Passivhaus Project Documentation Superpod® Passivhaus, Bass Coast, Victoria, Australia

Abstract / Zusammenfassung

Superpod® House on Bass Coast, Victoria, Australia

Data of building / Gebäudedaten

Year of construction/ Baujahr	2015	**Space heating / Heizwärmebedarf**	**21 kWh/(m^2a)**
U-value external wall/ U-Wert Außenwand	0.251 W/(m^2K)		
U-value basement ceiling/ U-Wert Kellerdecke	0.192 W/(m^2K)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	kWh/(m^2a)
U-value roof/ U-Wert Dach	0.137 W/(m^2K)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	kWh/(m^2a)
U-value window/ U-Wert Fenster	1.16 W/(m^2K)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	103 kWh/(m^2a)
Heat recovery/ Wärmerückgewinnung	83.5 %	Pressure test n_{50} / Drucktest n_{50}	0.57 h-1
Special features/ Besonderheiten	Solar hot water.		

1. Brief Description

Superpod® Passive House Building.

Bass Coast, Victoria, Australia

This house, designed by Superpod®, is one of the first certified passive house buildings in Australia. It was the first to be exhibited during the International Passive House Open Days.

The building system is designed to be commercial and completely scaleable. It is also the first certified passive house in the world using a patent-pending innovative steel faced sandwich panel construction and a steel frame, with no membranes or plaster.

The project presented design challenges due to the lack of passive house compliant components and suitable suppliers in Australia. The innovative construction system also required significant design development, with the goal of enabling quick, easy construction.

The building was constructed using tradespeople who had not been trained in passive house methods. The speed and ease of construction was thereby tested successfully, with the building being substantially finished as a site-build in under 4 weeks.

The comfort and aesthetic beauty of the building space showcase the ability of passive house comfort to transcend traditional preconceptions of aesthetics, and proves further the adaptability of the passive house standard to a variety of architectural styles and construction methods.

In many parts of Australia, timber and plaster are eroded by harsh conditions and termites, and are simply not suitable building materials. Large scale buildings are not typically made with timber framing in Australia, and in cyclonic and termite-prone regions a steel frame is often required.

Further, Superpod® shows that Passive House works in heat waves as well as cold periods, debunking the myths prevailing that Passive House is only suitable for cold climates.

Superpod® offers a passive house building with strong steel framing and encased in metal. It is fast to erect and capable of withstanding cyclones, while remaining comfortable, and requiring very little power. This is a great development for the advancement of the Passive House Standard.

Building components and methodology

The Superpod® system is internationally patented (EU, US, China, and patent-pending elsewhere) and designed so as to achieve the Passive House Standard with minimal construction time and effort.

A structural concrete slab was first installed, on the top of a 6 metre rise. The access to the site was clear but challenging due to the slope and sometimes soft soil. A challenge in the slab was a “step down” to achieve a sunken lounge room and work with the levels of the site.

The steel frame was completely prefabricated and prepainted off site. It was installed in less than a day. Thermal bridges were minimised through the steel frame to the structural slab.

Insulation was installed in the floor above the structural slab. This is unusual for these parts of Australia. A second slab was poured over the floor insulation, providing a continuous layer through the “step down” in the floor.

Windows were installed into the pre-designed openings in the frame. Due to the best views being to the East and South, we did not focus entirely on solar facing windows. This was a useful test of the Passive House Standard where solar access is not optimal.

The sandwich panel wall and roof construction was completed very quickly. Thermal bridges were avoided due to careful detailing, and airtightness methods were achieved without the need for a membrane. The design intent was to avoid plaster, even though it can be added for aesthetic preferences later. The sandwich panels were laid around the “outside” of the steel frame, so that there is a complete insulation layer around the framing.

The insulation is PIR foam infill sandwiched between steel skins for the wall and roof panels. The floor is PIR foam board laid between two concrete slabs. The exterior wall is also the interior wall and consists of the sandwich panel. Walls were 80mm thick, the roof was 150mm thick, and the floor was 100mm thick.

The building is fairly open plan although it was designed to be a 2 bedroom home if need be.

Windows were Kommerling Upvc frames with steel reinforcement and triple glazing. The 76 series was used. Tilt and turn windows, opening doors and some fixed frames were used. The u values and g value are g value .6, glazing U.9 and Frame U1.2-1.3.

The heat recovery unit was installed locally and commissioned by an air conditioning supplier. A Brink Renovent Sky 150 was installed on a frame made under the ceiling, and boxed in. 100mm ducts were installed and are exposed in the building.

