Project Documentation

1 Abstract

Hazel Tree Passive House, Herefordshire, England

1.1 Data of building

Year of construction	2023	Space heating Load	**17 kWh/(m²a)**
U-value external wall	0.112 W/(m²K)		
U-value basement ceiling	0.100 W/(m²K)	Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)	**45 kWh/(m²a)**
U-value roof/ U-Wert Dach	0.108 W/(m²K)	Generation of renewable	**40 kWh/(m²a)**
U-value window/ U-Wert Fenster	0.70 W/(m²K)	Non-renewable Primary Energy (PE)	NA
Heat recovery	75 %	Pressure test n_{50} /	**0.14 h-1**
Special features/ Besonderheiten	Solar panels, Compact heat pump with combined water heater and tank.		

1.2 House Hazel Tree Passive House

Conceptually, the house is inspired by a nut, with a warm and soft inner environment protected by a tough outer shell. The nut opens over the entrance to reveal the warm inner within.

The rural site is verdant with exceptional views over an apple orchard to the south east to the Herefordshire hills beyond. The house is south-east facing and takes advantage of an existing hazel tree which is located directly in front of the largest area of glazing to act as shading in the summer months, whilst allowing the sun through in the cooler months. Further shading is provided on the south-west and south-east elevations in the form of an overhanging roof that also shelters the main entrance, and frames a view towards the orchard.

The form is modest and simple with a rectangular plan and steeply pitched roof which contains the first floor rooms. The roof alters in height on the west side to facilitate the overhang and achieve more space upstairs. A double height atrium creates a more open feel, reveals the structure, and brings light deeper into the plan.

The house employs a variety of natural materials including 80mm thick external wood fibre insulation and clay plaster applied directly onto additional wood fibre insulation internally. The structure is comprised of timber I-joists that are filled with blown cellulose (Warmcel). This breathable construction system was chosen because of the simplicity of the detailing at key junctions such as the eaves because the same layers are applied to the wall and roof enabling neat and consistent thermal bridge free detailing. Pro-passive OSB racking board and Tescon Vana tape are employed internally to achieve brilliant airtightness and vapour control. To protect the building from the elements, profiled steel roofing sheets and thermowood cladding are installed over a ventilation void that also conceals the rainwater pipes.

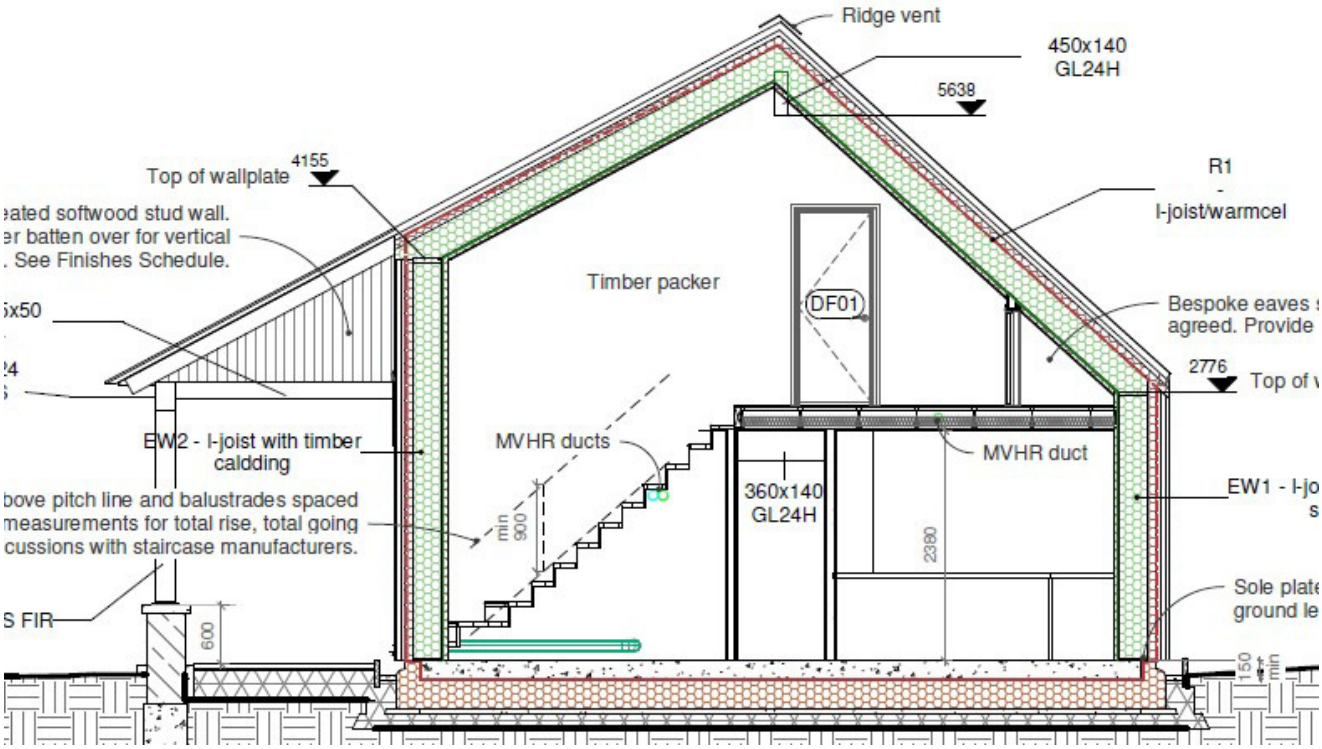
An array of 10 PV panels (LG Solar 400Wp NeONH+ V6) are placed on the roof. Heating is via two towel radiators placed in the bathrooms on both floors. The heat is generated by a combined ASHP water heater and cylinder (Ariston Nous Plus) which is directed mainly for the domestic hot water but had been adapted to include the towel radiators.

