# Passivhaus Project Documentation
# Wrexham Passivhaus

*Design/Architecture*: Simmonds Mills Architects
*Structural Engineer*: Bob Johnson Structural Engineers, Shrewsbury
*Building Services*: Alan Clarke
*Passivhaus Designer*: Tim Martel
*Builder*: EcoVert Solutions Ltd
*Certification ID*: 5326

## 1 Abstract

Detached two storey, 4 bed, dwelling nr Wrexham, Wales, constructed in 2016. This new build Passivhaus replacing a previous dwelling on the same site. Some of the brick from the previous house was reused and is exposed in the dining room and lounge, the brick plinth wall around the outside is actually brick slip in order not to compromise the insulation thickness. There are large overhangs to South and motorised external blinds for shading. A covered walkway is to the North and East. It is certified as Passivhaus Classic.

## 2 Building Data

This house has a warm roof construction with exterior insulation on a single skin masonry wall. The brick plinth is in fact brick slip, which is relatively easily added to the insulation in this position. Roof lights are motorised and have external shading as protection from overheating.

| | |
|---|---|
| U values:<br>Floor 0.138 W/m$^2$K<br>Wall 0.12 W/m$^2$K<br>Roof 0.10 W/m$^2$K<br>Window, average 0.77 W/m$^2$K | Effective Efficiency of heat recovery system: 90.6%<br>Annual Space Heat Demand based on PHPP: 14.0 kWh/(m$^2$.a)<br>Primary Energy demand based on PHPP: 103 kWh/(m$^2$.a)<br>Frequency of overheating: 0.5%<br>Airtightness test result: 0.4 ach |

## 3 Elevations of Building

Front of the building facing North.

South Elevation, facing the garden.

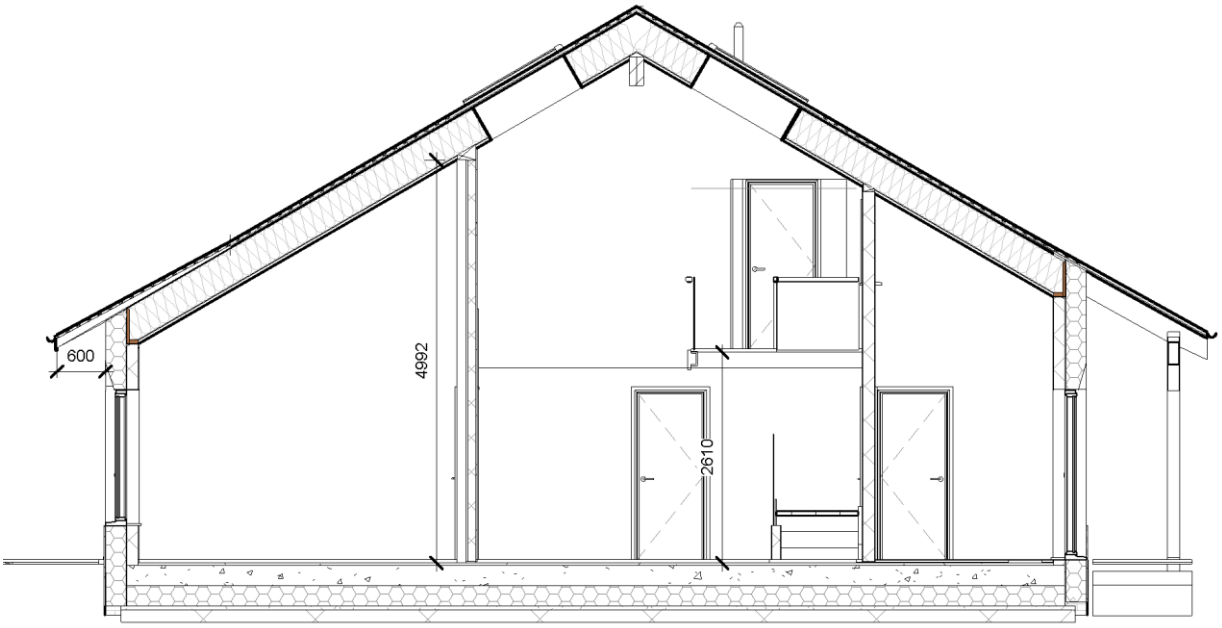
West Elevation, close to a neighbouring wall.

