, but now there is a trend towards modular over conventional construction for primary urban residences. This trend is on par with what's happening in Europe, Asia and Northern America, says Jan, and he sees this as a strong indicator that prefab is becoming an "accepted way to build".

In addition to the prefab factory setting offering potentially safer, cleaner, and more reliable conditions that enable less waste and more accuracy than a building site, consumers are turning to modular and prefab to avoid what Jan calls "the Grand Designs experience, where you inevitably encounter budget and time overruns". Clients who need to rent or be out of home while they build can reap the cost and time savings of being displaced for four to six weeks, rather than months with a traditional build.

Rowan Brown of architecture firm Lai Cheong Brown, designers of the off-grid prefab house on French Island featured in *Sanctuary 37*, also believes that prefab has the potential to grow in a number of directions, from large-scale developers using modular and prefab components for apartment buildings, to the largely untapped education and commercial sectors. This diversity in the market, he adds, will serve the Australian design community well.

To date, Australia's focus has been on building modules in factories as opposed to the European flat-pack approach, says Brown, but this, too, is changing.

Sven Maxa of Maxa Design, who has just completed a prefab Passive House in Heathcote, Victoria, is another industry insider expecting rapid growth due to a "better educated marketplace, where the advantages of modular and onsite labour savings in a costly building market prove to be more attractive."

"The way we prefabricate will change," he continues. "Manufacturing facilities will gradually become automated to achieve greater efficiencies in handling and storage, as well as reduce labour costs – making them a more affordable option for the consumer."

For now, Sven believes most people will continue to opt for traditional methods, "as that's what the majority of the building trades understand and are confident with." But as more designers, engineers, technicians and builders become familiar with prefab, and learn how to take full advantage of it, the more it will take over market share.

Tim Adams, a leader in sustainable house design and owner of F2 Design, views the shift to modular and prefab as inevitable. "But perhaps we should be heading towards off-site component manufacturing including flat-pack modules rather than fully assembled prefab pods, because of transport volume considerations and redundancy of structure only needed for the transportation phase."

While the potential benefits of modular and prefab are clear, what are the downsides?

Sven and Rowan both agree that

more time is required in pre-planning, documenting, and fabricating, with the process not linear like conventional design and build processes. This points to a required skills shift in the profession that is yet to be realised, and for homeowners, the need to lock in exactly what they're after much sooner in the process. The inherent flexibility that the current system enjoys will be much harder to accommodate.

To date, a hurdle to prefab's wide adoption has been cost; but as the balance shifts, higher prices may not always be a given. Tim in particular recognises that the prefab industry is at "impasse at the moment", where some off-site processes "have not yet reached sufficient scale and efficiency to make them more cost effective than traditional project home delivery methods."

Another challenge to overcome is the stigma of the perceived prefab "look", notes Rowan, and the idea that prefabrication is synonymous with mass-produced. However, Rowan believes prefab technology has the potential to continue to customise design, marrying custom design and the benefits of prefab. "Once people see the end result, they'll open their eyes to the possibilities."

For Tim, "the whole industry needs to change, from design through to implementation, including finance and payment models that value off-site production, as well as regulatory adaptation." Tim suggests that perhaps a skill transfer from existing manufacturing, such as the vehicle manufacturing industry, could assist in the transition. There remains an issue that some financial institutions can be unwilling to provide finance for this kind of home, as the asset is not constructed on site; this can be overcome, but can create obstacles for people trying to get a mortgage for a prefab home.

If prefab really is the housing solution for the future, then as Tim points out, while there will be an increase in technicians, there will be a reduced need for traditional trades. This means a significant industry shift will need to occur, including changes to building trades training. The current need for on-site assembly of "sticks and bricks is holding back improvements in productivity," he says.

Jan Gyrn believes prefab can complement the architectural industry, and there is, and will be, a skill requirement for modular design. "Architecture is still the most important part of the process."

Likewise, Rowan says designers and architects will always play a "fundamental role" in design and documentation, but perhaps they will become more part of the prefab process, with traditional architect-builder relationships transitioning to architect-prefabricator and architect-installer. Whatever the future brings for modular and prefab construction in Australia, one thing is for sure: once it arrives in earnest, "there will be no turning back," says Rowan.

Under construction: The author's passive solar house in Blampied, Victoria, is constructed with light-earth. All images: Mara Ripani.

Paving the way to owner-building

The pathway to owner-building has been a smooth one for Mara Ripani and her family, but there were some missteps made along the way that could have been avoided had they known what they do now.

OVER 13 YEARS AGO, MY PARTNER RALF AND I EMBARKED on our first owner-builder project, a renovation. We had purchased a small, double-brick house in Melbourne, north facing, and with space for chickens and growing food. Over several years we achieved our goal of maximising its comfort by increasing its passive solar performance. We then moved out of town and began a second, more ambitious project – a new light-earth house on six hectares (15 acres) in Blampied, Victoria.

For both projects we set out to build ourselves. For Ralf, this offered a mental break from his office job and all the social dynamics that come with it. For me it's an opportunity to work closely with someone I love, and a chance to fine-tune the ideas I've gleaned over 20 years of sustainability education.

We've found building together has been a positive experience, with mistakes made of course, but generally insignificant enough to cause little heartache. However, there was one mistake that could have cost us dearly. In this article I share the nine key things I needed to learn, and if you are starting out as an owner-builder, you will need to know these too – and so much more!

BEFORE YOU START: PLANNING/DEVELOPMENT APPLICATION

Be meticulous about your planning permit or development application. One of the most important steps to take, especially for those purchasing vacant land in regional areas, is to engage an excellent conveyancer. However, don't rely solely on their work; make sure yourself that the information included in the legal documents is accurate. If the sale of land comes with an existing planning permit, confirm the conditions of that permit by visiting your local government. Meet with a planning officer to identify conditions that may restrict your future build and ask them about overlays: heritage, environmental, bushfire, et cetera. Most local governments have development applications online with all conditions and validity dates.

We didn't do this, and experienced a terrible situation when we purchased our current property: the Section 32 (the relevant document in Victoria) was incomplete and did not include the conditions attached to the planning permit. Instead of being able to renew the permit two years later, we were told that we could no longer build; the value of our property plummeted. We consulted a lawyer, but it was through the help of a private planner that we managed to have the error identified and our permission to build reinstated. It was a very intense time for us.

RESPONSIBILITIES OF AN OWNER-BUILDER

The first part of an owner-builder's journey is to know your responsibilities: you must own the land on which you are building, and take full responsibility for all the residential building work. The level of involvement, though, is up to you. You can choose to project manage and engage trades and a registered builder, or project manage and do the building work yourself (using qualified

trades when required). If you plan to engage a builder to do all the building work and project manage the entire project, then you are not an owner-builder, and you should not enter into a building permit stating that you are.

REGISTER WITH THE RELEVANT AUTHORITY

You will need to find out if you require a 'certificate of consent' by registering your intention to owner-build with the relevant authority in your state or territory, and pay the associated fee. [In most states, owner-builder permits are required for projects over a certain dollar value, and this minimum differs everywhere.] Gaining consent will involve undergoing training and you may need to complete a course or obtain a current construction induction card or 'white card'. Don't be lured into doing online training in another state, as it will most likely not be recognised by the state you are in.

Be patient during this period. As you wait, engage an engineer, start thinking about your water and energy systems and landscaping, and organise soil tests for your property as these will also inform the building process.

DRAWINGS: ARCHITECT, DESIGNER OR DRAFTSPERSON?

Drawings will need to comply with building regulations, and most people will choose to work with a building designer or draftsperson to produce these. The builder we chose was also an experienced designer with an understanding of permaculture living, which was perfect for us, and all the drawings were done by him. But we made sure to keep the design simple to reduce costs and ensure we had the ability to build it! If you are a highly skilled and experienced builder looking for an innovative design, then working with an architect will give you room to workshop a range of design visions; the right architect may be willing to mentor you along the way. It's worth noting that some architects won't take on small projects; you may find it easier to identify someone who does by listing your project online with a trade directory, such as 'hipages'.

As an owner-builder be on-site as much as possible: "Be there for the pouring of the slab and when the plumber and electrician are due. Often details in plans aren't read and you need to be there to communicate exactly what you want."

Owner-building is not one size fits all, and you can decide what kind of owner-builder you want to be. Mara and partner Ralf worked with designers for both of their projects, but managed each build themselves. For their first project they constructed everything themselves, but for their second they worked collaboratively with a builder who was experienced with light-earth. Importantly, both times, they ensured the architects designed buildings to suit their ower-builder capabilities. Image: Mara Ripani

YOU'LL NEED DETAILED DRAWINGS

Once you have your permits, you will be tempted not to produce detailed drawings because 'you can do it later or as you go', but this will result in annoying compromises. Without the full picture and its details it can be hard to foresee how one decision impacts on another. Scaled drawings can be deceptive, especially if you are not experienced with reading plans, and rooms can look bigger or smaller in your mind than they actually are, but the placement of furniture will help you orient yourself. I suggest you map out the furniture carefully (bedroom, lounge, bathroom, kitchen, etc) – and almost everyone forgets to consider the placement of rubbish, recycling and compost bins! Think about hot water and solar panels (size your system at this stage so you know it fits your roof) and internet and mobile charging points.

