John and Kate sought to retain the industrial character of the warehouse, which has had several past factory-based lives, while making it a comfortable and energy-efficient 'machine for living in'. For Architect Antony Di Mase, one of the real achievements of the project is that though it followed the Passive House approach, "it's not engineer-driven, which many Passive Houses can be – it's architecturally pleasing."

Passive warehouse

An inner Melbourne warehouse is reimagined as a contemporary, comfortable 'machine for living' through the application of Passive House principles.

WORDS Verity Campbell
PHOTOGRAPHY Trevor Mein

LE CORBUSIER'S FAMOUS ASSERTION, "A house is a machine for living in", was a guiding principle for John and Kate in the refurbishment of their two-storey warehouse conversion in West Melbourne. More industrial relic than well-oiled machine, the warehouse needed a functional and sustainable makeover to suit the couple and their two children. They wanted to rearrange the layout to make it work better, while retaining the basic form upstairs with the great views of the city, access to daylight and outdoor living. "We also wanted to improve sustainability through the Passive House principles that we had heard about and were keen to introduce," says John.

Di Mase Architects was enlisted to "fix" the home. The existing structure was a "rabbit warren", with entry via the main bedroom. So the team at Di Mase (Antony Di Mase, Jim Stewart and Catherine Matthews) set to work on a floor plan that would resolve the issue. Their solution was to make the two-storey void and passageway the dramatic focal point of the home, with the main entrance and primary circulation space seamlessly connecting both floors.

While principal architect Antony Di Mase had had plenty of experience restructuring floor plans, Passive House *(Passivhaus)* – a building concept developed in Germany and used widely in Europe

The light-filled void serves as the dramatic focal point for the reimagined space. It also allows good solar gain to the thermally massive downstairs entry, with concrete floors and reclaimed brick wall, highlighting the warehouse's original, and new, stylish character.

The ground floor entrance leads to an office and space-efficient library, separated by striking internal steel-framed glazing, which allows borrowed light to infuse the space. The existing concrete floor was retained and restored. Large amounts of insulation and sealing have helped keep the home cool throughout summer, reaching only 24 degrees celsius downstairs and 27 upstairs, even as it tipped 42 outside during a recent heatwave.

and Japan – was something he hadn't worked with before. But it was a challenge he welcomed. "As an architect," explains Antony, "I was interested in it because the design and actual use of the building can be certified. It's not 'fluff' – results are measurable." In collaboration with the clients, builders, tradespeople and suppliers, the architect set out to conquer that "sharp learning curve".

"One of the hardest parts about Passive House," says Antony, "is that it doesn't tell you how to do it; it outlines the principles and it's up to each architect to apply those principles."

One of the key principles is air-tightness, to create a building where every kilowatt-hour of energy is retained for as long as possible. Applied to this warehouse, this meant an airtight layer on the inside, whole-building wrap-around barrier with bulk insulation and a weather-protection layer. Areas that receive solar gain were protected with an additional layer of reflective foil. It also required close attention to thermal bridges and sealing those pesky air leaks around doors, windows and even power points.

The house features high-quality, triple-glazed European-style windows and a heat-recovery unit that maintains a continuous, controlled supply of fresh air. In designing this, the team at DiMase Architects received advice from Peter Steudle of Passive House.

Passivhaus is more popular in Europe, where an estimated 25,000 certified houses have been built, but in Australia, sustainably minded architects tend to employ passive solar design principles. But is that just because passive solar is better understood here, and which approach – Passive House or passive solar design – is more appropriate to Australian conditions?

Antony recommends homeowners and architects look to the project to decide which approach should be applied. Inner-city sites with limited solar aspect may suit Passive House, while new homes on ample land might suit passive solar design, he suggests, but "the two systems aren't mutually exclusive". The warehouse is designed for air-tightness, but it can still be opened up on a gorgeous spring day, be shaded from summer heat and benefit from winter solar gain.

