PassivHaus Project Documentation

Old Holloway
ID: 5132

1.1 Building data

Designer: Juraj Mikurcik

Old Holloway is a new build, single storey family home in Little Birch, Herefordshire (UK), completed in 2017. Built with low impact building materials such as timber, straw, recycled cellulose and clay plasters, the project won UK Passivhaus Trust Award for Small Projects in 2018.

Special features: Ecococon prefabricated timber/ straw panels (passivhaus certified component)

Passive shading including roof overhangs and integrated external blinds

U-value walls	0.130 W/m²K
U-value floor	0.135 W/m²K
U-value roof	0.093 W/m²K
Uw value windows	0.80 W/m²K
PHPP Space Heating Demand	14.9 kWh/m²a
PHPP Primary Energy Demand	89.0 kWh/m²a
Air Test (n50)	0.4 1/h
Heat Recovery Unit Efficiency	87.7%
Frequency of Overheating	0%

1.2 Brief description of the construction task

Old Holloway is a modest, single storey house in rural Herefordshire designed by Juraj Mikurcik for his small family. The 95m^2 (TFA) house is located on an elevated site (224m above sea level) near Aconbury Woods. The south facing plot has far reaching views toward Forest of Dean, and the house is orientated perfectly due south. The house sits on the northern part of the site, and is partially dug into the ground to minimise impact on neighbouring properties.

The house was procured as a self-built project with a tight budget, with Juraj project-managing the construction. The construction commenced in August 2016 and finished in July 2017. The project achieved passivhaus certification in October 2017.

1.3 Project participants

Architect	Juraj Mikurcik
CEPH Designer	Juraj Mikurcik
Services Designer	Green Building Store and Alan Clarke
Drainage Design	Nick Grant
Structural Engineer	Isoquick and Ecococon
Builder	Mike Whitfield Construction Ltd
Certifying Body	WARM Ltd
Certification ID	5132

Author of Project Documentation: Juraj Mikurcik

Date and Signature: 9th December 2019

2 Views of Old Holloway

South view showing big glazed elements and a large roof overhang

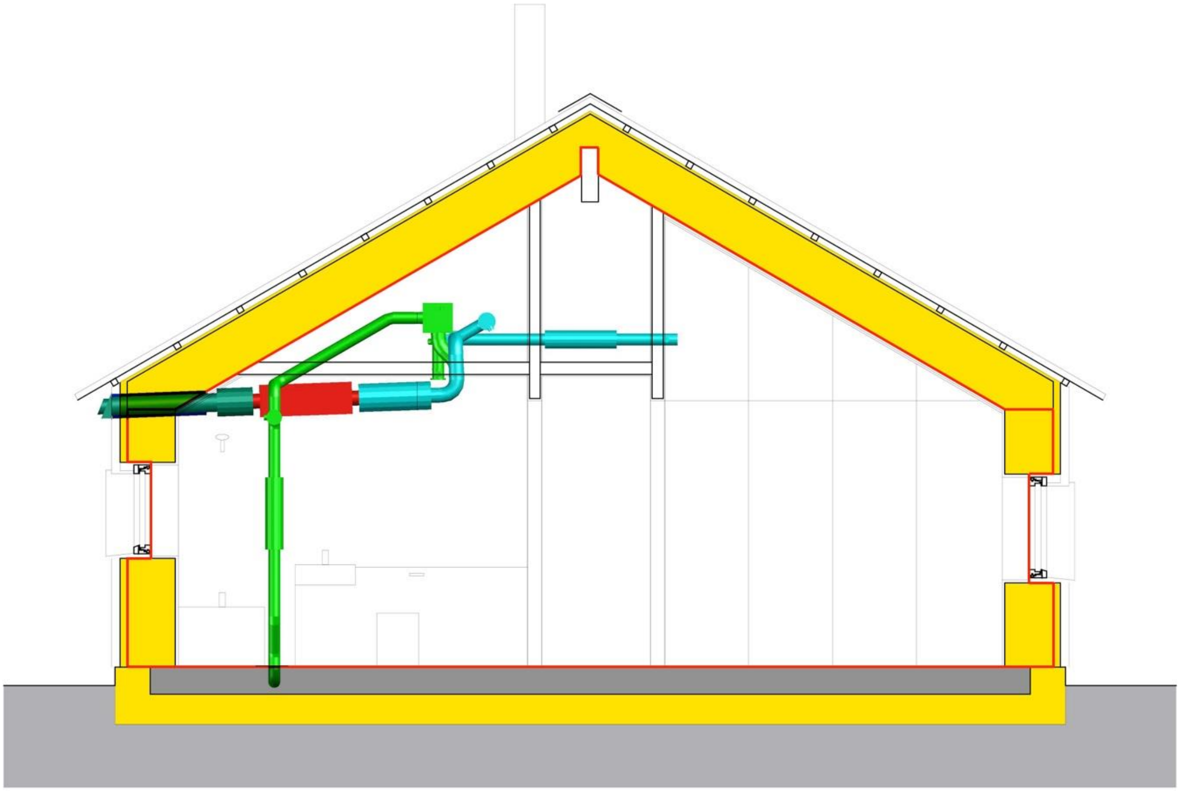
East view. One small window with external blind

West view. Two small windows

North view is unavailable due to close proximity to boundary

Interior view of the open plan dining room, kitchen and living room. Generous south facing glazing is shaded by substantial roof overhang.

3 Sectional drawing

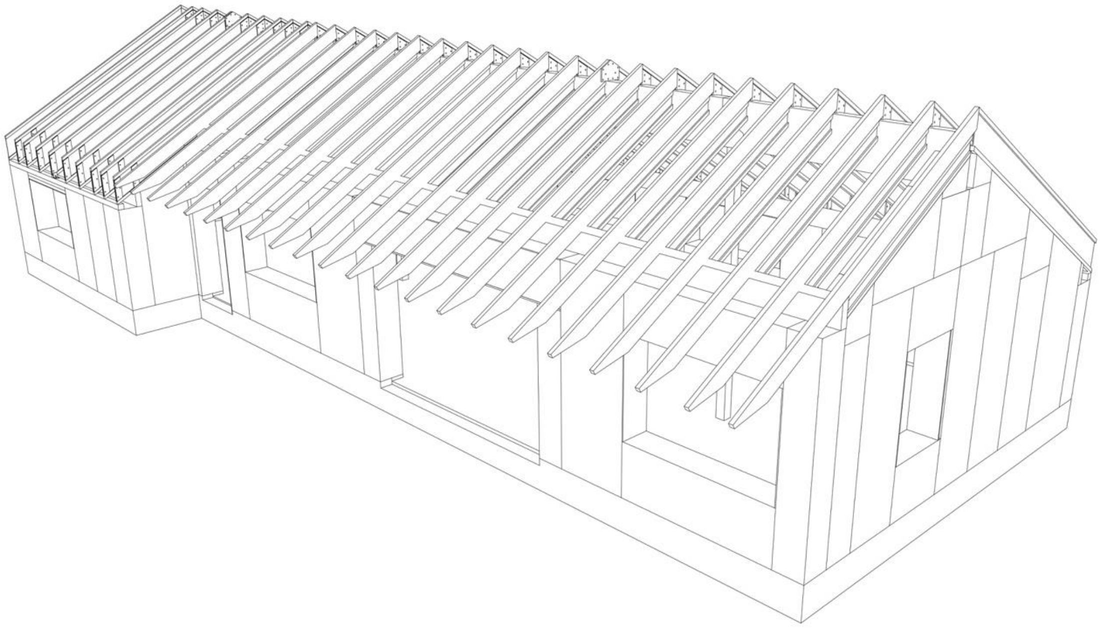


Cross section. Yellow colour represents the insulation zone, red line is the airtightness layer. Ventilation schematic is also indicated.


