Passivhaus Project Documentation

Woodlands, Storridge,
West Midlands, UK.

Passive House Database ID: 6159
Technical drawings in this document are not drawn to scale

1. Abstract

'Woodlands' is a single family house located in a peaceful valley near Storridge in Herefordshire. The Isoquick base was installed and poured on site with the green oak frame and external softwood panels being manufactured offsite in nearby Hereford and transported to site for erection.

1.1 Building Data

Year of construction	2019	**Space heating**	**13 kWh/(m²a)**
U-value external wall	0.102 W/(m²K)		
U-value floor slab	0.124 W/(m²K)	**Cooling & dehumidification demand**	2 kWh/(m²a)
U-value roof (avg.)	0.090 W/(m²K)		
U-value window (avg.)	0.890 W/(m²K)	**Non-renewable Primary Energy (PE)**	98 kWh/(m²a)
Heat recovery	88.8 %	**Pressure test n_{50}**	$0.48 h^{-1}$

© TJ Crump Oakwrights Ltd

1.2 Project Description

Designed by the in-house architecture team at Oakwrights, Woodlands was conceived to satisfy the desire of the clients to achieve a Passivhaus property whilst still incorporating a green oak frame as had been their original request.

The extant planning permission on the site was for the replacement of a bungalow with a relatively modest two storey cottage. With the site being in an Area of Outstanding Natural Beauty (AONB) and in order to replicate the volumetric space that this proposal afforded, the justification of a larger external volume was required by way of demonstration of the increase in material thicknesses required over those previously assumed to achieve the Passivhaus standard.

A change of orientation was also required to ensure that the dwelling could be designed as efficiently as possible to make best use of the expansive areas immediately south of the property.

The entire architectural process was undertaken in SketchUp, alongside evolutionary developments of a PHPP model directly extracted by the use of the designPH plugin.

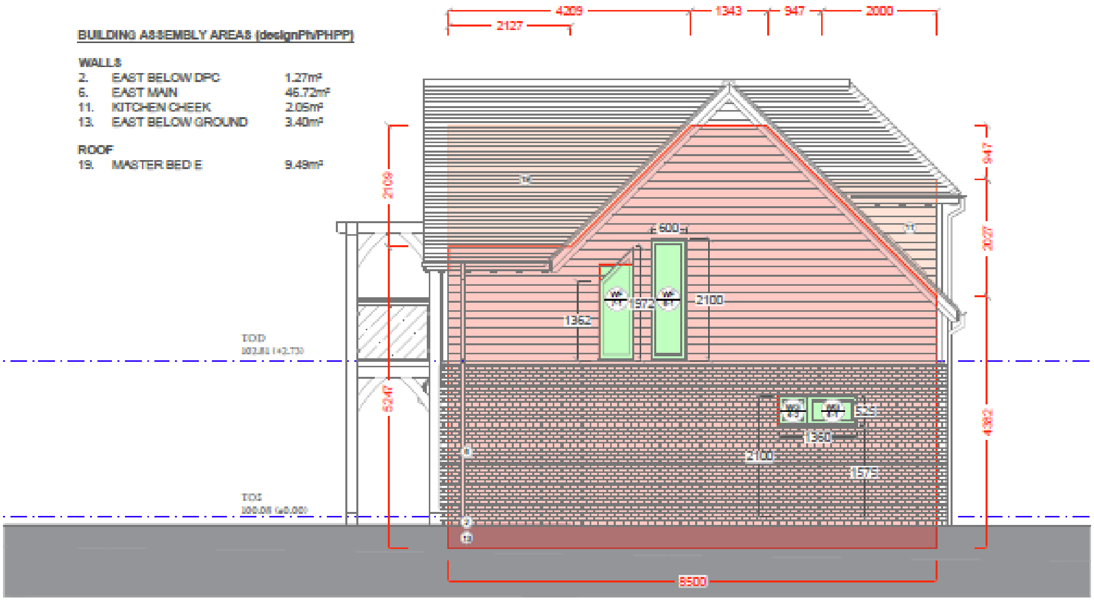
1.3 Responsible Project Participants

Architectural Designer:	David Bryan – www.oakwrights.co.uk
Building Services:	Green Building Store / Energy Zone
Main Contractor:	Furber Young Developments Ltd
Energy Consultant (PHPP):	David Bryan – www.oakwrights.co.uk
Certifying Body:	WARM: Low Energy Building Practice
Certificate ID:	22567_WARM_PH_20190917_MR
Document Author:	David Bryan – www.oakwrights.co.uk