BUILDING SURVEYOR AND OTHER TRADES

A good building surveyor can help safeguard against unsafe workmanship or poorly trained and inexperienced tradespeople, but as a registered owner-builder, you are legally responsible for the contracts with tradespeople and are obliged to check they have current licences and insurances. Whether you decide to go to a council-appointed or independent building surveyor, ask for permission to talk to past clients and ensure they have the experience or willingness to support your vision. The right surveyor will be a great asset in helping you understand how to meet the building regulations and how to build a home that is safe and will last a lifetime.

Equal to this is the need for you to be on site as often as possible to supervise trades. You will get best results if you produce detailed specifications for trades, and have contracts with clear payment milestones. But still, be there for the pouring of the slab and make sure the curing process is done well, and if it extends to the bathroom that the walk-in shower area has adequate fall. Be there when plumbers and electricians and other trades are due so you can communicate exactly what you want, as some details in plans can be missed. Importantly, supervise the installation of the insulation – if this job is executed poorly it's hard to check later.

Every step of the way, ensure the work is completed satisfactorily before you pay, and if you have finance involved your bank may need to be satisfied too. The only factor that will hold some to account is the payment you have yet to make. At times you will need to have a difficult conversation. If you can't stand confrontation of any kind then find someone who can advocate for you and seek advice early if there are disputes.

INSURANCE IS DIFFERENT FROM WARRANTY

Don't confuse construction insurance with building warranty insurance as they are completely different and apply at very

different times. Construction insurance covers you while you are building whereas warranty insurance is applied when you sell your owner-built home, to protect the new buyers.

Before you begin your build you will be required to get construction insurance – don't start building without it. I spoke to owner-builder friends recently who had trouble finding someone to insure them because they had begun their build prior to paying for insurance and once insured they were given a two-year window to finish (which is common and can be extended), but they have a long way to go with their house.

FINAL INSPECTION AND CERTIFICATE OF OCCUPANCY

You think you are finished, but are you? As an owner-builder, if there's one thing it's safe to assume, it's that your build will take you much longer than you thought. Before you can move in, you need a final building inspection and to be issued a Certificate of Occupancy. It's not unlikely the building inspector will arrive and identify something – the staircase does not have anti-slip tread or the rail height at the very top is short by 10cm. Hang in there, breathe in and out, and get on with it.

WHEN YOUR PARTNER IS THE BUILDER

When it's your partner who is the builder, you need to factor in how you are going to deal with the tricky times. Over two projects I've developed the ability to get my priorities straight in the difficult moments. It helped me to think 'first world problem' and 'how important is it really?' I think it was also important that I made my intentions clear from the beginning: that I did not want to be involved in building, but wanted to be involved in decision making.

We are still building as I write. We are up to the 'personalise your home' stage where we get to install bookshelves, build furniture and put up framed photographs stored for a long time. The house is becoming more familiar, cosy, less 'house' and more 'home', especially now that I have a pull-out drawer for my compost bin and another for my sourdough bread bakers' flour, and a large cupboard for my preserving kit!

Mara Ripani is an owner-builder and runs a business called Village Dreaming. She is also a sustainability advocate with qualifications in horticulture and environmental policy.
Find her on Instagram: @maravillagedreaming

Build without skip bins

Reducing waste is a challenge for any house project especially as the building industry is still geared towards landfill – contributing almost 40 per cent of Australia's overall waste. But, as owner-builder Greg O'Byrne found, he could all but eliminate landfill and even went without a skip bin when constructing his sustainable home.

WE HAVE ALL SEEN IT BEFORE: A HOUSE UNDER construction in a new sub-division or an intriguing renovation underway, but in the foreground is an overflowing skip bin. In it are offcuts of newly manufactured materials, demolished materials screaming out to explain their history and choc milk cartons, partially covered with a dried layer of waste concrete and tile grout. It's an all too familiar sight and unfortunately, a largely under-considered step in the big picture of building.

HOW TO AVOID SKIP BINS

We are nearing the end of our own building project in a small one-way street in inner Fremantle. Our challenge was to build a sustainable house in a long established urban environment. The first considerations about our waste were: "Where are we going to fit a skip bin?" followed by "What sort of things are we going to need to put in our skip bin?". With these questions presented, we set about affirming our ethos on waste. By deciding to incorporate waste minimisation wholly into our project, we found we didn't need a skip bin at all.

DECONSTRUCTION

First, there was a need to remove the old house from the block. We sourced multiple quotes from demolition contractors to do this job but their prices were based on profits made from salvaged materials. We were sure there was greater value in our old house for us, so we decided to do the majority of the demolition ourselves.

We salvaged about 7m^3 of jarrah timber, a house-worth of red bricks, weatherboards, large locally quarried limestone footing blocks, concrete pavers and old fittings like doors, bathtub and basins. Our ethos to recycle was encouraged by the desire to embody the character of the old house into our new one; there's no better way to do that than with salvaged pieces of the old house.

WASTE AS COMMODITY

Looking at waste as a commodity is one of the best ways to begin dealing with it. We have all heard of the reduce, re-use and recycle adage. All building projects, including ours, need new materials and lots of them. Reducing excess 'off-cut' material accumulation, or creating less waste is probably one of the best prongs on the fork to tackle, and most certainly has the biggest impact. This approach can certainly save money in a project's cost (most commonly borne by the owner). However, the volume of waste and how well it is managed will depend on the extent of your involvement and the commitment of any builders or contractors.

The waste from Greg's build was modest enough to fit in his regular council rubbish collection.

It took six weeks for Greg to dismantle the house by hand, a method that allowed him to reuse most of the materials in the new house; the brick walls were repurposed as paving.

Reduced waste on housing development sites is also possible. The Sociable Weaver team, when building at the Cape developent in Victoria, instituted a site-wide waste system that avoided the jumble of mixed-use skip bins. Image: Dave Martin

ACCURATE MATERIAL ORDERS

Most worksite skip bins contain brand new materials and this seems totally cost-ineffective, particularly to the owner, not to mention their short lifecycle before appearing in landfill. If you are ordering materials for a project, take the time to accurately calculate what is required. If you are unsure how much you need, under order, but be prepared to get a 'little extra' at a later stage. This sort of effort saves having to pay for something that you may end up also paying to get rid of later.

UPCYCLE

We all agree that junk is junk, but it is worth considering that we are not all the same. Some people see value in objects or items that others don't. The only difference in the junk's potential is the imagination devoted to it. We re-used our old earthenware sewer pipes by crushing them with a hammer and adding them to the concrete mix when pouring our exposed concrete floor. The results look great and tell a story, while they could've otherwise been in landfill.

There is an ever-growing number of people using re-purposed or up-cycled materials, particularly for construction purposes and there are great savings (and amazing results) to be achieved by doing so. Be willing to be flexible with the outcome of the final product. This may require close working relationships with your architect or structural engineer. It's much savvier to acquire materials you love and shape them into your project than picture something you like and try to find the perfect materials at a reasonable price.

ONLINE NETWORK

Our project would not have been what it is without the wonders of the inter-web. Countless items, from broken bricks, floorboards, scaffolding, laser level, brick saw and a ute were bought and sold through platforms like Gumtree. Rather than disposing of it when you are finished, consider if someone else may have a use for it, even if you think it's worthless. It can't go in the skip bin if you don't have one.

Acquired for free, our 70m^2 of temporary chipboard flooring was passed on two years later, largely unchanged, to a growing family building a bedroom extension, avoiding the bin on more than two occasions.

WE DID USE A WHEELIE BIN

But what about building site waste? Cement bags, brick pallet banding and all that cardboard packaging. How did we manage to do it on our project site? What waste there was, created daily, was sorted and stored in several designated areas at the end of the day.

Each week we had a budget of one council-collected wheelie bin and (unfortunately still the case in our suburb) one recycling bin per fortnight. We got really good at compressing, compacting and being efficient about loading these bins in a calculated manner, putting in them only what was absolutely necessary.

WASTE MANAGEMENT PAYS OFF

A skip bin on a building site seems more often than not to be an excuse to ignore or neglect the responsibilities of good waste management. Consider what it's actually going to be used for and ask yourself (and your builder) if it is really necessary. Like us, you may be surprised to find you can manage without one.

Greg's beautiful sustainable house featured in *Sanctuary* 40 and online, and regularly opens for Sustainable House Day.

Changing phase: Are PCMs living up to their promise?

The jury is still out on whether phase change materials (PCMs) offer bang for buck when it comes to home energy performance. But as more households and designers experiment with them and report results, Richard Keech considers why you might choose to use them.

YOU MAY HAVE HEARD OF PHASE CHANGE MATERIALS (PCMs) as being exotic and advanced building materials with great potential for use in green buildings (see *Sanctuary* 21). While no longer new, PCMs are still a niche product in Australia and around the world, and we're still discerning how and when they might best be used.

In a nutshell, PCMs are materials with a carefully selected melting point that aim to provide effective thermal energy storage without the disadvantages of conventional thermal mass.