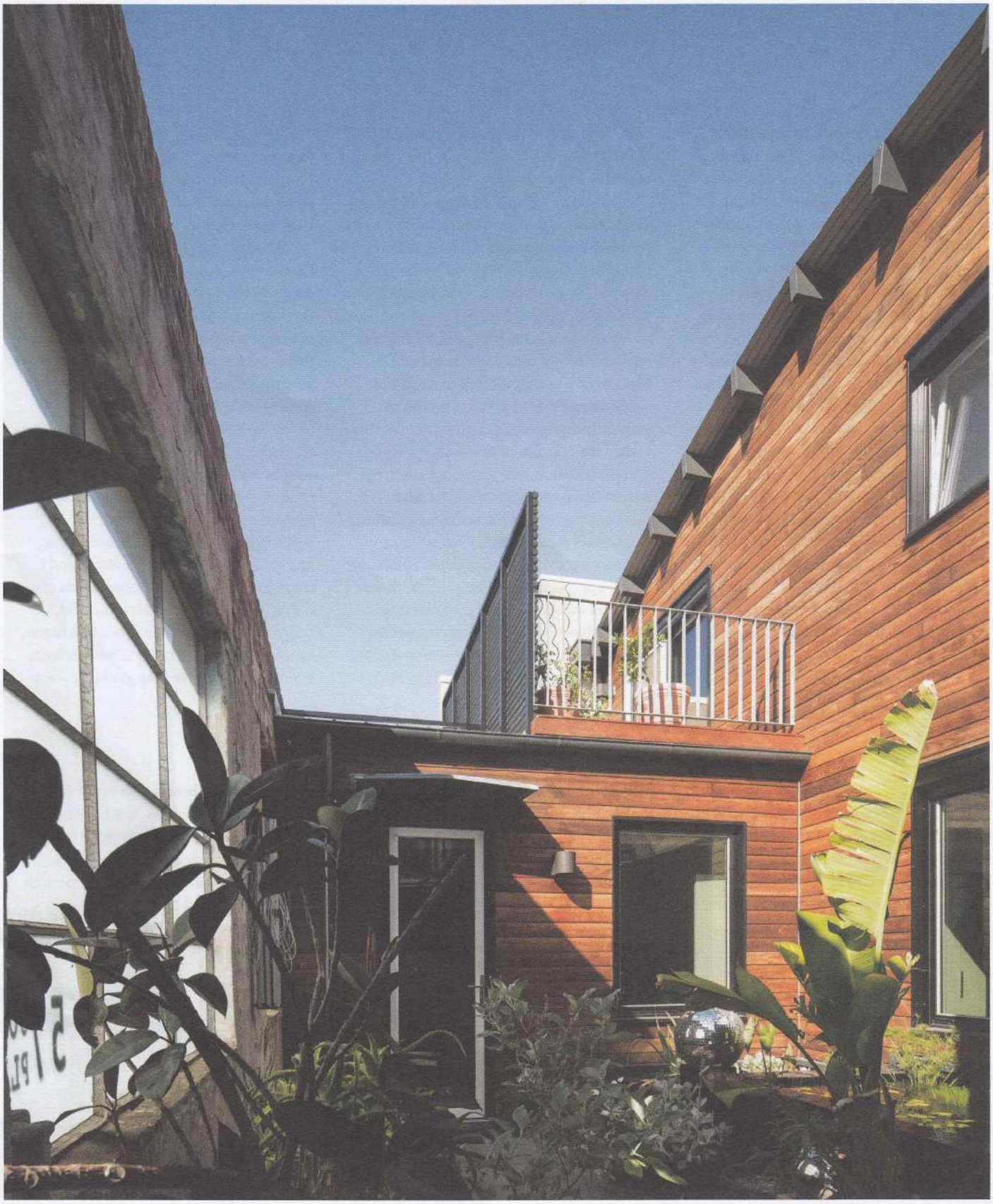
If you do decide to go down the Passive House route, Antony recommends getting started early so the principles can "filter through the project". "This is not the sort of thing you should decide to do midway through," he cautions. He also suggests enlisting the support of a specialist consultant to help guide the project.

While successfully applying Passive House principles to this 7 Star rated warehouse conversion has been rewarding, to Antony the home's environmental performance is just one part of its sustainability story. "It's a refurbishment and reuse of an existing building, and I think the environmental credentials of doing that are often underestimated."