2.0 Elevations – Drawings and Photographs

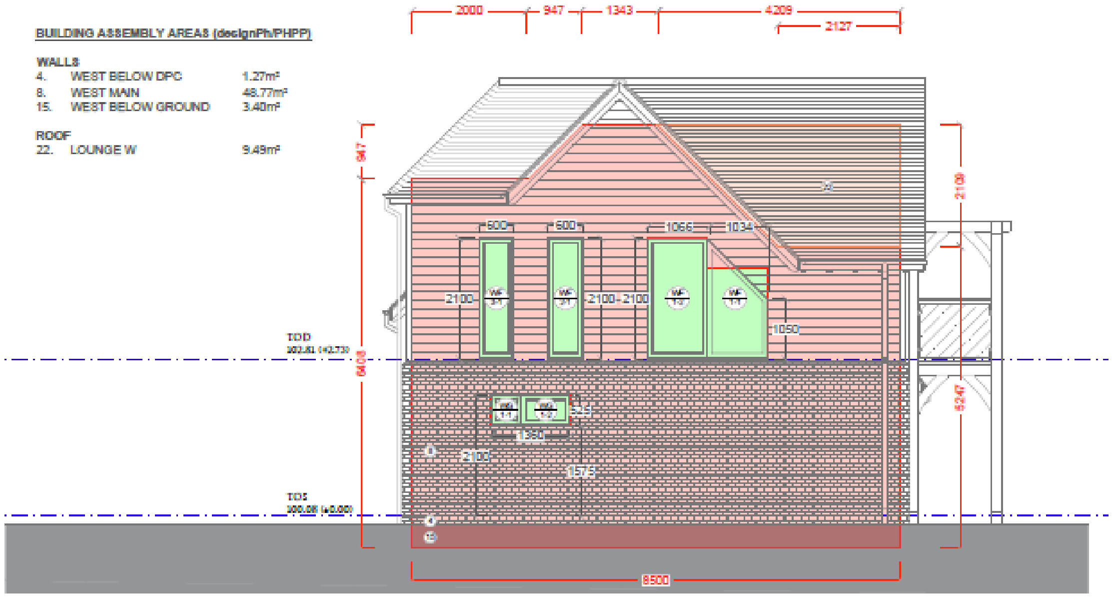
2.0.1 South Elevation

2.0 Elevations – Drawings and Photographs (continued)



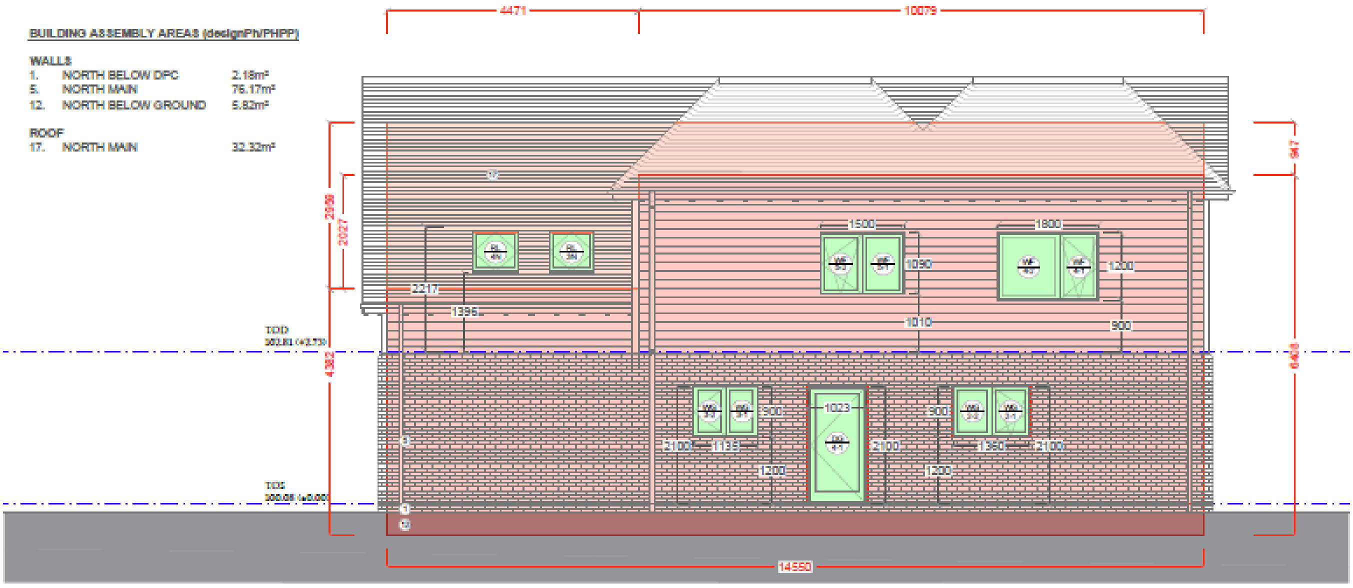
2.0.2 East Elevation

2.0 Elevations – Drawings and Photographs (continued)



2.0.3 West Elevation

2.0 Elevations – Drawings and Photographs (continued)



2.0.4 North Elevation

2.1 Internal Design

Example showing to green oak frame on RC slab and inboard of airtightness layer

Example of taping of panel joints (void battens left short for ease of taping)

Example of sliding doors sealed to slab prior to pouring of screed

The oak frame is specifically designed to be the primary support structure without penetrating any of the external walling. This retains the simple panel to panel connections and enables ease of construction.

