Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

Arthur Street Townhouse

Data of building | Gebäudedaten			
Year of construction Baujahr	2022	**Space heating Heizwärmebedarf**	**16 kWh/(m²a)**
U-value external wall U-Wert Außenwand	0.128 W/(m²K)		
U-value basement U-Wert Kellerdecke	0.158 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	45 kWh/(m²a)
U-value roof U-Wert Dach	0.089 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	0 kWh/(m²a)
U-value window U-Wert Fenster	0.72 W/(m²K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	101.60 kWh/(m²a)
Heat recovery Wärmerückgewinnung	88.2 %	Pressurization test n_{50} Drucktest n_{50}	0.42 h^{-1}
Special features Besonderheiten	Internal shading automation. Automatisierung der Innenbeschattung.		

Brief Description

Arthur Street Townhouse

The Arthur Street Townhouse project commenced on site in May 2021, was completed in March 2023, and achieved certification in November 2022.

The house was designed for an investor with an interest in high performance buildings and technology. The property is intended to be used as a low maintenance rental property or a home to spend a comfortable retirement. The building is located on a small, triangular corner site in central Dunedin, New Zealand. The street frontage is to the east with the outdoor terrace to the north.

The house is constructed using a mixture of light timber framed structure and structural insulated panels. The concrete floor slab is fully insulated using EPS & XPS. The windows are triple glazed European uPVC windows. Shading is provided by aluminium canopies and the cantilevered first floor.

Kurzbeschreibung

Stadthaus in der Arthur Street

Das Arthur Street Townhouse-Projekt begann vor Ort im Mai 2021, wurde im März 2023 abgeschlossen und im November 2022 zertifiziert.

Das Haus wurde für einen Investor mit Interesse an Hochleistungsgebäuden und -technologie entworfen. Die Immobilie soll als wartungsarmes Mietobjekt oder als Zuhause für einen komfortablen Ruhestand genutzt werden. Das Gebäude befindet sich auf einem kleinen, dreieckigen Eckgrundstück im Zentrum von Dunedin, Neuseeland. Die Straßenfront liegt im Osten, die Außenterrasse im Norden.

Das Haus besteht aus einer Mischung aus leichter Holzrahmenkonstruktion und strukturisolierten Paneelen. Die Betonbodenplatte ist vollständig mit EPS & XPS gedämmt. Die Fenster sind dreifach verglaste europäische PVC-Fenster. Die Beschattung erfolgt durch Aluminiumvordächer und das auskragende Erdgeschoss.

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	Architype Ltd www.architype.co.nz
Implementation planning Ausführungsplanung	Architype Ltd www.architype.co.nz
Building systems Haustechnik	Fantech NZ Ltd www.fantech.com.au
Structural engineering Baustatik	EngCo www.engco.co.nz
Building physics Bauphysik	Architype Ltd www.architype.co.nz
Passive House project planning Passivhaus-Projektierung	Architype Ltd www.architype.co.nz
Construction management Bauleitung	Stevenson & Williams Ltd www.stevwill.co.nz

Certifying body
Zertifizierungsstelle

Sustainable Engineering Ltd
www.sustainableengineering.co.nz

Certification ID
Zertifizierungs ID

7138	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivhausprojekte.de)

Author of project documentation
Verfasser der Gebäude-Dokumentation

Luke Campbell

Date Datum	Signature Unterschrift
10/05/2023	

1. Exterior photos - Ansichtsfotos

East Elevation

North Elevation

West Elevation

South Elevation

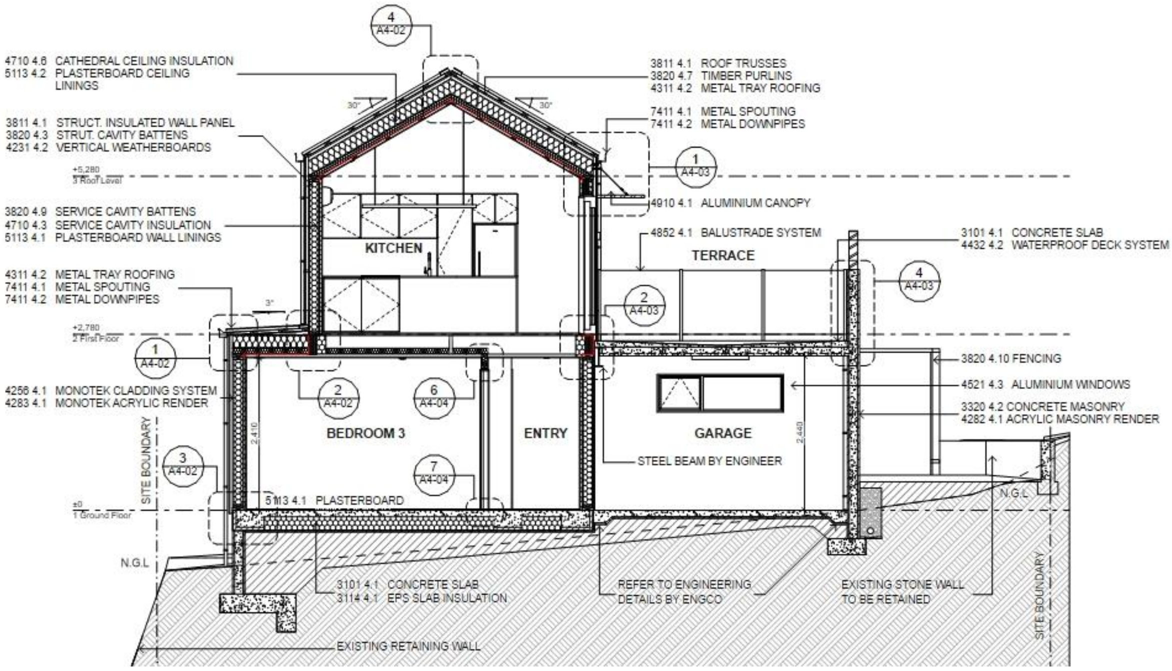
2. Interior photos - Innenfoto exemplarisch

