PassivHaus Project Object Documentation

1.1 Abstract

Detached House with 3 Bedrooms, 99 The Hawthorns, Gretna

1.1 Building data

Year of construction	2016	Space heating demand	**13** kWh/(m²a)
U-value wall – brick U-value wall – render	0.102 W/(m²K) 0.103 W/(m²K)		
U-value floor – ground bearing	0.096 W/(m²K)	Renewable Primary Energy (PER)	65 kWh/(m²a)
U-value roof – horizontal	0.065 W/(m²K)	Generation of renewable energy	39 kWh/(m²a)
U-value windows	0.77 W/(m²K)		
Heat recovery efficiency	87.2%	Pressure test n_{50}	0.35
Special features	The house includes solar PV panels, a solar PV battery system and an electric car charging point		

1.2 Detached House with 3 Bedrooms, 99 The Hawthorns, Gretna

The Hawthorns is a residential development constructed by a private developer. Since 1996 54 homes have been constructed to normal Building Regulations standards uing a limited number of bespoke designs developed each year.

The developer has committed to constructing all future homes using the PassivHaus standard to deliver zero carbon homes.

A pilot house near Carlisle which achieved PassivHaus Certification, was designed and constructed to test construction details and techniques for applying to construction at The Hawthorns.

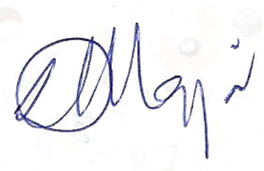
99 The Hawthorns is the first Certified PassivHaus at the Hawthorns and was completed in 2016. The house is available for open market sale but is currently rented.

1.3 Responsible project participants

Architect	White Hill Design Studio LLP
Implementation planning	White Hill Design Studio LLP
PassivHaus project planning	White Hill Design Studio LLP
Ventilation	Paul Heat Recovery Scotland Ltd
Developer	Hadrian Homes Ltd
Main contractor	T Graham & Sons, Langholm
PassivHaus Certifier	Warm Low Energy
Certification ID	14016_WARM_PH_20160815_MR
Project-ID (www.passivehouse-database.org)	6129