East Elevation, kitchen, dining room and pond.

## 4 Interior Views

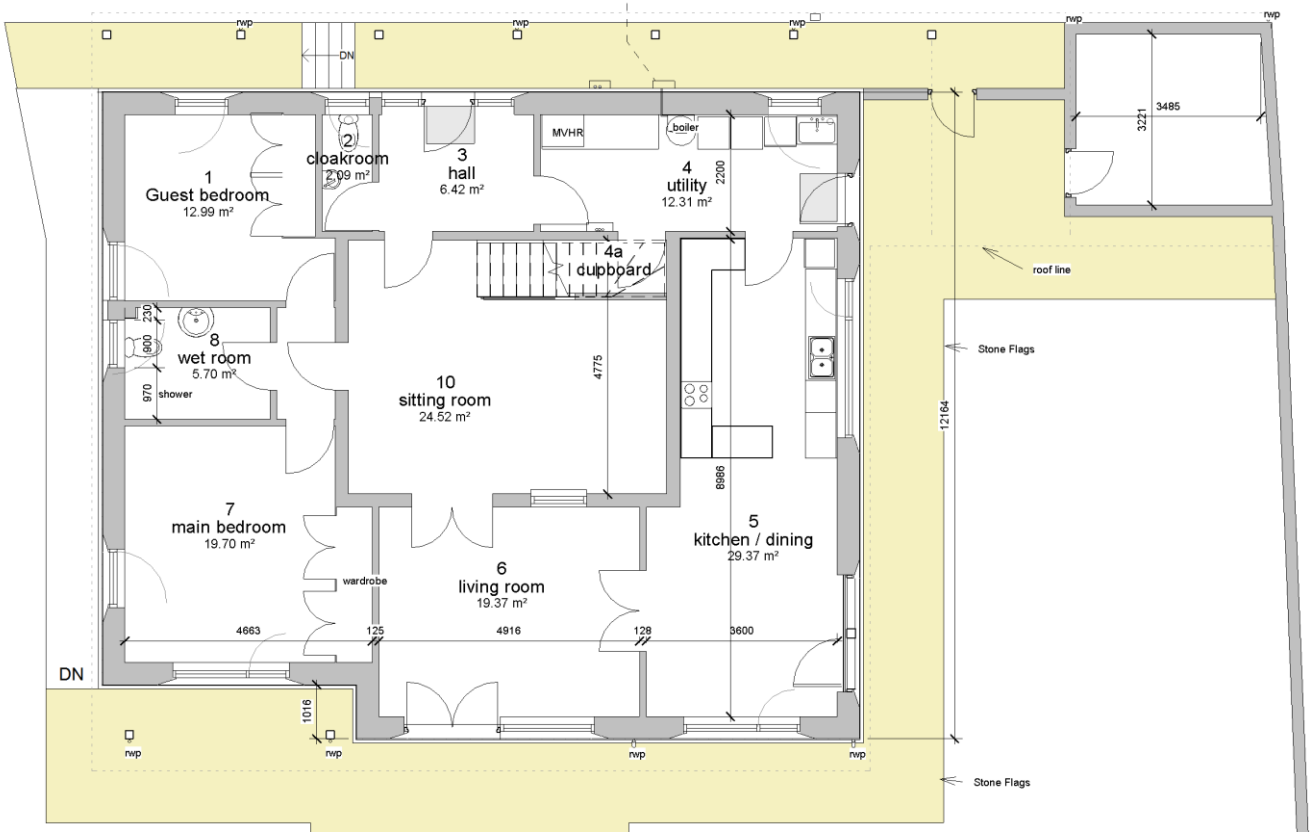
## 5 Building Section

Many spaces in the house are double height. In addition there is also a covered walkway outside the thermal envelope, shown to the right in this section.