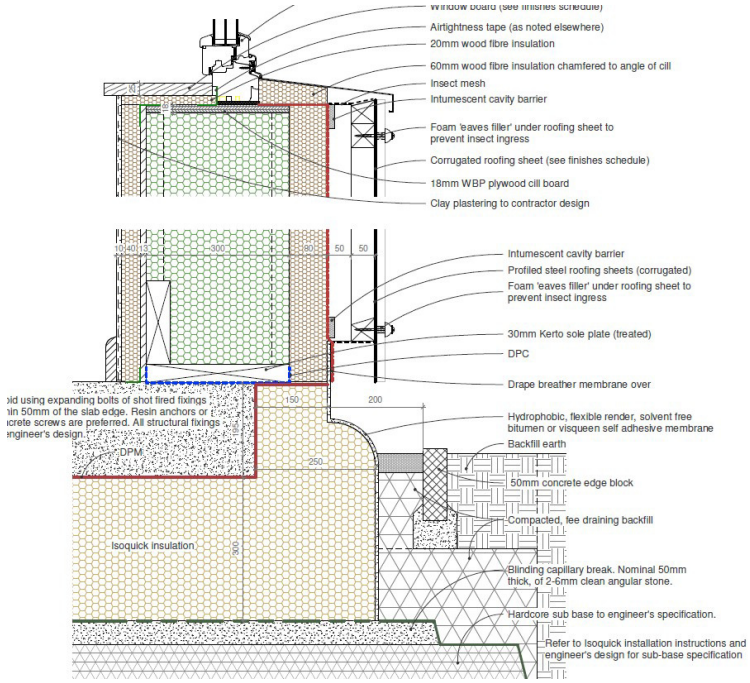
1.3 Responsible project participants

Architect	Joshua Wood from GreenTrace Architect https://www.greentracearchitect.co.uk/
Implementation planning	Joshua Wood from GreenTrace Architect https://www.greentracearchitect.co.uk/
Building systems	Green Building Store https://www.greenbuildingstore.co.uk/
Structural engineering	George Holland from Element Structures https://www.elementstructures.com/
Building physics	Joshua Wood from GreenTrace Architect https://www.greentracearchitect.co.uk/
Passive House project planning	Joshua Wood from GreenTrace Architect https://www.greentracearchitect.co.uk/
Construction management	Dai Rees from the Passive House Builder https://thepassivehousebuilder.co.uk/
Certifying body	Mead Consulting http://www.meadconsulting.co.uk/
Certification ID	38621_MEAD_PH_20230427_KM 7263
Author of project documentation	Joshua Wood from GreenTrace Architect https://www.greentracearchitect.co.uk/
Date, Signature	14.07.2023 