Kitchen through to Dining Room

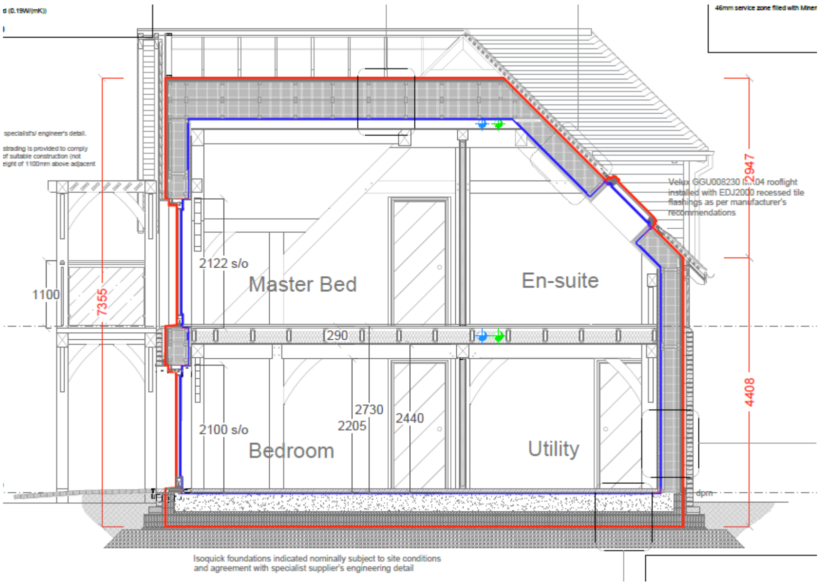
Living Room from Dining Room

Hall from Bedroom Door

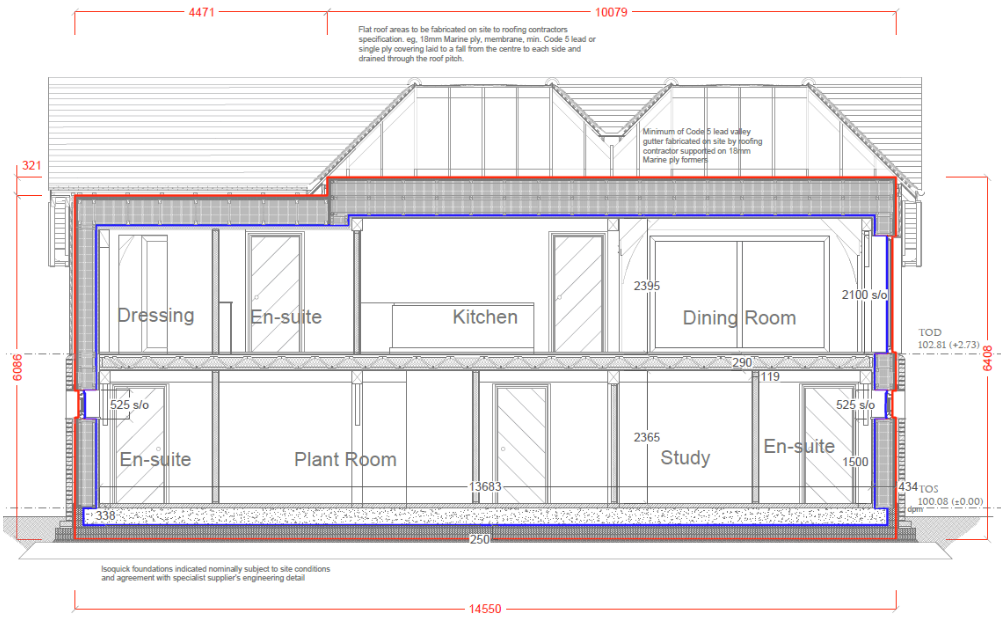
3.0 Building Sections

The following images represent two of the sections of the building illustrating the main intersection points and the airtightness and heated envelopes. The master bedroom section shows a brise soleil structure to the top of the balconies; this was replaced with a retractable shade by the clients.

3.0.1 Section through Master Bedroom and Bedroom Two



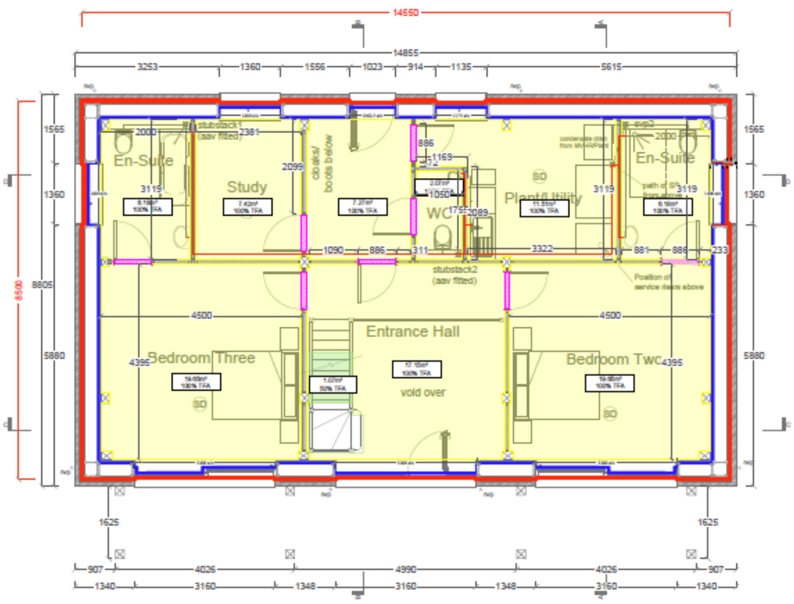
3.0.2 Section through Main section of Dwelling



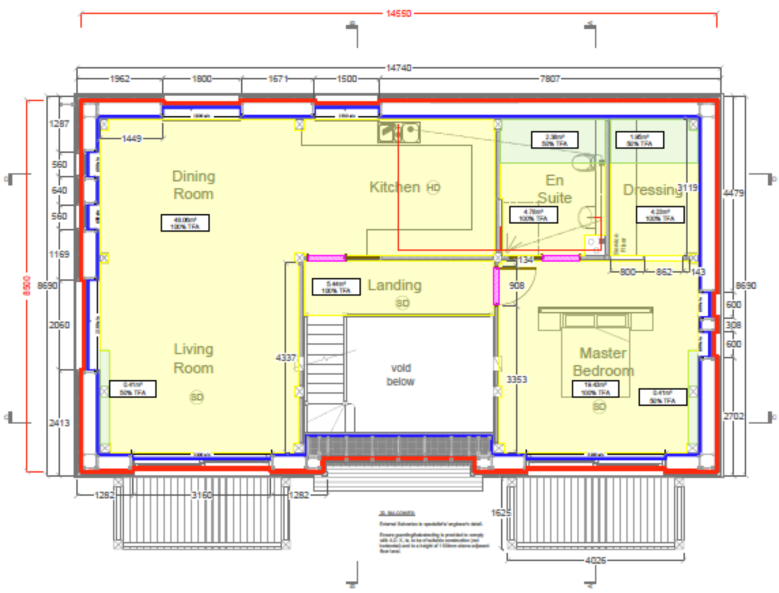
4.0 Floor Plans

The main house is configured as an upside-down dwelling to allow the maximum use of ambient light within the living areas and take advantage of the additional elevation to appreciate the views to the Malvern Hills to the south across the site. Access is provided from both the living room and master bedroom onto balconies which in turn provide the external shading to the south façade. There are also two guest bedrooms to the lower floor, each with access to the outside via sliding doors, shaded by the balcony structures above.