"Another thing I like about this house," he adds, "is that it's not engineer-driven, which many passive houses can be – it's

The original curved ceilings and carefully restored windows, along with an eclectic collection of antiques and lighting, give the warehouse a warm character despite its modern refurbishment. Di Mase Architects worked to restore the building's original joinery, including the steel kitchen benchtop and cupboards.

While the focus for the dramatic refurbishment was on air tightness and sealing in line with Passive House principles, the house can also be opened up to breezes and shaded from summer sun. The upstairs open plan kitchen and dining also benefits from northern light and solar gain through the double-glazed doors to the small deck and glazed roof of the void.



Behind the original brick facade of the warehouse visible from the laneway, is an enclosed garden featuring the large original pond, which was restored. Above this is one of three small decks that make use of reclaimed ironbark timber. "Our whole approach was to preserve what was good about the building and to reuse as much as possible," says Antony.

architecturally pleasing. The environmental features aren't tapping you on the shoulder, they're just there in the infrastructure for the long term."

This delicate balance between good design and energy efficiency is also applied to the approach to certification. "The house wouldn't necessarily achieve a full Passive House rating, partly because it's a renovation and retrofit," says John. The family's motivation was to apply the principles in their 'experimental' home while refashioning it as a tailored 'machine for living', rather than seeking formal validation, so it hasn't been submitted for certification. Achieving a 7 Star energy efficiency outcome was simply a welcome bonus, he says.

"We're still learning how the house works," John says. "It's called Passive House, but it requires active residents in order to get the best out of it," he laughs.

Australia is relatively new to Passive House building (there are still only around 6 certified houses built to the standard in the country) but the idea seems to be gaining something of a resurgence, partly through the formation of the Australian Passive House Association. However, there is debate as to whether our climate is suited to these well-sealed, highly insulated homes. Co-director of Pidcock Architecture, Fergal White, told *ReNew* editor Robyn Deed that it's an appropriate approach in all climate zones, the real advantage being the emphasis on ultra-low energy use in the home. In response to concerns about adequate ventilation and passive cooling, he suggests internal spaces are able to be opened up to the outside as required. The three underlying principles of a Passive House are insulation, air-tightness and a thermal breach-free envelope. A certified Passive House building uses no more than 46kWh/m² of operational energy per year, while maintaining a temperature of 20 degrees in each room. A key element of this approach is mechanical ventilation with heat (energy) recovery, providing fresh air all year round, for a healthy indoor environment while reducing energy use.

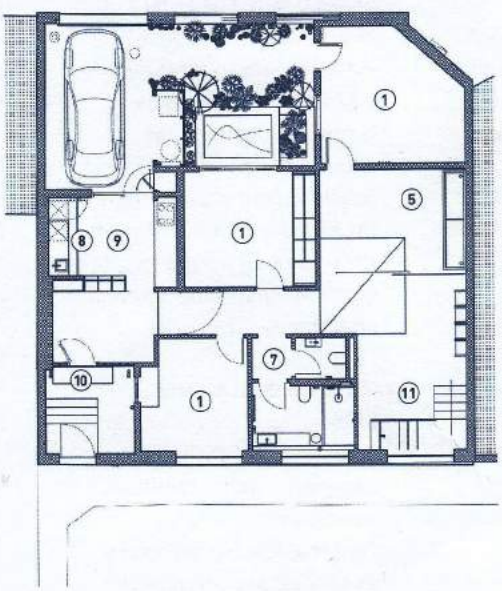
A note on terms: Passivhaus is the original German spelling of the building and design concept. Passive House is generally used in English speaking countries for comprehension, though it refers to the same methodology of certification, based on different climate zones.

See *ReNew* 133 for an article by Fergal White on a certified Australian Passive House, and p48 in this issue for a New Zealand example.