2 Views of Hazel Tree House

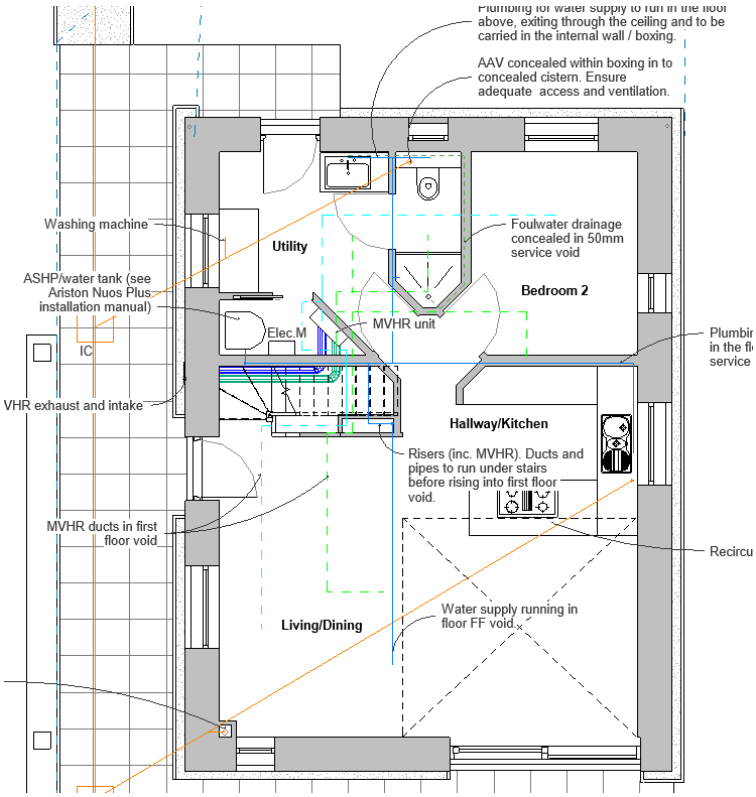
3 Section Drawings of Hazel Tree House





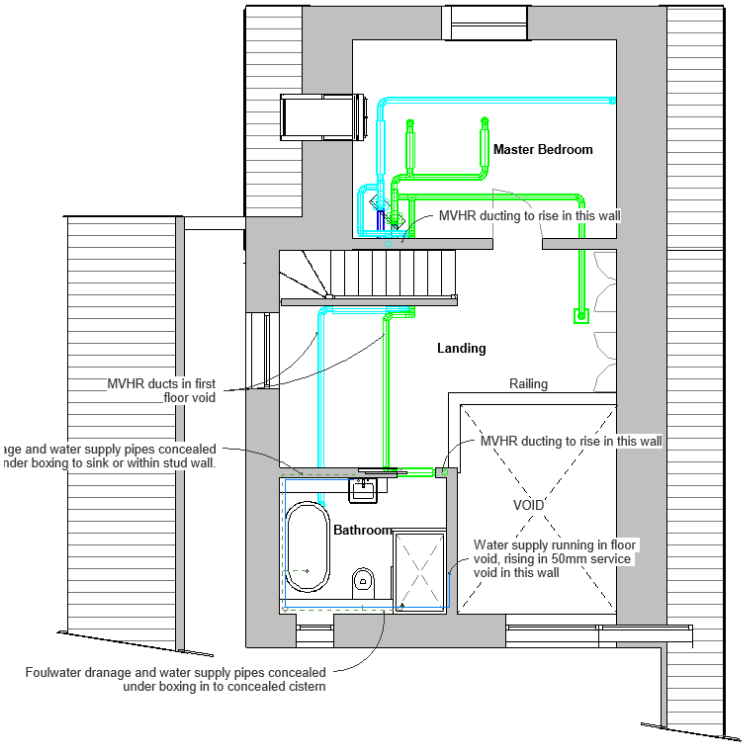
Cross-section through showing the thermal envelope with excellent uninterrupted insulation is clearly recognisable. The walls and roof are constructed in an identical build up which creates a seamless thermal bridge at the eaves and verge junctions. The insulated raft foundation keeps the concrete slab warm and avoids the need to insulate around foundations. The 250mm upstands ensure a complete wrap of insulation. The dashed red line (breather membrane above ground) indicates the extend of the thermal envelope inputted into the PHPP. The cross-section also shows the ductwork of the MVHR ducts that are located below the staircase before rising into the first floor.

4 Floor Plans of Hazel Tree House



Ground floor plan

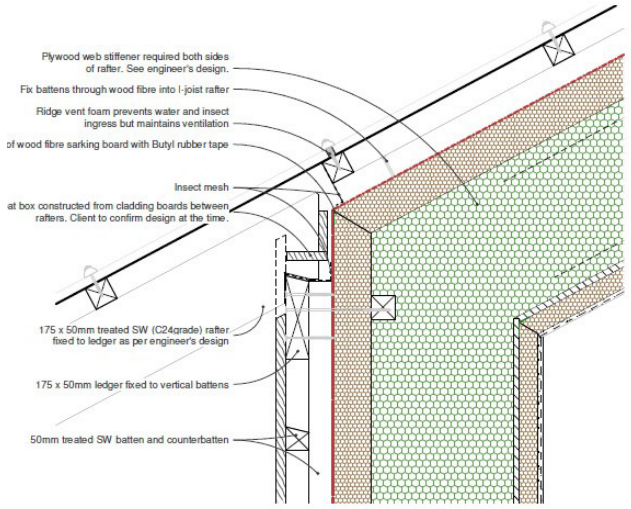
A simple rectilinear plan of good proportions in terms of form factor. The plan shows the location of the ASHP/hot water cylinder, located in the same location as the MVHR unit. The supply and exhaust ducts are shown entering the house under by the wall and being routed under the staircase to reach the unit.



First floor plan

All rooms upstairs are within the roof space. The roof alters in height on the west side to facilitate the overhang and achieve more space upstairs. A double height atrium creates a more open feel and brings light deeper into the plan. The MVHR Ducts are shown in blue (supply) and green (exhaust).