4.0.1 Ground floor plan



4.0.2 First floor plan

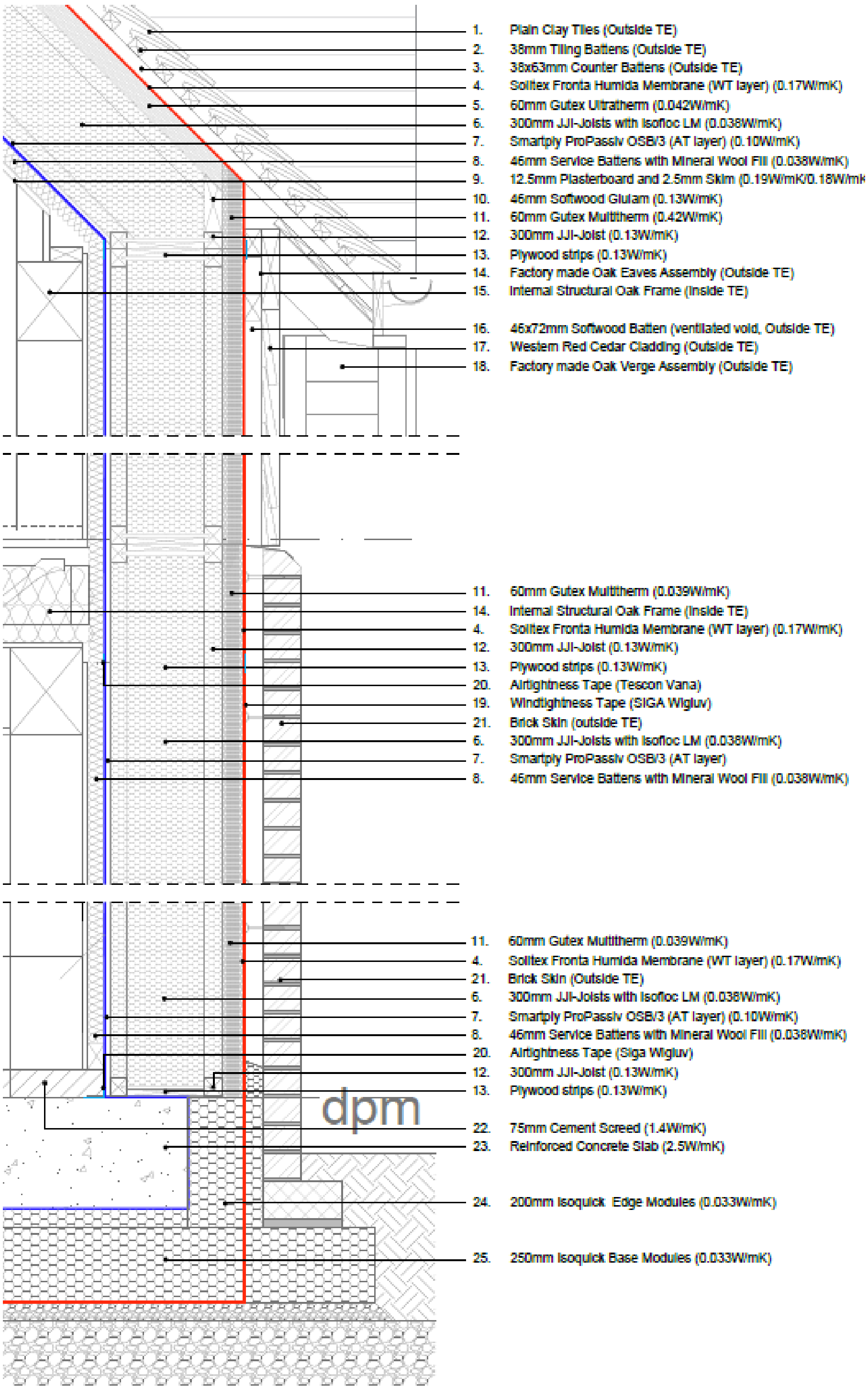


5.1 Construction Details

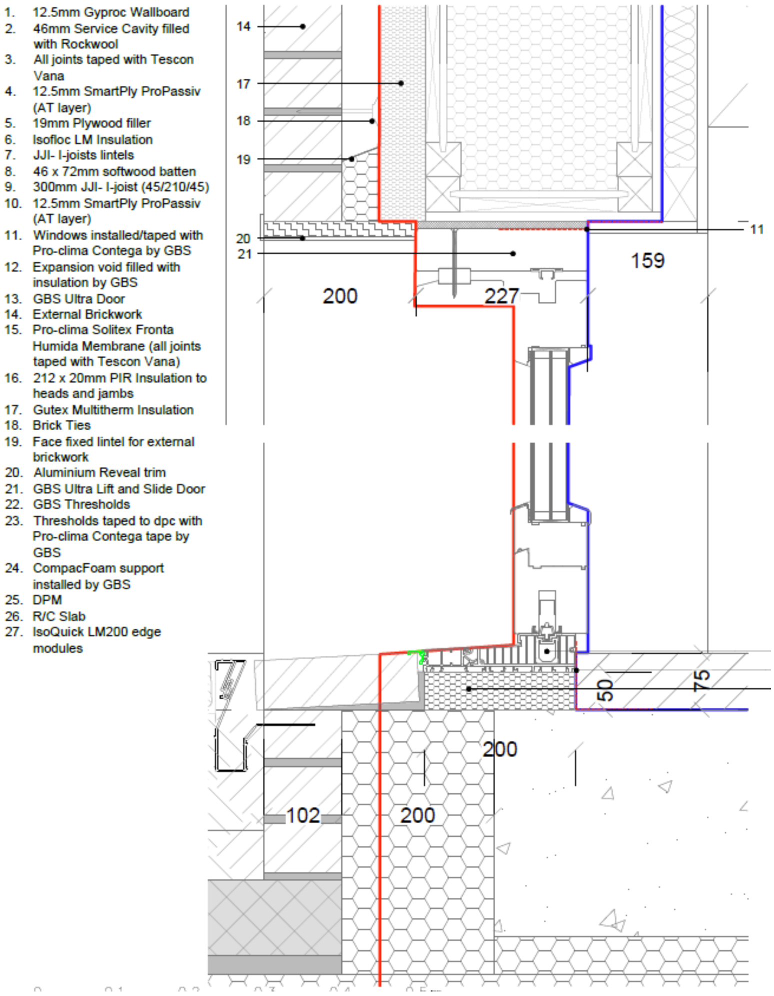
This section illustrates some of the critical junctions within the envelope.

The prefabricated walls and roof were transported to site, craned into place following the erection of the oak frame and all junctions checked for continuity of insulation and taped both internally and externally.