Roof: summer shading

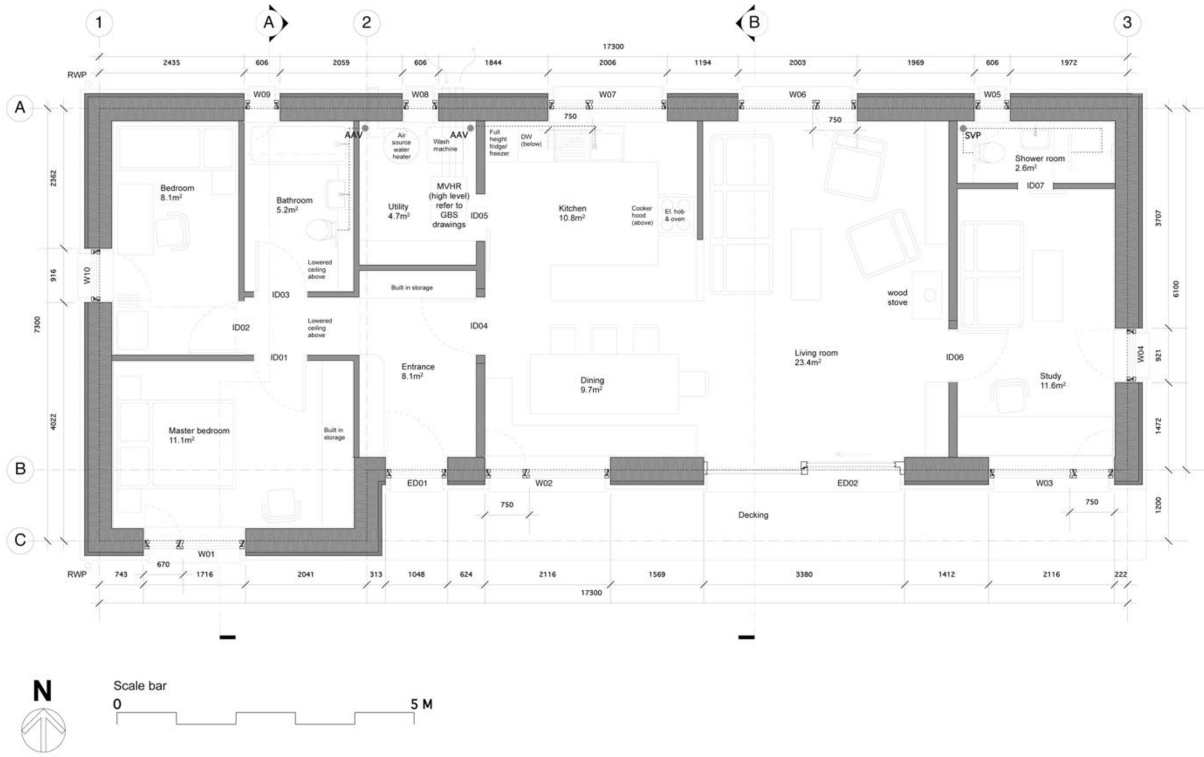

Roof: winter shading

Old Holloway house has been designed as a simple single storey section, extruded over the length of the building, with a significant recess on the south elevation to provide useful shelter and shade. Design of the section has been optimised to allow useful solar gain right into the heart of the house in winter, and to block out unwanted solar gains in summer. The thermal envelope is clearly defined and uninterrupted. Ground floor concrete slab is insulated from the ground with Isoquick EPS foundation system. External walls are prefabricated timber/ straw panels, cantilevered over the concrete slab edge to minimise thermal bridge at the junction. Roof is constructed using 400mm deep timber I-beams, or a combination of 200mm timber I-beams combined with 200mm solid timber joists that cantilever out over the south porch. There is a clear and simple airtightness strategy – see item 6. The central open plan living area and all bedrooms have high ceilings following the roof slope, whereas the bathrooms and small corridor area have flat lowered ceilings. The areas where ceilings are lowered allow for easy distribution of services.


Schematic of Ecococon panel project including roof elements

Aerial view of the construction site showing the walls (before woodfibre installation) and roof elements

4 Floor plan



Old Holloway is a single storey dwelling with pitched roof and a south facing verandah, it's sympathetic to the local vernacular architecture in its scale and massing. The house is cut in to the existing ground, minimising visual impact of the building on the site, neighbouring properties and wider landscape. Orientation of the house is perfect due south, maximising the far-reaching views and working with the existing site contours.

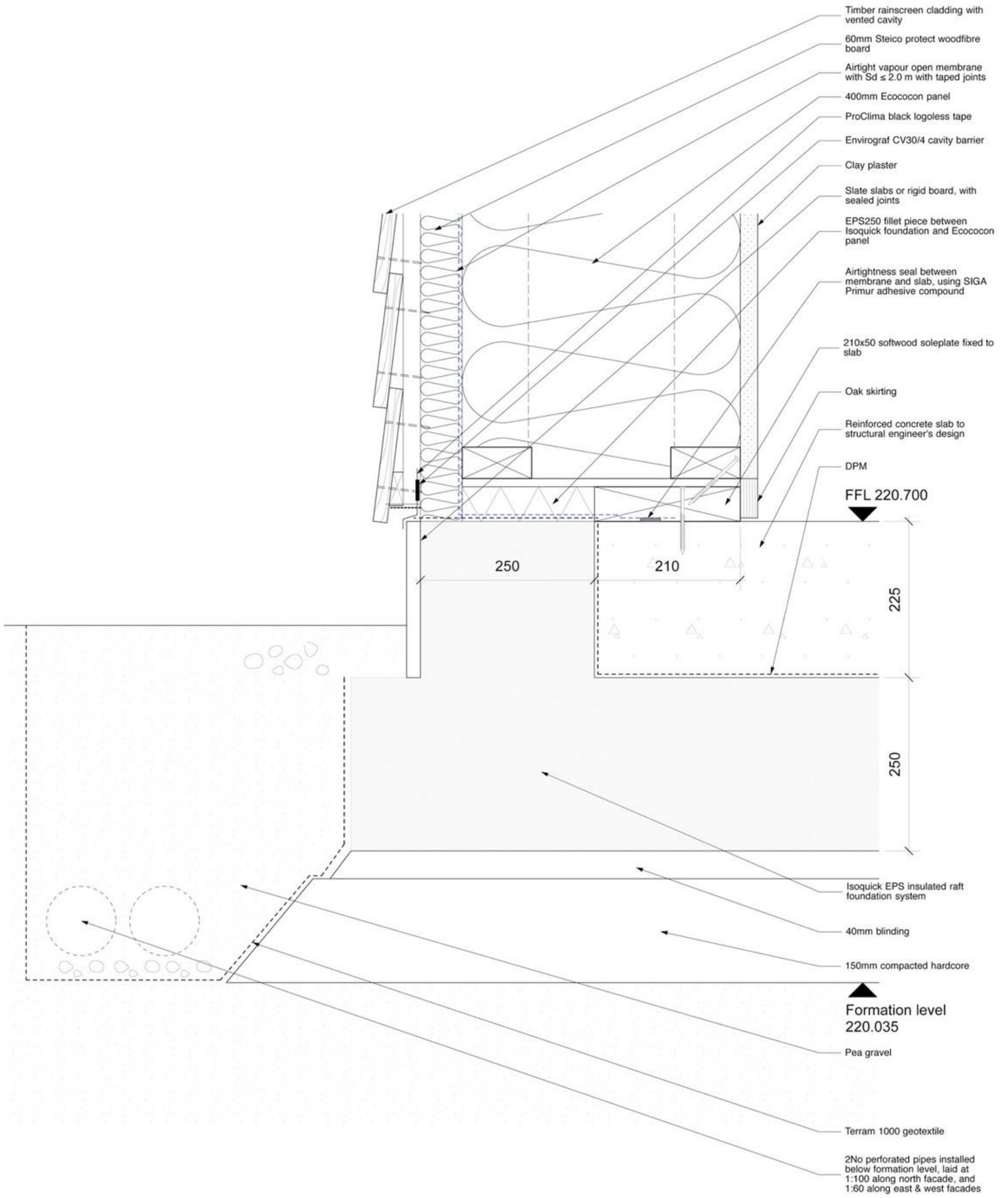
Entrance area under the recessed porch leads to the central 'heart' of the house containing kitchen, dining and living room to the right and 'sleeping block' with a bathroom to the left. The central open plan space has direct access to external deck via a large sliding door. Additional guest room/ study with its own en-suite shower room is located at the east end of the house. Utility room with MVHR and hot water cylinder with ASHP is centrally located adjacent to the kitchen. The house can be used as a two bedroomed house with a study, or as a three bedroomed house, adding flexibility.