5 Construction details of the envelope of Hazel Tree House

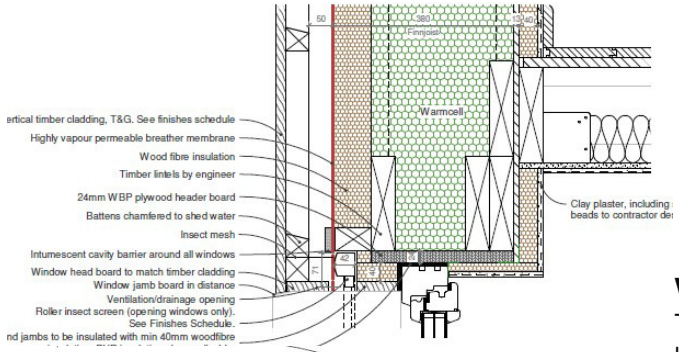


Eaves

Both the wall and the roof are constructed from 300mm deep timber I-joists filled with Warmcel insulation (blown cellulose) with 80mm wood fibre insulation (Steico Special Dry) and timber cladding on battens applied externally. 12mm Pro-Passive OSB, with 40mm wood fibre (Steico Internal) with clay plaster over applied internally. The enables a thermal bridge free junction.

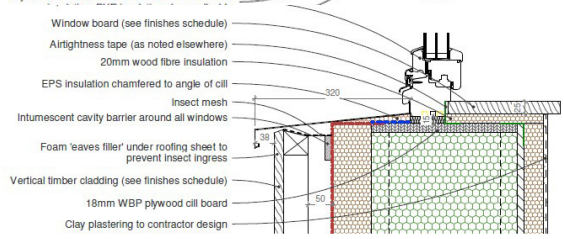
U-value of wall : **0.112 W/(m²K)**

U-value of roof : **0.108 W/(m²K)**



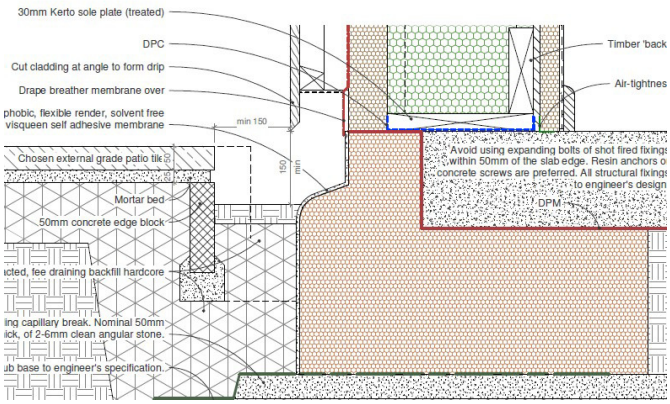
Floor junction

The first floor joists are supported on a timber ledger that is fixed over the Pro-passive OSB to retain the airtightness later in tact. Mineral wool acoustic insulation in the floor mitigates the minor reduction in insulation (40mm wood fibre) at this point.



Window cill & head

The timber windows are sandwiched by insulation at head and cill, as well as the jambs. The cill includes a chamfered EPS insulation under the cill. Internally the insulation is wood fibre. At the head, space is provided within the cladding void for rolling external shading blinds. The windows installation is made airtight with Tescon Profil tape and Compriband expanding foam tape.

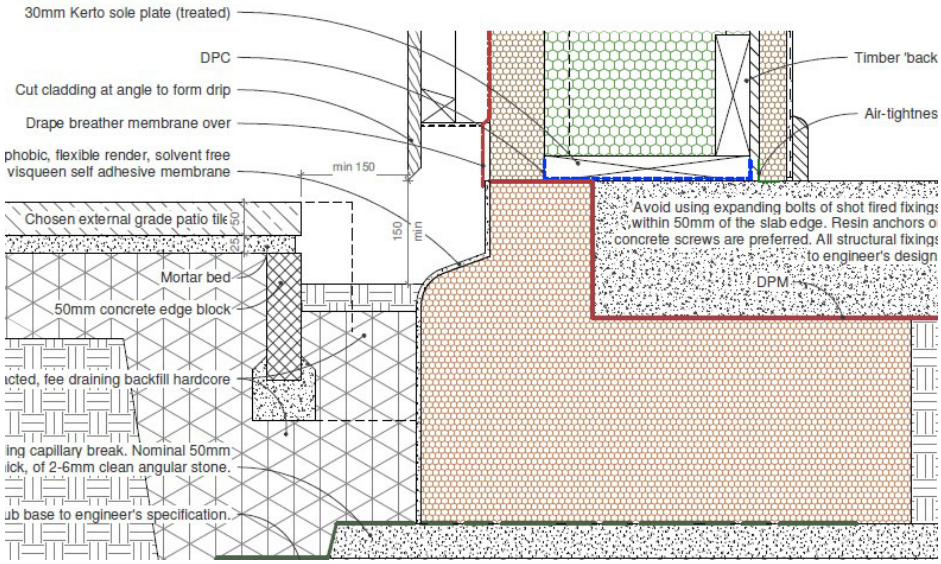


Wall to ground floor

The ground floor consists of an insulated raft foundation system: 300mm 'Isoquick' XPS insulation on compacted gravel/hardcore with a 250mm thick reinforced concrete slab over; power-floated to be the floor finish. The insulated raft foundation keeps the concrete slab warm and avoids the need to insulate around foundations. The 250mm upstands ensure a complete wrap of insulation. The Pro-Passive OSB is taped to the floor with Tescon Vana air-tight tape.