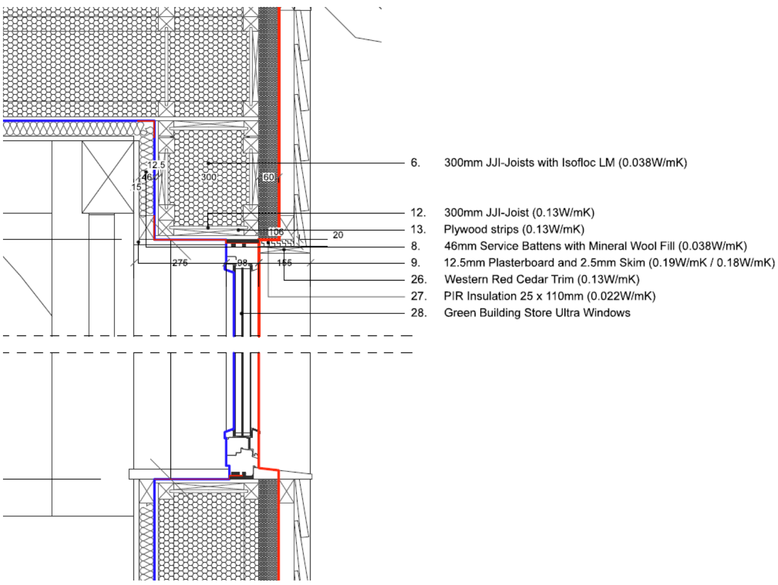
5.1.1 Primary wall details of the connections at floor slab, intermediate floor and eaves



5.1.2 Primary details of a ground floor sliding door installation



5.1.3 Primary details of a typical first floor window installation



The windows used throughout the house were supplied and fitted by Green Building Store from their Ultra tilt and turn range. Manufactured from FSC® certified redwood, these

98mm thick windows provide a practical solution suitable for use in a Passivhaus. The Dual compression seals fitted allow for long-term airtightness and the use of Proclima Contega tapes to seal the windows into the wall structure ensures the continuity of the airtightness layer throughout the building. The glazing varied slightly due to the requirements of Building Regulations but u-values ranged from 0.51W/m²K to 0.52W/m²K with g-values of 49 – 53% and frame u-values of 1.03W/m²K to 1.17W/m²/K. The rooflights used were Velux GGU008230 PH-certified units with frame u-values of 0.70W/m²K and glazing u-values of 0.51W/m²/K and g-values of 43%. These were installed with the use of SIGA tapes to ensure airtightness continuity.

6.0 Airtightness strategy and air test results

After being previously involved with a Certified Passivhaus where we used a separate membrane internally as the airtight layer we learnt that it was an added difficulty in providing the best detailing in terms of the taping of this membrane, particularly behind the oak timbers where access is severely limited. The enclosure system was evolved to incorporate SmartPly ProPassiv OSB board as the primary airtight layer in both the wall and roof constructions, with Tescon tapes utilised at the junctions for the airtightness continuity. Again, the corners were premanufactured in such a way that although an additional panel joint was created, it was much easier to access this and tape effectively.

Within the slab build-up, a heavy gauge damp proof membrane was incorporated, with this being taped to the wall structure and the ProPassiv was then also taped to the slab with Tescon tapes to provide an additional barrier.

An initial air test highlighted some issues with the centre seals on a set of sliding doors and two rooflights, which were remedied by the fitment of new seals.

The tests were carried out by db Air Tightness Testing

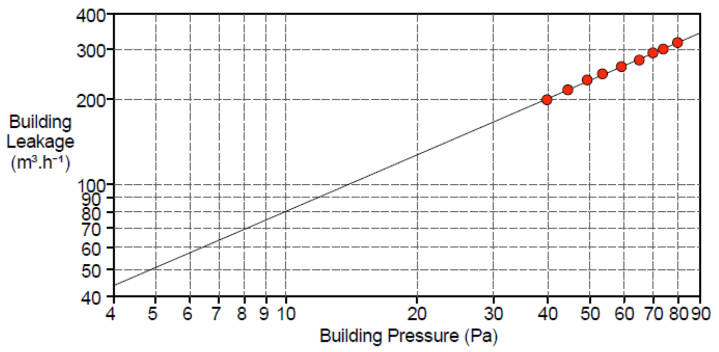
6.0.1 Depressurisation Test Results

Test Results		Q_{50}: Airflow ($m^3.h^{-1}$):	233
Measured Air Permeability ($m^3.h^{-1}.m^{-2}$)@50Pa	0.54	Design Air Permeability ($m^3.h^{-1}.m^{-2}$)@50Pa	0.65

Test Information		Regulation complied with:	ADL1A-2013
Test Method:	A	Test Standard:	EN13829
ATTMA TS1 Leakage Area (m^2):	0.012	Type of Test:	Depressurisation

Building Leakage Curve			
Air Flow Coefficient (C_{env}) ($m^3.h^{-1}.Pa^{-n}$):	17.4	Air Leakage Coefficient (C_L) ($m^3.h^{-1}.Pa^{-n}$):	17.5
Exponent(n):	0.662	Coefficient of Determination (r^2):	0.9982

Air Leakage Graph



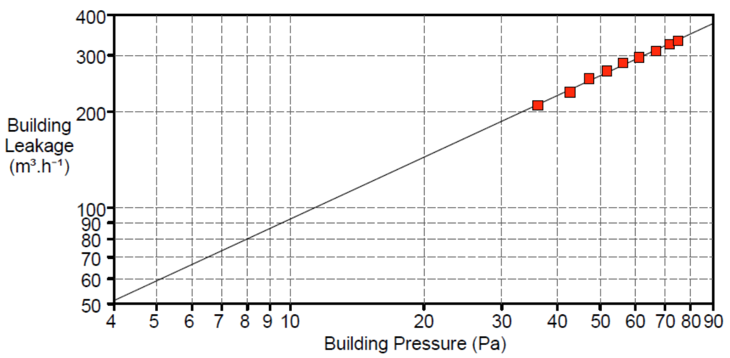
6.0.2 Pressurisation Test Results

Test Results		Q_{50}: Airflow ($m^3.h^{-1}$):	259
Measured Air Permeability ($m^3.h^{-1}.m^{-2}$)@50Pa	0.60	Design Air Permeability ($m^3.h^{-1}.m^{-2}$)@50Pa	0.65