Windows are optimised for views and daylighting.

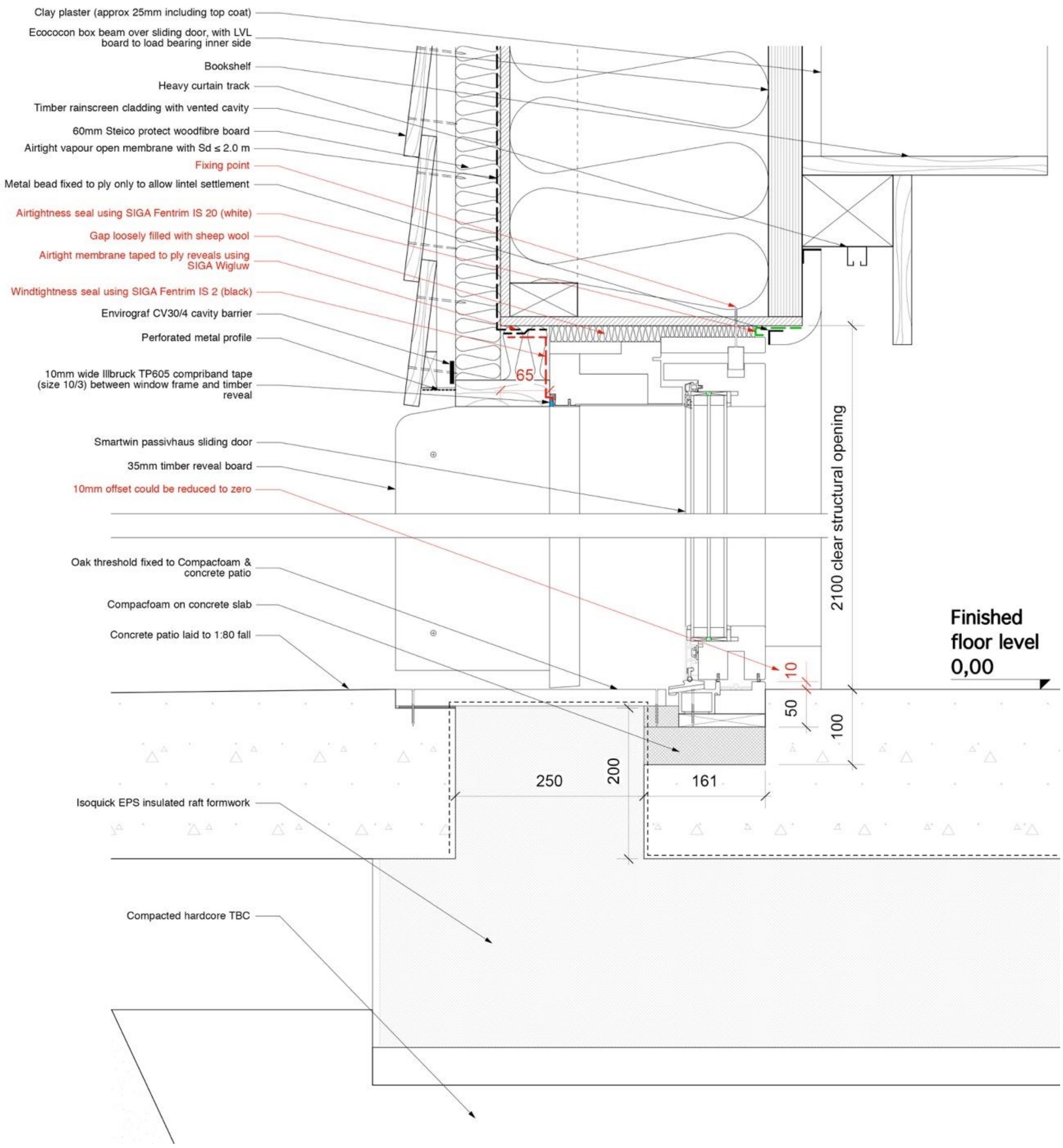
5 Construction details of the envelope

5.1 Construction of the floor slab with junctions of exterior walls and sliding door

Ground floor construction is a 225mm exposed reinforced concrete slab on waterproof membrane, 250mm thick Isoquick ESP insulated foundation system, sitting on 45mm sand blinding and 150mm of compacted hardcore. Isoquick system incorporates perimeter upstands, which help eliminate thermal bridges around the slab edges.