U-value of floor : **0.100 W/(m²K)**

5.1 Construction including insulation of the floor slab

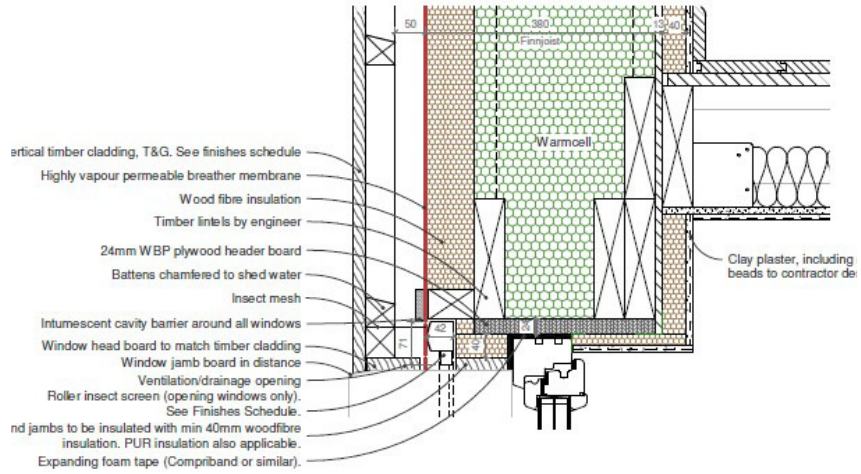


Wall to ground floor

The ground floor consists of an insulated raft foundation system: 300mm 'Isoquick' XPS insulation on compacted gravel/hardcore with a 250mm thick reinforced concrete slab over; power-floated to be the floor finish. The insulated raft foundation keeps the concrete slab warm and avoids the need to insulate around foundations. The 250mm upstands ensure a complete wrap of insulation. The Pro-Passive OSB is taped to the floor with Tescon Vana air-tight tape.

U-value of floor : **0.100 W/(m²K)**

5.2 Construction including insulation of exterior walls



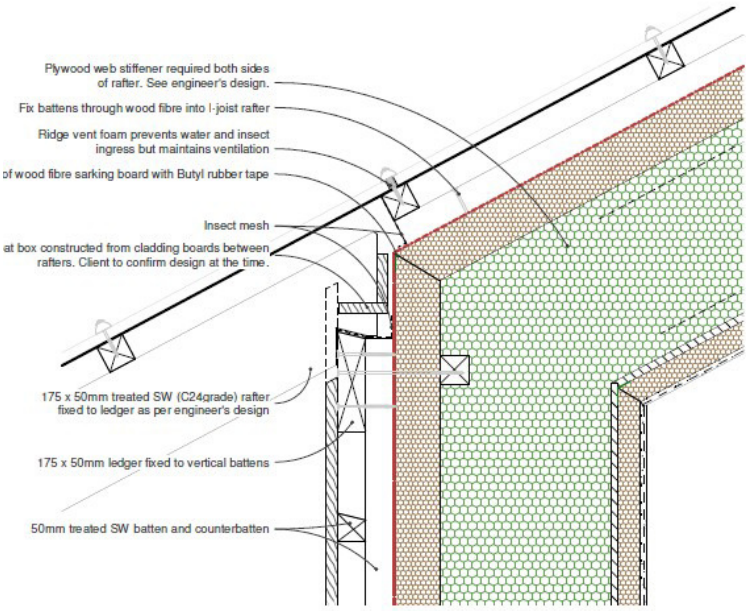
Both the wall and the roof are constructed from 300mm deep timber I-joists filled with Warmcel insulation (blown cellulose) with 80mm wood fibre insulation (Steico Special Dry) and timber cladding on battens applied externally. Internally, 12mm Pro-Passive OSB, with 40mm wood fibre (Steico Internal) with clay plaster.

U-value of wall : **0.112 W/(m²K)**

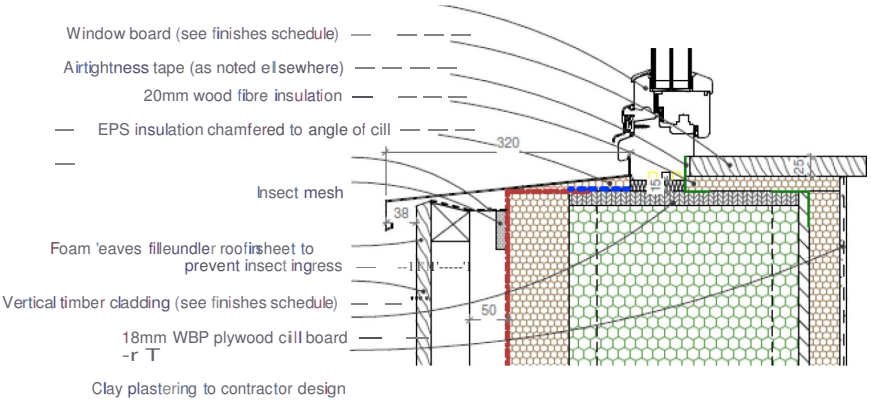
5.3 Construction including insulation of the roof