Test Information		Regulation complied with:	ADL1A-2013
Test Method:	A	Test Standard:	EN13829
ATTMA TS1 Leakage Area (m^2):	0.013	Type of Test:	Pressurisation

Building Leakage Curve			
Air Flow Coefficient (C_{env}) ($m^3.h^{-1}.Pa^{-n}$):	21.1	Air Leakage Coefficient (C_L) ($m^3.h^{-1}.Pa^{-n}$):	21.1
Exponent(n):	0.641	Coefficient of Determination (r^2):	0.9938

Air Leakage Graph



6.0.3 Air test certificate

Registered Certificate of Air Permeability Test
(Low Energy Building)

Test Credentials

Test Provider:	DB Air Tightness Testing
Address:	16 Milford Close, Walkwood, Redditch, England, B97 5PZ
Test Engineer:	David Bevan
Qualification:	Level 1
Tester Registration No:	0134
Unique Certificate No:	10539933

Building and Test Details

Building or Plot No:	Woodlands
Tested Building Address:	Woodlands, Batchcombe Lane, Storridge, Herfordshire WR13 5ES

Footprint (GFA, m^2):	105.2		
Surface Area (m^2):	428.6	Volume (m^3):	1.0
Date of Test:	07 February 2019		

Temporary sealing (Positive):

All traps and toilets were filled and MVHR was sealed and all internal doors were kept open.

Temporary sealing (Negative):

All toilets and basins were filled MVHR was sealed and all internal doors were kept open.

Deviations (Positive):

None

Deviations (Negative):

None

Simplified Test Data and Result

This certificate is a short form report. If a full compliant report is required, please contact the testing company. Enquiries about this certificate should be made to: Scheme Manager, ATTMA, First Floor, Flint House, Flint Barn Court, Church Street, Amersham, Buckinghamshire, HP7 0DB or visit www.attma.org.

The key Leakage characteristics of the building are:

	Result (AP_{50})	Result (ACH_{50})	Target (ACH_{50})
Positive:	0.54 $m^3.h^{-1}.m^{-2}$ @50Pa	231.44 $m^3.h^{-1}.m^{-3}$ @50Pa	
Negative:	0.60 $m^3.h^{-1}.m^{-2}$ @50Pa	257.16 $m^3.h^{-1}.m^{-3}$ @50Pa	0.60 $m^3.h^{-1}.m^{-3}$ @50Pa
Average:	0.57 $m^3.h^{-1}.m^{-2}$ @50Pa	244.30 $m^3.h^{-1}.m^{-3}$ @50Pa	

6.0.4 Derivation of Air Test Result Data to $_n50$ values

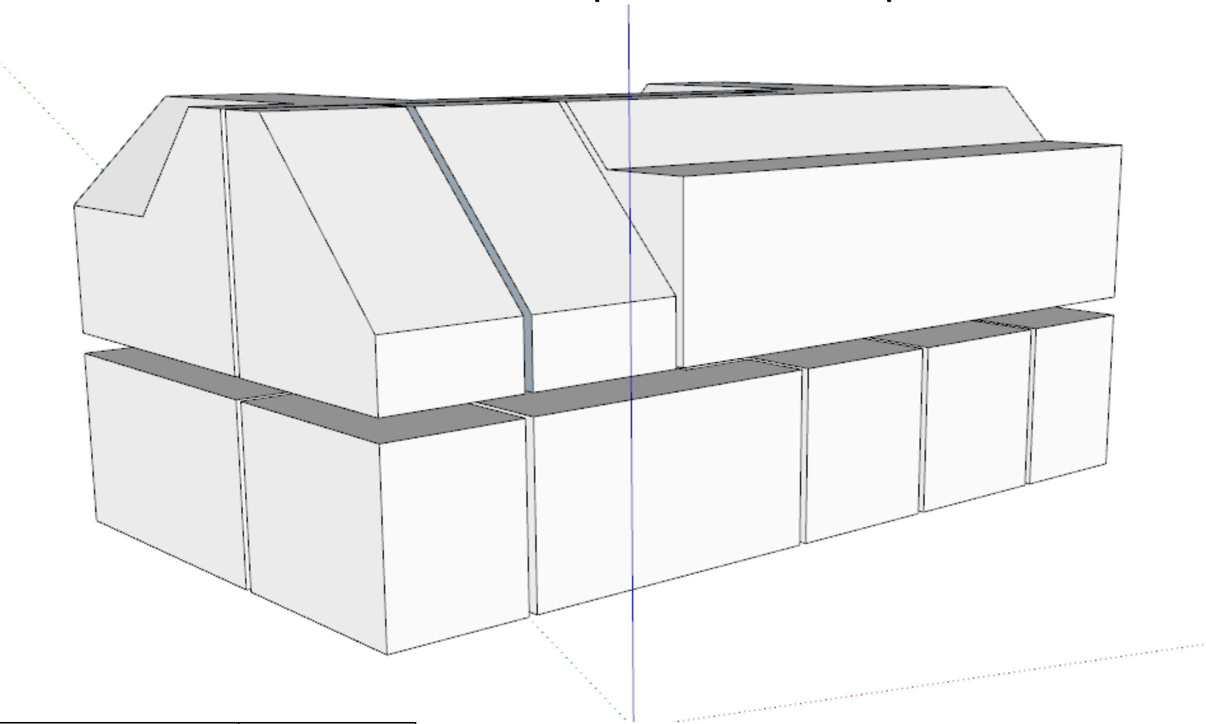
Airflow result obtained from Pressurisation Air Test carried out on 7th February 2019 by David Bevan

Q_{50}: Airflow ($m^3.h^{-1}$):	**259**

Airflow result obtained from Depressurisation Air Test carried out on 7th February 2019 by David Bevan