Junction of floor slab with external wall

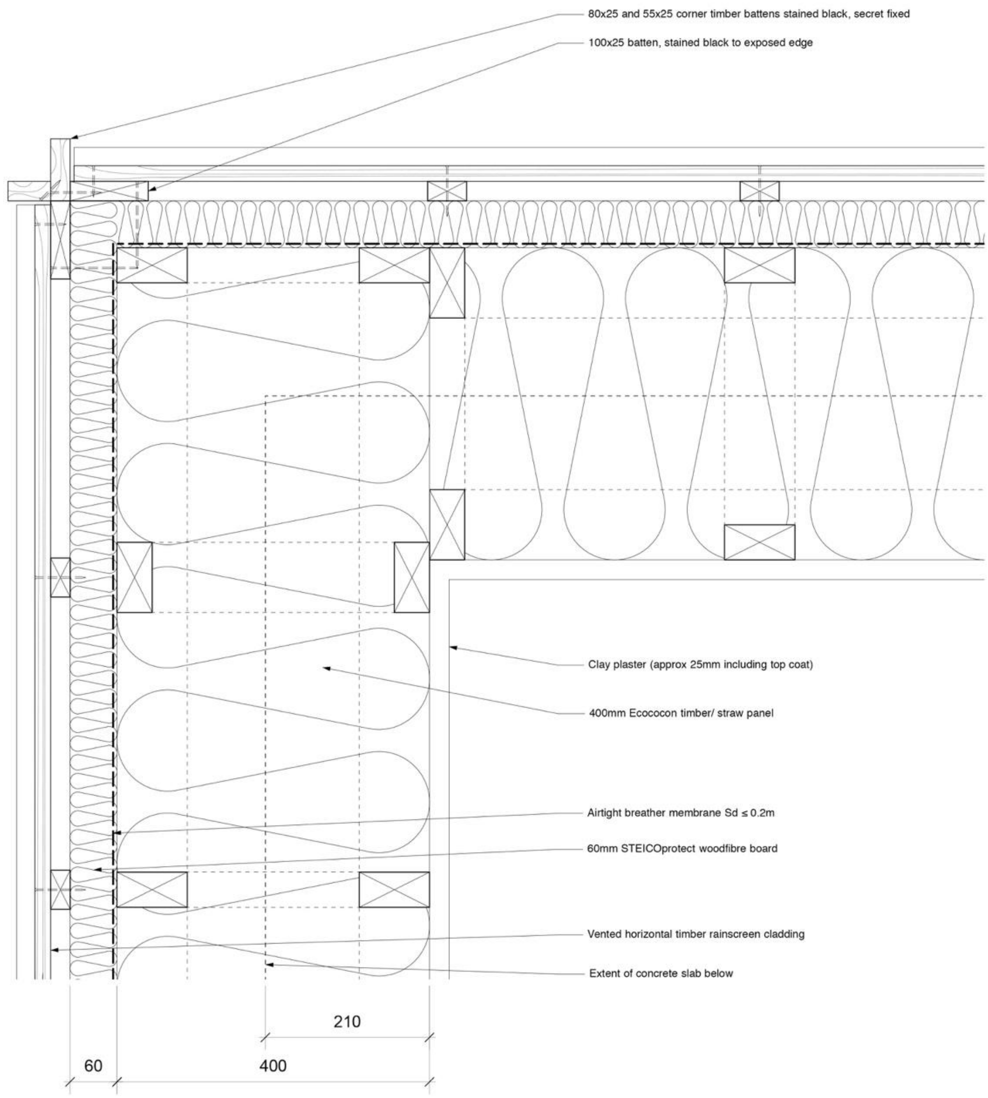


Junction of floor slab with sliding door

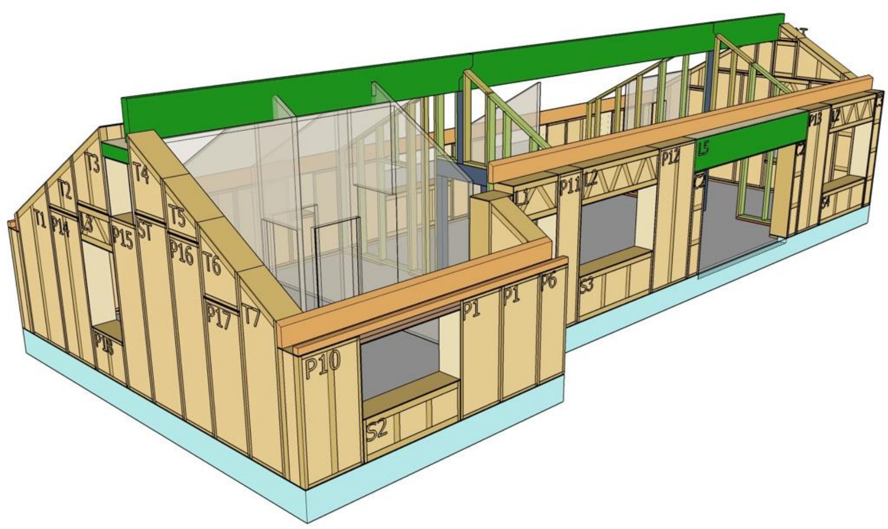
Installation of Isoquick EPS foundation insulation

Pouring of concrete slab

5.2 Construction of the exterior walls



Corner junction of external walls



Schematic of Ecococon prefabricated timber/ straw wall panels
External walls are made from Ecococon prefabricated panels. Ecococon system is a passivhaus certified component and Old Holloway was the first UK project where this system has been used.

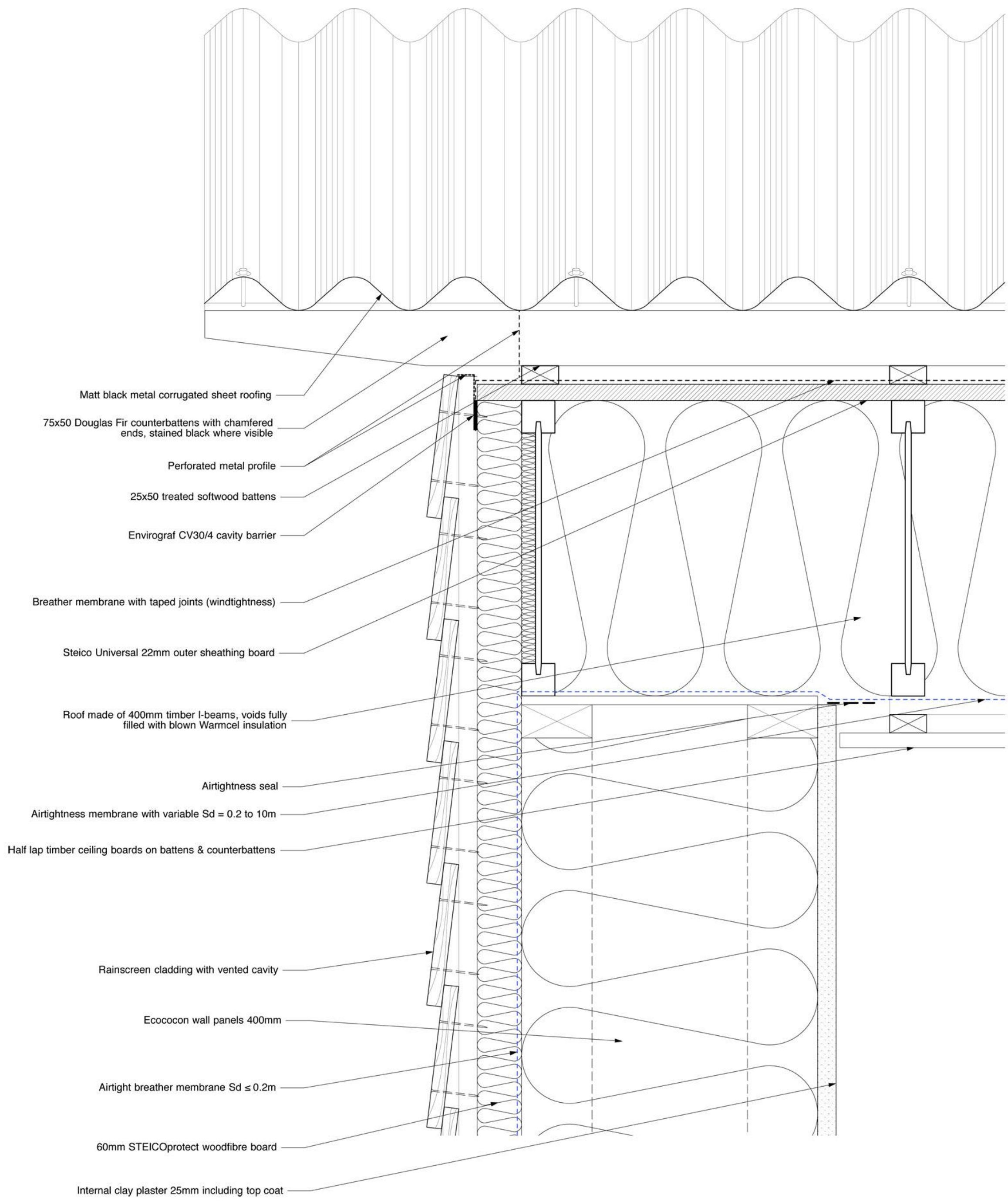
Prefabrication allowed for rapid and accurate construction (example: external walls erected in three days, house watertight in four weeks). Ecococon panels are 400mm thick, internally plastered with self-finished clay plaster (no paints). Externally, Dupont Tyvek Pro airtightness membrane has been fixed to the timber studs and covered with 60mm of Steico Protect woodfibre boards. Locally sourced timber rainscreen cladding has been used as an external finish.