Living & Terrace

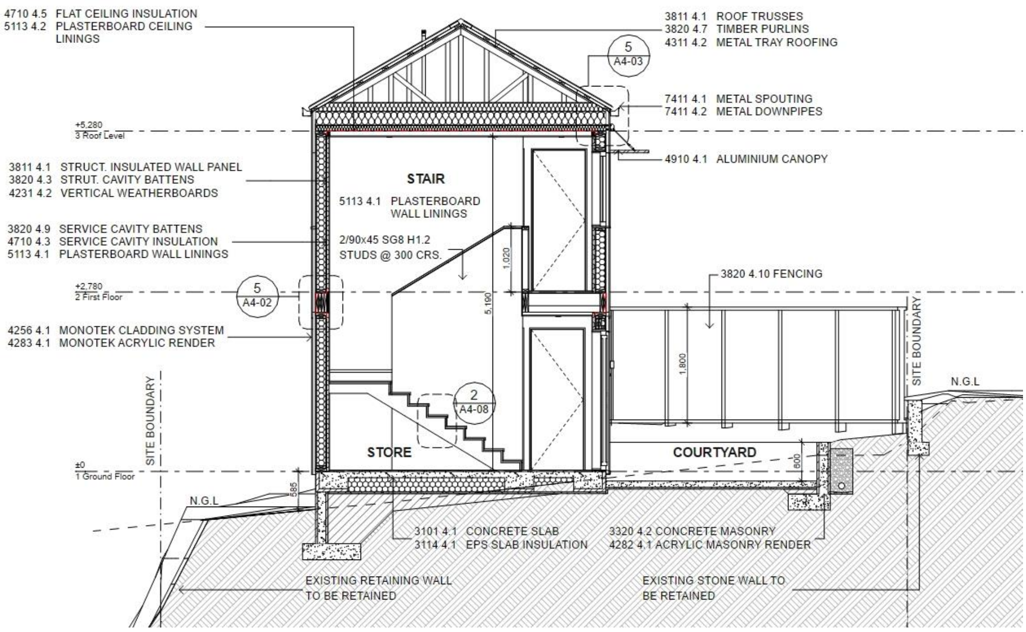
Kitchen & Dining

3. Sections - Schnittzeichnung

The concrete floor slab sits on expanded polystyrene insulation & extruded polystyrene insulation under the footings which also return up the side of the foundation, fully insulating the slab. The walls are constructed of structural polyisocyanurate insulated panels. The mid floor is made up of standard timber floor joists which vary in size to provide distribution of the ventilation ducting. The roof is constructed using sloping flat, common, and parallel chord scissor timber roof trusses with glass wool insulation. Aluminium canopies and the first-floor cantilevers provide shading.