Q_{50}: Airflow ($m^3.h^{-1}$):	**233**

Volumetric Data calculated from 3D SketchUp model of the envelope



Kitchen/Lounge	138.168m3
Hall/Landing	86.31m3
Master Bed	58.171m3
Dressing	14.835m3
ES	16.608m3
Bed 2	48.226m3
Bed 2 ES	15.214m3
Bed 3	48.226m3
Bed 3 ES	15.214m3
Study	18.113m3
Rear Hall	17.755m3
Utility	28.208m3
WC	5.045m3
TOTAL	**510.093m3**

6.0.5 Calculation of $_{n}50$ result from derived and calculated data

$$_{n}50 = \frac{V_{50}}{V_{n}50}$$

Therefore,

Pressurisation Result

$$_{n}50 = \frac{259m^3}{510.093m^3}$$

$$\mathbf{_{n}50 = 0.508h^{-1}}$$

Depressurisation Result

$$_{n}50 = \frac{233m^3}{510.093m^3}$$

$$\mathbf{_{n}50 = 0.457h^{-1}}$$

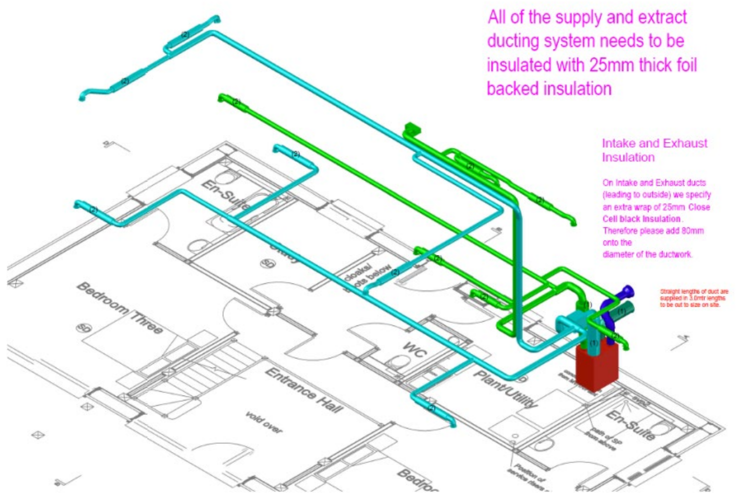
Average Result

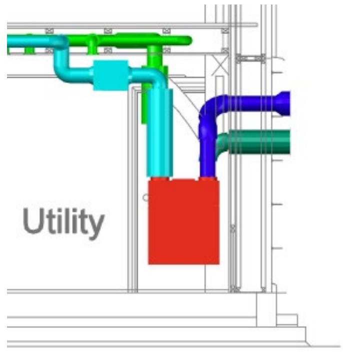
$$_{n}50 = \frac{246m^3}{510.093m^3}$$

$$\mathbf{_{n}50 = 0.482h^{-1}}$$

7.1 Ventilation layout

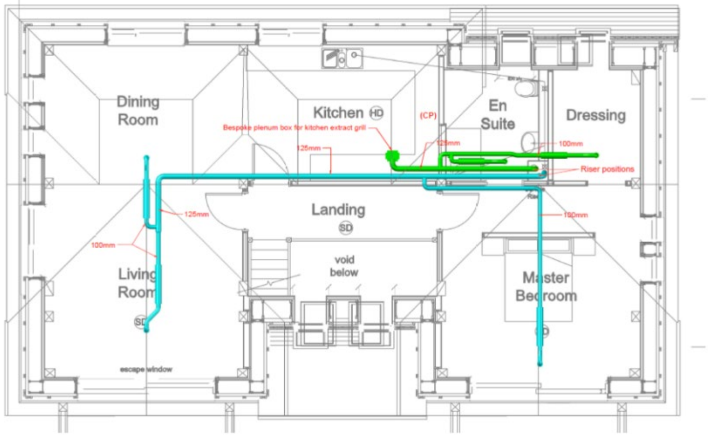
The heat recovery unit is located in the utility room along with the majority of the plant for the house. The intake and exhaust for the unit are to the north façade to benefit from the shaded area of the house. There are no issues at all with air quality at this remote location as the house is at the head of a private no-through road. The unit is located close to the north wall to minimise the lengths of ductwork required and maximise the efficiency.



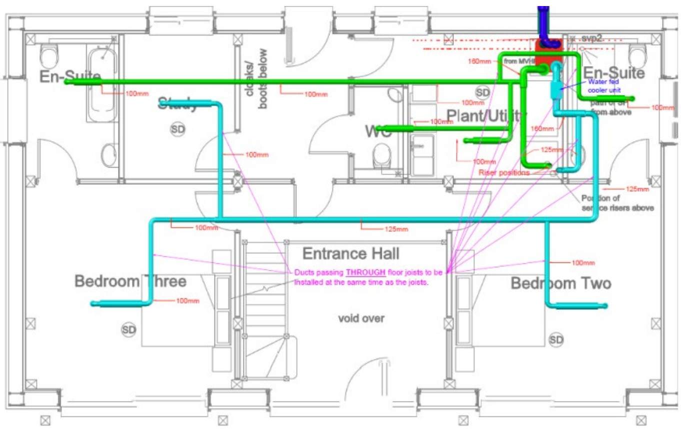


Elevational view of unit installation

3D ductwork layout (extract – green, supply – blue)



First floor plan (colours as above)



Ground floor plan (colours as above)

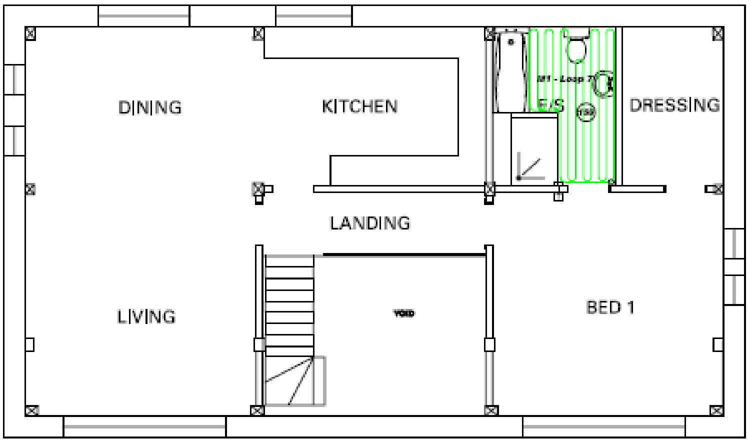
7.2 Ventilation Unit

The unit utilised in the building is a PH-certified (0956vs03) Zehnder ComfoAir Q350, with a derived efficiency of 88.8% as calculated with the duct lengths and an electrical efficiency of 0.24 Wh/m³. It is also fitted with a cooler battery operating off the GSHP on demand, as the clients had the desire to be able to control this more should external temperatures rise in the future, beyond those allowed in the climate data.