Installation of Ecococon prefabricated timber/ straw wall panels with no heavy machinery needed. All external walls were finished in three days.

Clay plaster applied to Ecococon straw panels wall

Finished window in a clay plastered

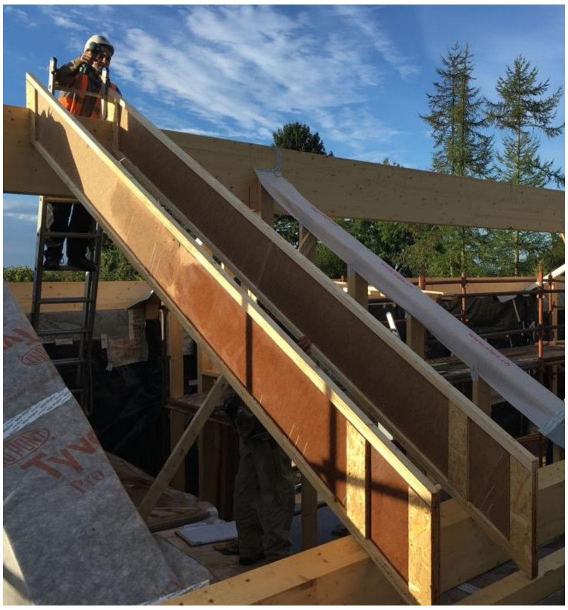
5.3 Construction of the roof



Detail of junction between gable wall and roof

Pitched roofs were constructed using 400mm deep timber I-beams at 600mm centres generally, or a combination of 200mm deep timber I-beams with additional 200x50mm timber joists cantilevering over the porch. Timber I-beams were supported on external walls and on the central ridge glulam beam. The glulam beam was partially recessed into the insulation zone. All voids between the timber I-beams were insulated with Warmcel blown recycled cellulose insulation, ensuring that all spaces were fully filled.

A Siga Majpell 5 airtightness membrane was installed directly under the I-beams, and service installation zone was installed before the final finishes were applied. I-beams were covered externally with 22mm Steico Universal woodfibre board, SIGA Majcoat breather membrane, timber battens and counterbattens and corrugated metal roofing panels were installed as the final finish.



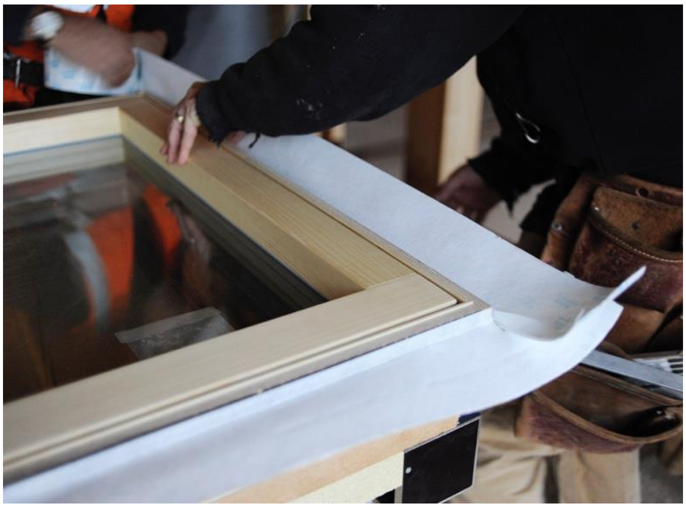
Installation of roof joists

Installation of Warmcel insulation between roof
joists

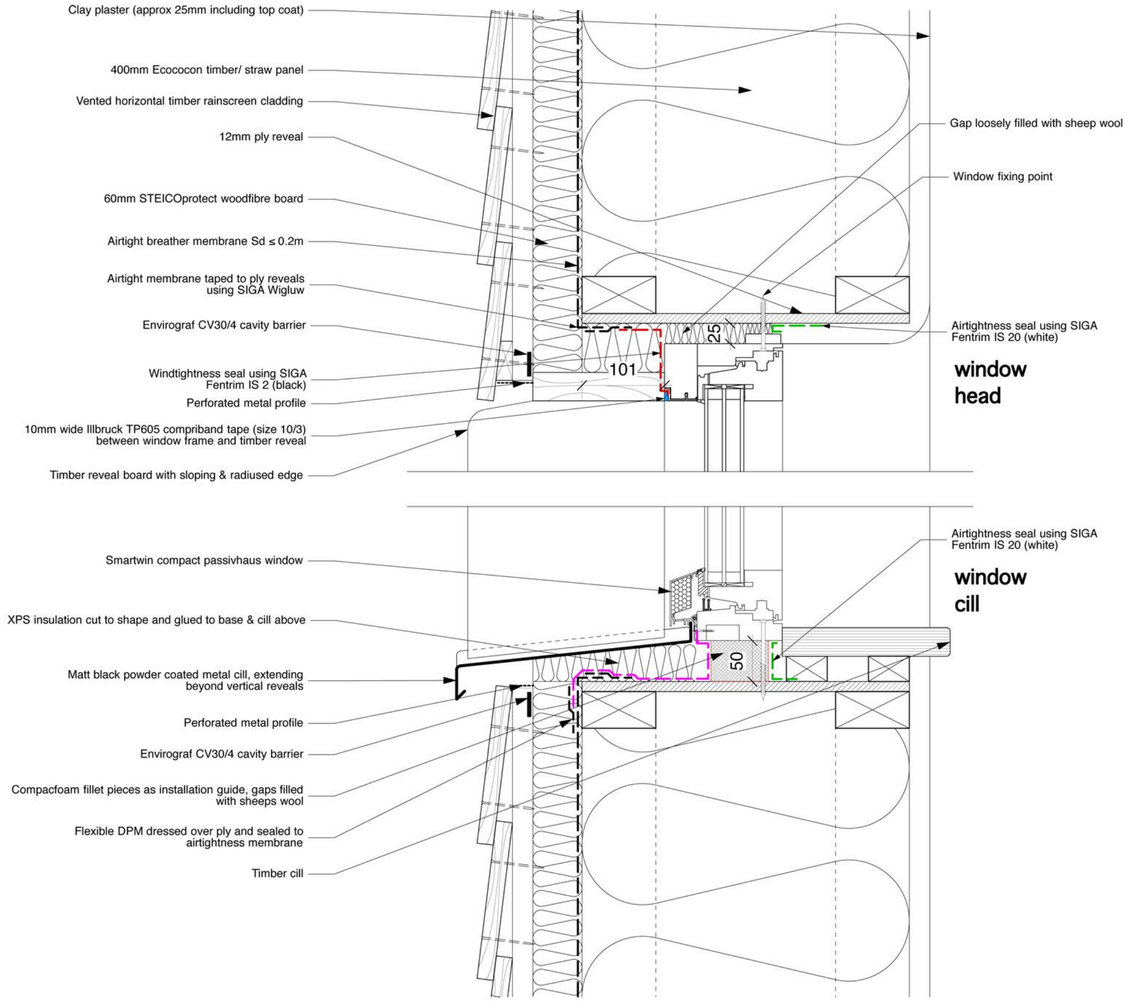
5.4 Windows

Windows and doors are Smartwin passivhaus certified components (phA), supplied by Hoblina (SK). The window and door frames are wooden, with an insulated core, and with further insulation to the outside face. Externally they are aluminium clad. Fixed glazed units, opening windows, sliding doors and entrance doors have been used. Windows and doors incorporate triple glazed units with low-e coatings and Swisspacer Ultimate glazing spacers. Some south and east facing windows include integral external blinds that help to control solar gains during summer months. Windows were sealed to plywood reveals using SIGA Fentrim IS 20 airtightness tapes. Gaps between frames and plywood reveals were filled with sheep wool insulation, and externally the frames were sealed using SIGA Fentrim IS 2 tapes.