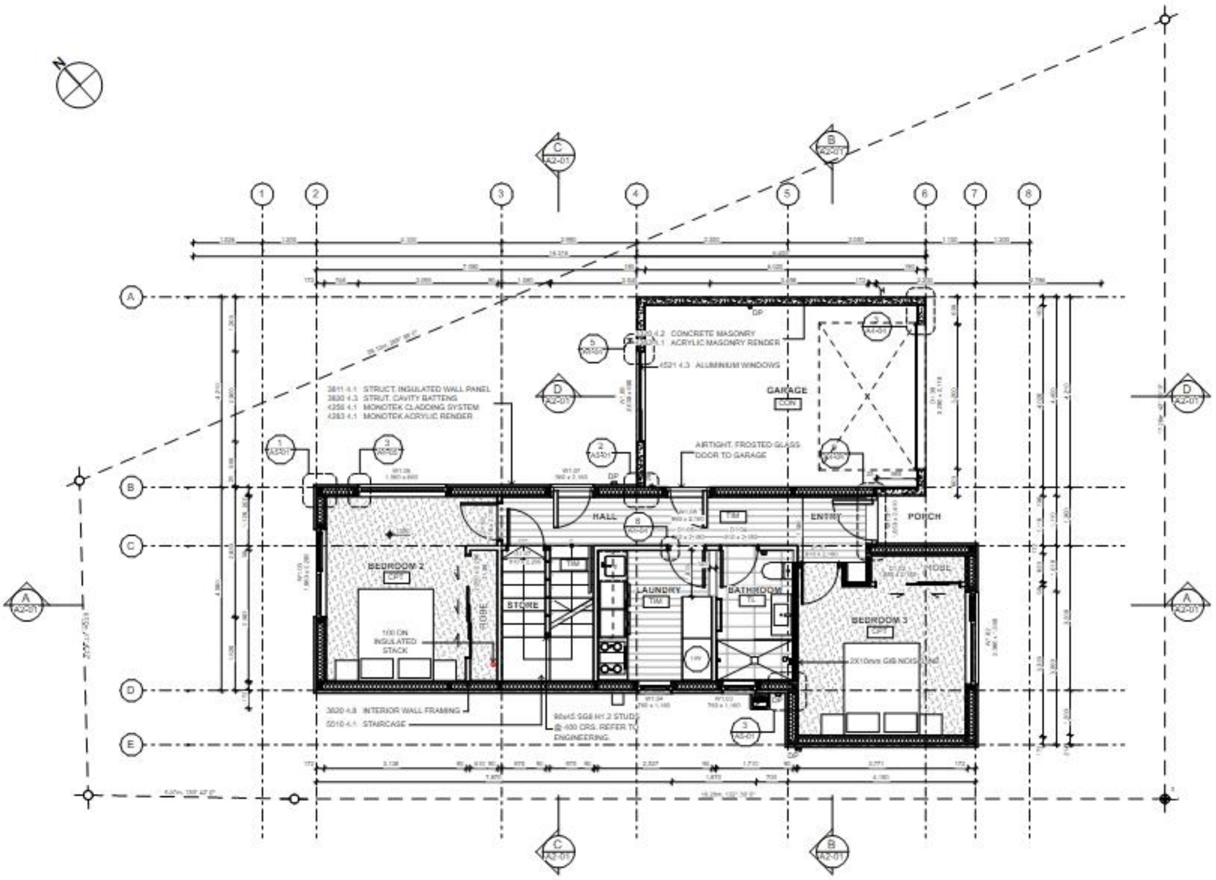


Section B-B

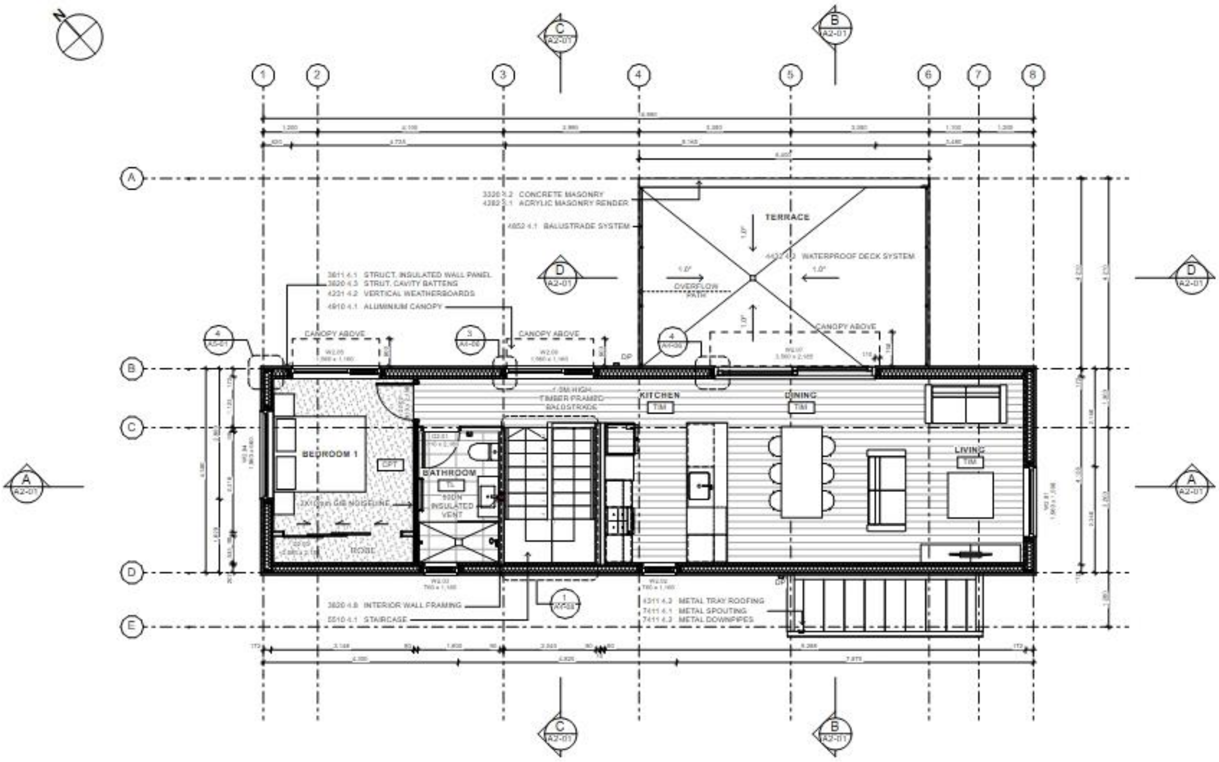


Section C-C

4. Floor plans - Grundrisse



Ground Floor Plan



First Floor Plan

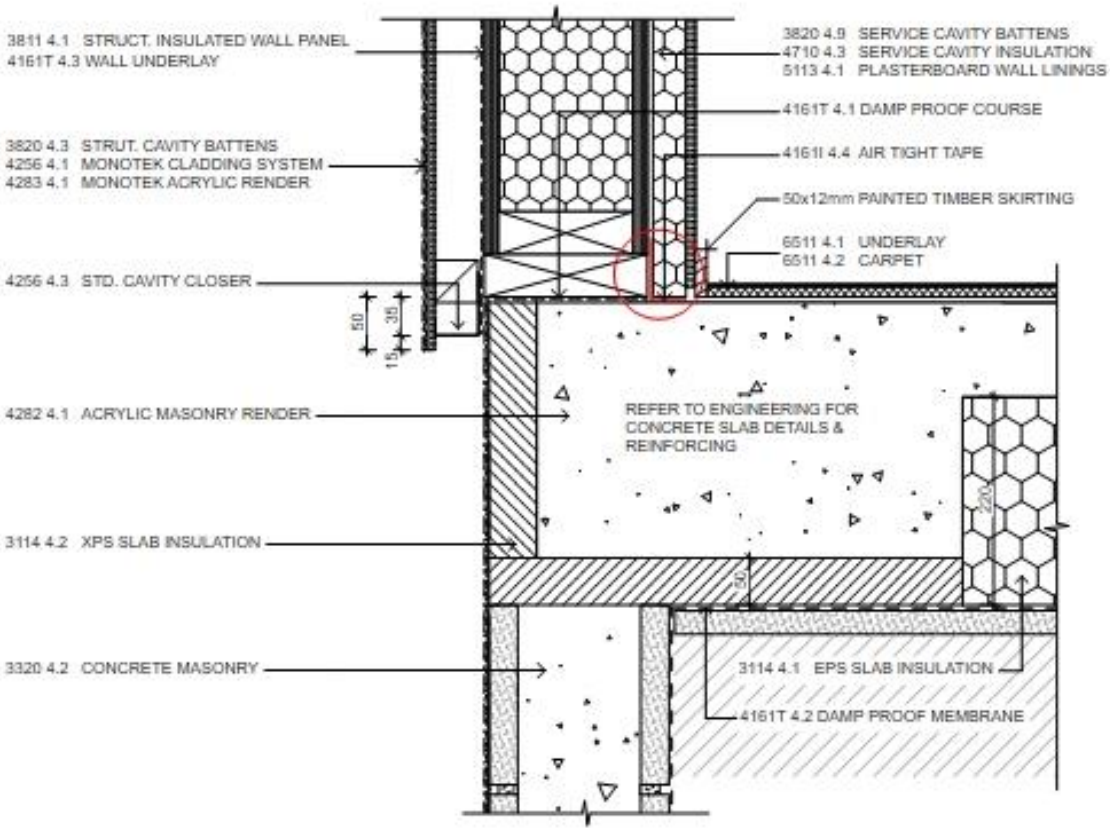
5. Floor slab/ basement ceiling construction including insulation Konstruktion der Bodenplatte

The reinforced concrete floor slab is 100mm thick and sits on 220mm of expanded polystyrene (EPS) insulation. The slab edges and structural thickenings are 260mm thick and insulated with 60mm thick extruded polystyrene (XPS) which also return up the side of the foundation. The XPS has a higher compressive strength compared to EPS and is required under load-bearing walls. The slab edges are protected from water and UV light with the use of an acrylic render system which is applied to the outside face of the insulation. The render is dressed down onto the damp proof membrane which is laid under the whole slab.

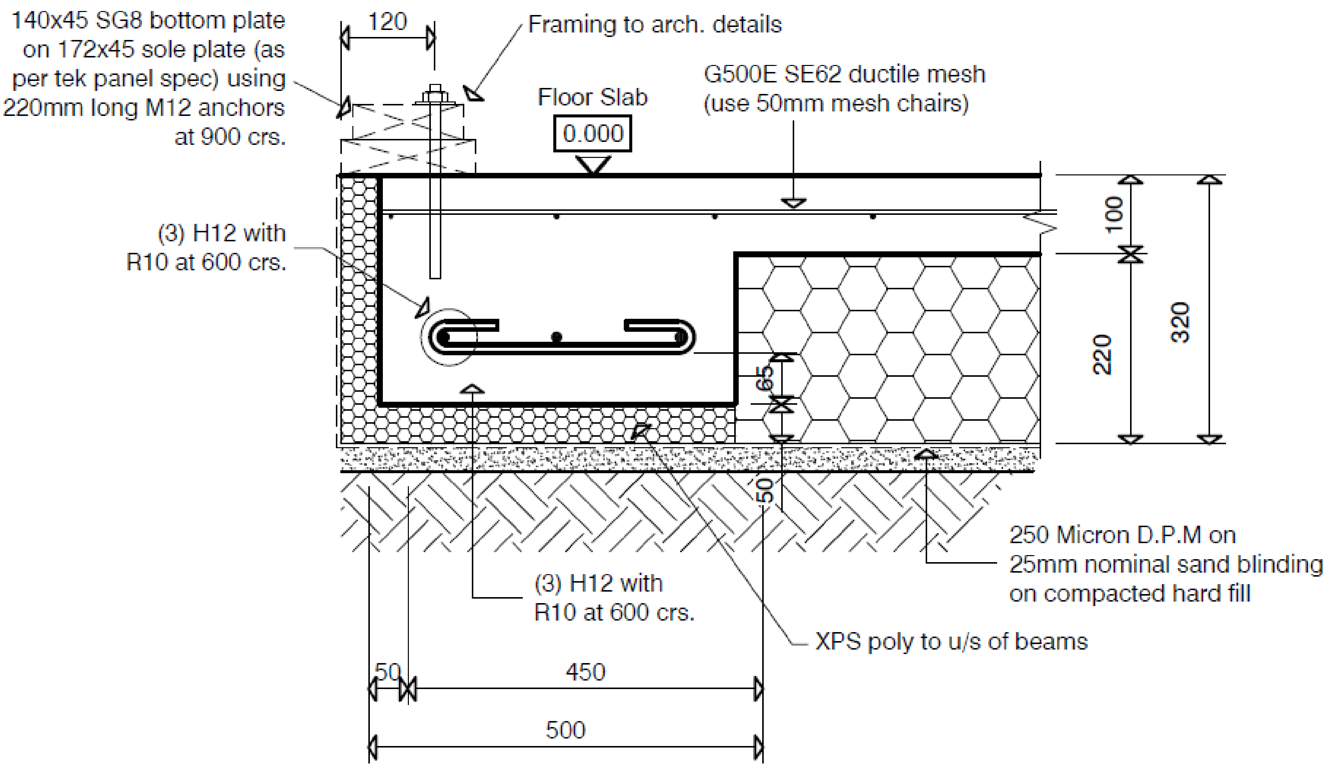
A timber sole plate and a timber bottom plate are fixed to the slab @ 900 crs using M12 concrete anchors. The anchors are installed a minimum distance from the edge of the slab to prevent the concrete from breaking as the bolts are tightened. The structural insulated wall panels, which have a recessed base, are then fitted over the bottom plate, glued and nail fixed to provide a structural connection. The SIPs are taped and adhered to the concrete slab to create an airtight connection.