1.1 Responsible project participants

Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	McCabe Architects
Implementation planning/Designer Ausführungsplanung	Fiona McKenzie/Superpod Pty Ltd
Building systems/ Haustechnik	Passive House Academy, Ireland
Structural engineering/ Baustatik	Shan Lau, DSL Consulting
Building physics/ Bauphysik	Passive House Academy, Ireland
Passive House project planning/ Passivhaus-Projektierung	Passive House Academy, Ireland
Construction management/ Bauleitung	Fiona McKenzie/Superpod Pty Ltd
Certifying body/ Zertifizierungsstelle	Passive House Institute Darmstadt www.passiv.de
Certification ID/ Zertifizierungs ID	Project-ID 4159 (www.passivehouse-database.org)
Author of project documentation / Verfasser der Gebäude-Dokumentation	Fiona McKenzie, Director, Superpod Pty Ltd
Date, Signature/ Datum, Unterschrift	 2 September 2019

2. Views of the building

View from the North-East. Entrance door faces East.

View from the North.

View from the South.

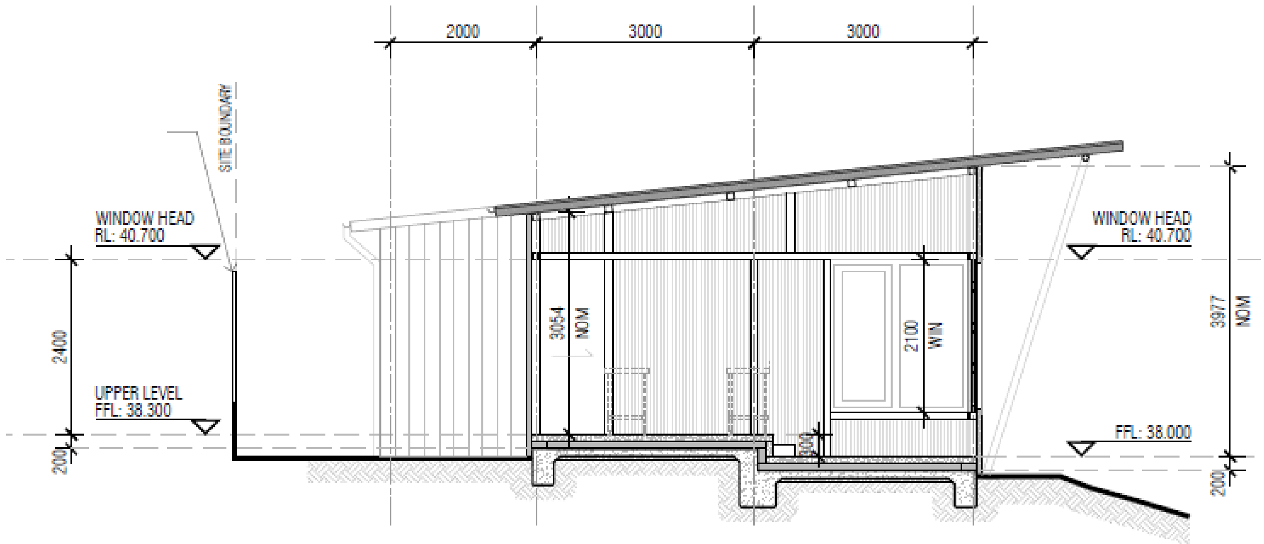
View from the South-East.

Interior of the building

Interior of main living space with view of the countryside and sloping block.
The sunken lounge steps down from kitchen/dining area.