Author of project documentation: David Major, White Hill design Studio LLP

Date/signature



29

September 2019

2 Views

South & East Elevations

West & South Elevations

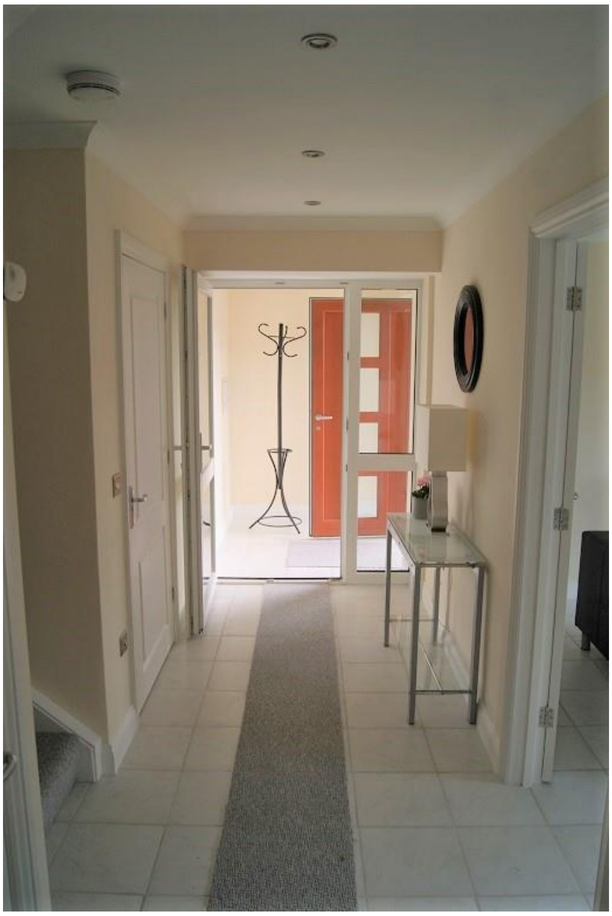
North & East Elevations

Internal views

Living Room

Kitchen

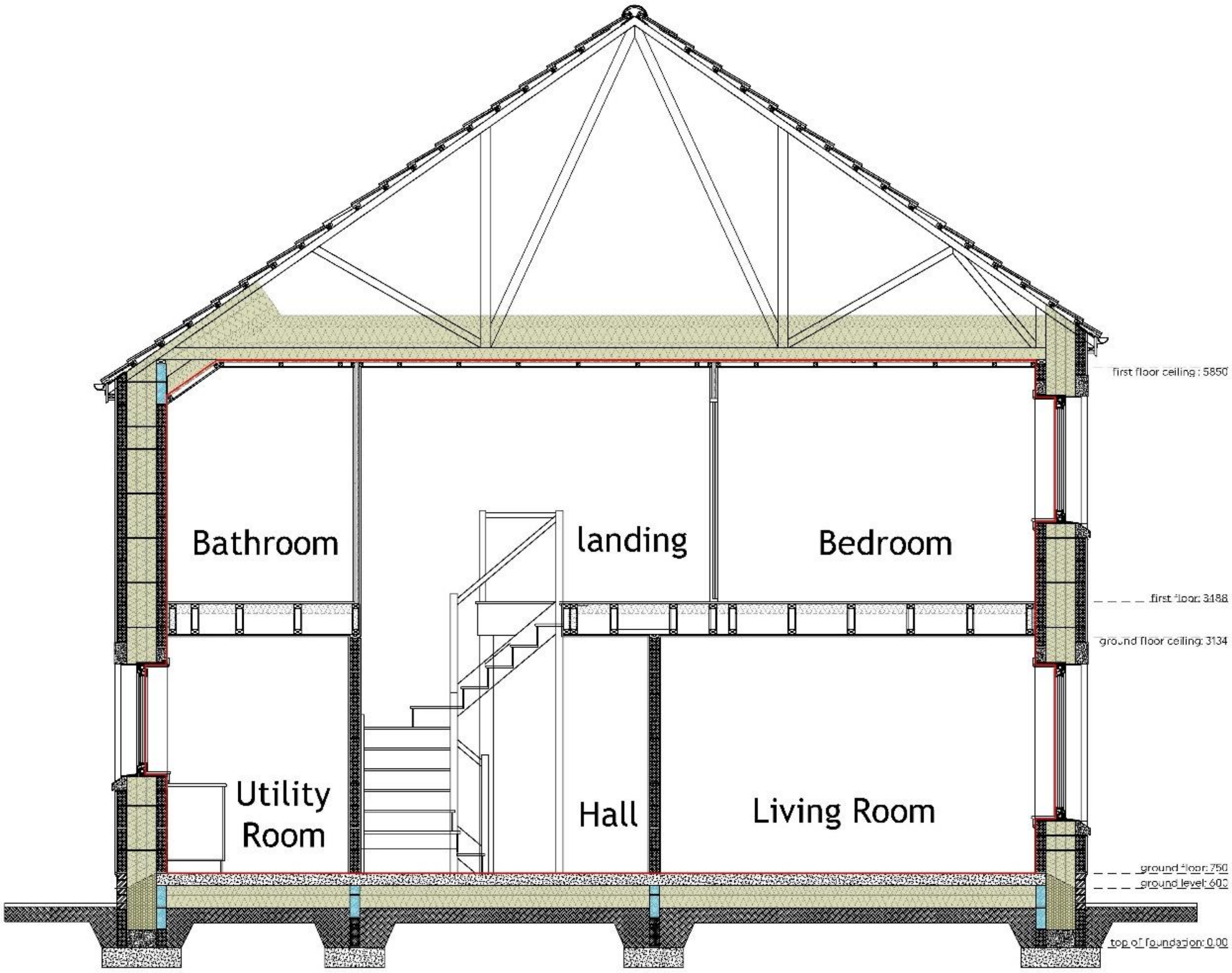
Breakfast Area



Hall

Bedroom

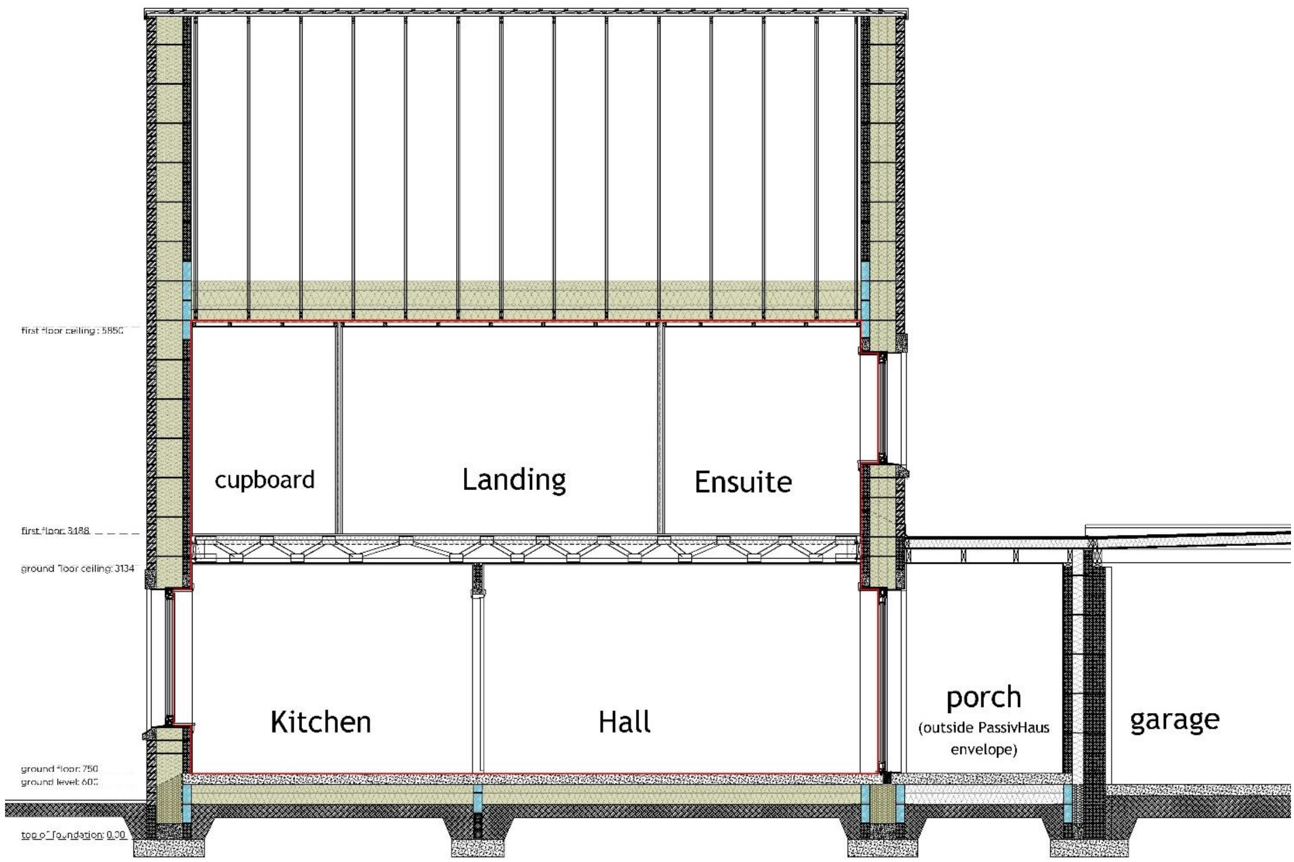
3 Sections



Section A-A

The house has masonry cavity walls fully filled with mineral fibre insulation, a ground bearing concrete slab on rigid PIR insulation. The ceilings are mostly horizontal with a small area of sloped ceiling.