A home with lots of thermal mass can be a mixed blessing. When the temperature of a thermal mass is within your comfort range, then high thermal mass works in your favour by slowing down temperature change. However, if thermal mass is too hot or too cold then it works against you by forcing you to expend large amounts of energy to get comfortable. Think of an old cold church and you get the idea. The other problem with high thermal mass is the weight involved. Heavy materials bring a range of problems in building design and construction.

Imagine if you could get a material that had the property of high thermal mass in the comfortable temperature range, but a low thermal mass outside this range. If such a material was reasonably low density, then this would overcome both disadvantages of normal thermal mass. This is the promise of PCMs: they are a discreet and simple way of adding to or improving on the benefits of thermal mass.

THE SCIENCE BEHIND PHASE CHANGE

Usually when we talk PCMs, we're actually talking about materials that are kept within a system and cycle back and forth between two phases (solid and liquid) as heat flows in and out. A range of such materials exists; most are either made of special salts, or waxy/oily organic compounds.

Phase change materials work because of the curious physics of materials around their melting point. Take water for example. It will only take about 4.2kJ of heat to raise the temperature of one litre of liquid water by one degree. However, it takes about

Heat rises, making the ceiling the best place to install PCM, although it can also be effective in walls and floors, depending on your design and intention. This house in Hampton, Victoria (see case study) has installed BioPCM in the ceiling and available cavities at the top of living room walls.

340kJ of heat to take the same amount of water from just frozen to just unfrozen. This large amount of extra heat energy required to change phase (in this case from solid phase to liquid phase) is called latent heat. The same thing happens going from liquid to gas, which is exploited in refrigerators and air conditioners.

Normally adding heat energy to a material leads to an increase in temperature. The magic of PCMs is that when they are at their melting/solidifying temperature, adding or removing heat energy results in no temperature change of the material (up to a point). The exploitation of this for thermal comfort is what incorporating PCMs in buildings is all about.

APPLICATION AND LOCATION

When properly placed in a building structure PCMs are reported to improve the passive thermal performance of a lightweight building by at least 1 Star (note proxy measures need to be used in NatHERS software as the available tools don't yet model PCMs). However, PCMs alone are no silver bullet for better building performance. The building orientation and available solar gain are factors, and it is important to use PCMs in conjunction with other energy efficiency measures, such as improved levels of insulation, draught proofing and efficient glazing.

Given these materials melt, they need to be properly contained. So, unlike most building materials, PCMs need to be fully contained within some other material or structure. This can take the form of pellets or pouches of material in sheet form. In large commercial systems the PCM can be within balls inside a tank of water, or as a slurry of material inside a tank.

To be most effective, the PCM should be thermally coupled to the internal building material, that is, there should be no air gaps between the PCM sheet and the back of the interior lining material. Using PCMs in the ceiling is therefore likely to work best, because the material is in continuous contact with the plaster simply under its own weight. It is also used in walls and floors, but careful attention should be paid to ensuring unbroken contact.

PRODUCTS

In Australia today, of the ready-to-use, off-the-shelf PCM products, the best known is BioPCM. Another product, Comfort Board from Knauf, was discontinued in 2017 due to lack of consumer demand for it, among other factors. A new entrant in the Australian market is Infinite-R.

BioPCM Mat Q24 comes in the form of a flexible plastic mat containing a matrix of sealed pockets of the PCM material. The product weighs 2.7kg per square metre and transitions from solid to melted across the range 20 to 24 degrees Celsius. The distributor recommends fitting 1kg to 2kg of BioPCM per cubic metre of room volume. The PCM material in BioPCM is a blend mainly comprising oily organic compounds with fire retardant added for safety. BioPCM is manufactured in the USA and is available in Australia from Phase Change Energy Solutions.

Typical use of this product is as an adjunct to insulation. For example, the sheets are sized to fit between ceiling joists and would normally be sandwiched between the ceiling plaster and the insulation. It's straightforward to lift any existing insulation batts and insert the BioPCM sheets before replacing the insulation.

Infinite-R seems equivalent to BioPCM in as much that the PCM comes encapsulated in plastic sheets which are installed in ceilings or walls, usually along with insulation. However, Infinite-R PCM compound is a blend mainly of salt, clay and water. It is available in a range of melting points (18, 21, 22, 25 and 28 degrees Celsius). It claims to be able to store heat at 1.1MJ/m^2 (0.3kWh/m^2).

CLIMATE ZONE

Phase change materials work best in locales with moderate to large diurnal temperature variation, because this is necessary to recharge the PCM. This makes them more suitable to temperate climates as opposed to coastal tropical regions, for example, where there is little variation between daytime and overnight temperatures.

COST AND BENEFITS

The building design process is inherently about values and choices, and your decision whether to invest in PCMs as opposed to another form of thermal mass or an efficient heating/cooling system will depend on your site and specific circumstances. Where the application of PCM has best potential for cost benefit is in the renovation of an existing lightweight dwelling with accessible attic roof volumes to allow easy placement on the ceiling under bulk insulation, and also potentially in modular and tiny houses.

In Australia, expect to pay between $55 and $110 per square metre for PCM. When compared to the approximately $10 per

square metre for bulk insulation it can appear very costly, especially when extrapolated over a large area of ceiling.

As noted earlier, PCMs act as thermal mass, making it an adjunct to, not replacement for, insulation. If your building were not fully insulated with other energy efficiency measures also employed, the economics would make it unlikely to be worth the investment.

WHERE PCMS CAN MAKE SENSE

Passive-only house

One case where PCMs might make sense is where the design specifies that active heating and cooling is not permitted. Maybe you're aiming for a fully passive 10 Star design. In such a case the additional cost and effort in using PCMs may be worth it because you can avoid the capital and running cost of a heating and cooling system. For PCMs to work in this scenario, there needs to be sufficient day/night temperature variation for the PCM material to 'recharge'. An example of this is the 10 Star house built in 2017 at The Cape development in Victoria, which used PCM to raise the score from about 9.8 to 10 Stars. In this instance, the PCM fell outside of the protocols for regulatory compliance therefore allowing NatHERS rating tools to be used for predicting how the house would perform based on the occupant's intended use; quite different to the mandated assumptions for building permit approval.

When resilience is a premium

This scenario is an extension of the situation above. If a building needs to remain comfortable in the event of the failure of the heating or cooling system (including blackouts), then the effective thermal mass of PCMs might be worth the investment. Given the likely future incidence of severe heatwaves this option is more than theoretical. For thermal resilience, PCMs such as BioPCM or Infinite-R can often be easily retrofitted to an existing building, whereas adding conventional thermal mass would normally be challenging.

Getting a difficult design over the line

In an ambitious new-build situation, a number of situations might arise where using PCMs might get the designer out of a tight corner to achieve the required building energy star rating. Designing to achieve desired thermal performance involves lots of trade-offs. Say an initial home design doesn't achieve the design star rating – perhaps because of large amounts of glazing. In this situation, a sufficiently qualified designer or expert who has the ability to reach compliance using a performance-based solution, might use PCMs as a way of adding working thermal mass without needing the structural changes that heavy (normal) thermal mass would entail. In such a situation the PCMs might be cheaper than the alternative re-design. In this specific example it might be better (thermally) to constrain the window size, but maybe there are other pressing considerations. Ⓢ

CASE STUDY

Winner of the 'best ecologically sustainable design' award from their local Bayside council, Bruce and Jan's Hampton house in Melbourne's south is formally rated at 7.8 Stars; with phase change materials and structural insulated panels (which aren't yet rated in NatHERS tools) the home's as-built performance is closer to 9 Stars.

Their decision to use PCM was made when they realised the internal masonry walls they planned to use for thermal mass would add 150mm to the wall thickness, significantly reducing floor space in the 160m² house.

"The house has been designed for thermal comfort from day one. When we decided the bricks would impact too much on room sizes we investigated lightweight thermal mass. We found it was also more cost-effective than bricks," says Bruce.

Jan and Bruce are savvy with material selections and carefully considered where the BioPCM product they had chosen would have best effect. They decided to install it in the ceiling throughout the whole house. "The PCM is between the insulation and the plaster. It fits between the trusses and deliberately droops a little so it will be in direct contact with the plasterboard."

Where it would fit neatly with the SIPs, it's installed in some wall cavities down to one metre below the ceiling.

Richard is an engineer, consultant and author with particular interest in renewable energy and energy efficiency. He has masters degrees in both Engineering (Electronics) and Environment (Energy Efficiency). He was a lead author of the Zero Carbon Australia Buildings Plan, and is a regular contributor to the ATA's publications on topics related to energy efficiency. Richard lives in Melbourne with his family in their zero-carbon home and is the author of *The Energy Freedom Home* published by Scribe.