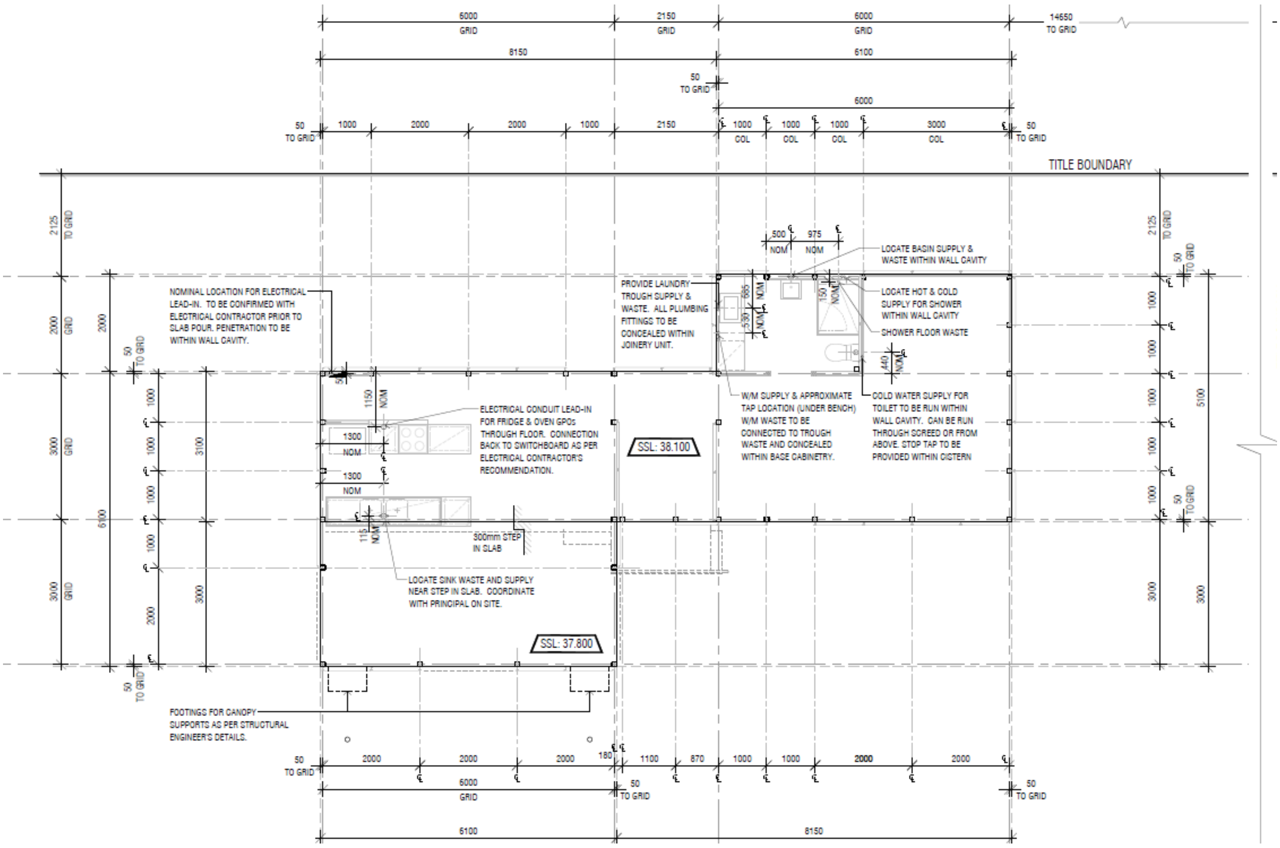
Open-plan bedroom.

3. Sectional drawing



This typical section shows continuous insulation around the building, including through the staggered floor. The steel frame supports the panel walls and roof, as well as windows and doors.