Photo : Concrete Slab Edge

Photo : Concrete Slab Insulation



Concrete Slab Edge Architectural Detail



Concrete Slab Edge Structural Detail

6. Wall construction including insulation - Konstruktion der Außenwände

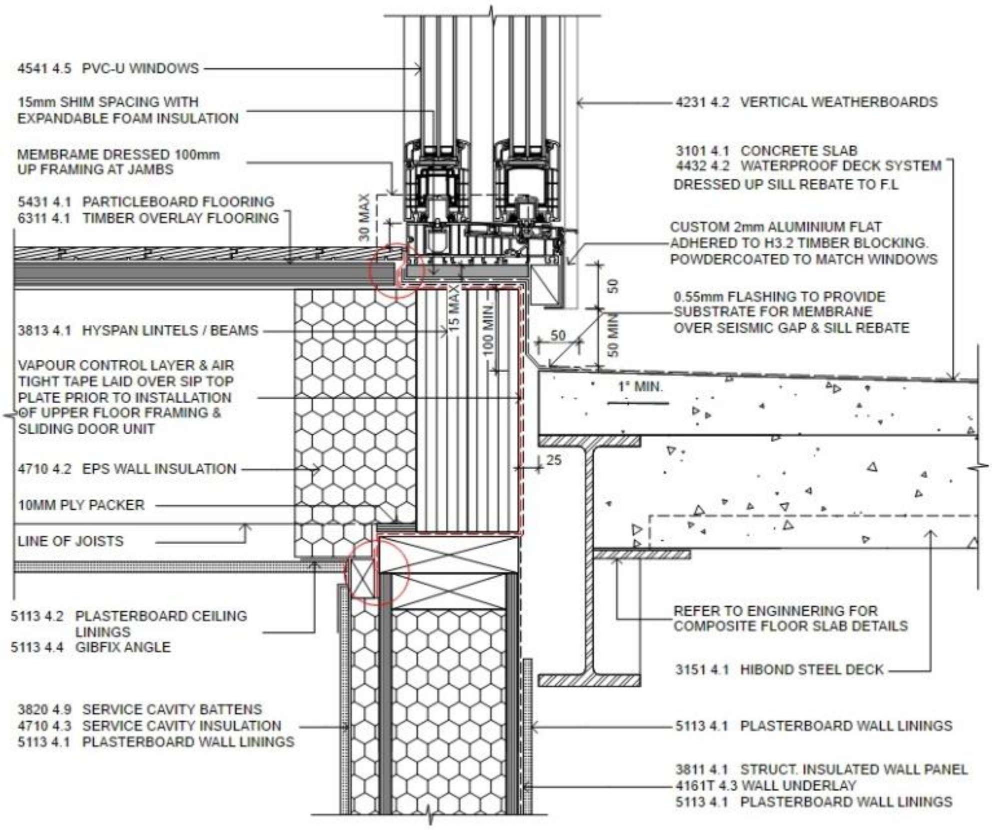
The exterior walls of the house are structural insulated panels or SIPs which are also lined with a polyisocyanurate (PIR) backed plasterboard. Kingspan Tek Panels were specified which compose of a 142mm PIR core with a thermal conductivity of 0.024[W/(mK)], sandwiched between two sheets of 15mm Oriented Strand Board (OSB).

At the midfloor junction the timber floor joists are supported by the lower floor SIPs and insulated with EPS. Pro Clima Solitex Extasana an airtight, weather resistive barrier was wrapped around the boundary joists and taped to the inside, OSB face of the upper and lower SIPs or the OSB flooring under the sliding door with Tescon Vana. The wall panels which support the timber roof trusses were also taped to the Intello ceiling airtightness barrier.

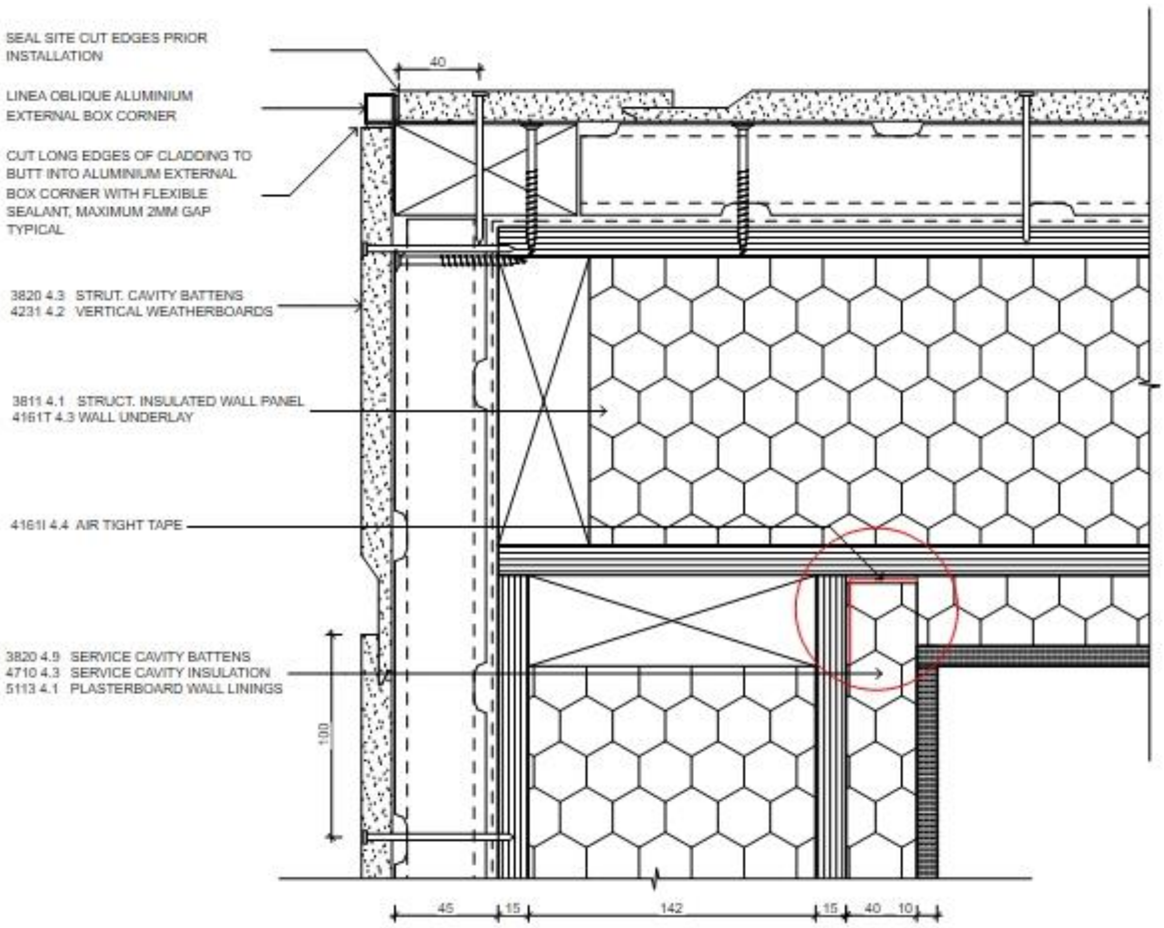
Where possible lintels were designed as SIP box beams to reduce thermal bridging, though some solid timber lintels were required for larger spans. The structural insulated panels were joined at the corners with large Spax screws and made airtight with Tescon Vana tape used on the inside join.