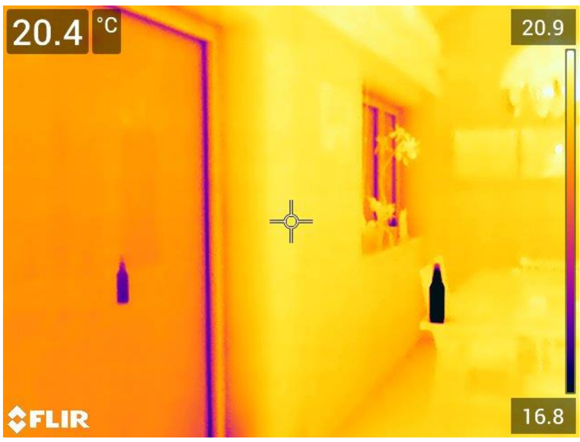
Uf U-value	between 0.53 and 0.93 W/m^{2}K (depending on location)
Glass U-value	between 0.53 and 0.64 W/m^{2}K (depending on location)
Glass g-value	between 0.54 and 0.62 (depending on location)
Overall Uw U-value	0.80 W/m^{2}K (average)



Airtightness tapes pre-installed to window frames *Window installation into plywood reveals*



Details of a typical window cill and head



Infra red image of the sliding door. Cold beer reflected in glass

Photo of window cill and integral external blind

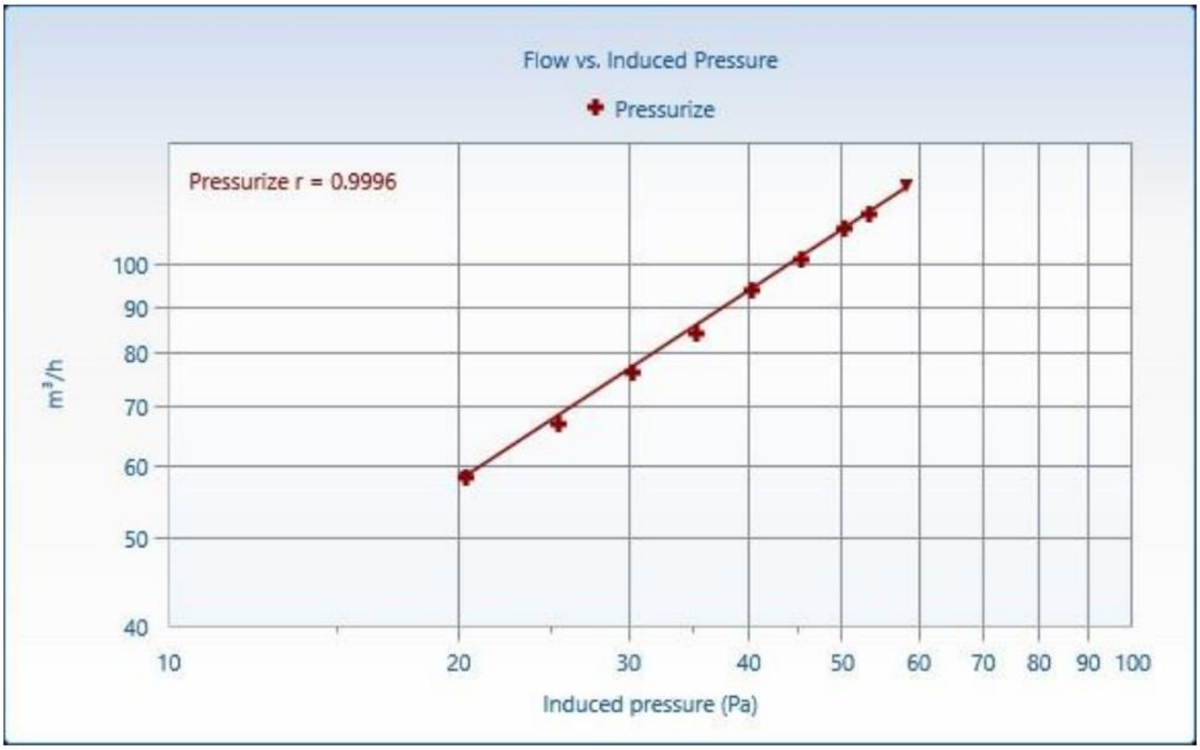
6 Airtightness

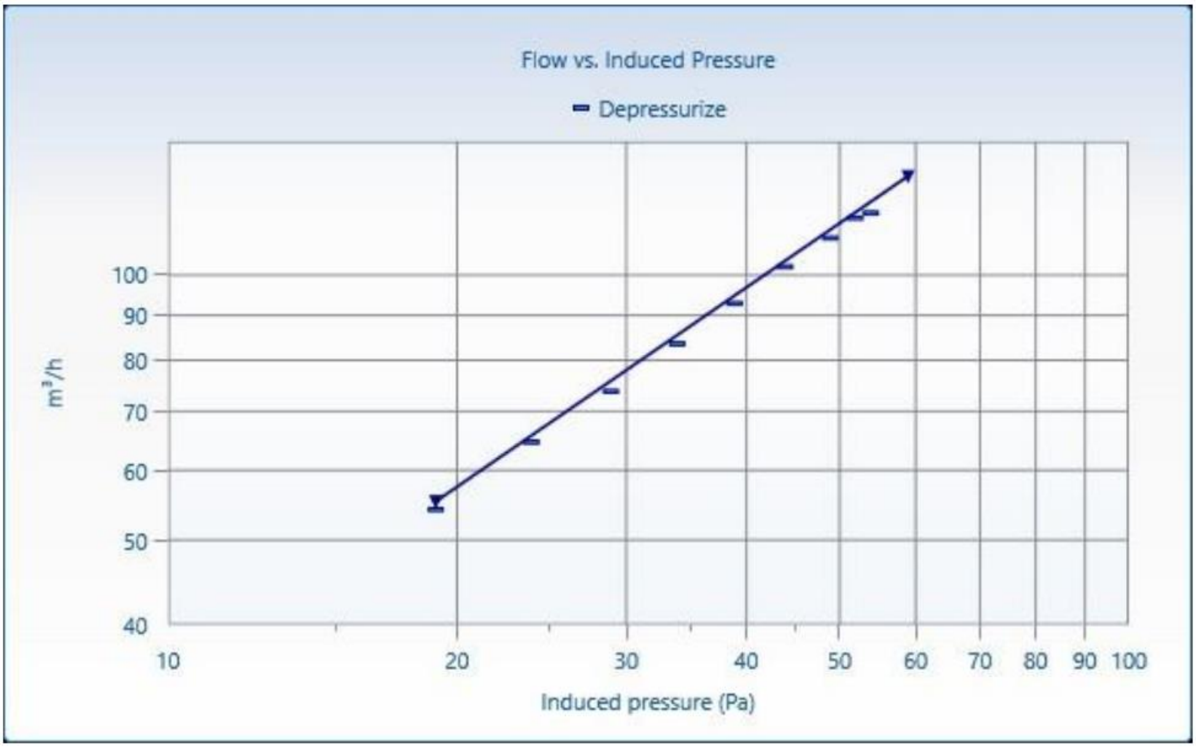
There is a clear and simple airtightness strategy. Concrete slab is inherently airtight. Slab is sealed to an airtight membrane fixed to the outer face of prefabricated wall panels, sandwiched between the panel and 60mm external woodfibre board. It is important to point out that the airtightness membrane on walls is very vapour open with Sd value of ≤ 0.2 to minimise risk of interstitial condensation in the straw insulation zone. Airtightness membrane then moves back to the inside below roof structure and continues as a high Sd value membrane below roof timber I-beams. The membrane is sealed to the ridge glulam beam. Two pressure tests were carried out. The first one was done by Paul Jennings at an early stage when the windows were in but no internal plastering was done. This indicated a good result of n50 0.36 air changes per hour. Nick Grant helped during the air test and used a smoke gun to check and identify leaks. The final air test was done just before completion by Melin, and the result was n50 0.38 air changes per hour (n50 pressurised was 0.3703 and n50 de-pressurised was 0.3856 ac/h).