4. Floorplan

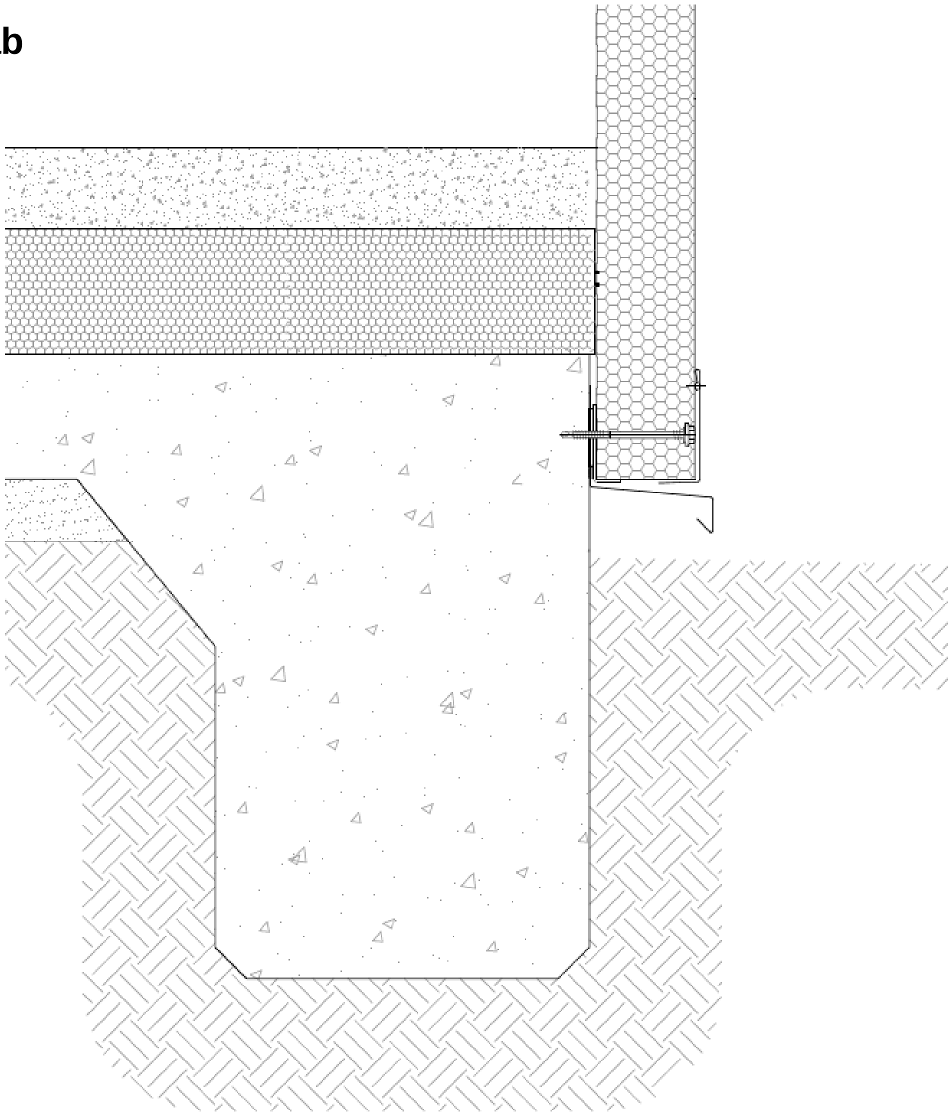


The floorplan shows the steel columns around the perimeter of the concrete slab, with continuous insulation provided by externally-laid sandwich panels. Windows are supported by the steel columns and beams.

All windows have removable block-out shading which is visible from photos but not shown on the drawings.

5. Description of the construction

5.1 Floor slab



The structural slab is concrete with beams as engineered. PIR foam panel is laid over the slab. A second finished floor slab is laid on top of the insulation layer.

Assembly no.	Building assembly description	Interior insulation?
03ud	Floor	0

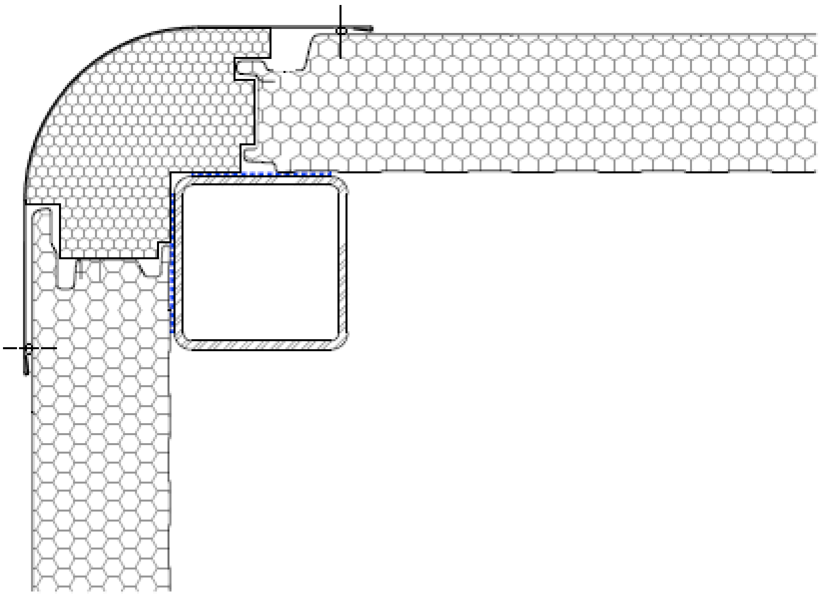
Heat transfer resistance [m²K/W] interior R_{si}: 0.17 exterior R_{se}: 0.00

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Floor Insulation	0.020					100
2.		1.600					50
3.							
4.							
5.							
6.							
7.							
8.							
	Percentage of sec. 1	100%	Percentage of sec. 2	0.0%	Percentage of sec. 3	0.0%	Total 15.0 cm

U-value supplement 0.00 W/(m²K)

U-Value: 0.192 W/(m²K)

5.2 Exterior walls



Insulated wall panels are laid vertically and screwed to the concrete slab and steel frame at the ends of each panel. The wall panels are sandwich panels with .6mm thick metal skins either side of 80mm PIR foam core. Thermal cuts are made where necessary to ensure the insulation layer is continuous. Corner junctions include extra foam pieces with curved flashings over as shown above.