The SIPs were pre-manufactured offsite and installed in a timely manner.

Photo: SIP panel installation



Detail: Mid Floor / Sliding Door Sill



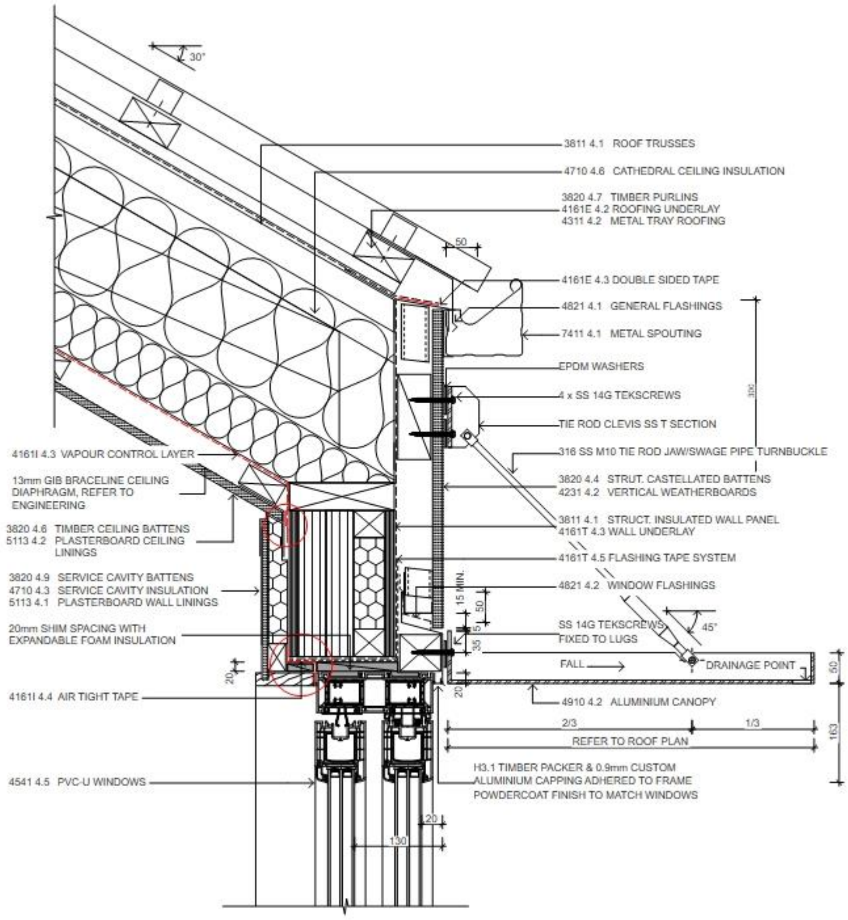
Detail: First Floor Corner

7. Roof construction including insulation - Konstruktion des Daches

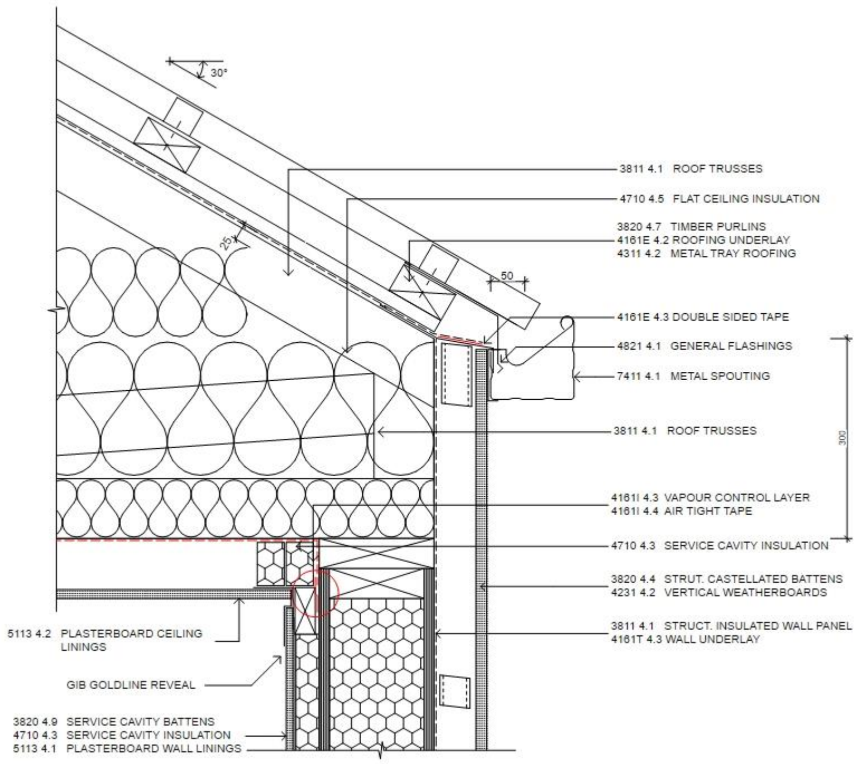
The roof was constructed using commonly available timber trusses. A heel height of 300mm was required for the parallel chord scissor trusses which conveniently provided sufficient depth for dense glass wool batt insulation. Insulation was also carefully fitted between the webs of the trusses to ensure there were no uninsulated gaps. Polypropylene strapping was fixed between the trusses to support the batts before the airtightness membrane was also applied to the underside of the trusses. This membrane was then taped to the inside face of the SIPs.

Pro Clima, Solitex Mento 3000 roof underlay was fixed directly to the top of the trusses before a 20mm timber counter batten was also fixed in line with the truss. The purlins and roofing were then fixed over the battens. This method was used to create a drained and ventilated cavity to deal with any possible condensation that forms above the thermal envelope.