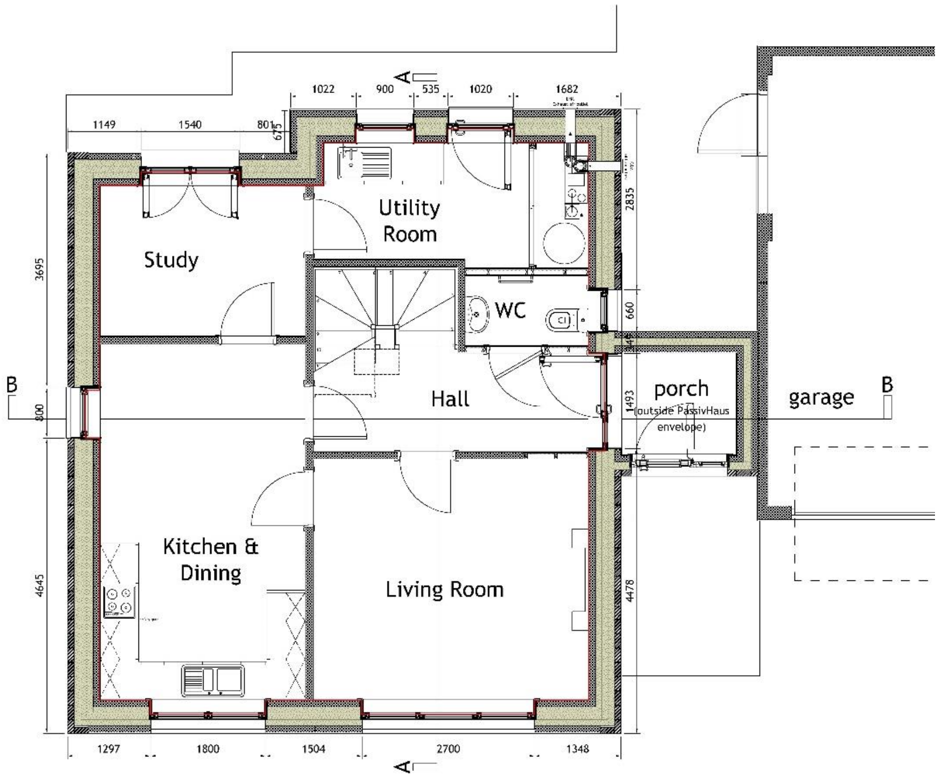
The section drawing shows the continuous insulation envelope has been maintained around the external fabric of the house. Careful consideration was given to the junctions for floor, wall and roof. Blue hatching indicates locations where lightweight concrete block work was built in.



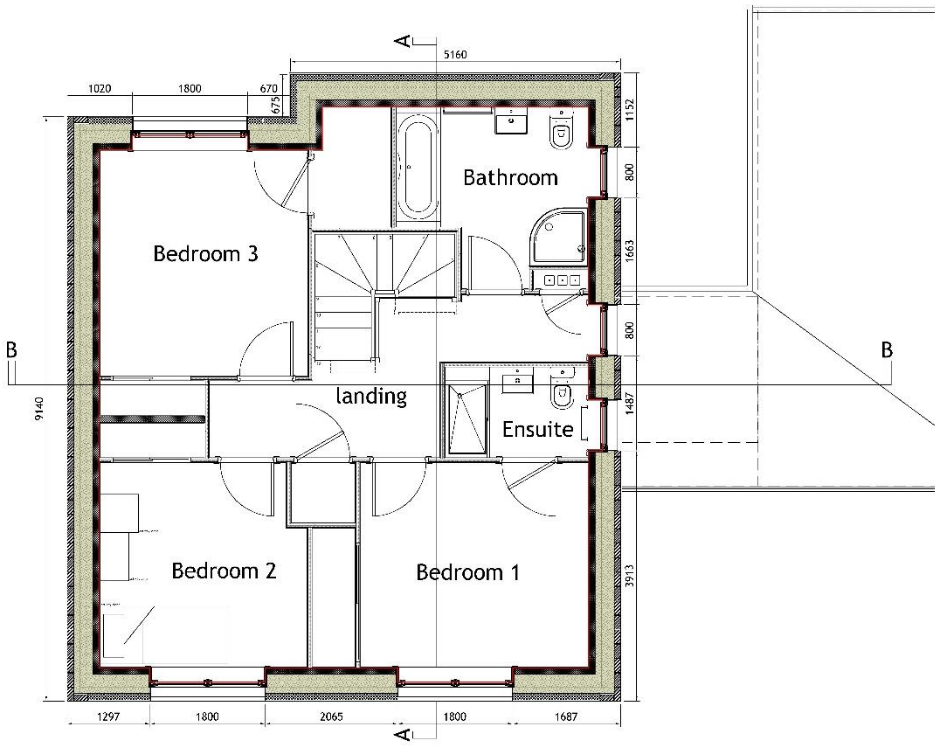
Section B-B

The long cross section shows the continuous insulation layer with the horizontal ceilings.

4 Floor Plans



Ground Floor Plan

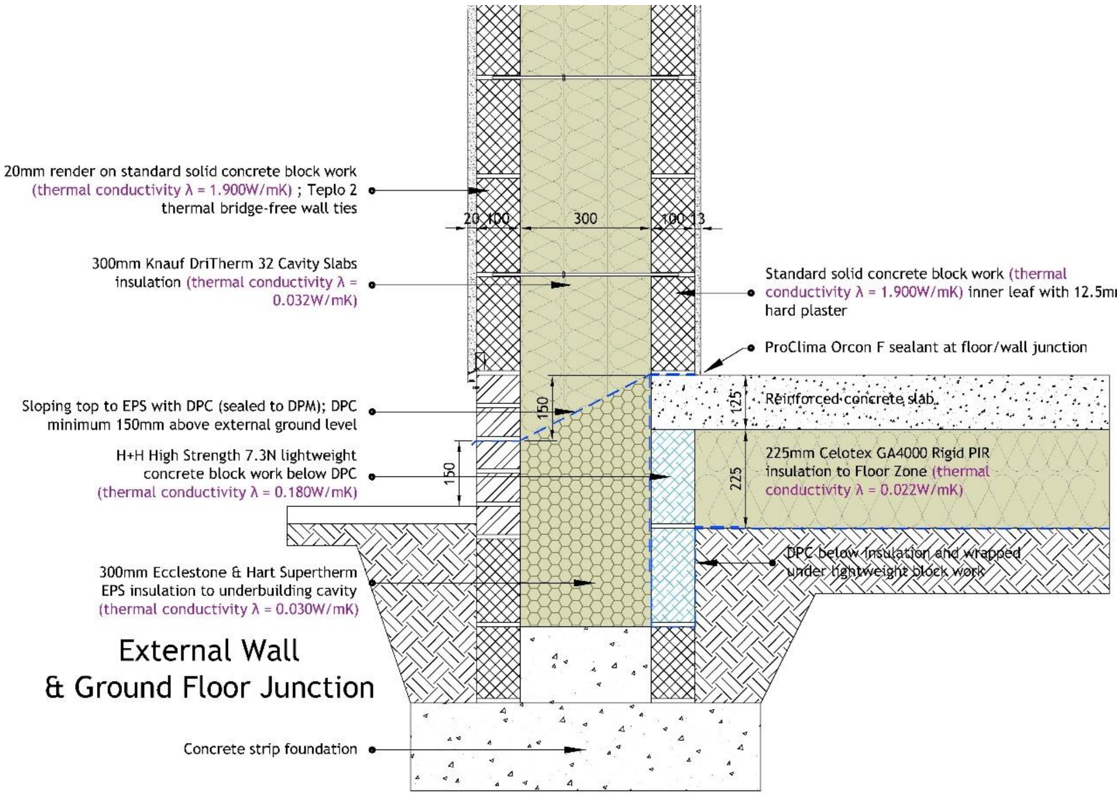


First Floor Plan

5 Construction Details

5.1 Ground Floor Details

The external walls are masonry cavity walls with 300mm wide cavity fully filled with mineral fibre insulation. Teplo thermal bridge free wall ties were used. The external leaf was either clay facing brick or cement render on solid concrete block work.