---> Auxiliary calculation to the right

Assembly no.	Building assembly description	Interior insulation?
01ud	Wall	0

Heat transfer resistance [m²K/W] interior R_{si} : 0.13

exterior R_{se} : 0.04

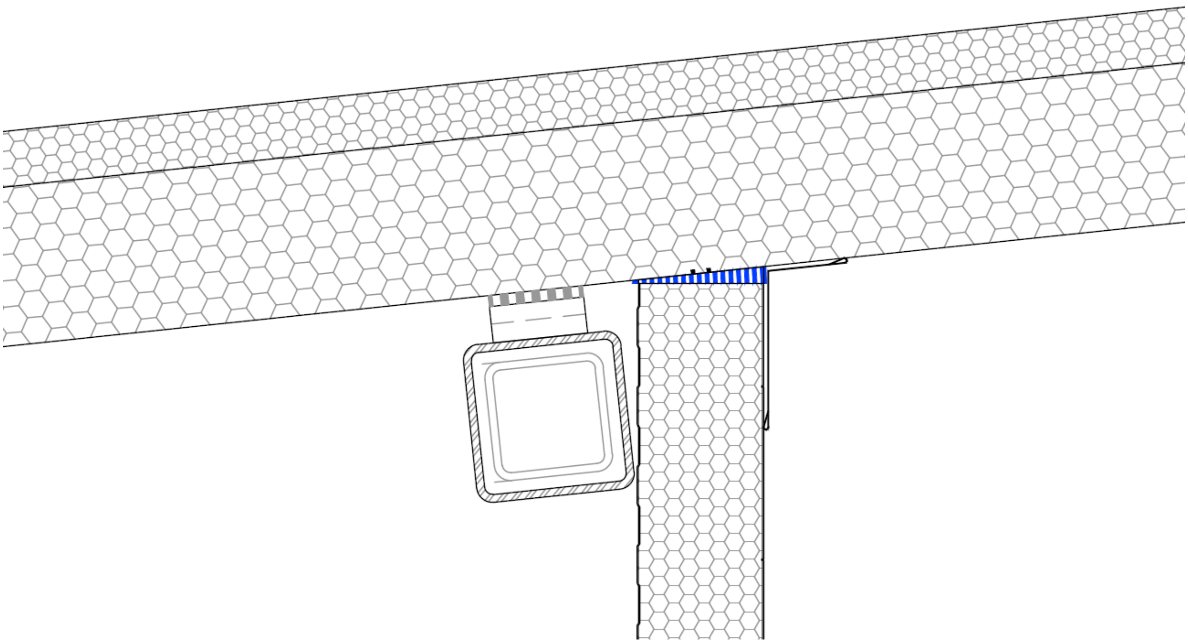
	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Zincalume Skin	110.000					1
2.	Polyisocyanurate Core	0.021					80
3.	Zincalume Skin	110.000					1
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%	0.0%	0.0%	8.1 cm

U-value supplement 0.00 W/(m²K)

U-Value: 0.251 W/(m²K)

5.3 Roof



The roof is made up of sandwich panels laid over steel beams where specified by the engineer. The roof panels are 150mm thick with metal skins and 150mm PIR core. Thermal cuts are made where necessary to ensure the insulation layer is continuous. Airtight seals are placed between wall and roof panels.

Assembly no.: 02ud | Building assembly description: Roof | Interior insulation?: 0

Heat transfer resistance [m²K/W] interior R_{si}: 0.10 exterior R_{se}: 0.04

	Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
1.	Zincalume Skin	110.000					1
2.	Polyisocyanurate Core	0.021					150
3.	Zincalume Skin	110.000					1
4.							
5.							
6.							
7.							
8.							