Photo: Roof insulation being installed



Detail: Scissor Truss Roof Eave



Detail: Girder Truss Roof

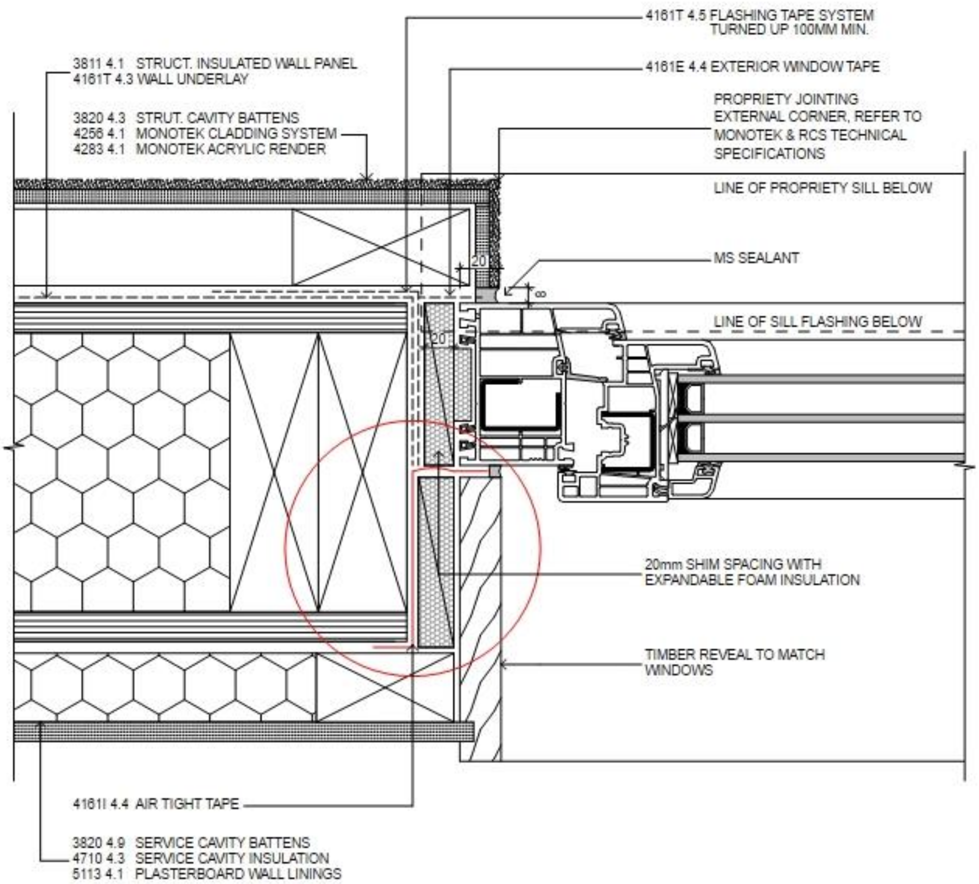
8. Window and window installation including glass Ug / g-value and frame performance - Fenster und Fenster-Einbau

The windows specified for this project were ECO PVC 83 windows supplied by Eco Windows. The windows were imported from Germany and manufactured by Gealan. The profile used is a certified passive house component window system named S9000.

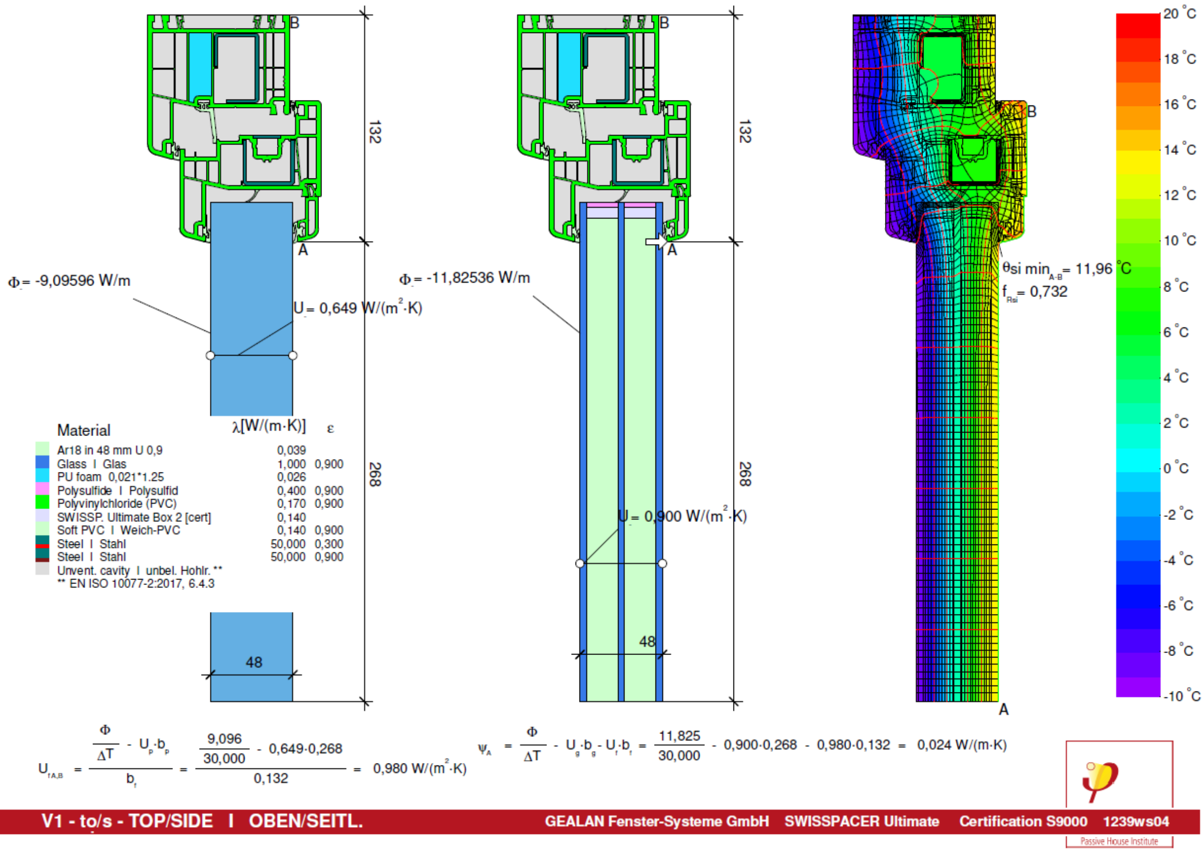
The window frames are UPVC with a coloured acrylic exterior layer. The frames generally have a U_f Value ranging between 0.97-1.08 W/(m²K). The insulated glass units specified are generally triple glazed with 4mm glass, low emissivity coated, and 90% argon filled. The $_g$ value of the 4mm glass was 0.53. Swissspacer Ultimate spacers were used which have a Glazing Edge Psi-value of 0.22-0.24. W/(mK). The U_g Value was 0.50 W/(m²K).

The window frames were fitted flush with the outside face of the wall panels. The wall claddings were detailed to lap over the front of the window frames which helped to reduce their apparent width. All window frames were taped to the inside face of the SIP panels to ensure an airtight connection. The Psi-value of the window installations were generally 0.031-0.047. W/(mK)

A lift and slide glass doors was also used on this project. Frame U values for these windows varied between 1.16 – 1.69 W/(m²K). The sliding doors were also rebated into the timber floor structure to provide a level entry at the thresholds.