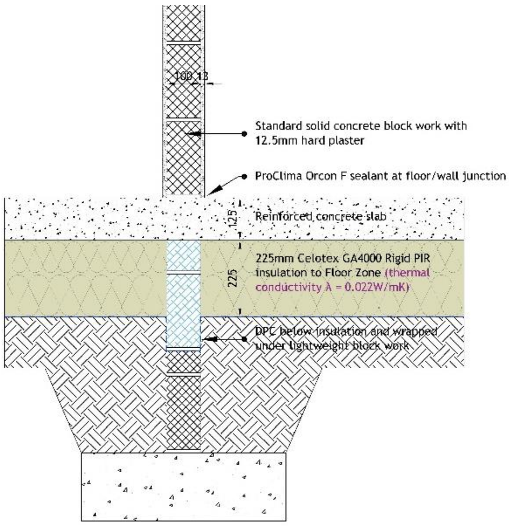


External Wall
& Ground Floor Junction

Following the development of a thermal bridge-free ground floor detail with masonry cavity walls for the pilot project, the same detail was used for this house. The damp proof membrane was wrapped around the lightweight block work to keep it dry and to avoid the drop in thermal performance when the blocks absorb moisture.

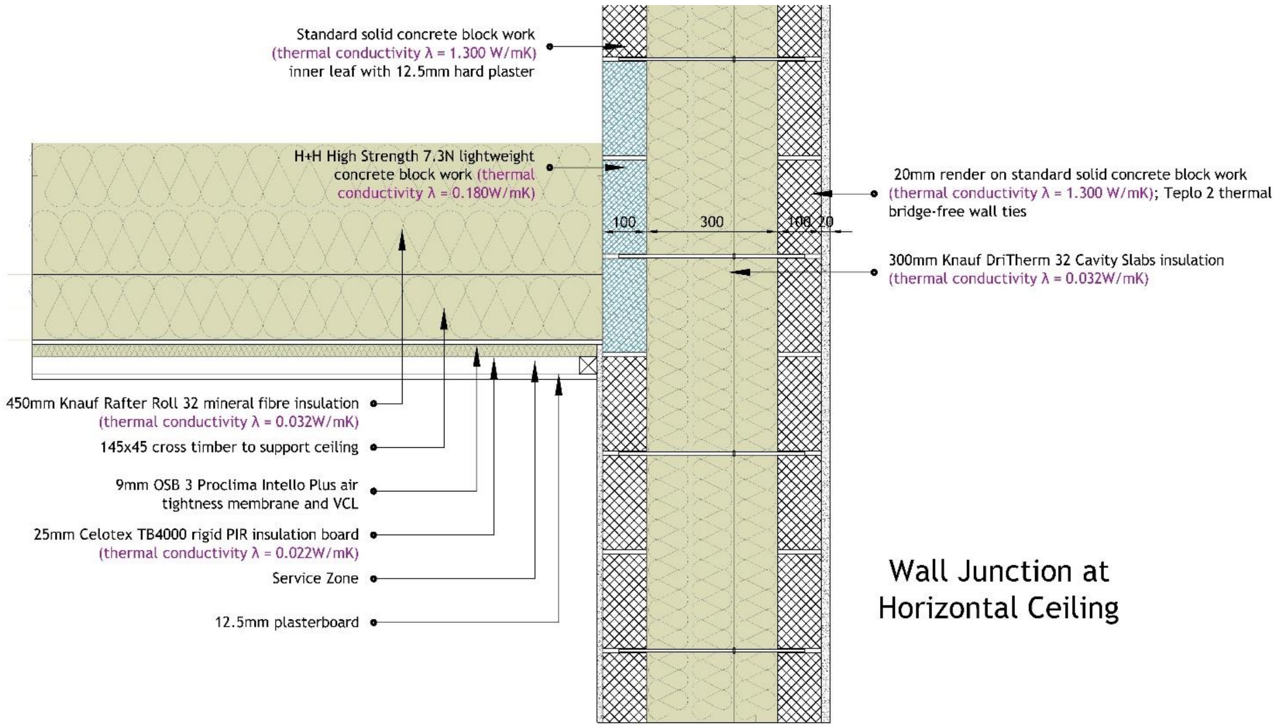
The cavity below ground level was filled with EPS insulation which does not absorb water. 2 layers of lightweight block work were built on the inner leaf below the concrete slab.

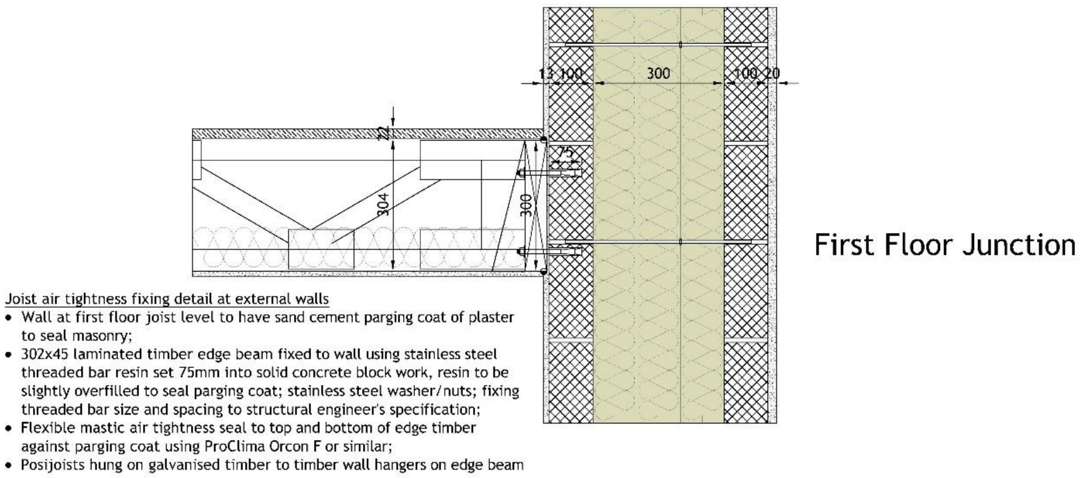
For this house, the concrete slab was cast over the top of the substructure block work to simplify construction and eliminate the possibility of loss of air tightness due to walls going through the slab. 2 layers of lightweight concrete block work wrapped in DPM were built in below the slab.