Percentage of sec. 1: 100% | Percentage of sec. 2: 0.0% | Percentage of sec. 3: 0.0% | Total: 15.1 cm

U-value supplement: 0.00 W/(m²K) | **U-Value: 0.137** W/(m²K)

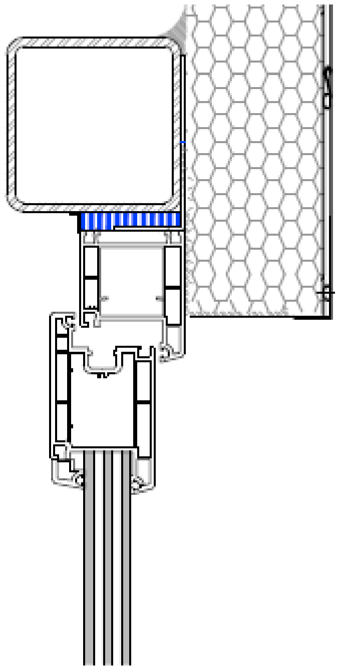
5.4 Windows

The windows were a Kommerling-framed triple glazed Upvc window with a g value of .60, and average U value of 1.16 (1.14 for North and East windows, 1.16 for the South, and 1.19 for the West).

The U value of the glazing was .9, and the U value of the frames was between 1.2 and 1.3.

Opening windows used the tilt and turn function.

External moveable roller shutters cover all windows (not shown).



Windows were attached to the internal frame with airtight seals. The insulated sandwich panel walls overlap the structural frame, and foam insulation continues to wrap over part of the window frame, without introducing metal skins into the window junction.

6. Airtight envelope

A continuous airtight layer is a requirement of the Passivhaus standard and typically difficult to achieve with traditional membranes and tapes. The Superpod® system relies on the inside metal face of the sandwich panel itself as the key to the airtight layer, thus avoiding the need for separate membranes. The concrete slab in the finished floor is also an airtight layer.

Sealing up the joints between sandwich panels was facilitated by tapes and/or caulk.

A panel joint sealed from the inside continues the airtight layer provided by the internal steel lining of the panels, thus eliminating the need for additional membranes.

The blower door test result was .57 under depressurization, and .57 under pressurization. Conducted by Burkhard Hansen of carbonlite.