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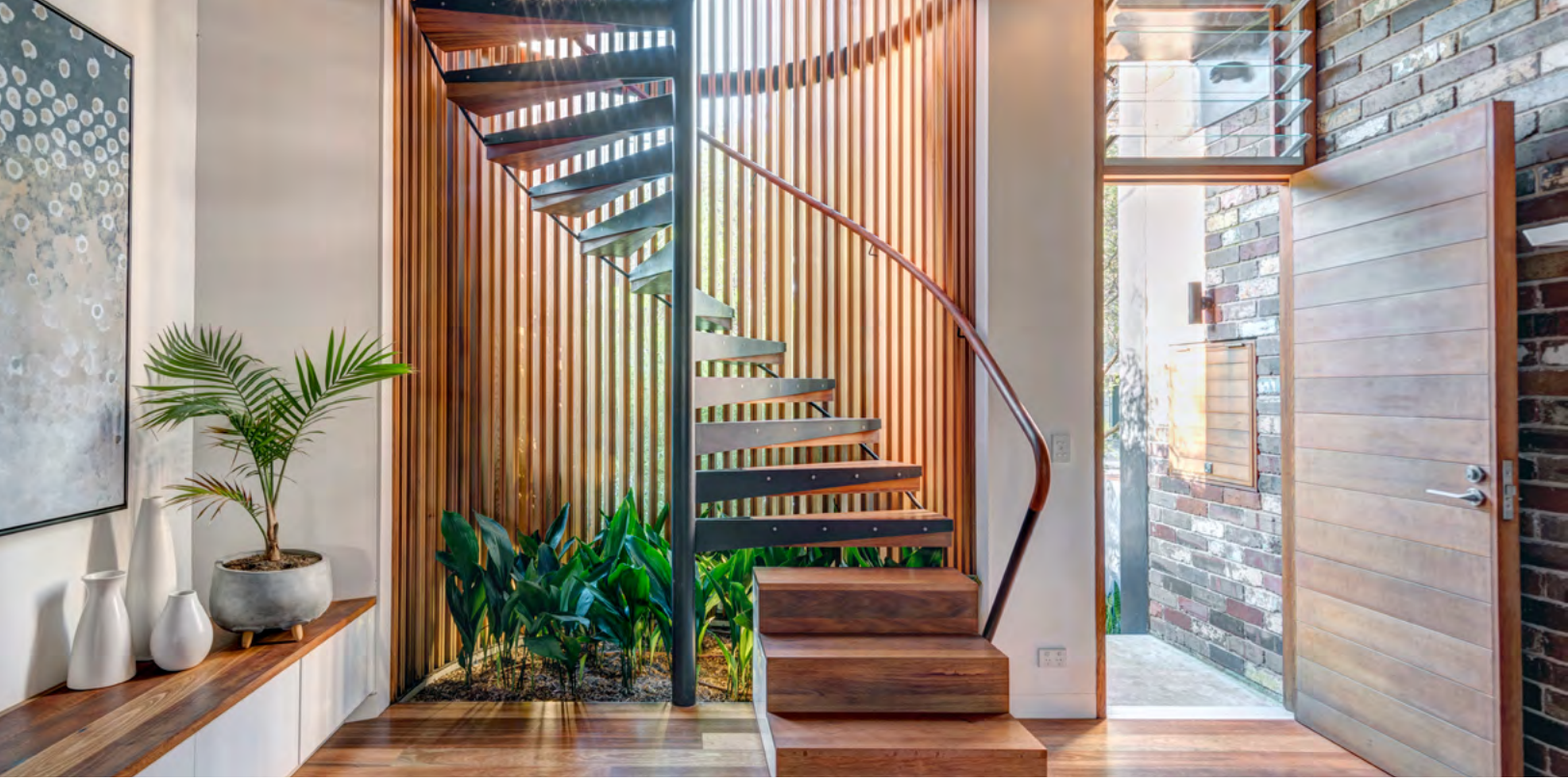


Stairs with flair

The humble staircase can do far more than provide access to your second floor. Anna Cumming shows that with a bit of creativity, stairs can fulfil multiple purposes from storage and thermal regulation to design feature or just sheer fun.

AS OUR CITIES GROW AND THE NEED FOR CLEVER URBAN densification grows with it, more and more new homes and extensions are going up to increase living space while preserving precious outdoor area. And to get upstairs, you need – well – stairs. It's easy to think of a set of stairs as nothing but a space-hungry necessity, but with some thought they can be so much more, as architect Shae Parker McCashen of Green Sheep Collective counsels: "The need for stairs provides an opportunity for an exciting design feature. Any built element should offer more benefits than its traditional singular function – stairs can provide a beautiful aesthetic and offer many functions beyond travel between levels."

STYLE

Architect Steffen Welsch also loves stairs. "They allow you to explore a space. They can be a feature – we often involve artists in our stair designs – but they can also be hidden or in an unexpected location and add an element of surprise." Depending on the space available and the look you're after, stairs can be straight, curved or spiral; cantilevered, suspended or supported from underneath; open or closed-tread; tucked away behind a door or a sculptural statement.

Space-saving styles include spiral stairs, ladders, moveable stairs and alternate-step stairs which save on horizontal space by

This dramatic staircase is part of a Copenhagen apartment renovation by Danish architects JAC Studios. The lightweight steel upper section is suspended from the first floor level to give the impression of levitation; the lower section is a series of stacked concrete plateaux, some of which extend to form seating and a hearth for the fireplace. Note that tighter regulations would require a balustrade if this stair was replicated in Australia.
Image: Karina Tengberg.

As part of this renovation of a narrow Sydney terrace, CplusC Architectural Workshop moved the staircase to the front facade, improving the flexibility of the internal spaces. The semi-circular stairwell pushes into the front garden and is clad with strips of glass and timber, allowing a subtle visual connection to the street; it doubles as a greenhouse for the plants below the stairs. The spiral stair is made from angled steel welded on site, with recycled spotted gum treads; the timber unit that serves as the first three steps also contains storage. Image: Murray Fredericks.

Stairs and their balustrades can be approached as a decorative as well as a functional feature. This one in a Melbourne house designed by Steffen Welsch is the centrepiece of the dining room, and boasts a beautiful cut-metal balustrade reminiscent of a dragonfly's wing, designed by artist Laura Woodward. Steffen and his team ensured that it complied with regulations for height and maximum gap size. The staircase also incorporates storage underneath, heating and a hidden docking station, and allows light in from above. Image: Rhiannon Slatter.

The brief for these stairs in Techné Architecture + Interior Design's Carlton North House in inner Melbourne was for "a simple, fluid form that created something of a 'moment' within the house," says Techné director Nick Travers. "Taking out flex and bounce in the design required a bit of thought. The plate steel folded treads and risers act structurally in concert with the balustrading and handrail to provide stability." The timber treads soften the aesthetic and also make using the stairs quieter. Image: Ben Hosking.

Future-proofed design: Latching sliding doors at the bottom of the stairs in this home built for a retiring couple in Woodend, Victoria, serve two purposes. For now, they allow the upstairs to be closed off thermally and acoustically. The design also accommodates the residents' possible future changing needs: if reduced mobility required it, they could move into the downstairs bedroom and a second (currently unused) door to the entry lobby combined with closing the sliding doors could provide private access to the second storey accommodation for a tenant or carer. Read more about the design process for this house in Design Workshop, *Sanctuary* 34.

For this narrow townhouse, Melbourne architect Shae Parker McCashen designed an open stair to maximise natural light and ventilation. Timber treads match the flooring, and the almost invisible glass balustrade enhances the open feel of the stair and allows for views to the courtyard. The stairwell also acts as a 'thermal chimney' in summer allowing warm air to travel up to the second floor and exit via high level openable windows. Image: Emma Cross.

The tiny two-storey prefabricated Warrander Studio was an exercise in stripped back efficiencies (spatially, functionally and structurally), and the task of integrating storage to allow the spaces to function effectively was fundamental. The under-stair space was utilised for as much storage as possible, including a coat cupboard, two pull-out pantries for food storage, and integrated drawers in the stair risers for smaller items. The double height polycarbonate light shaft in the stairwell brings in soft translucent natural light, adding to the space's sense of generosity. See our profile on p59 for more detail on the Warrander Studio. Design and image: Makers of Architecture.

providing a half-width tread on each step. Note though that these styles are generally only permissible for "non-habitable" rooms such as lofts and storerooms not used on a daily basis.

REGULATIONS

Whatever style of stair you choose, you'll need to ensure it complies with the National Construction Code (NCC), which regulates stair construction and design. It sets out the requirements for balustrades, handrails, the height and depth ratios of stair treads, and anti-slip surfaces; these are designed to ensure stairs are safe and comfortable to use. For example, the gaps under open-tread stairs must not allow a 125mm sphere to pass through, a safety requirement to stop small children slipping through.

This staircase works hard. It's unconventionally located in the centre of the living/dining/kitchen area to enable best use of space upstairs on this narrow site. At ground level, the space underneath is utilised for a dining table, but there's still plenty of built-in storage: "By turning the traditional infill strategy to a stair upside down, we fit in substantial storage above the raking stair ceiling, accessed from the first floor," explains designer Greg McNeil of Bios Design Build Sustain. The stair also acts as a thermal chimney, but importantly a door at the top can be closed to avoid this heat transfer to the upper floor when it's unwanted. The open treads maintain sight lines through the interior. Image: Meagan Harding

MATERIALS

Commonly used materials for stairs include timber, metal, concrete and glass. Your choice will depend on the design for your stairs, your aesthetic preferences and your budget. Remember to take into account the embodied energy of the material, and consider using recycled material if you can.