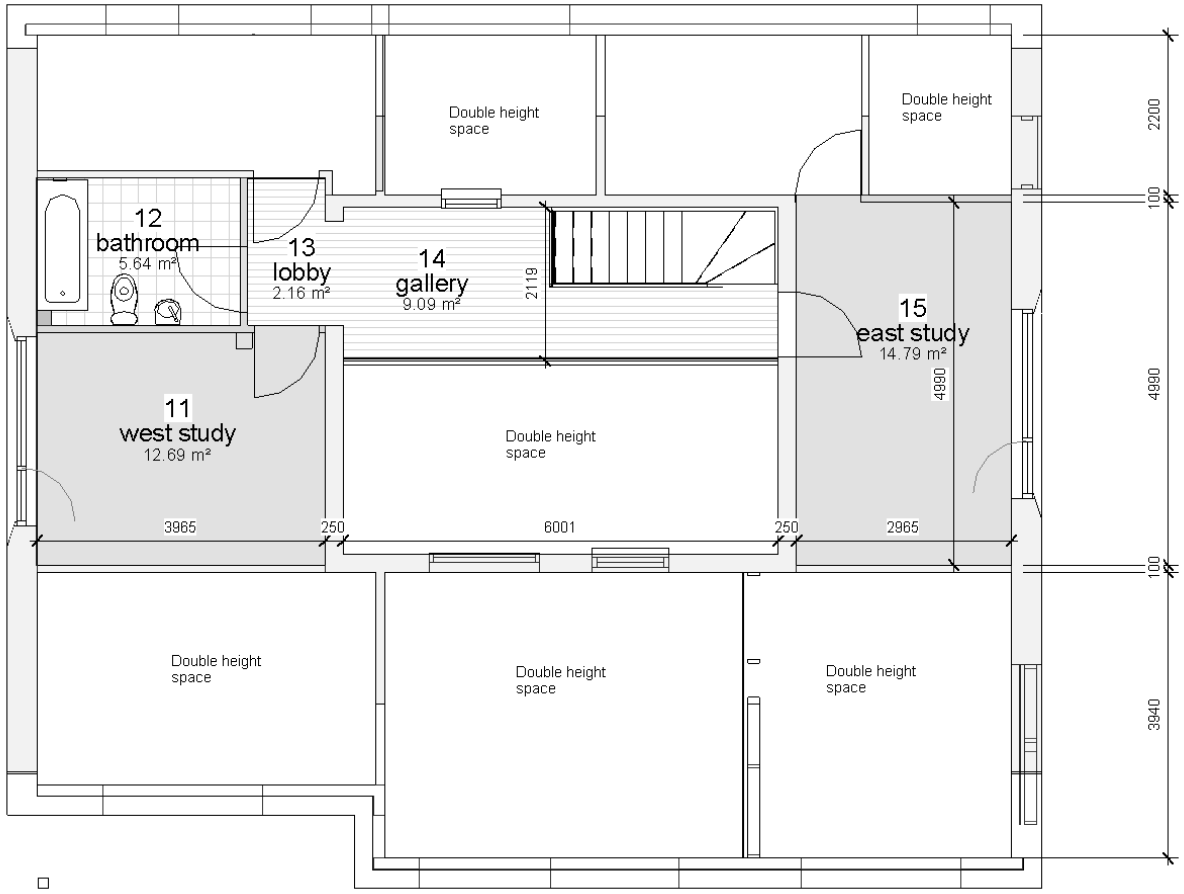



## 6 Floor Plans

### Ground Floor Plan

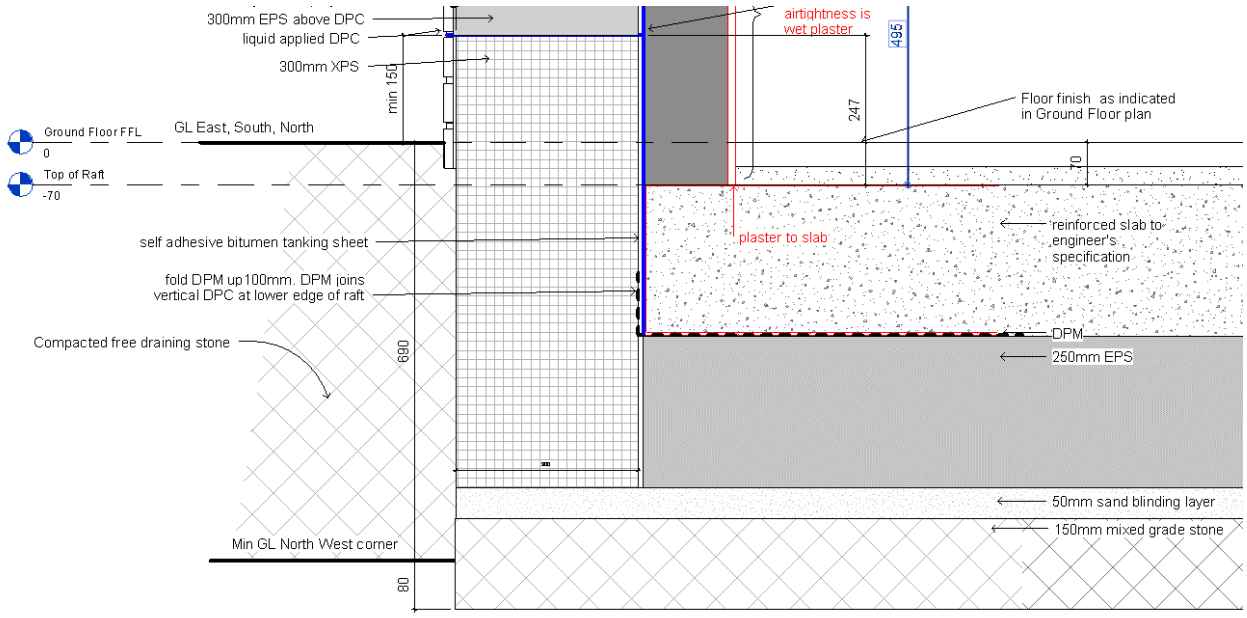


**First Floor Plan**




## 7 Construction of Floor Slab

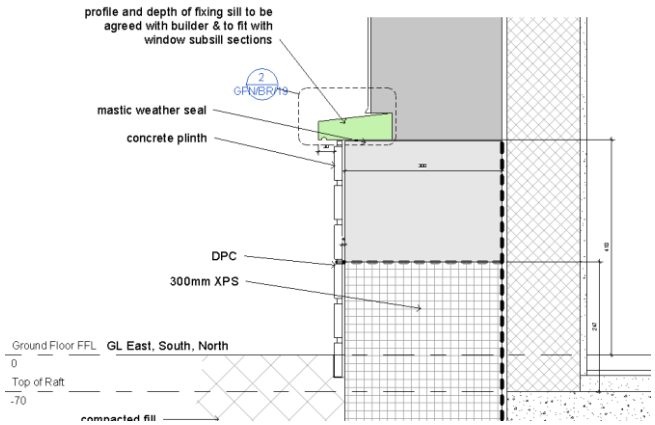
The floor insulation is high density EPS supporting a reinforced concrete raft. Exterior walls are built directly off the raft allowing the floor and wall insulation to meet with no thermal bridge.