Detail: Typical Window Jamb



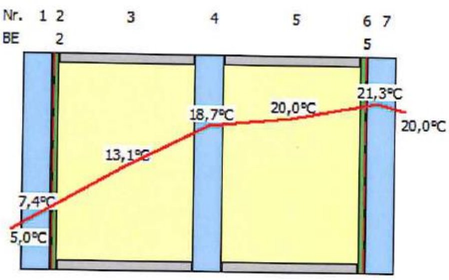
Report - Certified Passive House Component

Berechnung SommerGlobal
Premium 0.5

TERMOBIT ISOLIERGLAS

Projekt: ca. 32 - 33 dB - ungeprüft
Position: 01
Schichtaufbau (von außen nach innen)

Nummer	BE	Bezeichnung	mm
1		Float ExtraClear	4,00
2	2	ClimaGuard Premium2 (εn=3%)	
3		90% Argon	18,00
4		Float ExtraClear	4,00
5		90% Argon	18,00
6	5	ClimaGuard Premium2 (εn=3%)	
7		Float ExtraClear	4,00
			48,00



Transmission, Reflexion, Absorption

ρ_v = 0,16 (Lichtreflexionsgrad außen)

ρ'_v = 0,16 (Lichtreflexionsgrad innen)

ρ_e = 0,33 (direkter Strahlungsreflexionsgrad außen)

ρ'_e = 0,33 (direkter Strahlungsreflexionsgrad innen)

α_e 1 = 0,12; 3 = 0,04; 5 = 0,05 (direkter Strahlungsabsorptionsgrad)

T_{UV} = **0,22** (ultravioletter Transmissionsgrad)

T_v = **0,74** (Lichttransmissionsgrad)

T_e = **0,46** (direkter Strahlungstransmissionsgrad)

R_a = 98 (allgemeiner Farbwiedergabeindex)

EN 410

SC = 0,61 (Shading Coefficient, g/0,87)

b-Faktor = 0,66 (VDI 2078, g/0,80)

q_i = **0,06** (sekundäre Wärmeabgabe nach innen)

g = **0,53** (Gesamtenergiedurchlassgrad)

EN 673 Einbauwinkel = 90° vertikal

U_g = **0,5 W/m²K** (Wärmedurchgangskoeffizient)
Korrigierter Emissionsgrad gemäß EN 12898:2019

EN ISO 52022-3 T_e = 5,00 °C T_i = 20,00 °C

g_{th} = 0,035 (Wärmestrahlungsfaktor)

g_c = 0,027 (Konvektionsfaktor)

g_v = 0,000 (Belüftungsfaktor)

E_s = 300,00 W/m² Systemhöhe = 1,50 m

$h_{c,e}$ = 18,00 W/m²K $h_{c,i}$ = 3,60 W/m²K

q_i = **0,062** (sekundäre Wärmeabgabe nach innen)

g_{tot} = **0,53** (Gesamtenergiedurchlassgrad)

Glass information

9. Air leakage testing - Beschreibung der luftdichten Hülle

An airtight envelope was formed by connecting one section of the thermal envelop to the next. The concrete floor functions as the lower floor airtightness layer which, as discussed, is sealed to the SIPs, which are in turn sealed to the Proclima Intello fixed under the roof trusses. Sealing is generally achieved using Pro Clima Tescon Vana tape and Orcon sealing glue. The windows and doors are also a key part of the airtight envelop which are also taped to the OSB of the SIP walls.

The kitchen rangehood is a recirculating model with charcoal filters. The outlet is located above the kitchen joinery, rather than outside the building. A condensing dryer is also specified which does not vent to the outside.

An average air leakage result at 50 Pascals of 0.42 1/h was achieved during the final blower door test.

Test Results at 50 Pascals:	Depressurization	Pressurization	Average
q_{50} : m³/h (Airflow)	143 (+/- 0.6 %)	124 (+/- 2.9 %)	133
n_{50} : 1/h (Air Change Rate)	0.45	0.39	0.42
q_{F50} :			
q_{E50} : m³/(h·m² Envelope Area)	0.39	0.34	0.37
Leakage Areas:			
ELA $_{50}$: m²	0.0043 (+/- 2.9 %)	0.0038 (+/- 2.9 %)	0.0041
ELA $_{F50}$:			
ELA $_{E50}$: m²/m²	0.0000120	0.0000104	0.0000112
Building Leakage Curve:			
Air Flow Coefficient (C_{env}) m³/(h·Paⁿ)	9.6 (+/- 2.6 %)	9.5 (+/- 15.3 %)	
Air Leakage Coefficient (C_L) m³/(h·Paⁿ)	9.7 (+/- 2.6 %)	9.5 (+/- 15.3 %)	
Exponent (n)	0.687 (+/- 0.008)	0.656 (+/- 0.043)	
Coefficient of Determination (r^2)	0.99981	0.99352	

Test Standard:	ISO 9972
Test Mode:	Depressurization and Pressurization
Type of Test Method:	Method 1 - Test of Building in use
Purpose of Test:	Final Test $n50 \leq 0.6$ 1/h

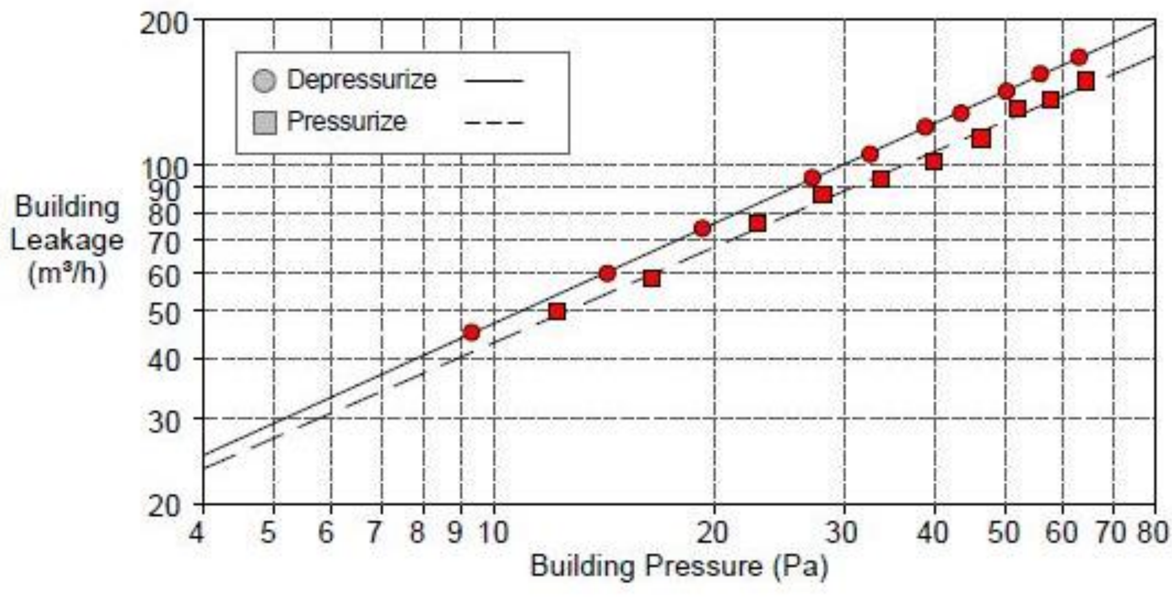


Photo: Airtightness control layer

Photo: Air tightness tape to windows

10. MVHR - Lüftungsgerät

The location of the ventilation unit was also planned at a very early stage in the design process. The intension was to locate the unit in an accessible, central location and to reduce the length of duct runs and make changing the filters easy. It was also located to have good access to the outside air to reduce the length of the intake and exhaust pipes, thus reducing thermal bridging.

The system specified was a Zehnder Comfoair Q350. This system has an effective heat recovery of 88% and an electrical efficiency of 0.24 Wh/m3. The unit was located in the laundry as this location which best fulfilled the above requirements. Boost switches were installed in the bathrooms and kitchen and cables run back to the main unit. This allows occupants to boost the system during showers and while cooking. The system can also be control via a smart phone app.

