Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

Brookmere Farm, Hall Lane, Mawdesley, Ormskirk

Building Data | Gebäudedaten

Year of construction Baujahr	2017	**Space heating** **Heizwärmebedarf**	**14.4** **kWh/(m²a)**
U-value external wall U-Wert Außenwand	0,155 W/(m²K)		
U-value ground floor U-Wert Erdgeschossplatte	0,102 W/(m²K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	49 kWh/(m²a)
U-value roof U-Wert Dach	0,126 W/(m²K)	Generation of renewable Energy Erzeugung erneuerb. Energie	n/a kWh/(m²a)
U-value window (ave) U-Wert Fenster	0,9 W/(m²K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	54 kWh/(m²a)
Heat recovery (effective) Wärmerückgewinnung	85.6 %	Pressurization test n_{50} Drucktest n_{50}	0,37h^{-1}
Special features Besonderheiten	Reuse of a steel framed agricultural building, wrapped with SIPs panels.		

Brief Description

Brookmere Farm, Hall Lane, Mawdesley, Ormskirk

Brookmere Farm is a 5 Bed Passivhaus dwelling developed by the reuse of a steel portal framed agricultural farm building in Ormskirk. The house has a gross internal floor area of 356m2 (3767 square foot) and meets the Passiv Haus Classic dwelling standard. The planning requirements restricted the overall height of the development; therefore, the ground levels were reduced around the site to provide additional height to the internal spaces.

The original portal frame was temporarily supported while the excavation of the ground levels around the structure was carried out. The steel columns were extended and bolted to the new insulated concrete raft foundations, incorporating steel reinforcement to form ground beams, to match the upper steel frame structure. The Kingspan TEK SIPs Building System was selected to 'wrap' the steel frame for the walls and roof. Kingspan provide technical support in terms of calculated thermal bridges for the system and checking interstitial condensation through calculations. The roof panels have a low percentage of timber bridging at only 4%. Also, Phi Architects had previously worked with the Kingspan TEK Delivery Partners and were confident that they could deliver the airtightness required with this system for the superstructure. For the ground floor, a lapped and taped visqueen membrane provided damp and air tightness between the concrete and insulation below.

The structural solution was in 3 layers, the existing steel portal frame supported the new internal first floor and roof. The SIPs panels formed an independent thermal layer around the portal frame and the outer masonry supported the steel framed balconies and entrance canopies without penetrating the insulation layer. Beneath the timber sole plate, a Marmox thermal block was incorporated to prevent thermal bridging at the wall to floor junctions.

The house is clad in Western Red Cedar boards and Sto rendered blockwork walls. The roof is finished with zinc standing seam cladding and Fakro rooflights have external electrically operated blinds to prevent overheating. The windows, supplied by Internorm, are triple glazed aluminium clad timber with integral electrically operated blinds to all opening windows. Large sliding doors allow access to the external landscape from the living areas on the south elevation. There is a deep overhanging roof to the kitchen dining area for solar shading and brise soleil to individual windows on the south-east and south-west elevations. The balconies also act as solar shading to the living rooms below.

The MVHR system was designed by Total Home Environment and the Zehnder ComfoAirQ 350 is located in the utility room with extract and intake to the south-east elevation.

As part of the project there is a 150m2 garage and workshop , the client was able to relocate their existing PV array onto the garage roof.

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	(revised planning and post planning stage) Sara Darwin Phi Architects 31 Hawthorn Grove Stockport SK4 4HZ
Implementation planning Ausführungsplanung	Planning consultant: Stephen Abbott Associates LLP
Building systems Haustechnik	Total Home Environment
Structural engineering Baustatik	Toby Savage Design
Building physics Bauphysik	-
Passive House project planning Passivhaus-Projektierung	Sara Darwin Phi Architects 31 Hawthorn Grove Stockport SK4 4HZ
Construction management Bauleitung	Client: Mr and Mrs Tinsley

Certifying body
Zertifizierungsstelle

WARM
3 Admirals Hard, Plymouth, PL1 3RJ

Certification ID
Zertifizierungs ID

6868	Project-ID (www.passivehouse-database.org) Projekt-ID (www.passivhausprojekte.de)

Author of project documentation
Verfasser der Gebäude-Dokumentation

Sara Darwin (Phi Architects)