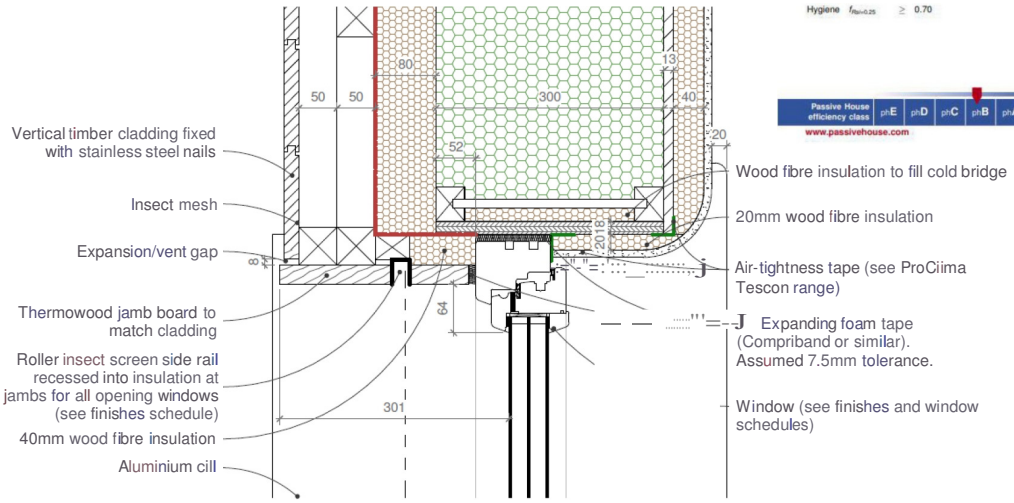
Both the wall and the roof are constructed from 300mm deep timber I-joists filled with Warmcel insulation (blown cellulose) with 80mm wood fibre insulation (Steico Special Dry) and timber cladding on battens applied externally. Internally, 12mm Pro-Passive OSB, with 40mm wood fibre (Steico Internal) with clay plaster. This enables a thermal bridge free junction at the eaves and verge.

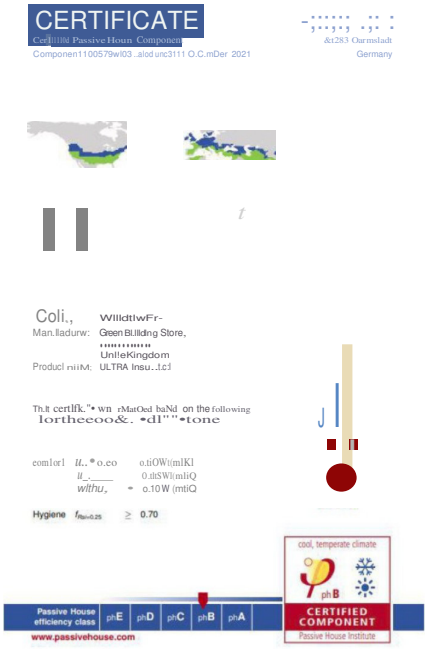
U-value of roof : **0.108 W/(m²K)**



5.4 Window sections including installation drawing





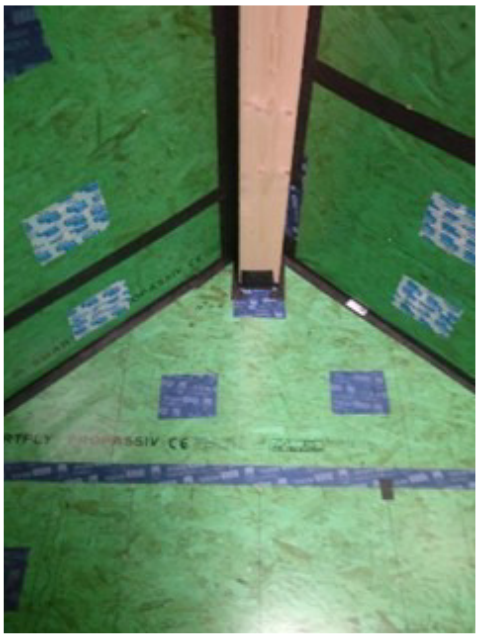


Window cill & head

The Green Building Store 'ULTRA', triple glazed timber windows and doors are sandwiched by insulation at head and jambs with 20mm Steico Dou Dry wood fibre internally and 40mm extremally. The cill includes a chamfered EPS insulation piece externally and 20mm wood fibre internally . At the head, space is provided within the cladding void for rolling external shading blinds.