Doors requiring undercuts are marked in red on the ventilation drawings. Undercutting the doors allows air from positively pressurised spaces (like bedrooms and living areas) to move through to negatively pressurised spaces (like bathrooms and the kitchen and laundry) where the air is returned to the main ventilation unit for heat recovery and exhaust.

Supply & exhaust air grilles are located on the southern side of the building, out of sight.

Photo: Ventilation unit within laundry cupboard

11. Ventilation ductwork - Lüftungsplanung Kanalnetz

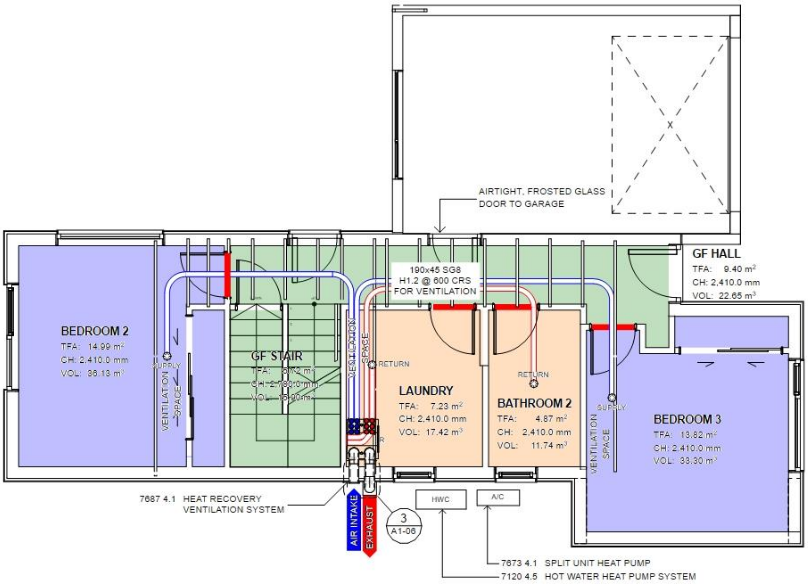
The strategy for the distribution of the ventilation ducting was established early in the design process. The layout is a "spider" design, meaning that each compartment is serviced by a separate, duct that returns to the main ventilation unit. The layout relies on the mid-floor and ceiling zones to run supply and exhaust ducts.

Smaller timber midfloor joists were specified above the hallway to allow for the ducting runs to the ground floor rooms. A dummy wall on the upper floor, directly above the ventilation unit, acts as a shaft to the upper floor ceilings. Timber blocking was installed between the airtightness barrier and trusses to create a services cavity. One floor mounted supply duct was also provided in the Living area which was run through the midfloor.

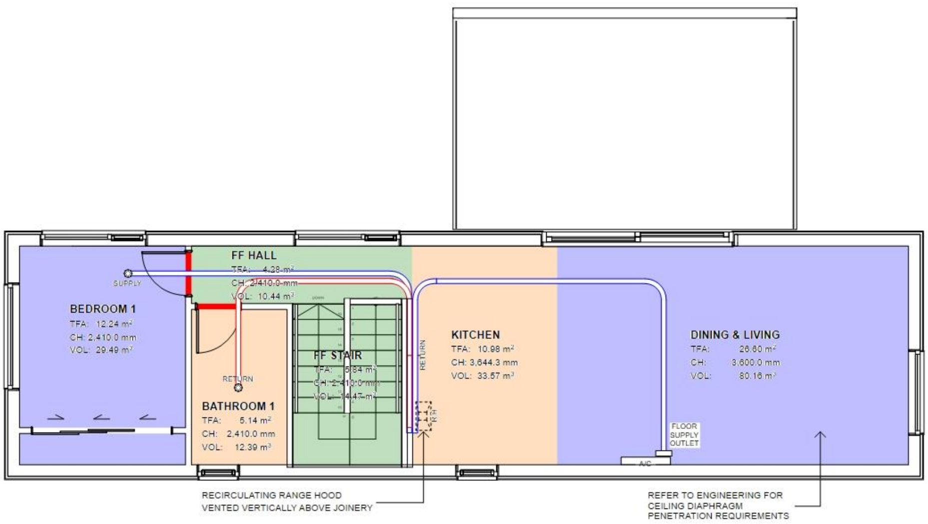
The ducts used were a combination of Zehnder ComfoTube (flexible 90mm round pipe) and Flat 51 (51mm oval, flexible flat pipe). Zehnder valves and other components were also installed.

The internal doors are all undercut 20mm to allow air to circulate between supply zones (Bedroom & Living rooms) to the return zones (Bathrooms, Laundry & Kitchen) via the hallways and stairs which are not directly ventilated.

Photo: Ventilation ducting installation



Ground Floor Ventilation Plan



First Floor Ventilation Plan

12. Heating systems - Wärmeversorgung

Heating and cooling for the house are supplied via a small Panasonic, split system, 2.0kW, air to air heat pump. This system can provide a maximum of 2.0kW cooling and 2.7kw heating. The selected model was a high wall unit mounted in the living area. The outdoor unit is located on the southern side of the dwelling, out of sight.

Hot water heating is supplied with a Reclaim Energy CO2 to hot water heat pump, split system. A tall stainless steel hot water tank with insulated hot and cold water pipes is located inside the laundry room while the outdoor unit is also located on the south side of the dwelling.

13. Building costs - Baukosten

Approximately $870k
$6,800 NZD per square metre.
Including internal fitout and appliances and smart home technology.
Excluding. GST.

14. Publications featuring the building - Literatur

N/A

15. PHPP-Ergebnisse

Passive House Verification

Building:	Arthur Street Townhouse		
Street:			
Postcode/City:	9016	Dunedin	
Province/Country:	Otago	NZ-New Zealand	
Building type:	Dwelling		
Climate data set:	NZ0013a-Dunedin		
Climate zone:	4: Warm-temperate	Altitude of location:	84 m
Home owner / Client:			
Street:			
Postcode/City:			
Province/Country:		NZ-New Zealand	

Architecture:	Architype Ltd.		**Mechanical engineer:**	(Builder)Stevenson & Williams Ltd	
Street:	42 Queens Gardens PO Box 5510		Street:	PO Box 4007, St Kilda	
Postcode/City:	9058	Dunedin	Postcode/City:	9046	Dunedin
Province/Country:	Otago	NZ-New Zealand	Province/Country:	Otago	NZ-New Zealand
Energy consultancy:	Architype Ltd.		**Certification:**	Sustainable Engineering Ltd	
Street:	42 Queens Gardens PO Box 5510		Street:	65B Hungerford Road	
Postcode/City:	9058	Dunedin	Postcode/City:	6023	Houghton Bay
Province/Country:	Otago	NZ-New Zealand	Province/Country:	Wellington	NZ-New Zealand

Year of construction:	2022	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.5	IHG cooling case [W/m²]:	3.2
No. of occupants:	2.6	Specific capacity [Wh/K per m² TFA]:	72	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	113.4				
Space heating	Heating demand	kWh/(m²a)	16.39	≤	15	-	yes
	Heating load	W/m²	10.20	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	2.06	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0.13	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.42	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	101.60	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	44.56	≤	60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	0.00	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Jason	Quinn	
Certificate ID	**Issued on:**	**City:**	
36773_SENZ_PH_20221117_JEQ	17/11/22	Wellington	

Energy balance heating (monthly method)