Date 1.08.22 Datum	Signature Unterschrift

1. Project Photographs

South-West elevation

North west elevation

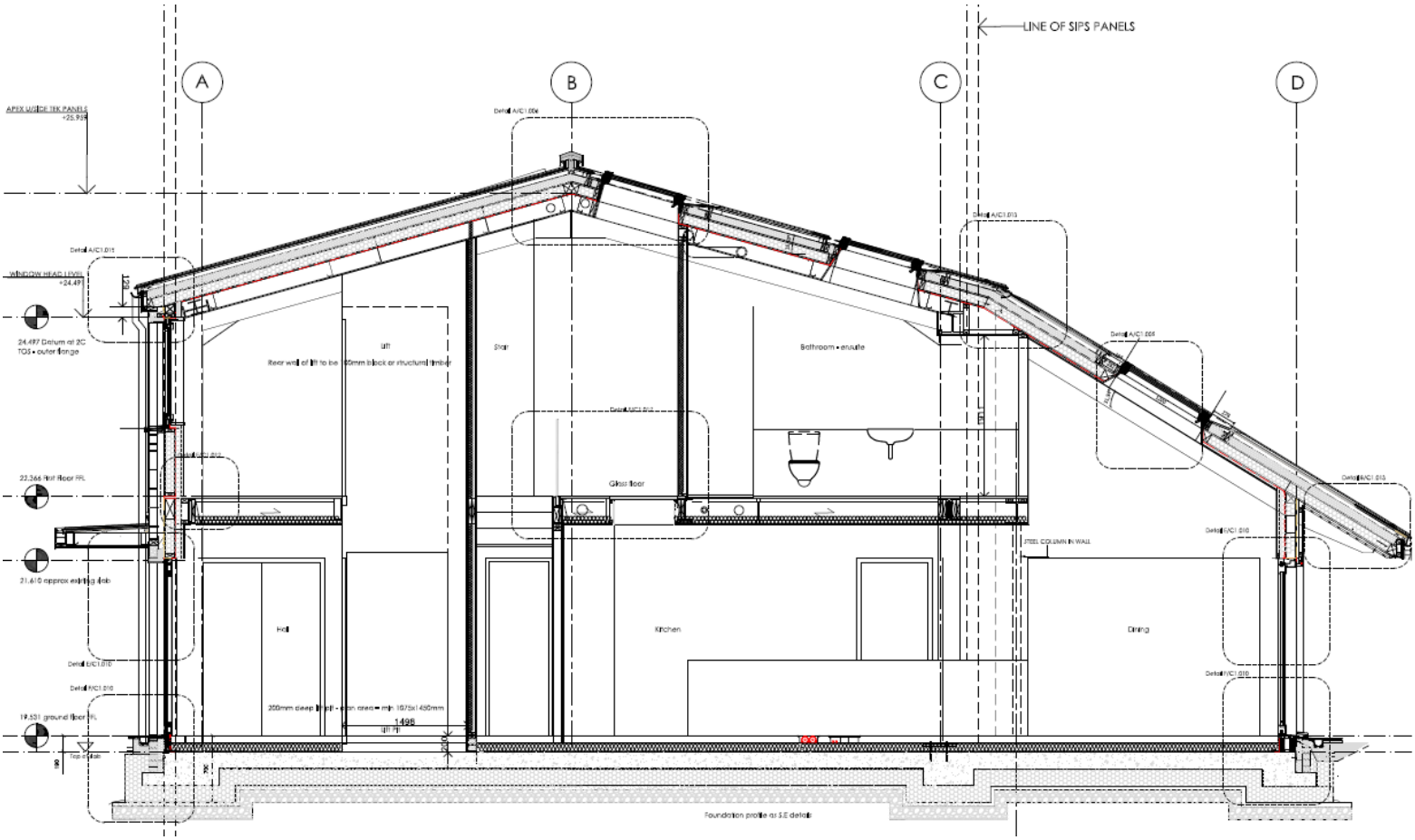
North East elevation

South-East elevation

2. Interior Photographs

© Peter Cook

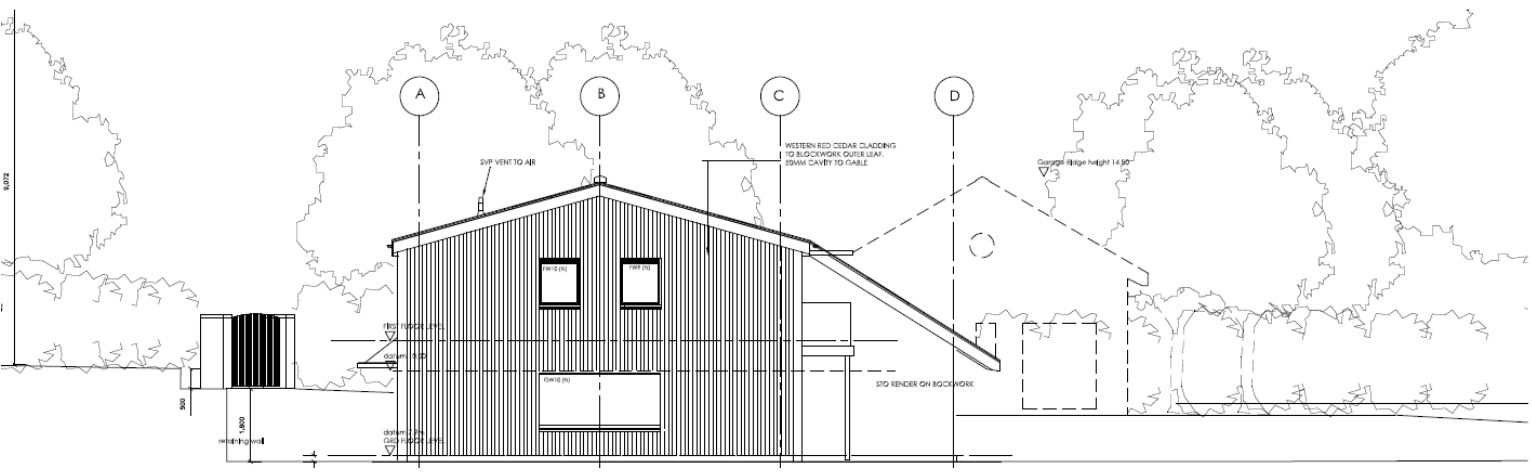
3. Section