Internal Load Bearing Wall
at Ground Floor Junction

5.2 External Wall Details



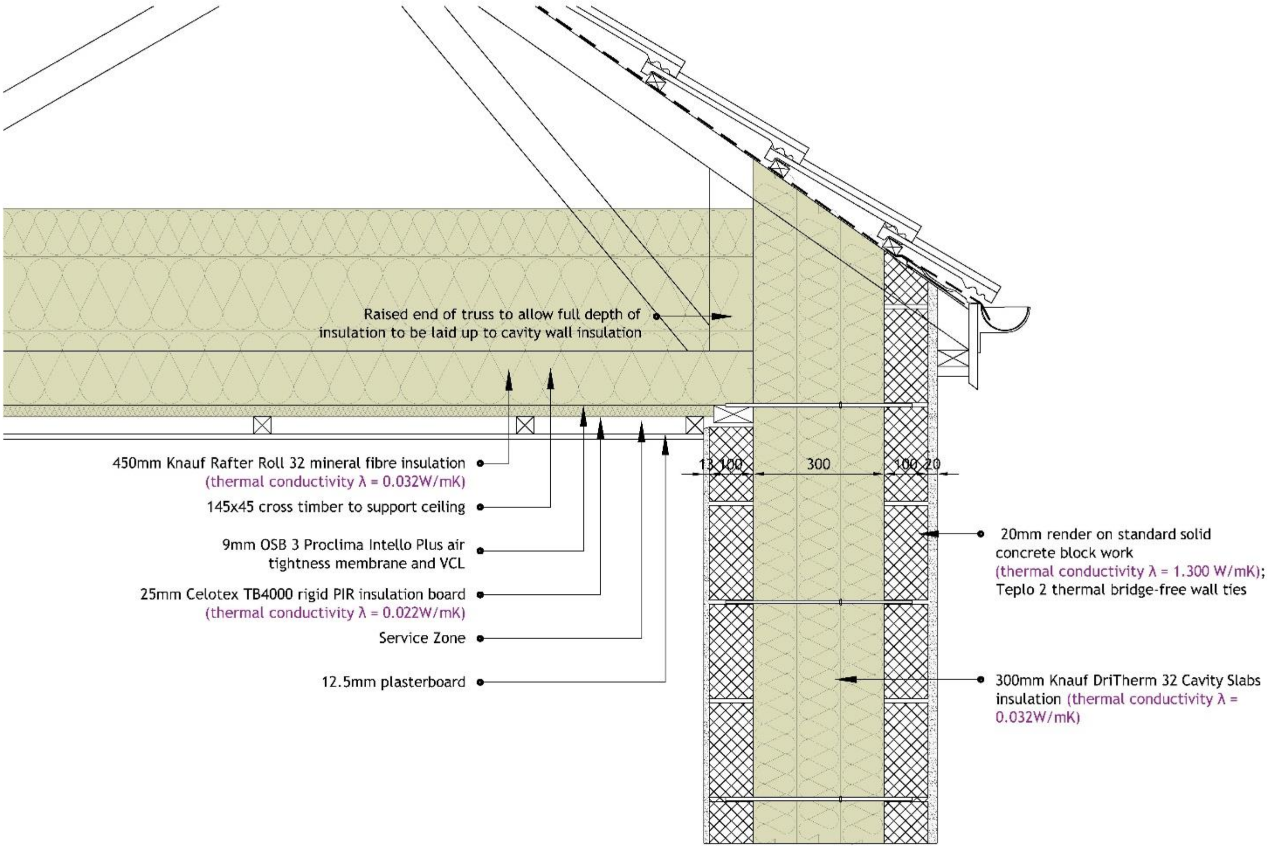


The first floor junction to the external wall and the horizontal ceiling junction with the external wall used the same details as the pilot project.

For the first floor joists, a parging coat of hard plaster was applied to the wall before a solid laminated timber wall bearer was bolted to the concrete block work. Care was taken with the depth of the bolts to not penetrate through the blocks.

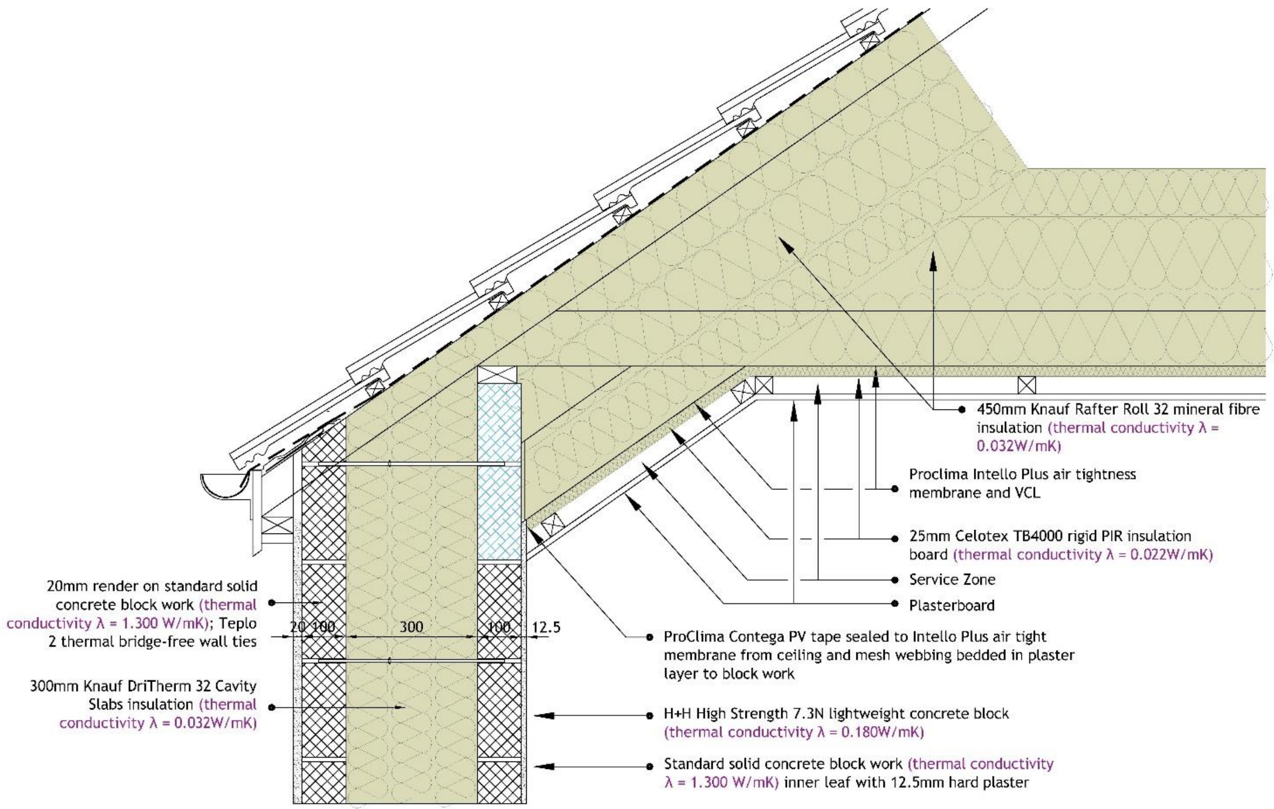
At the horizontal ceiling junction, lightweight blockwork courses were built for the full depth of insulation to minimise thermal bridging