## 8 Construction of Exterior Walls

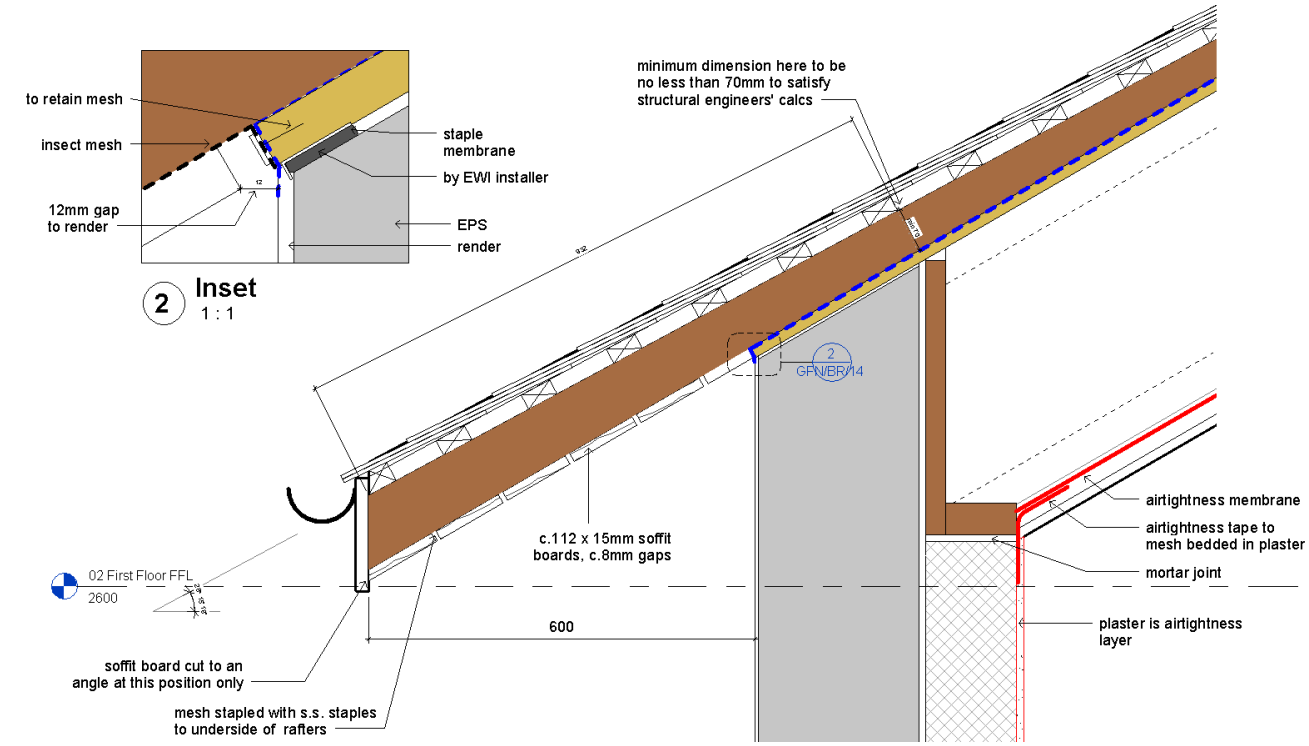
Exterior walls single skin concrete blockwork with an external insulation of graphitised EPS k=0.032 and render. The EPS is fully bonded to the wall with adhesive and also has thermal bridge free fixings. This produces a very simple construction.

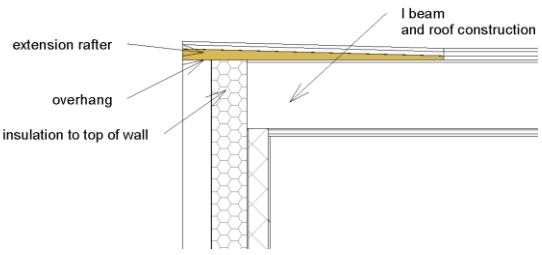
At external corners the insulation simply wraps round the other face of the wall.