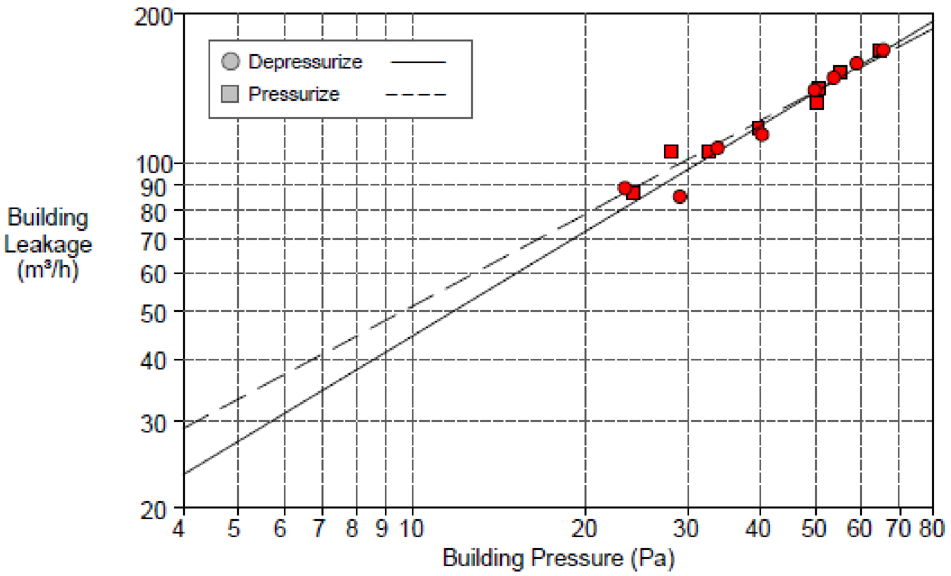
carbonlite design+build

BUILDING LEAKAGE TEST

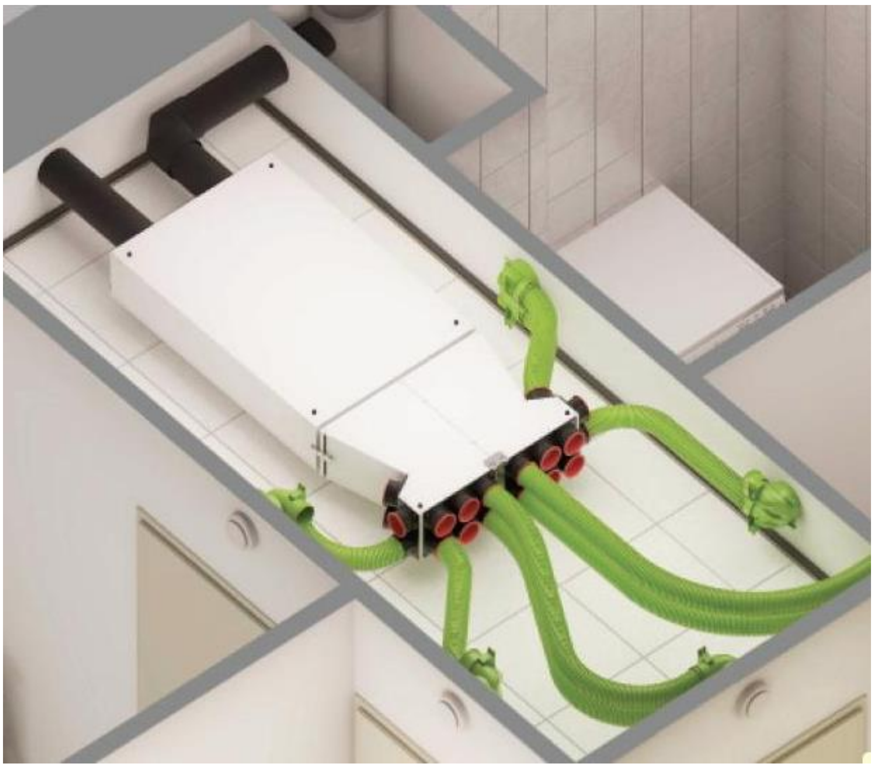
Date of Test: 22/12/2014		Technician:	Burkhard Hansen
Test File: Blower door test result1 Wonthaggi		Project Number:	BD12-2014/01
Customer:	Fiona McKenzie 51 Wishart Street Wonthaggi, Victoria 3995 Phone: +61434601835 Fax: Email: fionamckenzie@vicbar.com.au	Building Address:	Superpod 51 Wishart Street Wonthaggi, Victoria 3995

	Depressurization	Pressurization	Average
Test Results at 50 Pascals:			
V50: m³/h Airflow	139 (+/- 5.9 %)	139 (+/- 4.7 %)	139
n50: 1/h (Air Change Rate)	0.57	0.57	0.57
w50: m³/(h·m² Floor Area)	1.84	1.85	1.84
q50: m³/(h·m² Envelope Area)	0.42	0.42	0.42
Leakage Areas:			
Canadian EqLA @ 10 Pa (cm²)	49.8 (+/- 22.9 %)	57.2 (+/- 17.9 %)	53.5
cm²/m² Surface Area	0.15	0.17	0.16
LBL ELA @ 4 Pa (cm²)	25.2 (+/- 36.8 %)	31.2 (+/- 29.0 %)	28.2
cm²/m² Surface Area	0.08	0.10	0.09
Building Leakage Curve:			
Air Flow Coefficient (Cenv) m³/(h·Paⁿ)	8.8 (+/- 58.2 %)	12.3 (+/- 46.0 %)	
Air Leakage Coefficient (CL) m³/(h·Paⁿ)	8.8 (+/- 58.2 %)	12.2 (+/- 46.0 %)	
Exponent (n)	0.705 (+/- 0.155)	0.622 (+/- 0.123)	
Correlation Coefficient	0.97666	0.98085	

Test Standard:	EN 13829
Test Mode:	Depressurization and Pressurization
Type of Test Method:	A
Regulation complied with:	CARBONlite design+build $n50 \le 0.6$ 1/h