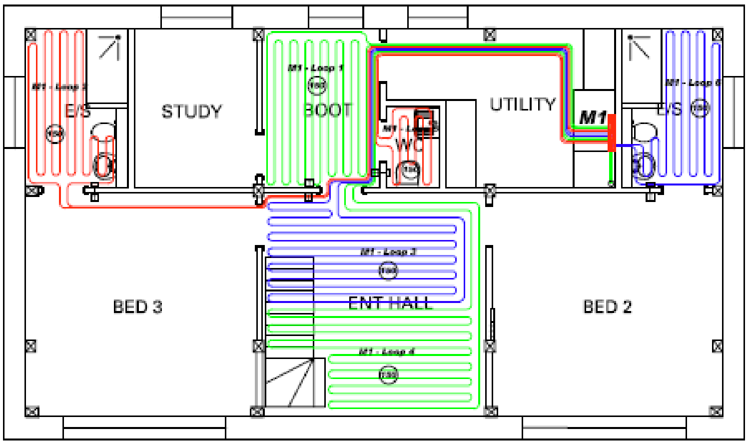
Photo of MVHR installation prior to the cooler battery and feed pipework being insulated

8.0 Heating strategy

Heating is provided via a ground source heat pump and an out-and-back loop to the south of the house. This is fed into the house via underfloor heating to the hall and all ensuites, in addition to this there is a dual-fuel towel rail provided in each ensuite. Room thermostats are provided to regulate the flow of the system to ensure maximum efficiency.



First Floor Plan



Ground Floor Plan

9.0 PHPP verification

Passive House Verification

Building:	
Street:	
Postcode/City:	Storridge
Province/Country:	Herefordshire / GB-United Kingdom/ Britain
Building type:	Residential Building
Climate data set:	GB0007a-Sutton Bonnington
Climate zone:	3: Cool-temperate; Altitude of location: 88 m
Home owner / Client:	Andrew Burnett & Linda Atkinson
Street:	Batchcombe Lane
Postcode/City:	WR13 5ES Storridge
Province/Country:	Herefordshire / GB-United Kingdom/ Britain

Architecture:	David Bryan - TJ Crump Oakwrights Ltd	Mechanical engineer:	Green Building Store
Street:	The Lakes	Street:	Heath House Mill, Heath House Lane,
Postcode/City:	HR4 7PU Swainshill	Postcode/City:	HD7 4JW Golcar
Province/Country:	Herefordshire / GB-United Kingdom/ Britain	Province/Country:	Huddersfield / GB-United Kingdom/ Britain
Energy consultancy:	David Bryan - TJ Crump Oakwrights Ltd	Certification:	WARM: Low Energy Building Practice
Street:	The Lakes	Street:	3 Admirals Hard
Postcode/City:	HR4 7PU Swainshill	Postcode/City:	PL1 3RJ Plymouth
Province/Country:	Herefordshire / GB-United Kingdom/ Britain	Province/Country:	Devon / GB-United Kingdom/ Britain

Year of construction:	2019	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]:	2.4	IHG cooling case [W/m²]:	2.4
No. of occupants:	3.0	Specific capacity [Wh/K per m² TFA]:	72	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

		Value		Criteria	Alternative criteria	Fulfilled?[2]
	Treated floor area m²	182.1				
Space heating	Heating demand kWh/(m²a)	13	≤	15	-	yes
	Heating load W/m²	10	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m²a)	2	≤	15	15	yes
	Cooling load W/m²	4	≤	-	10	
	Frequency of overheating (> 25 °C) %	-	≤	-		-
Airtightness	Pressurization test result n_{50} 1/h	0.5	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	98	≤	135		yes

[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	Mike	Roe	
Certificate ID	**Issued on:**	**City:**	
22567_WARM_PH_20190917_MR	16/09/19	Plymouth	

10.1-10.2 Costs

The costs for the project are confidential

11.0 User Experience

The following is an extract from an email received from the clients at the end of June 2019 after being in the house since the early March 2019.

> *"Put simply, we have no significant issues with the house and are delighted with the pleasant and clear differences in indoor comfort.*
>
> *In a little more detail, having moved in at the beginning of March, there having been no heating in the house, it took about 3-4 days for the temperature to reach a comfortable level without intermittent additional heating. The house quickly settled down and running the MVHR system on full for a couple of weeks also quickly reduced post wet-trade building humidity levels.*
>
> *It is striking how comfortably warm the house feels, especially when coming in from outside. This 'comfort' is not about a blast of heat as one might wish for in a conventional house, but a gentle comfort in all parts of the house. In contrast, in the last few very hot days, it's striking how comfortably cool it is compared to the outside.*
>
> *The house has an atmosphere that consistently [feels] 'calm', clean, pleasant and relaxing. We are getting more used to closing the blinds on the south-facing roof windows and the horizontal blinds on the two balconies on hot sunny days; this, plus Mediterranean purging, is contributing to keeping the indoor environment very comfortable.*
>
> *It is noteworthy that on 29 June, the hottest day of the year so far, and with outdoor temperatures locally exceeding 32degC we only felt slightly too warm in the afternoon. In our old house, even on less hot days, we would have had fans on most of the time and all night and still found sleeping difficult."*