For renovations, architect Terry Bail of Archology often crafts stairs and balustrades using timber reclaimed from the demolished part of the house. Steffen is a fan of glass, because "it is unexpected, it gives you a sense of floating, it allows light into the space underneath, and it pushes the capability of the material."

Another option is to source and reuse an entire set of stairs, though this is best done early in the design process to ensure they fit seamlessly.

A space-saving spiral staircase was chosen for access to the roof terrace above this backyard studio in Richmond, Melbourne, and placed externally to preserve the privacy of the studio. The stair is galvanised steel to withstand the elements and pool chemicals. "The double helix of the stair also works sculpturally against the brick wall – particularly the shadows in the late afternoon," says the architect, Mark Austin. Design: Austin Maynard Architects; image: Tess Kelly.

Sydney architect Terry Bail knows how to create a 'wow' factor with his designs. This incredible stairwell with slippery dip in his 'Gibbes Street' project was built by Create Constructions in conjunction with the immensely talented joiner Oscar Priekaerts. Image: Jon Bader

MULTI-PURPOSE DESIGN

Beyond the basics, don't miss the chance to make your stairs do double or triple duty. The under-stair space can be fitted out with storage, a resting place, a desk, or even an indoor garden. Stairwells can also work as lightwells, and as an integral part of the passive thermal design of the house: like many designers, Steffen uses them as thermal chimneys, explaining that "in winter they bring warm air upstairs and reduce the need for heating, in summer they can draw hot air from downstairs to outside and keep the house cool." Where possible, it can also be a good idea to have a door at the top or bottom of the stairs to allow thermal and acoustic zoning of the house when required.

"A stair can double as a bookshelf, have a tread become a benchtop, allow views and a sense of connection to other spaces, or provide beautiful detailing in line with other joinery in the design," says Shae. Terry agrees: "I like to use them for light and ventilation when you have sites that do not offer great opportunities for those."

Give some thought to future-proofing the design, too, if possible. While acknowledging the difficulty of accommodating accessibility in multi-level homes, Shae says that providing wide, non-slip, straight-run stairs should allow for the future installation of chair lifts; another option is to plan in space for an elevator if it's ever needed.

TOP TIPS FROM THE EXPERTS:

"Don't miss a design opportunity to do something different. Think of your stairs as a chance to create a visually stunning feature in a room, the focal point to plan the house around. Choose the material and design depending on whether you need light access, ventilation, and so on."
– Terry Bail, Archology

"See a stair as a multi-purpose object and incorporate other uses – think of thermal performance, storage, a play or resting spot underneath, incorporate a slide if you dare. And make comfort a priority – if you can, make them wider and shallower so they are comfortable to walk on."
– Steffen Welsch

"Consider stairs as an opportunity for an exciting and beautiful design element - they can be so much more than a utility or forgotten design opportunity!"
– Shae Parker McCashen, Green Sheep Collective

Part of a renovation to a single-fronted terrace house with a party wall on the north side, this staircase was deliberately located on the north boundary as a way of getting north light down into the living areas below. "Council wouldn't let us put a north-facing window on the boundary, so instead we glazed the roof to the stair and put an external automated blind over it to protect from excess sun," explains designer Ande Bunbury. As the stair runs alongside the kitchen, she decided to make the space underneath work hard as a "wall of storage" including fridge and pantry. The stair is constructed of recycled messmate with a Livos oil finish.
Image: Ben Hosking

The rise of the courtyard

WORDS

Marie Carrel

As courtyards replace backyards as the primary outdoor space, architect Marie Carrel explains how they are best designed to maintain liveability.

COURTYARDS HAVE BECOME something of a buzzword in our suburbs as they constitute the secluded private open space that developers are generally required to provide when building units. They are essentially a reduced version of the backyard, but while they do not allow for cricket-playing, they are still the place to have a barbecue and let the kids grow some strawberries. These are welcome lifestyle ingredients in modern Australia where people like to eat outside and often love gardening, but have no time to maintain extensive gardens.

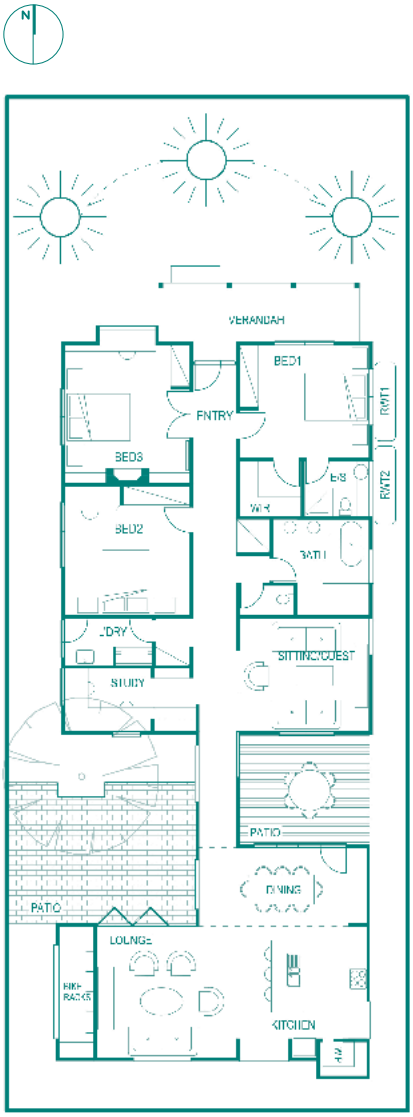
Nonetheless, many multi-unit developments have been designed with courtyards that are too small for lifestyle purposes and appear to be mere leftover ground between the house and the fence. They are token gestures designed to satisfy an accommodating municipality rather than provide thoughtfully-planned outdoor living space.

'COURTYARD HOUSES' VERSUS 'HOUSES WITH COURTYARDS'

There is an important distinction between a 'courtyard house' [see box] and a courtyard more broadly, that small outdoor space tucked in next to or behind a house, or provided as part of a multi-unit development.

Courtyard homes have been used throughout history in many cultures and represent a significant archetypal building form which is still useful today. In modern Australia, you might see a house built around the perimeter of an open space as a secure and protective structure affording privacy from neighbours. However, they are not an immediate choice for the average sized Australian block.

While there would be plenty of room for courtyard homes on acreage (where privacy is not an issue), suburban properties are rarely wide enough to accommodate building wings along each side boundary as well as a decent sized courtyard in the middle. Additionally, courtyard houses spread out the built form and create smaller outdoor spaces, as opposed to a more compact home that leaves a bigger backyard ready for playing cricket. As a result, they are better suited to adult entertainment than to children's recreation. An L-shaped home with a solid brick wall on the unbuilt boundary might be an option to solve these



The image (far left) and site plan for this renovation illustrate one of Marie Carrel's favourite uses of courtyards. The house was undersized for a family of five and with a south-facing living area; the owners engaged Planet Architecture to provide more generous living space and bring the sun in. Marie added an extension 'pod' to the south, separated from the original house by two courtyards that allow northern sun access to the new living space. They also offer shaded and sunny outdoor space at different times of the day. Image: Ben Wrigley

issues, providing a happy hybrid space between courtyard and backyard.

WHEN COURTYARDS WORK BEST

I use courtyards liberally in my practice, but almost solely in that particular situation where a property presents a south-facing backyard. We locate the sleeping zone at the front of the property and connect it to a living area pod at the rear with a courtyard or two in between. This allows both the front and the rear rooms to secure passive solar access while offering privacy to the living areas. It's an effective design strategy which leaves either no backyard behind the rear pod or a small one, depending on property size and owners' wishes.

Houses that face other directions may also benefit from courtyard spaces. For example, where a long external wall faces either east or west, it can be indented with a courtyard to provide north-facing windows to some adjacent rooms. The land pocket hence created can also be pleasantly landscaped to provide a small garden view or a petite deck. This is in fact a charming way to introduce additional private open space and different aspects from the house.

GETTING THE SIZE RIGHT

We find in our practice that minimum dimensions of 5m x 8m and adequate landscaping go a long way towards providing a pleasant courtyard space. A 5m width allows for proper setback of the facade from the fence, which when the

A courtyard created inside the perimeter walls of the existing house was a radical and successful solution to the challenge of renovating this stone villa in Adelaide to provide more space, better orientation and a higher level of comfort. The new house is set along the southern boundary, allowing plenty of north sun access across the courtyard into the living area. We profiled this house in *Sanctuary* 14. Design: Energy Architecture, image: Andy Rasheed/ eyefood.

A series of courtyards is central to the design of this house on a small inner-city site, creating "five distinct pavilions allowing occupants to be together yet apart", explains architect Steffen Welsch. "They provide visual connection between rooms, but also acoustic separation." The courtyards bring sunlight into rooms that would otherwise have had only south facing windows, and are designed for good cross ventilation. Design: Steffen Welsch Architects, image: Shannon McGrath

courtyard is on the north ensures adequate passive solar access is retained even when the house next door goes up another floor. This dimension effectively allows for a 3.5-metre-wide patio or deck suitable for dining and a 1.5-metre-wide garden bed along the fence, which is adequate for planting small deciduous trees and providing a green view from inside. The 8 metre length accounts for a 4-metre-long deck or patio (this will end up a 3.5m x 4m area) and another 4-metre-long patch that can be turfed or dedicated to growing vegetables.