5.3 Roof Details



Horizontal Ceiling at External Wall

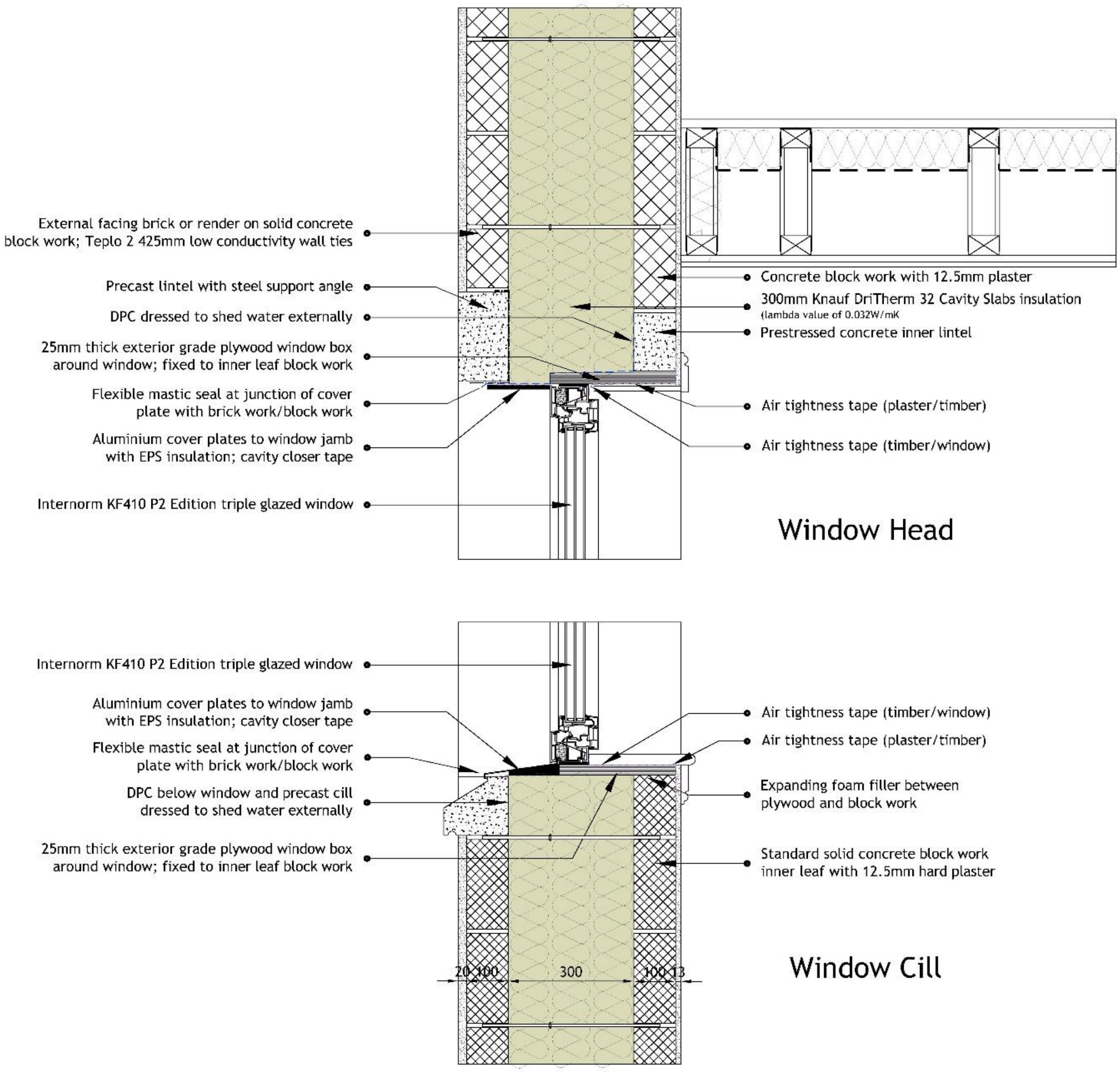
Most of the ceilings in the house are horizontal. A factory made roof truss system was used for the roof construction and at the eaves a raised truss end design was used to allow full depth ceiling insulation to be easily installed to be continuous with the wall insulation.



Sloping Ceiling at External Wall

The stepped floor plan created a short section of sloping ceiling at the eaves. Lightweight concrete block work was used below the wall plate support for the roof trusses to limit thermal bridging at this location and additional insulation was installed on the slope to maintain-the roof insulation value.

5.4 Window Details



The windows and external doors are Internorm KF410 P2 triple glazed Upvc windows with insulated frames

Windows and external doors we fitted with plywood window boxes secured to the inner concrete block work leaf. This allows the windows and external doors to be placed in the middle of the insulation layer providing thermal bridge free detailing.

Folded aluminium cover plates were made to weather seal the gap from the outside of the windows to the external blockwork and brickwork. The void in the cover plates were filled with EPS insulation. A layer of external wind tightness tape was installed from the window onto the external masonry before fitting the cover plates.