## 9 Construction of Roof

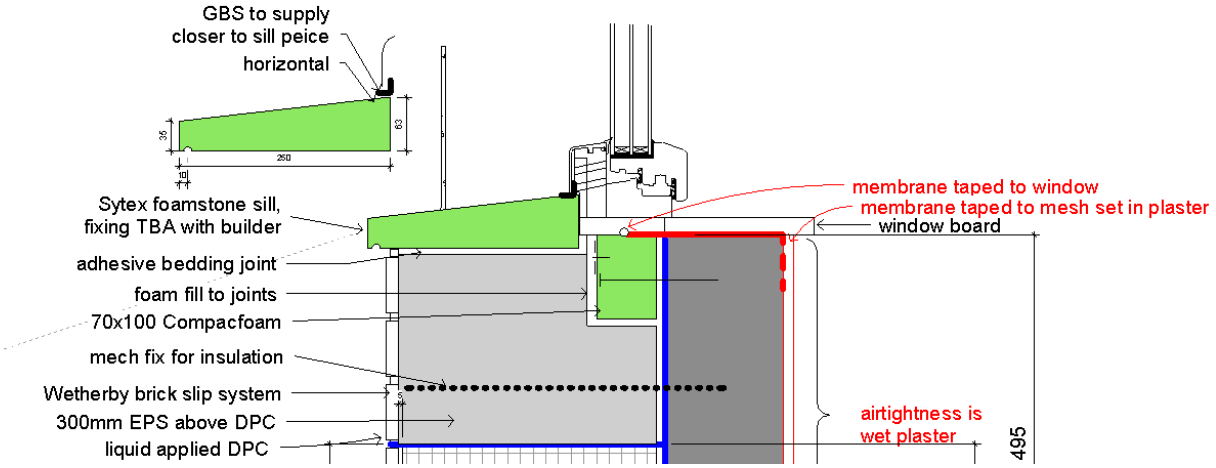
This building has a large roof constructed of I-beams resting on interior and exterior walls. The Warmcel insulation k=0.040W/mK, links well with the external insulation of the wall. The diagram below also shows large overhangs to the South to give shading in summer. The form of ladder truss used at the gable was chosen by the architect and is shown below.



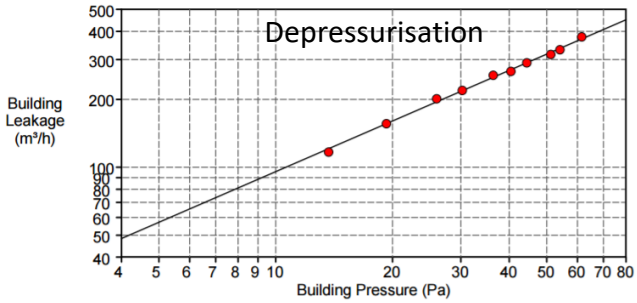
## 10 Windows and Installation

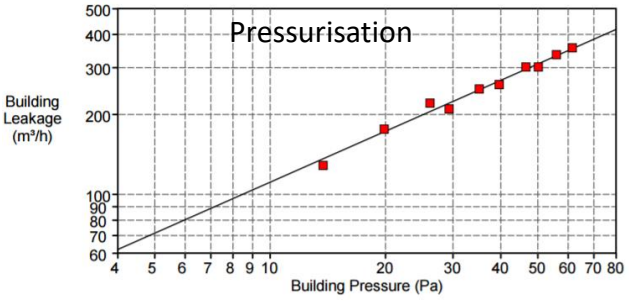
Windows are triple glazed Green Building Store Progression inward opening windows, a typical installation detail is shown below. Windows are supported on compacfoam. The timber and cork frame has a U-value of 0.77W/m$^2$K. Insulation is slightly tapered on the outside of windows but a Therm calculation showed the installation Psi was still excellent. Glazing has a U-value of 0.53 W/m$^2$K and a g value of 0.5. The 3 roof lights are Fakro U5 with similar characteristics and very importantly motorised operation including external blinds. We originally specified Fakro U6 but the manufacturer suggested that for this size of window this would be too heavy for the motor mechanism.