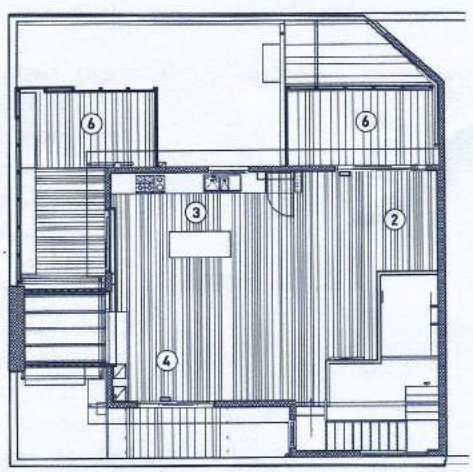
LEGEND

① Bedrooms
② Dining
③ Kitchen
④ Living room
⑤ Study
⑥ Deck
⑦ Bathroom
⑧ Laundry
⑨ Store
⑩ Entry
⑪ Lobby

GROUND FLOOR PLAN



FIRST FLOOR PLAN



Gezellig House

—Specifications

Credits

DESIGN
Di Mase Architects

BUILDER
PM&R Constructions

PROJECT TYPE
Renovation

PROJECT LOCATION
West Melbourne

COST
$450,000 to $500,000 (incl. professional fees)

SIZE
Land 190 sqm, house 230 sqm over 2 levels, excl. decks

BUILDING STAR RATING
7 Stars

Sustainable Features

HOT WATER
- Reuse of existing gas boosted solar hot water system installed by Going Solar.

RENEWABLE ENERGY
- 4.5kW solar system, 16 panels, installed by Going Solar.

WATER SAVING
- Flambe kitchen mixer by Armando Vicario, 5-star WELS
- Arq bathroom basin Mixer by Roger Seller, 6-star WELS
- Laufen Pro A wall-hung toilet pan, 4-star WELS
- Oxygene sink mixer to laundry, 5-star WELS.

PASSIVE DESIGN
- Attention was mostly on sealing through Passive House principles, with the building's original siting, structure and location limiting passive solar opportunities, but the living space does benefit from passive solar gain through the north-west facing double-glazed doors
- The entry skylight is shaded by an external blind, and all external windows and doors have external blinds integrated into the joinery
- Operable windows with the restored decks allow good cross ventilation.

ACTIVE HEATING & COOLING
- Stiebel Eltron Heat Recovery System, supplied and installed by Passive House Pty Ltd
- Nobo electric wall-mounted heating panels.

BUILDING MATERIALS
- Silvertop ash timber screen boards by Radial Timber
- Curved custom orb roof sheeting by Blue Scope Steel, with U-Form Profilit Glass Wall System, installed by Jeniton
- Woodform Expression Cladding in burnt ash to exterior
- Reused existing bricks to boundary wall, cleaned on site
- Existing concrete floors repolished and reused alongside new concrete floor
- Existing Victorian ash floorboards sanded and finished
- Reclaimed ironbark timber decking
- Wall tiles by Artedomus in Richmond
- Internal joinery by Design Excellence
- Insulation: Gutex Thermoroom Woodfibre Insulation board to existing masonry walls; Bradford Gold High Performance Batts; Kingspan Kooltherm insulated plasterboard; Foamular Polyboard Enviro 300 & FM250 extruded polystyrene; double-sided reflective expanded insulation by WaveCore Max Silver Batts; Pro Clima Intello vapour check airtight membrane; Pro Clima Solitex Extasana wall wrap; Pro Clima Solitex Mento 300 roof underlay.

WINDOWS & GLAZING
- Triple-glazed timber windows, doors and roof glazing by European Timber Windows and Doors
- Steel window restoration by Steel Windows Services
- Internal glazed screen by Skyrange Windows.

LIGHTING
- Lighting Design by Relume Consulting
- LED lighting installed throughout
- Fittings supplied by Flos, Tobias Grau, Jielde, Oluce and Major Graphic Signs.

PAINTS, FINISHES & FLOOR COVERINGS
- Low-VOC paints including Enviro Low Sheen, Aquanamel paint systems by Dulux
- Existing masonry walls clad with Gutex wood fibreboard, finished with Murobond Mineral Silicate paint
- Cyndan Heat Shield solar-reflective paint to existing steel-framed windows
- Internal timber floors finished with Ardvos oil from Livos
- Clear oil-based finish to timber deck and external cladding
- Tretford Goat's Hair Carpet in 'Night Sky'.

OTHER ESD FEATURES
- Energy-efficient kitchen appliances by Gaggenau, incl. recirculating rangehood and induction cooktop
- Adaptive reuse of original building to great expense, to avoid waste and retain original features and character
- Pro Clima weather-tightness and air-tightness/moisture control membranes supplied by Passive House Pty Ltd.
- Blower Door testing by Passive House.