6 Airtightness

6.1 Air tightness strategy

Ground Floor:
Air tightness at ground floor level was provided by the top of the concrete slab

External Walls:
Air tightness at external walls was provided by 2 coat hard plaster

Roof:
Air tightness at roof level was provided by ProClima Intello airtightness membrane, all joints taped with ProClima tapes

Window and external doors:
Air tightness tapes were used to seal from the wall plaster onto the plywood window box and then from the window box onto the window and door frames

First floor joist:
The air tightness detail is described in External Wall details above.

A single steel beam was required by the Structural Engineer and this penetrated the inner leaf of the concrete clock work in one location. To avoid air leakage, the beam end in the wall was fully wrapped in a pocket of air tightness membrane with an overlap internally to allow the membrane to be sealed into the plaster layer with fleece backed tape providing a good key into the plaster. The detail eliminated air leakage at this location

Ceilings junctions to external walls:
A generous lap of the air tightness membrane was taken down the walls to allow the installation of air tightness tapes from the membrane into the wall plaster. A tape with a plastering mesh was used

Services
Where electrical switch and socket boxes were raggled into the concrete block work, these were bedded in plaster to provide air tightness to the block work. ProClima air tightness grommets were used for services penetrations through external walls.

A strip of air tightness tape was installed behind electrical cables which were set into the plaster to avoid any gaps in the hard plaster air tightness layer.

Toolbox and manufacturer talks

During the construction phase of the project we held on-site toolbox talks and visits from air tightness tape supplier to demonstrate the products and techniques and to deal with crucial details such as the steel beam end. These talks ensured that the trades on site were familiar with the materials and how to carry out the high quality of work required to achieve the air tightness.

6.1 Air tightness test

The air tightness test was carried out by Air Testing Scotland Ltd. The n_{50} over pressurisation test result was 0.34 and under pressurisation test result was 0.27

Pressurisation test results

Building and Test Information	
Test file name:	The Hawthorns Pressurised.
Building volume:	334.7
Building Height (from ground to top):	0
Floor Area:	64.8
Envelope Area:	299.3
Results	
Air flow at 50 Pa, Q_{50} [m^3/h]	113.5
Air changes, n_{50}	0.34
Equivalent leakage area at 50 Pa [cm^2]	56.55
Permeability at 50 Pa [$m^3/h/m^2$]	0.379

Depressurisation test results

Building and Test Information	
Test file name:	The Hawthorns depressurised.
Building volume:	334.7
Building Height (from ground to top):	0
Floor Area:	64.8
Envelope Area:	299.3
Results	
Air flow at 50 Pa, Q_{50} [m^3/h]	90.65
Air changes, n_{50}	0.27
Equivalent leakage area at 50 Pa [cm^2]	45.20
Permeability at 50 Pa [$m^3/h/m^2$]	0.303

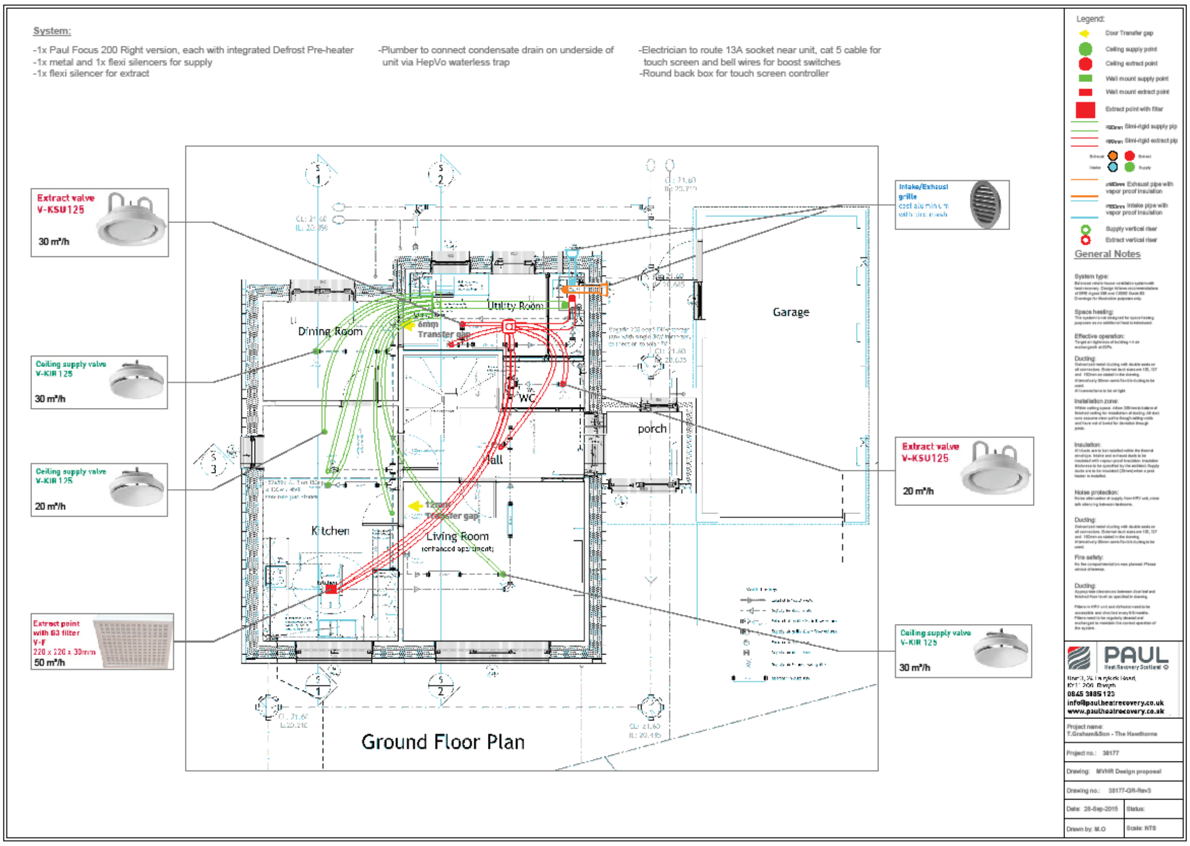
7 Ventilation

The ventilation system is a Paul Focus 200 unit with high and low level external wall vents. Lindab spiral steel ducting was used for primary runs from the ventilation unit to manifolds with semi-rigid PE ducts Lindab to room valves.