## 11 Airtightness

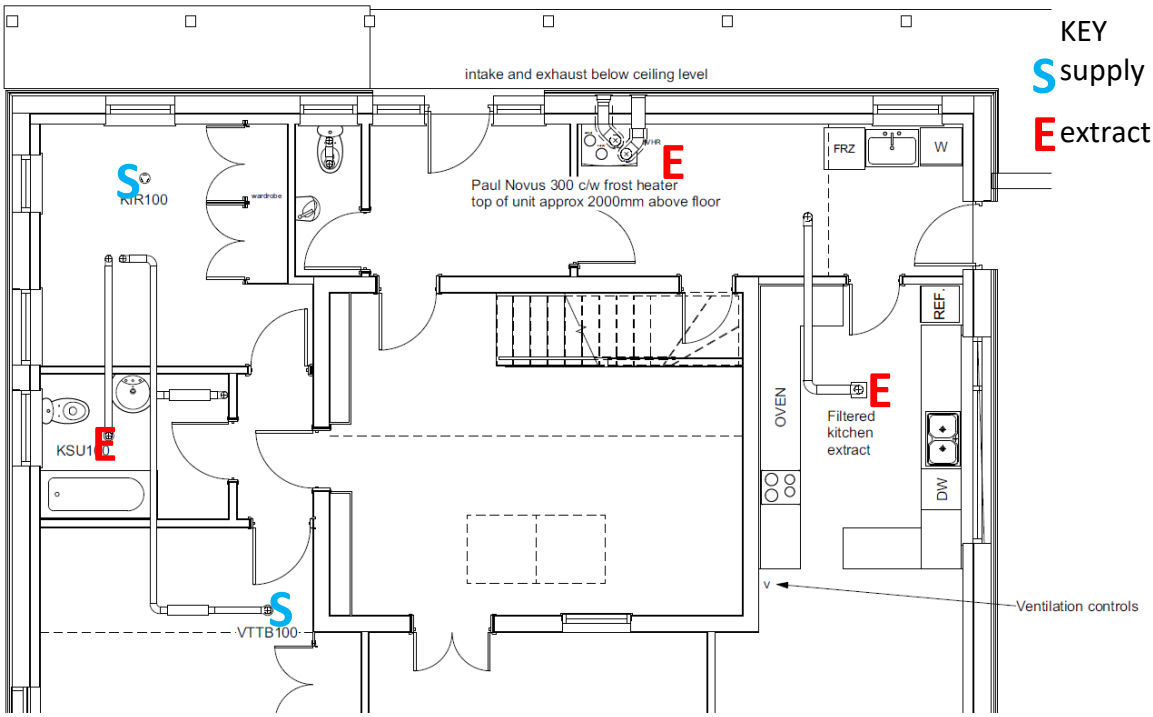
Airtightness is provided by the plaster layer on interior walls, airtightness membrane for the roof and the concrete slab. Airtightness tape was used at the join between the wall and the floor before the walls were plastered. The image on the left shows this tape with the surfaces primed beforehand. Wherever there pipes or cables passed through the airtightness layer proprietary seals were used, below right shows a seal around the soil and vent pipe in the roof. With these measures the airtightness achieved a very respectable 0.4 air changes per hour.