PITFALLS FOR SUSTAINABLE DESIGN

Courtyard houses can also be problematic for a low energy home as you may end up with more rooms than you wish for that face east, south or the dreaded west. As well as being space-hungry, they also require more external walls, resulting in higher building costs and greater energy loss than rooms huddling together in a compact house. So, while courtyard houses might be attractive as they offer seclusion and a generally well-considered outdoor space, they do not suit all properties and are generally not designed with environmental sustainability highest on the agenda.

COURTYARDS AND THE FUTURE OF BACKYARDS

The beloved Australian backyard is under siege and two powerful forces are turning it into a fast-disappearing act in most residential streets. The first is commercial reality as developers know that building two or three homes onto a single house block is a profitable enterprise in a hot real estate market.

The second is that there is now substantial demand for smaller quarters. In part, it comes from residents culturally used to living closer to each other and who may even prefer it that way. But there is no denying that a younger generation of Australians, the ones raised in the iconic Australian backyard, are now relinquishing it too. Indeed, what to do when that green patch you can afford for your children is an hour and a half away from the city centre you still want quick access to? This can raise questions in some people's minds about the next generation of children being raised in a courtyard, or worse, on a balcony!

I have no such fears personally, my brother and I having been raised in an eighth-floor apartment in central Lyon, France. But while the garden-loving Australian culture may object to most kids being raised in these conditions, it is certainly evolving to accept smaller outdoor spaces and appreciate low-maintenance requirements. This is not to say that a courtyard of any design or size can successfully replace a backyard. I note with concern that many authorities and developers have been quick to adopt minimum requirements that are falling well short of providing an adequate and pleasant outdoor space.

Where the unit courtyard is designed as a meaningful space rather than an

afterthought, it will be well used and cared for. Such a setting encourages occupiers to look at units and townhouses as a sustainable place to live rather than as temporary or compromised accommodation – and they get to enjoy the pleasures of an outdoor space while staying close to the city centre. There is no doubt that where town planning authorities defend adequate courtyard dimensions, the dwindling of the backyard can contribute to the sustainability of our ever-densifying cities. This while helping to moderate our fear of raising kids in a concrete jungle.

Marie Carrel of Planet Architecture integrates ESD (environmentally sustainable design) with high functionality and stylish aesthetics. Her vision is to deliver sustainable design and information services widely to accelerate the rate of change towards sustainability.

This 25m² extension in Footscray, Victoria, made full use of an undersized backyard. A third bedroom and new wet-areas were arranged around two courtyards, providing multiple sources of light and ventilation for each of the new rooms as well as the existing house. Large cedar windows were used to ensure that the courtyards and the adjoining rooms felt unified, widening the apparent size of both and reducing the scale of the courtyards' surrounding walls. Corrugated steel was selected as a cladding material for its plainness – metal sheets were simply mounted either horizontally or vertically to provide the courtyards with a nestled sense of being embraced by the backyard sheds and lean-tos that are a common sight in Melbourne's understated inner west. Design: Jonathan Wong Architects, image: Kevin Hui

Built on an exposed coastal site on French Island, Victoria, this house by Lai Cheong Brown is a contemporary version of a traditional courtyard house. Instead of verandahs, an open-air deck at the heart of the home provides a protected outdoor space and lets natural light into all of the living spaces. See the full profile in *Sanctuary* 37. Image: Jaime Diaz-Berrio

COURTYARD HOUSES

The courtyard house is an archetypal building form that is still useful today. As well as offering privacy and protection, courtyard homes have also been used to provide shelter from fierce winds in extreme climates as well as natural ventilation in hot or tropical areas.

The original courtyard houses date back to 6000BC and are thought to have developed from the need to let smoke escape through a hole in the roof of houses with a central fireplace. Over time, the roof opening got bigger and the courtyard house was born. Such dwelling types are common in India, Mexico, China and the Middle East. In China, several houses would be built for extended family members around a central compound to provide independent living as well as ready help and company. The Roman courtyard house is constructed around the central impluvium, a basin designed to collect water from the house roof.

Open source home automation

Home automation need not tie you to one brand or another. Designer Paul Hendy explains how he used the open standard KNX software to augment his passive solar home for ultimate comfort.

THERE IS NOTHING NEW ABOUT BUILDING AUTOMATION; it's been around ever since the room thermostat was first invented 130 years ago. There is nothing new about sustainable homes either; they too have been around for over 50 years. However automation in sustainable homes is a relatively new phenomenon and has the potential to move low energy consuming sustainable homes into the mainstream.

Sustainable building embraces passive design principles, natural ventilation being one of the keystones of a passive building design. In climate zones similar to South Australia, where early morning temperatures during the summer often fall below 20 degrees Celsius and the coldest time is typically 7am, you need to drag yourself out of bed around 4am to open your windows and allow cool air to naturally ventilate your home. However times are changing and technology is enabling a whole new audience to look seriously at sustainable, liveable homes.

Today's homeowner generally isn't looking to interact with their home; they're accustomed to homes with ducted air conditioning as the primary way to heat and cool, and do not necessarily possess the knowledge of passive design and natural ventilation principles that the target audience of sustainable design were aware of 20 years ago. Today's homeowner is familiar with the 'press the button' approach, especially as manufacturers embrace the internet of things (IoT) and the ability to control lighting, heating and home security remotely via a mobile phone through companies like Google, Amazon and Apple becomes increasingly familiar.

But what happens when you want the ability for all the 'things' to talk to each other, when each manufacturer has developed their own ecosystem or proprietary control system? Enter the alternative: non-proprietary or open source control systems, like KNX. This is the core control system that the Corten House uses.

This home was constructed in 1904 and is a heritage-listed

A full profile of Paul Hendy's KNX-automated sustainable house is available in issue 41 and *Sanctuary* online. His use of smart tech in conjunction with classic passive solar design shows the possibilities for marrying old and new, and for enabling passive systems to better suit a range of lifestyles – especially where someone may not be home to manually ventilate a hot house when the cool change comes! Image: Shane Harris

cottage located in an inner Adelaide suburb, typical of so many in Australia's cities. The home's orientation is far from ideal, with living areas facing south and poor natural ventilation because of the proximity of other homes that disrupt natural airflow. The decision was made in 2015 to build an addition at the rear. It was carefully designed to create enough high-level north-facing windows for winter solar gain to heat the home through the winter. This scenario is where home automation can come into its own – the new high-level windows were fully automated. Depending on the data from the sensors on the ceiling they can open and close to ventilate in summer and winter. Once the sensors feel the drop in temperature outside, they will open the windows for you, even at 4am. The system can also purge the home of hot air by sucking it out via ducts throughout the home. This 'forced ventilation' makes it possible to have natural air flow even in a built-up city environment.

This, however, is just the beginning. The house consists of two parts – the old traditional stone-walled cottage, cool all year round with small windows and a verandah completely shading the north-facing windows in winter, and the new addition, warm and light-filled. To boost the old part of the house and bring it to the required level of comfort, excess heat from the new extension is moved to the old house. This can even be reversed in the summer months using the 'coolth' inherently stored both in the cottage and in the new basement that houses the main bedroom and ensuite and is ventilated via earthtubes.

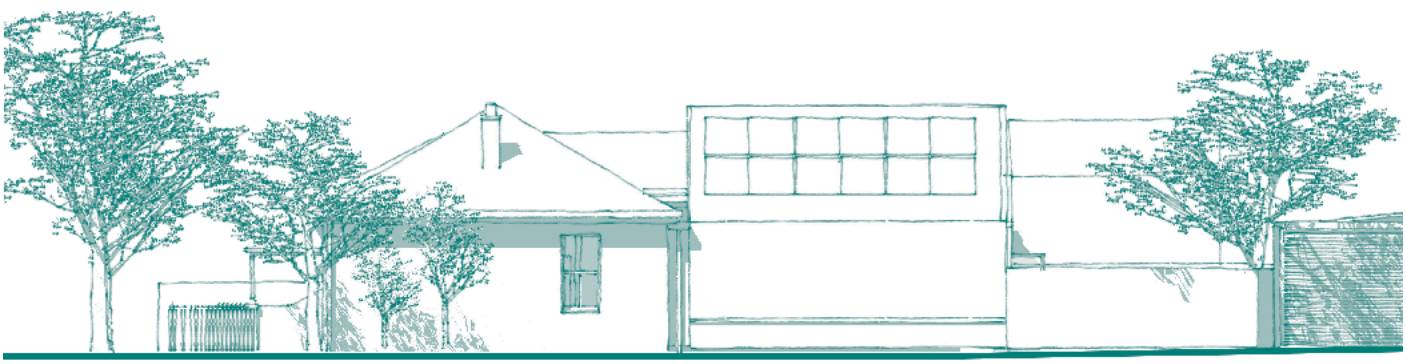
Working with various sensors both inside and outside the home, the KNX system controls various electronically operated flaps or dampers which work in conjunction with electric fans in the ductwork to move thermally moderated air around. Depending on the outside temperature the KNX system will either circulate warmth inside the home or it will ventilate to the outside. It's even smart enough to shut down the house when there is a heat wave and not ventilate at all if the outside temperature isn't cool enough. When this happens the KNX control system seamlessly communicates with the small multi-head reverse cycle air-conditioner to help maintain pre-set comfort levels inside the home. A carbon dioxide sensor is also incorporated to ensure healthy air quality in the basement – again the KNX system controls this.