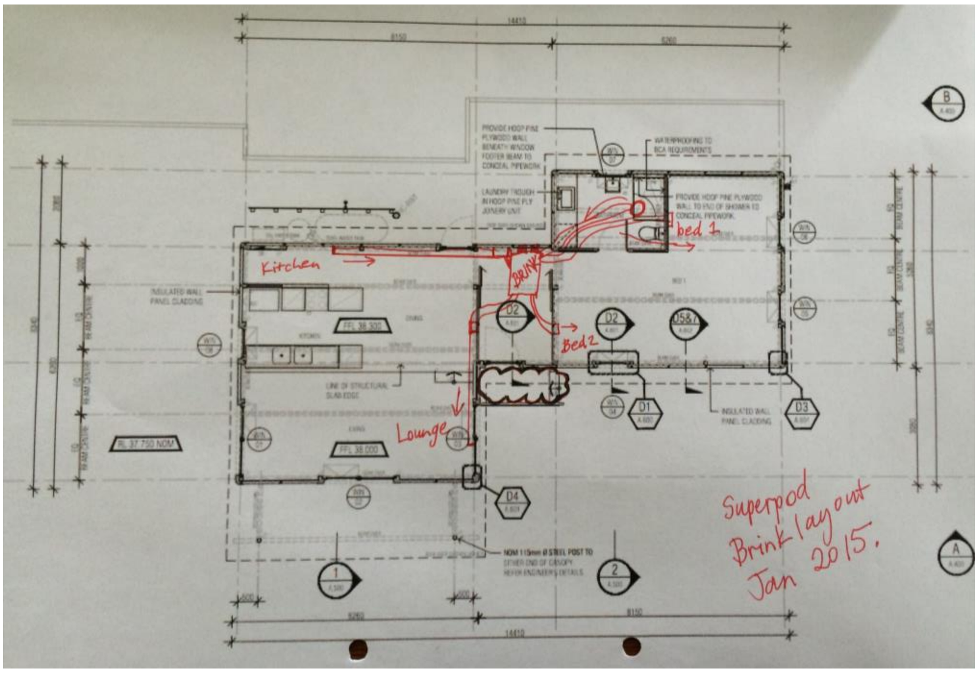


7. Ventilation system



The Brink Renovent Sky 150 was installed under the roof in a timber envelope with openable doors to enable access to the unit and its filters. (The photo above is a typical installation.)

The Brink is certified by the Passive House Institute and has an effective heat recovery efficiency of 83.5% and a specific power input of .44 Wh/m^3.



The MVHR unit is located in the centre of the building against a South facing wall. The duct layout has two extracts: in the kitchen and the bathroom; and three intake ducts: in the lounge room and two bedroom areas.

8. Heat/cool air supply system

There is no central heating or air conditioning in the building. Solar hot water is fed through solar panels on the roof, gas boosted.

During construction the sealed insulated envelope provided great comfort during heat wave days. This was without the blower door test and without the air ventilation unit being used. The tradespeople commented that in all other construction sites they would open windows during a heat wave. For the Superpod® passive house it was more comfortable to keep them closed.

For much of the year no heating is required. If necessary small portable heaters may be used occasionally. It is possible to instal a small split system air conditioner but that has not yet been done.

9. PHPP Key results

The results of the PHPP show that it meets the requirements.

Building:	Superpod House
Street:	51 Wishart Street
Postcode / City:	Wonthaggi
Country:	Australia
Building type:	Residential
Climate:	[AU] - Melbourne
Altitude of building site (in [m] above sea level):	-
Home owner / Client:	Fiona McKenzie
Street:	c/-lvl 6, 550 Lonsdale St
Postcode/City:	Melbourne 3000
Architecture:	McCabe Architects
Street:	39 Langridge St
Postcode / City:	Collingwood 3066
Mechanical system:	
Street:	
Postcode / City:	

Year of construction:	2014		Interior temperature winter:	20.0	°C	Enclosed volume V_e m^3:	287.8
No. of dwelling units:	1		Interior temperature summer:	25.0	°C	Mechanical cooling:	
No. of occupants:	2.1		Internal heat sources winter:	2.1	W/m^2		
Spec. capacity:	60	Wh/K per m^2 TFA	Ditto summer:	2.1	W/m^2		

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	73.4	m^2		
Space heating	Heating demand	**21**	kWh/(m^2a)	15 kWh/(m^2a)	-
	Heating load	**10.3153**	W/m^2	10 W/m^2	yes
Space cooling	Overall specif. space cooling demand		kWh/(m^2a)	-	-
	Cooling load		W/m^2	-	-
	Frequency of overheating (> 25 °C)	2.5	%	-	-
Primary energy	Heating, cooling, auxiliary electricity, dehumidification, DHW, lighting, electrical appliances	**103**	kWh/(m^2a)	120 kWh/(m^2a)	yes
	DHW, space heating and auxiliary electricity	62	kWh/(m^2a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m^2a)	-	-
Airtightness	Pressurization test result n_{50}	**0.6**	1/h	0.6 1/h	yes

* empty field: data missing; '-': no requirement

Passive House?	yes

The innovative and fast Superpod® system has now been patented in the E.U., the U.S., and China. It is patent pending in other countries. With climate change an urgent and pressing issue; the speed, scaleability and suitability of this new passivhaus system to different climates and environmental challenges poses a real opportunity.

Further information may be found on the website: www.superpodhome.com