Initial air test with Paul Jennings and Nick Grant. Notice the small fan installed in the window

Nick Grant checking for air leaks using smoke gun

Airtightness membrane sealed to glulam wall plate, before airtightness membrane was installed under roof timber I-beams





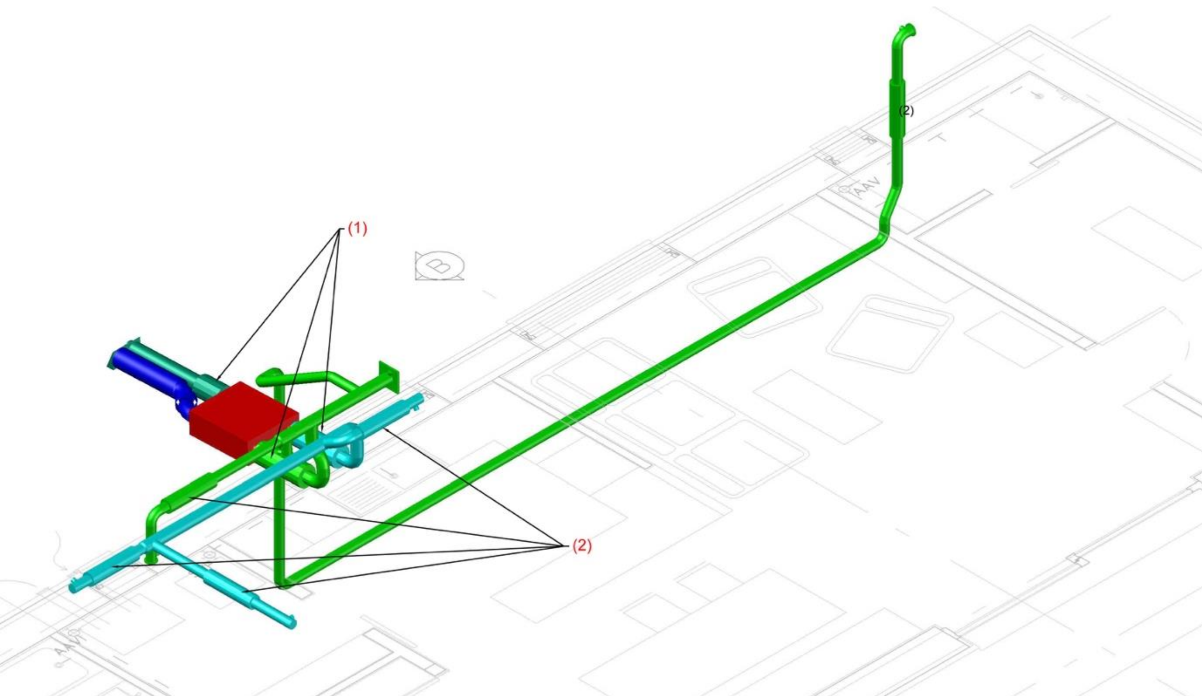
Pressurise and de-pressurise graphs of the final air test

7 Ventilation

7.1 Ventilation design

Old Holloway has a simple, minimal ventilation system based around Zehnder Comfoair 160 VV Luxe MVHR unit (certified passivhaus component with efficiency of 87.7% and Pel ≤ 0.45 Wh/m³) and Lindab steel ductwork, supplying fresh air to occupied spaces and extracting from bathrooms, kitchen and utility store via a cascade system. The MVHR unit has a built-in frost protection and automatic summer bypass (set at 21C). The system was designed by Green Building Store and Alan Clarke, and commissioned by Alan Clarke and Nick Grant.

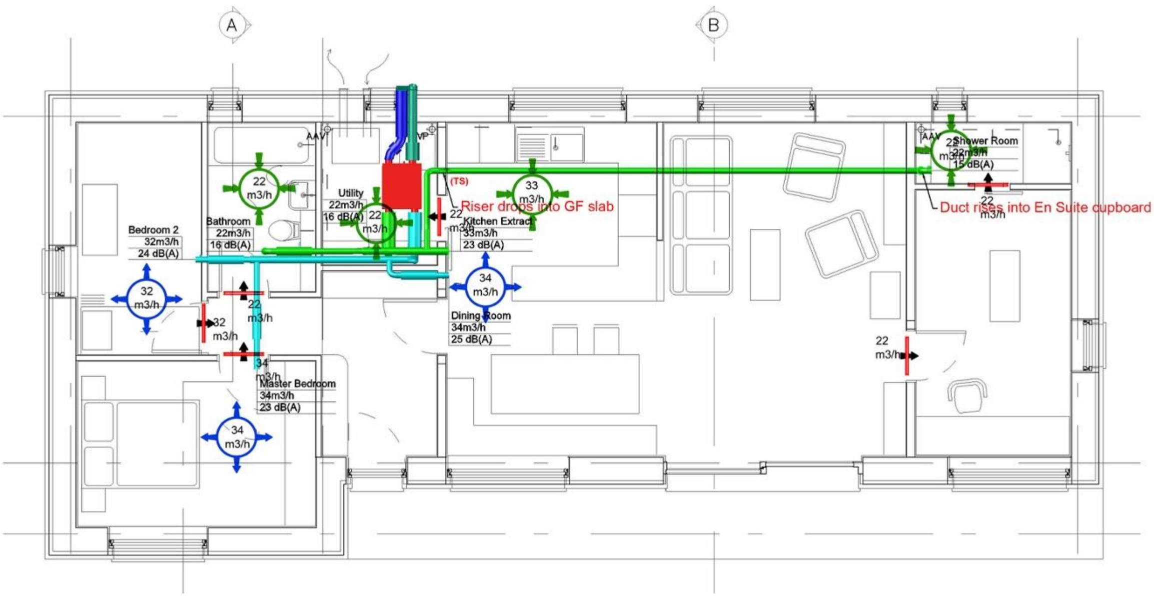
Alan Clarke and Nick Grant commissioning the ventilation system



3D schematic of the ventilation system

7.2 Ventilation ductwork

MVHR unit is centrally located in the Utility room, with short insulated fresh air intake & exhaust ducts through external wall, terminating via a combined Maico terminal. Ductwork is Lindab circular steel type, with crosstalk attenuators near every room terminal. Fresh air is supplied to Master bedroom, Bedroom 2 and Dining room. Air is moved between rooms via gaps under doors (Entrance hall and Study are the air transfer areas), and extracted in Bathroom, Shower room, Utility room and Kitchen. The system has three air flow settings: low (70m^3/h), standard (100m^3/h), and boost (130m^3/h). Typically, it runs on the standard setting.