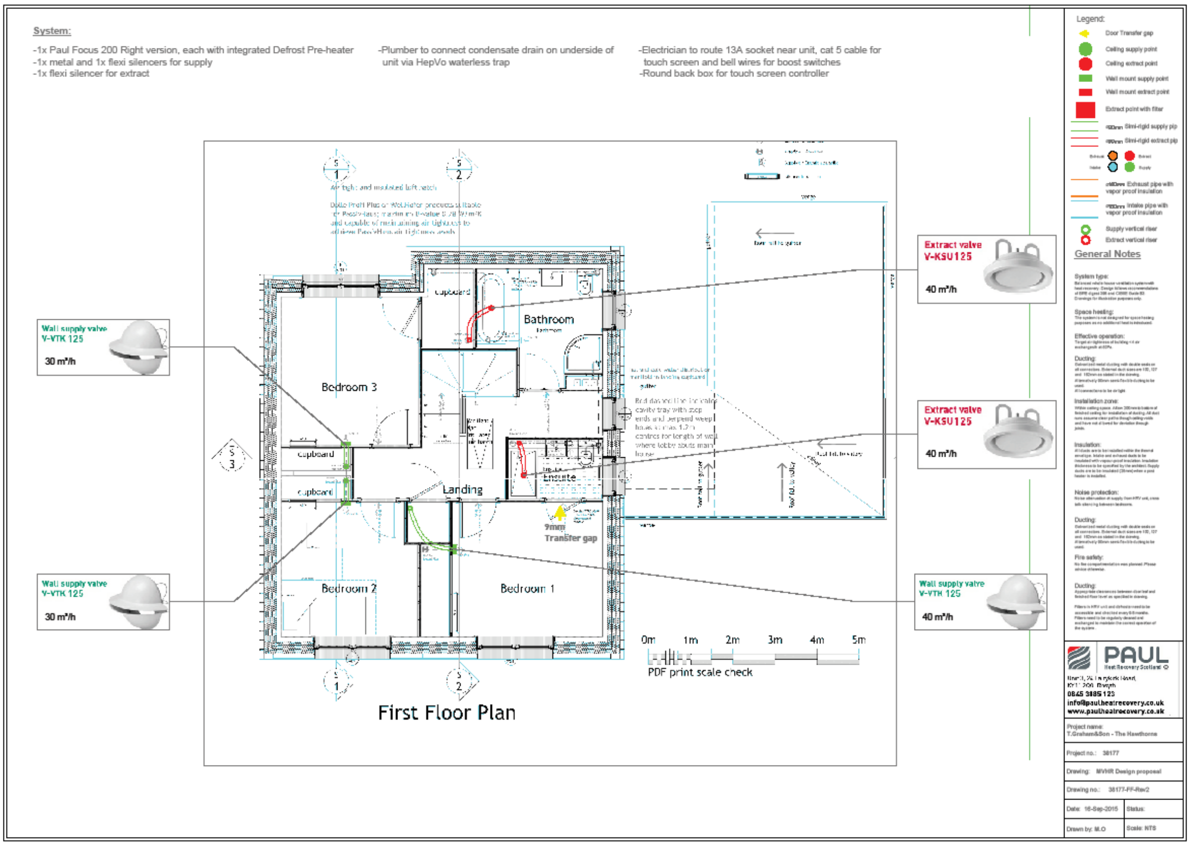
The system was designed, installed and commissioned by Paul Heat Recovery Scotland, Dunfermline.

The first floor joists are open web joists allowing a flexible service space for the ducts within the floor zone and short rises to valves at first floor level. Silencers were included in the system to prevent cross talk.

The MVHR unit is located on the ground floor in the utility room to allow for easy access for maintenance.



Ventilation Ground Floor layout (courtesy of Paul Heat Recovery Scotland)



Ventilation First Floor layout (courtesy of Paul Heat Recovery Scotland)

8 Heating & DHW

The hot water system is from direct electric. The 14 panel solar PV array located on the south facing roof feeds into an insulated thermal store.

Space heating demand has been reduced through good insulation levels, so no additional boiler has been installed. Residual heating is supplied from a small electric feature stove and limited areas of electric under floor heating mats were installed in the living and dining areas for comfort.

A 4.8kW battery storage system has recently been installed to allow greater use of on-site generated electricity. The solar PV system is set up to meet in-house electricity demands first, then to heat water and then to battery storage.

9 PHPP Verification

Certificate

Certified Passive House Classic

WARM

Authorised by:

Passive House Institute
Dr. Wolfgang Feist
64283 Darmstadt
Germany

99
The Hawthorns, DG16 5QA Gretna, United Kingdom/ Britain

Certified
Passive House
Passive House Institute
classic

Client	Hadrian Homes Aglionby Grange CA4 8AD Aglionby, United Kingdom/ Britain
Architect	White Hill Design Studio LLP Annan Water DG10 9LS Moffat, United Kingdom/ Britain
Building Services	Paul Heat Recovery Scotland 24 Fairykirk Road KY11 2QQ Rosyth, United Kingdom/ Britain
Energy Consultant	White Hill Design Studio LLP Annan Water DG10 9LS Moffat, United Kingdom/ Britain

Passive House buildings offer excellent thermal comfort and very good air quality all year round. Due to their high energy efficiency, energy costs as well as greenhouse gas emissions are extremely low.

The design of the above-mentioned building meets the criteria defined by the Passive House Institute for the 'Passive House Classic' standard:

Building quality		This building		Criteria	Alternative criteria
Heating					
Heating demand	[kWh/(m²a)]	13	≤	15	-
Heating load	[W/m²]	9	≤	-	10
Cooling					
Frequency of overheating (> 25 °C)	[%]	5	≤	10	
Airtightness					
Pressurization test result (n_{50})	[1/h]	0.4	≤	0.6	
Renewable primary energy (PER)					
PER-demand	[kWh/(m²a)]	65	≤	60	65
Generation (reference to ground area)	[kWh/(m²a)]	39	≥	-	7

The associated certification booklet contains more characteristic values for this building.

M Roe

Plymouth, 19 August 2016
Certifier: Mike Roe, WARM: Low Energy Building Practice

www.passivehouse.com **14016_WARM_PH_20160815_MR**

10 Costs

The house was built for £1,300/m^2

11 User experience

The house has been occupied since 2016 and the house has proved to be easy to use and the systems have been working well together, maintaining comfortable conditions throughout the year. The addition of the battery storage will reduce imported electricity demand further reducing running costs.

12 References

The house is open to visitors as part of the doors open days being held as part of Cumbria Action for Sustainability Environment Festival 2019.