While maintaining the comfort levels of the home, the KNX control system also communicates with the solar panel array and monitors energy generated, used and exported. It has been programmed to prioritise certain aspects of the home as well. For several hours during the day hot water takes priority for electricity use, unless the comfort levels within the home are not met.

There is of course, much more to it. The automated controls of the Corten House allow its owners to dim the lights, among other features, using one mobile phone app or (soon to be integrated) voice control. In total there are 12 different components in the Corten House that are linked together and controlled by the KNX system, ranging from hot water to smoke detectors. While the house would have remained a sustainable building without the home automation, it would have required considerably more input from its owners. Now it is as easy as pressing the button on your phone, or just sitting back and allowing the KNX control system to do its job. This is the real game-changer, the fact that home automation enhances sustainable design by removing the manual input that has been part of sustainable living for so many years; it's opening the doors (automatically) to the new and exciting future.

FOR MORE ON KNX:
knx.org and knx.org.au

The west elevation of Paul's Corten House shows the original cottage and passive solar addition (with basement under). By integrating the active and passive heating and cooling systems they can maintain the internal temperature consistently between 18 and 24 degrees.



Treat your site right

Too often gardens are trampled and destroyed during a building project but if you protect, rather than neglect, your soil and vegetation you'll reap the rewards in your new garden, writes landscape designer Michael Tanner.

I'VE BEEN STRUCK BY A CONCERNING trend in our ever-busy urban landscape: something I call bare earth gardening. This is where an existing house is razed, the site scraped of any skerrick of identity and then replaced with a new building, a new garden and a new life.

There is an unfortunate misconception that it's easier to create a new home and garden from an entirely bare and blank canvas. This is far from true. In fact, by taking this approach there's a real risk the site will never regain the qualities that are scraped away.

CONSIDER YOUR LANDSCAPE EARLY, AND AS PART OF THE HOUSE DESIGN

As a landscape designer, I've been involved in the making and remaking of gardens for lots of different clients. Along the way I've realised that every site I've worked was unique and full of its own inherent qualities, and that the best design outcomes are when I've been able to get involved in the process early, meeting the client or clients, their family, close friends and even near neighbours.

This process helps enormously with understanding who the garden is for and how it will be used. Further, where I've been able to meet with the architect, it has helped me better understand their take on the site and their understanding of the clients. Finally, when I've met the builders I've had the very best results. Why? Because we've worked together to achieve a larger design goal and preserve the best qualities of the site and what is already there: the soil, the trees, the microclimate and the myriad habitats that each of those elements support.

Generally, this interaction has happened well before I start the more formal steps of drawing or drafting – the part people might most associate with the design process. It's these early steps – the 'pre-design' ones – that are critical in making a garden because they connect the client, the designers, the builders and landscapers with each other and with the site.

WRITE A LANDSCAPE DESIGN BRIEF

For a successful and sustainable garden, it is important to create a 'what's in and what's out' kind of map. This is fundamentally the bones of your design brief which should be a clear and concise picture of what your garden needs to look like and how you want it to perform – now and into the future so it can accommodate your changing lifestyle. It's a statement of what you want from your garden; for example: 'a relaxing, sustainable garden with interconnected spaces for play, relaxation and edibles, inspired by Australian bushlands'.

UNDERTAKE A SITE ASSESSMENT

Use a site assessment checklist and local landscape design guidelines available through your council to work with your designers, or on your own, to gain a solid understanding of the existing condition and attributes of your site. Take into account the local climate now and what it might look like in the future (use climate tools for this – such as Climate Change in Australia).

Do this early, ideally before an existing house is demolished or changed, so you can fully understand how the site looks and feels with a building on it. Do it more than once if possible, in the hottest and coolest seasons. This way you know your garden will be resilient now and in the future.

It's a great idea to identify what plants and trees are important to you, the ones you really want to keep, and tag these so everyone knows they are part of the new garden. If trees or established shrubs need to be transplanted to a different position in the new garden, plan to do it in their dormant season or in cool conditions.

Likewise, identify the areas on your site with the best soil – protect this as much as possible. If substantial excavation or vehicle movement across the site is likely then it's worthwhile creating an area to stockpile excavated top soil – if that's not possible see if there's somewhere you can store it offsite, such as with a neighbour. Good soil from

The owner of this site has had the original house demolished but clearly marked trees and plants to be kept for inclusion in the new garden. The process has taken longer than expected, but the retention of the existing site soil has reduced erosion and biodiversity losses. Even the 'weeds' seen here help to preserve soil conditions by reducing evaporation.

The correct method to successfully retain existing trees on development sites involves protecting the critical root zone (area under the canopy) by fencing it off and covering with mulch.

your garden shouldn't be removed – it's just too valuable.

CONSIDER YOUR HOUSE DESIGN

You need to understand how your existing or new house will impact on the garden. How do existing trees affect the movement of light and wind through the site? What will any proposed building do to existing soils, including drainage?

This is where the early involvement of a landscape designer with your architect or building designer can really pay dividends. Carefully considering how existing trees might add value – aesthetically, ecologically and financially – to your new or renovated home might require the eyes of someone expert. All too often I've seen trees substantially reduced or removed on sites where they might've made great contributions to liveability.

PROTECT THE EXISTING SITE

The site owner and/or builder need to properly protect mature trees on development sites. To ensure this happens, it is important to establish rules and outcomes for the protection of your site's existing soil and vegetation. Make sure your designers, builders and contractors understand and commit to these protections. The earlier the garden design process is started the better the outcome should be.

Plan to protect

Retaining natural soils and biodiversity of your site will reduce erosion and form the basis of you new garden – even 'weeds' can help preserve soil conditions by reducing evaporation.

The more intimate you are with a site, over a longer period (seasons rather than weeks) the more you and your designer will be able to respond intelligently and sensitively to the site. This should mean saving the existing site soil, and minimising soil compaction and contamination.

Physical controls

If you allow heavy traffic across the root zone or the stockpiling of materials onsite, it will result in substantial soil compaction and potential root damage for trees and significant vegetation. Too often I've seen fencing around trees that is inadequate. The correct method for protecting existing trees on development sites is to fence or create 'no go' zones around the critical root zone (area under the canopy) and cover the area with mulch. Fences and signs should be in place to protect everything you want to keep. For mature trees and significant vegetation, there may also be local council permit conditions and/or relevant Australian Standards you need to consult.

Protect your soil

When it comes to soil, the rule of thumb should be: protect rather than replace. Once natural soils are removed or eroded away, soil profiles compacted or upturned, mature trees removed, roots damaged or local fauna displaced it can be both expensive and a long process to restore or replace. Good dirt is garden gold – keep it at all costs. Even if the soil's not perfect, you can work with it rather than dump it somewhere else, particularly given in that process of dumping it may become contaminated with building materials.

What not to do: Even though an attempt to protect this tree has been made it doesn't meet local council permit conditions or the relevant Australian Standard. This may result in long-term damage to the tree.

Maintain tree amenity

The large leafy green canopy of mature trees often extends over many properties and even though a tree might 'belong' to you because it's growing on your property that tree has a significant value in terms of amenity and ecology to your neighbours. So it's good sense to consider their perspectives. 'Shared' trees cool and shade many houses, they slow winds, clean dust and pollutants from the air, increase oxygen levels, and provide habitat for birds and insects that in turn contribute to the quality of many lives – through pollination, joy, pest control and so on. Established trees are the pillars of the local ecosystems of our neighbourhoods. If you doubt that, just visit a new development site – the treeless variety – to get a sense of how life without trees might feel. Saving trees saves habitat for existing fauna and flora, whether indigenous, native or exotic.

When a tree needs to be removed, consult with your landscape designer, a horticulturist or arborist. It's worth asking if the tree can be transplanted on site or moved to a new home.

SITE PROTECTION LAWS

The Australian Standard *AS 4790-2009 Protection of trees on development sites* provides detailed instructions on the process of identifying, protecting and controlling existing trees on building sites. This is the main standard that local councils use when instructing developers on protecting or removing and replacing existing trees. However, council rules and codes vary considerably so not every 'significant' tree will be identified as needing protection – it often comes down to whether a project even requires a building permit (garden makeovers often don't), a development permit or other more complex permission and permits.

This means it's really up to you and your designer to identify and protect significant trees, beyond your council's requirements. In short, don't just rely on your local council's rules. But do use *AS 4790-2009* to inform your builders on how you want significant trees protected on your site.