Drawing of the ventilation system with air flow rates

Ceiling mounted MVHR unit

8 Heat supply system

The main space heating is provided by a small 4kW wood burning stove (Morso S11-42), with Poujoulat Efficience triple wall flue. This is a completely room sealed system with good airtightness seals. No radiators or underfloor heating are used.

Supplementary heating is provided by small towel rails in bathrooms, connected to DHW cylinder. Domestic hot water is provided via Ariston Nuos 200 hot water cylinder with integral air source heat pump.

Installation of wood stove and flue

Finished installation

Triple wall flue roof terminal with integral air intake and exhaust

9 Brief documentation of important PHPP results

Passive House Verification

		Building:	Old Holloway Cottage
		Street:	
		Postcode/City:	HR2 8BA / Little Birch
		Province/Country:	Herefordshire / GB-United Kingdom/ Britain
		Building type:	House
		Climate data set:	GB0014a-Sennybridge
		Climate zone:	3: Cool-temperate; Altitude of location: 224 m
		Home owner / Client:	Juraj Mikurcik & Joyce Freeman
		Street:	
		Postcode/City:	HR2 6PQ / Aconbury
		Province/Country:	Herefordshire / GB-United Kingdom/ Britain
Architecture:	Juraj Mikurcik	**Mechanical system:**	Green Building Store
Street:		Street:	Heath House Mill
Postcode/City:	HR2 6PQ / Aconbury	Postcode/City:	HD7 4JW
Province/Country:	Herefordshire / GB-United Kingdom/ Britain	Province/Country:	Yorkshire / GB-United Kingdom/ Britain
Energy consultancy:	Juraj Mikurcik	**Certification:**	WARM: Low Energy Building Practice
Street:		Street:	3 Admirals Hard
Postcode/City:	HR2 6PQ / Aconbury	Postcode/City:	PL13RJ
Province/Country:	Herefordshire / GB-United Kingdom/ Britain	Province/Country:	Devon / GB-United Kingdom/ Britain

Year of construction:	2016	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]:	2.6	IHG cooling case [W/m²]:	2.6
No. of occupants:	2.3	Specific capacity [Wh/K per m² TFA]:	100	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	95.6				
Space heating	Heating demand	kWh/(m²a)	15.0	≤	15	-	yes
	Heating load	W/m²	12	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	0	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.4	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	89	≤	120		yes
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	142	≤	-	-	-
	Generation of renewable energy	kWh/(m²a)	0	≥	-	-	

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

The key information from the PHPP Verification sheet

10.1 Overall construction costs

Approximately €1,560/m² of gross internal floor area

10.2 Building costs

Approximately €156,000 including VAT rebate for a self-build project

11 User experience

LIVING IN OLD HOLLOWAY PASSIVE HOUSE

The first year threw extremes of both heat and cold at Old Holloway cottage – so how did it fare?

Juraj and Joyce moved in during the of summer 2017, but the house maintained a steady 20 to 21C, without heating, well into the autumn. It wasn't until November that they felt cold enough to light the stove, which they continued to do every couple of nights or so through the winter. They report that it generally only needs to burn for an hour if the sun has been out, but longer when the weather has been grey.

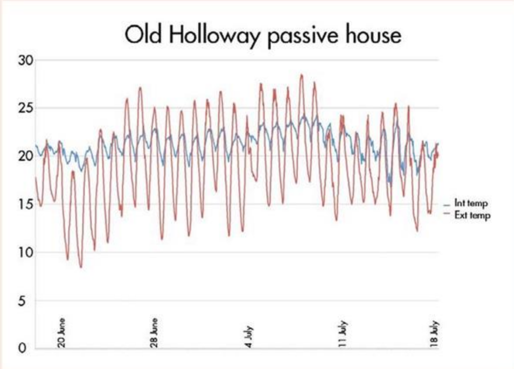
Even when the 'beast from the east' struck last February, indoor temperatures were remarkably even. Not only was that episode bitterly cold, it was also very windy: the kind of weather where airtightness comes into its own.

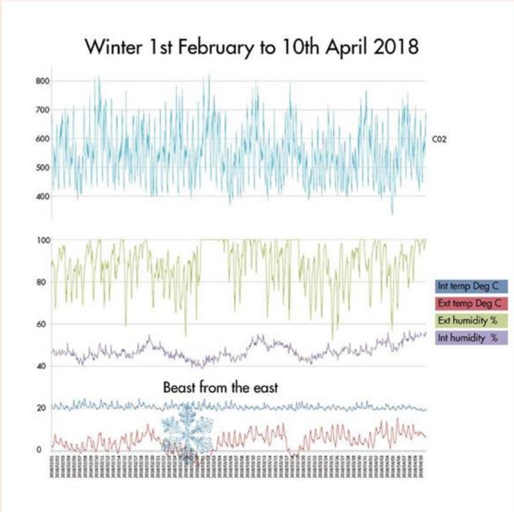
So far Joyce and Juraj haven't spent a penny on firewood, as the first winter only used up around one cubic metre of construction offcuts, and Juraj reckons there is another three winters' worth left — a dramatic contrast to costs at their previous home.

Between the south-facing glazing, the stove and any additional heat gains (e.g. from cooking), the living area tends to be a couple of degrees warmer than the bedrooms, which is how Juraj and Joyce — and indeed many people — like it.

And then of course there was 2018's summer. Passive House Plus visited the house on a warm muggy day, and it felt pleasantly cool inside. And this is borne out by the monitoring results. Overall, PHPP predicted 0% overheating, and despite this year's prolonged heatwave, this has been achieved, with internal temperatures remaining below 25C (the passive house definition of overheating) at all times.

While outside temperatures regularly hit 25C to 27C, inside the temperature generally peaked around 22C or 23C, with night purges bringing it back down to around 20C each night. As the hot weather carried on, indoor peaks to some extent reflected conditions at night: a spell in early July where night-time temperature lows outside started to edge upward saw indoor temperatures creep up too, towards 24C, but with outdoor daytime highs of 27 and 28, this still felt very comfortable, Juraj says.





User feedback from the article in Passive House Plus magazine, Issue 27

Measured energy consumption

Calculated space heating demand based on 1m^3 of burnt wood over the winter heating season of 2017/2018 (assumed calorific value 1,800kWh per tonne and weight of 500kg/m^2 timber) is 9.5 kWh/m^{2}a. Ariston Nuos 200 water cylinder with integrated air source heat pump consumed 1,641 kWh or approx. 32kWh per week between July 2017 and July 2018, providing all domestic hot water and some space heating via towel rails in bathrooms for six months of the year. Difficult to estimate the portion of energy used for heating the towel rail as it is not sub-metered. Conservative estimate is approximately 15% of output to towel rails and 85% for domestic hot water. Total electricity use was 4,457kWh between October 2018 and October 2019.

Old Holloway during 'Beast from the East' Feb 2018

12 Reference to publications relating to this project

Case study in Passive House Plus magazine, issue 27
Project blog: www.oldholloway.wordpress.com