- Triple glazing. SGG Planitherm XN II. U g-value = 0.52 W/(m^{2}K) g -value = 54 % (varies)

6 Description of the airtight envelope including pressure test result



The airtightness layer consists of Proppassive OSB (12mm) air-tight racking boards installed on both walls and roof internally. Joints and abutments are taped with Pro Clima Tescon Vana, Teson Invis, and Tescon Profil tapes. At junctions with structural components, membranes are draped over prior (see top-right photo) for taping later to the Propassive board. EPDM grommits are used for service penetrations. The windows installation is made airtight with Tescon Profil taped to the board and window with Compriband expanding foam tape in the tolerance gap.

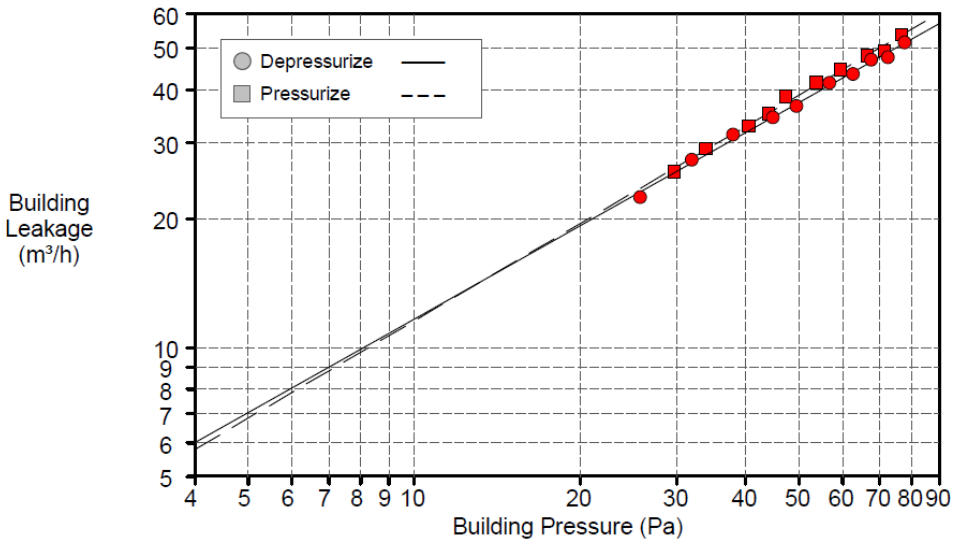
6.1 Air pressure test result

Customer:	Dai Rees The Passive House Builder 1 Cwm Maddoc Barns Broad Oak Hereford, HR2 8QZ Phone: Fax: Email: dai@thepassivehousebuilder.co.uk	Building Address:	Fawley Ecohouse Kings Caple Hereford, HR1 4UQ

Results for Passivhaus and Low Energy Building

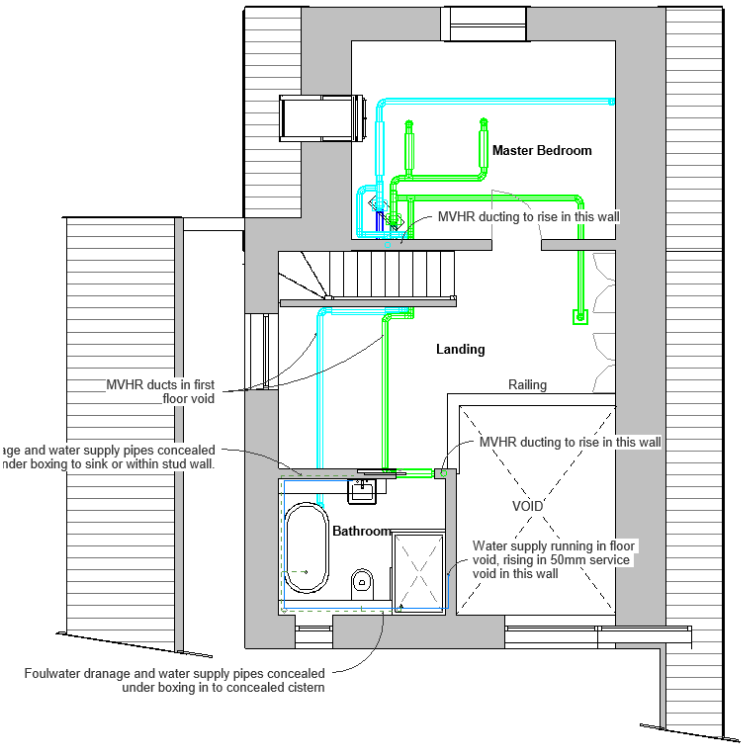
	Pressurised test	Depressurised test
r^2 (Correlation >=0.98 - <=1.00)	0.9974	0.9976
n (Slope >=0.50 - <=1.00)	0.753	0.723
n_{50} (Air Changes per Hour)	0.14	0.13