ONLINE RESOURCES:

Climate Change in Australia: www.climatechangeinaustralia.gov.au

Sustainable Sites Initiative: www.usgbc.org

Your Home: yourhome.gov.au

Significant Trees: nationaltrust.org.au

Australian Tree Protection Laws: treenet.org

Wildlife Friendly Gardens: wires.org.au

Design for Urban Wildlife: habitatsteppingstones.org.au

What not to do: This retained Silver Birch is undoubtedly intended to be a feature design element of this new build. Unfortunately, the lack of a tree protection zone with barrier fence and mulched area around the trunk means the tree is a very likely candidate for failure. Heavy traffic across the root zone and the stockpiling of materials around it, will result in substantial soil compaction and potential root damage.

IMPORTANT CONSIDERATIONS

Design brief – this should be a clear and concise statement of what your garden will be (for example: a relaxing, sustainable garden with interconnected spaces for play, relaxation and edibles, inspired by Australian bushlands).

Design fee proposal – a document from your designer/architect/contractor that clearly responds to the design brief, identifies and lists what will be delivered (in terms of design context and extent), a timeline for the project and the fees involved.

Design plans – every project is different in style and extent, as is every budget. Fundamentally, your plans will include draft and finished concepts, the planting plan, irrigation, lighting and hardscape details (such as elevations/perspectives and construction drawings).

Council permits – these might be basic or complex depending on your site, but will generally detail the council's expectations and requirements in regard to tree protection, existing vegetation, access, and building and development.

Designers in profile

—Sustainable architects, building designers and energy efficiency experts

In this new section, we introduce you to some of the sustainability experts in the *Sanctuary* ecosystem. This issue, we asked them what building material they most like working with, and why?

SID THOO
Architect
www.sidthoo.com; @sidthoo
Works in Western Australia

Sid has been a practising architect since 2007. "Practising is the operative word," he says. "I am constantly learning and looking for opportunities to improve the design of the built environment, while trying to have a positive impact on the planet, rather than just minimising harm."

He credits an architectural science lecturer at university with sparking his interest in sustainability, but it was an early, not very sustainable project – a $300,000 carport! – that gave Sid the impetus to embrace sustainable design. "The projects that excite me the most aren't necessarily the ones with the biggest budgets or the most innovative technologies. It's actually when I'm working for a passionate client, and we're working with a dedicated builder. The client and I need to share and develop together their vision for a more sustainable building, and if we aren't working with a builder that also shares the vision, the best sustainable design ideas won't be implemented to their full potential."

Sid says that he doesn't really have a favourite building material, but tries to work with whatever best suits his client's needs and budget, while achieving optimum performance. "All building materials use up finite resources and have an impact upon the environment. I see it as my professional responsibility to use those resources in as responsible a manner as possible, by creating beautiful buildings that perform and have a long, useful life."

MIRANDA CORKIN
Building designer, MKC Building Design
www.mkcbuildingdesign.com.au
Works in Blue Mountains, NSW

After a career in international sports marketing then designing and managing a wellness retreat, Miranda developed an interest in building design and sustainability as part of a healthy lifestyle. Seven years ago she began designing her own home, and has since gained her qualification as a building designer and started her own business.

"Having been an owner-builder, I love working with owners who really want to be involved and make informed choices about their home and their lifestyle," she says. "They don't have to be owner-builders themselves, just want an interesting, carefully thought out, personal home, rather than an 'off-the-shelf' house."

She considers sustainability to be a fundamental and integral part of the design process. "Good sustainability in design is current best practice; it's likely to improve the capital value of your home, make it less expensive to run and operate, and more comfortable to live in. What's not to like in that?!"

Miranda loves working with natural, tactile materials and soft shapes. "I grew up in a 400-year-old cottage in England which had wonky beams, wavy floorboards and very few right angles. Natural materials lend themselves to softer shapes than angular, hard blocks, so I love strawbales, cob and timber which can be hand-crafted. My home has fine polished renders, tactile curved walls, and smooth woodwork."

SHAE PARKER MCCASHEN
Architect, Green Sheep Collective
www.greensheepcollective.com.au
@greensheepcollective
Works mainly in Victoria but open to projects anywhere in Australia

Shae's decision to make a career in sustainable architecture was greatly influenced by two homes she grew up in near Bendigo, Victoria. Built by her parents, the houses were nestled into the bush and featured strong passive solar design principles. "I am so grateful for the way my parents showed me how beautiful our natural environment is, and taught me why it is to be respected and valued," she says.

These days Shae is Director of architecture firm Green Sheep Collective. "We prioritise and advocate for sustainable design because we believe in the preservation of our environment – for the benefit of the planet and all species on it, and as a way of caring for people and community." She especially enjoys projects working with clients similarly passionate about the environment, or where there is an opportunity to produce a building that gets people thinking about how sustainable design works.

Shae says that she likes to work with materials in a way that's 'honest' – expressing the true nature of the material. Sustainably grown and harvested timber is a particular favourite. "I love the varied textures and colours within it, how the appearance can change over time, and the wide variety of applications – from joinery to cladding, structure, landscaping and so on. How diverse and wonderful!"

Ask our experts

Your design, product and specification questions answered by our expert columnists.

Emma Scragg is an architect, adventurer, writer and photographer based in Brisbane, and a regular *Sanctuary* contributor.
Dick Clarke is principal of Envirotecture, a sustainable building design firm in Sydney.
Tim Adams is principal of F2 Design, a sustainable building design firm based in Melbourne and Victoria's Surf Coast.

Q – I live in a low-set brick veneer house in Brisbane with a terracotta tile roof. I'd love to get the walls insulated but not sure what the best approach is for southern Queensland. I am hoping I don't need to remove all of the plasterboard to fit batts! Thanks. – *Euan, Qld*

A – Removing plasterboard does seem the most obvious approach, but also the most destructive option. I'd first look at ways to shade the brickwork on the outside: light coloured limewash (if dark brick) or vegetation that offers shade, but doesn't compromise the footings of the masonry. If you have sufficient boundary clearances, another option may be to extend the roof overhangs. This is a bit fiddly, but much less intrusive and labour intensive than peeling off internal linings and repairing/replacing trims. In *ReNew* 99, there was an article suggesting that cutting a band of plasterboard across the middle of the external walls can be a good option in order to feed insulation up and down between the studs, although this approach could make it difficult to achieve a tight fit. If bricks are not an aesthetic appeal, you could investigate adding battens to the outside of the brickwork plus an insulated, lightweight skin. Ortech straw wall panelling could be good option together with a fibre cement or metal cladding. It has a generous span between supports and has some level of insulation. – *Emma Scragg*

Q – We're building an extension in Melbourne with a polished concrete slab and a lot of north-facing glazing that will be shaded in summer. Our architect specified a SHGC (solar heat gain coefficient) of 0.56 for the single glazing we were intending to get; we have since decided to get double glazing. I checked with the window company regarding what the ratings are on the windows ordered by our builder and they said U-value 2.1 and SHGC 0.32. Based on my reading, the SHGC value seems very low and I'm concerned that the winter warmth from the sun – which is what this room is all about! – will be lost, or at least not maximised. Will the glazing on order give us the winter heat gain we want? If not, what values should we be seeking and what's feasible for double-glazed units? Neither our builder nor our architect has expertise in this area and the window company was not very forthcoming. – *Mae, Melbourne*

A – Yes I share your concerns, and as I wrote in a windows article in *Sanctuary* 40, getting the specifications wrong for your glazing can undermine your passive solar design. A better specification in your situation would be U-value 1.37 with SHGC 0.58. Viridian Lightbridge with these specs is being promoted heavily and the pricing should reflect that – although there are some other glass specs that exceed this performance but will likely come at a higher cost. – *Dick Clarke*

Q – We are building a new house on a farm in western Victoria. We have worked with a sustainable architect for our plans and are now trying to work with a volume builder, using a standard timber frame. He's able to fit an R2.5 insulation batt at most in the walls, but we're wondering if there are other insulation options that we can use to make the wall better? For example, is there any benefit in using Timbercrete in place of bricks for the standard brick veneer or any other material? Also, is it true that if you connect solar PV to the grid you are only allowed 5kW of panels? – *Michelle, Warrnambool*

A – Timbercrete is a good material to use to improve the performance of the walls. It is more expensive as I am sure you know, but it may be worth it depending on what your budget/aims are. There is a Bradford R2.7 product available that fits standard wall frames, although R2.5 in your climate could be adequate. You could potentially up the results further by using something like Kingspan Insul-break wrap which will provide better summer performance as it is reflective, and add another R0.14 or so. FirstRate NatHERS software is a powerful aid to making detailed wall system selections. The 'wall builder' facility now allows for precise measurement of the thermal performance of all possible wall assembly combinations so that decisions can be based on hard numbers as opposed to general principles.

On solar, there are many regional areas where export limits are enforced. The ATA advises you to speak directly to your distribution company, as it is very address-specific. Sometimes individual houses are permitted to have a slightly larger PV system depending on where they sit on the grid. The cap relates to 'exports' not 'size' per se – so you can actually have a larger system if your inverter can be programmed to only export up to the limit. And there are ways for inverters to divert power to your hot water service to use the energy you generate. It may be worth making an appointment to speak with an ATA energy analyst if you want to discuss specific opportunities, but that's it in a nutshell. – *Tim Adams*

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