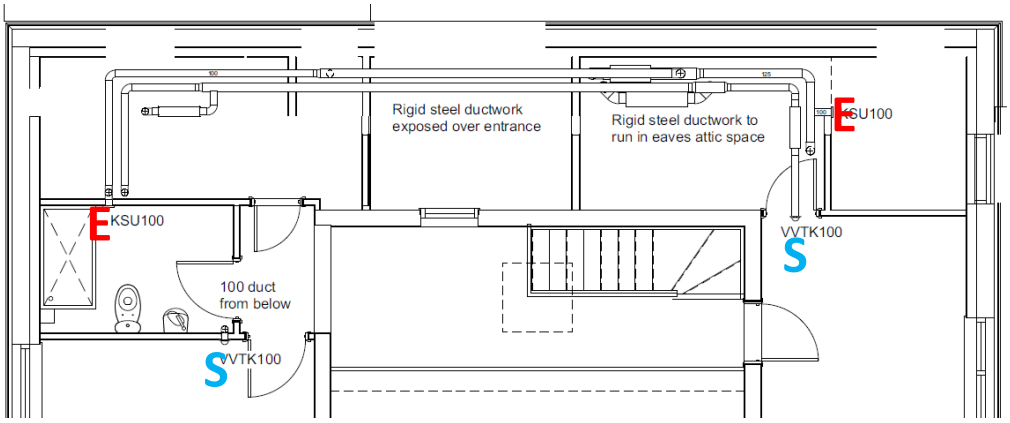


## 12 Layout of Ventilation System Ducting

An MVHR is located at the front of the house directly on an external wall to minimise intake and exhaust duct lengths. Rigid metal ductwork is routed through the first floor. Fresh air is taken from near the front door. Air is supplied to bedrooms and open plan areas and is removed from bathrooms, a WC, utility room and kitchen. Larger gaps under the doors allow air to transfer between rooms.



## 13 Ventilation Unit

The Paul Novus 300 unit is insulated and Passivhaus certified. The unit is installed in a cupboard that allows rapid drying of clothes without adding moisture to the house. The unit has a Specific power input of 0.24Wh/$m^3$ and the Effective Efficiency of heat recovery of the system is 90.6%. The image right shows the unit before the cupboard was built around it.

## 14 Heat Supply

Heat is supplied by a condensing gas boiler to radiators and also to a hot water tank.

## 15 PHPP

### Passive House verification

| | | | | | |
|---|---|---|---|---|---|
| Building: | Confidential | | | | |
| Street: | | | | | |
| Postcode / City: | | | | | |
| Country: | | | | | |
| Building type: | | | | | |
| Climate: | [UK] - West Pennines (Fairfield) | Altitude of building site (in [m] above sea level): | 75 | | |
| Home owner / Client: | Confidential | | | | |
| Street: | | | | | |
| Postcode/City: | | | | | |
| Architecture: | Simmonds Mills | | | | |
| Street: | 57 Portfield Street | | | | |
| Postcode / City: | Hereford, HR1 2SE | | | | |
| Mechanical system: | | | | | |
| Street: | | | | | |
| Postcode / City: | | | | | |
| Year of construction: | 2016 | Interior temperature winter: | 20.0 °C | Enclosed volume $V_e$ m³: | 660.4 |
| No. of dwelling units: | 1 | Interior temperature summer: | 25.0 °C | Mechanical cooling: | |
| No. of occupants: | 5.3 | Internal heat sources winter: | 2.1 W/m² | | |
| Spec. capacity: | 180 WhK per m² TFA | Ditto summer: | 3.2 W/m² | | |

Specific building demands with reference to the treated floor area

| | | | | Requirements | Fulfilled?* |
|---|---|---|---|---|---|
| | Treated floor area | 186.7 | m² | | |
| Space heating | Heating demand | 14.0 | kWh/(m²a) | 15 kWh/(m²a) | yes |
| | Heating load | 9.5 | W/m² | 10 W/m² | yes |
| Space cooling | Overall specif. space cooling demand | | kWh/(m²a) | - | - |
| | Cooling load | | W/m² | - | - |
| | Frequency of overheating (> 25 °C) | 0.5 | % | - | - |
| Primary energy | Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances | 103 | kWh/(m²a) | 120 kWh/(m²a) | yes |
| | DHW, space heating and auxiliary electricity | 49 | kWh/(m²a) | - | - |
| | Specific primary energy reduction through solar electricity | 39 | kWh/(m²a) | - | - |
| Airtightness | Pressurization test result $n_{50}$ | 0.4 | 1/h | 0.6 1/h | yes |

* empty field: data missing; "-": no requirement

## 18 Users Experiences

The owner reports that gas usage has been very modest through their first winter. Adjustments were recently made to the temperature compensation for the boiler which needs lower output than expected.

Summer temperatures have been a little warm in recent hot sunny weather. There has been a problem with one of the blinds and the house may not be getting the night-time ventilation it needs. Temperatures are not excessive, they have not reached 25°C which would be overheating by the Passivhaus definition.