Average Air Changes per Hour (n_{50}) = 0.135h^{-1} @ 50Pa



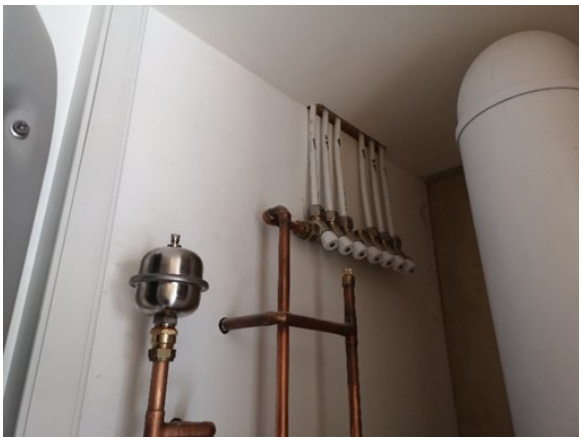
The air pressure test was carried out by Elmhurst Energy on 1st August 2022. A previous air-pressure test was carried out 3 months before once the airtightness layer was complete, and before installing internal linings such as the clay plaster etc.. The test concluded an Average Air Changes per Hour (n50) of 0.135h-1 @ 50Pa.

7 MVHR and ductwork planning



Mechanical Ventilation with Heat Recovery. Summer bypass was installed. The system was suppled by Green Building Store and consists of Ubbink NV, Ubiflux F200 unit with 125mm ComfoPipe EPP pipes (see photo on RHS) for the supply and exhaust at the junction with the external wall prior to meeting the unit. These ducts are located under the stairs and were provided with additional mineral wool insulation (circa 100mm thick all round) and reflective foil duct wrap. All joints taped with Tescon Invis tape. Circulation is then achieved via 100mm rigid ductwork concealed within the floor.

8 Heat supply



Heat supply is via an Ariston Nuos Plus Air Source Heat Pump with integral hot water cylinder (200l). This is mainly used for domestic hot water but also serves two towel radiators located in the bathrooms (one on each floor). The heat pump is located internally within the plant room, adjacent to an external wall for air intake via direct ducting.

10 PHPP calculations

Passive House-Verification

PHPP

Building:	Hazel Tree House
Street:	Kings Caple
Posl code/City:	Herefordshir HR1 4UQ
ProvinoefCountry:	Herefordshire GB-Ilnee Kingdom !Britain
Building type:	1-Freesl anding single family house
Climate dall a set:	GB0007a-Sutton Bennington, Altitude corrected
Climate zone:	3: CoolHemperate Altitude of location: 6B.1 m
Home owner f Client:	
Street:	
Postcode/City:	Herefordshire HR1 4UQ
Province/Country:	Herefordshire GB-United Kingdom/ Britain

Architecture:	Greentrace Architect		
Street:	26 Greenbank Road		
Postcode/City:	BS31RJ	Bristol	
Province/Country:	Bristol	GB-United Kingdom/ Britain	
Energy consultancy:	Greentrace Architect		
Street:	26 Greenbank Road		
Postcode/City:	BS31RJ	Bristol	
Province/Country:	Bristol	GB-United Kingdom/ Britain	

Mechanical engineer:	Green Building Store Ltd		
Street:	Heath House Lane		
Postcode/City:	HD7 4JW		
Province/Country:	Huddersfield	GB-United Kingdom/ Britain	
Certification:	Mead Ltd		
Street:	3 Harvey Road		
Postcode/City:	N8 9PD	London	
Province/Country:	London	GB-United Kingdom/ Britain	

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) winter [W/m²]:	2.6	IHG summer [W/m²]:	2.6
No. of occupants:	2.3	Specific heat capacity [Wh/K per m² TFA]:	60	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 kWhl(mZa)	17	15		
	Heating load W/m>	10		10	
Space cooling	Cooling & dehum. demand kWhl(mZa)	-			
	Frequency of overheating (> 25 °C) %	0	10		§ §
	Frequency of excessively high humidify (> 12 gfkg) %	0	20		
Ainlghtness	Pressurisation test result nso 1fh	0.1	0.6		Yes
Non. renewable Primary Energy (PE)	PE demand kWhl(mZa)	56			
Primary Energy Renewable (PER)	PER demand kWhl(mZa)	45	60	60	G
	Generation of renewable energy kWhl(mZ a) (in rellallioo to projedled building	40			

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

Passive house Classlc? Yes

Task:	First name:	Surname:	Signallure:
12-Certi lication	IKym	IMead	

11 Construction costs

Hazel Tree House has a cost per m^2 of circa £2,600. This excludes external landscaping works but does include photovoltaic system (and of course all internal mechanical and electrical works). The house was constructed from January 2022 to February 2023. Material costs during this time were rising rapidly due to the war in Ukraine and COVID-19, which in turn affected the overall construction costs. Nevertheless, the cost per m^2 is considered to be good for the high specification of the Passive House.