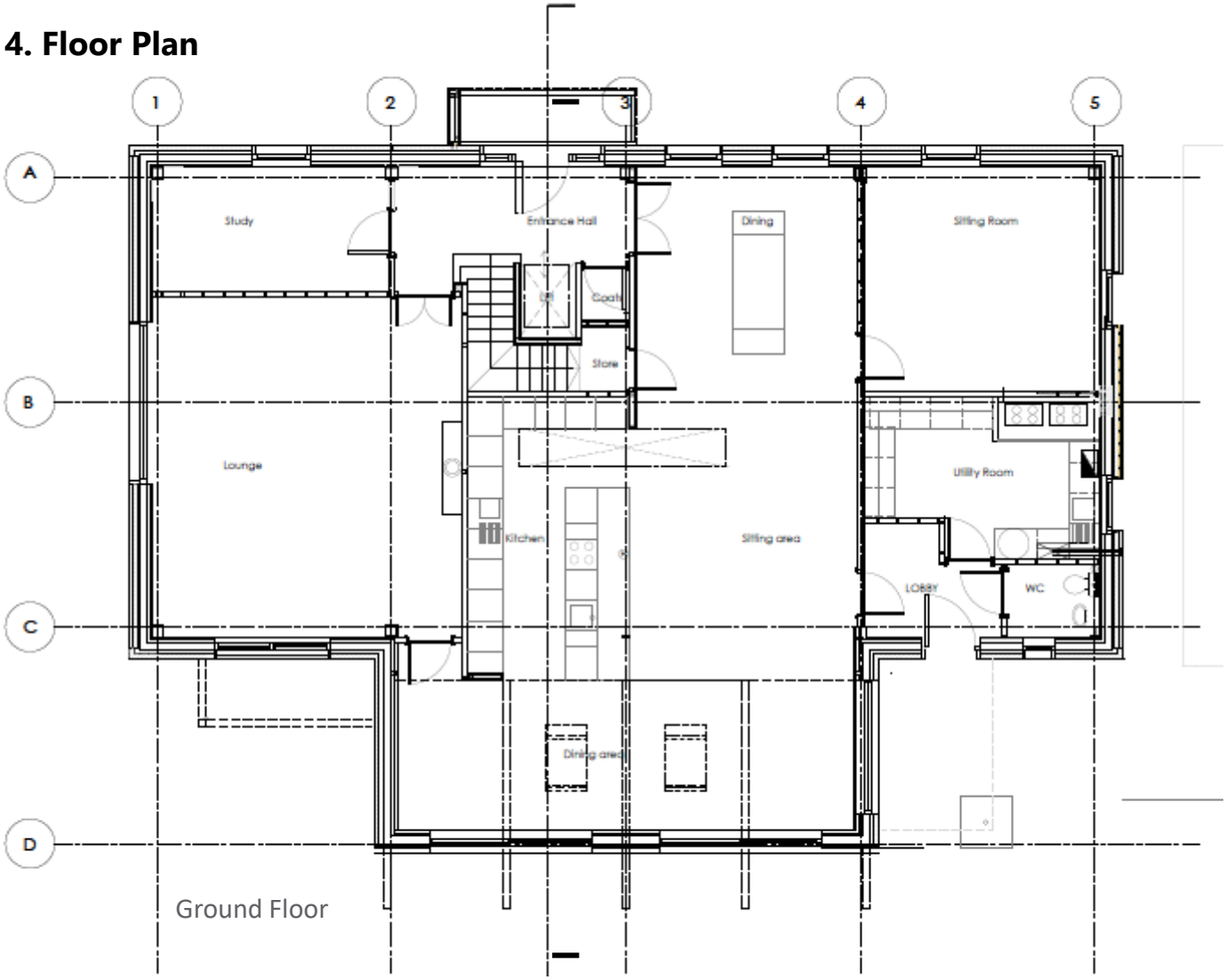
Section AA and North Elevation

The section shows the original steel portal frame for the agricultural barn was retained and the Kingspan TEK SIPs panels wrapped the whole structure. There was an extension between gridlines C and D at ground floor.

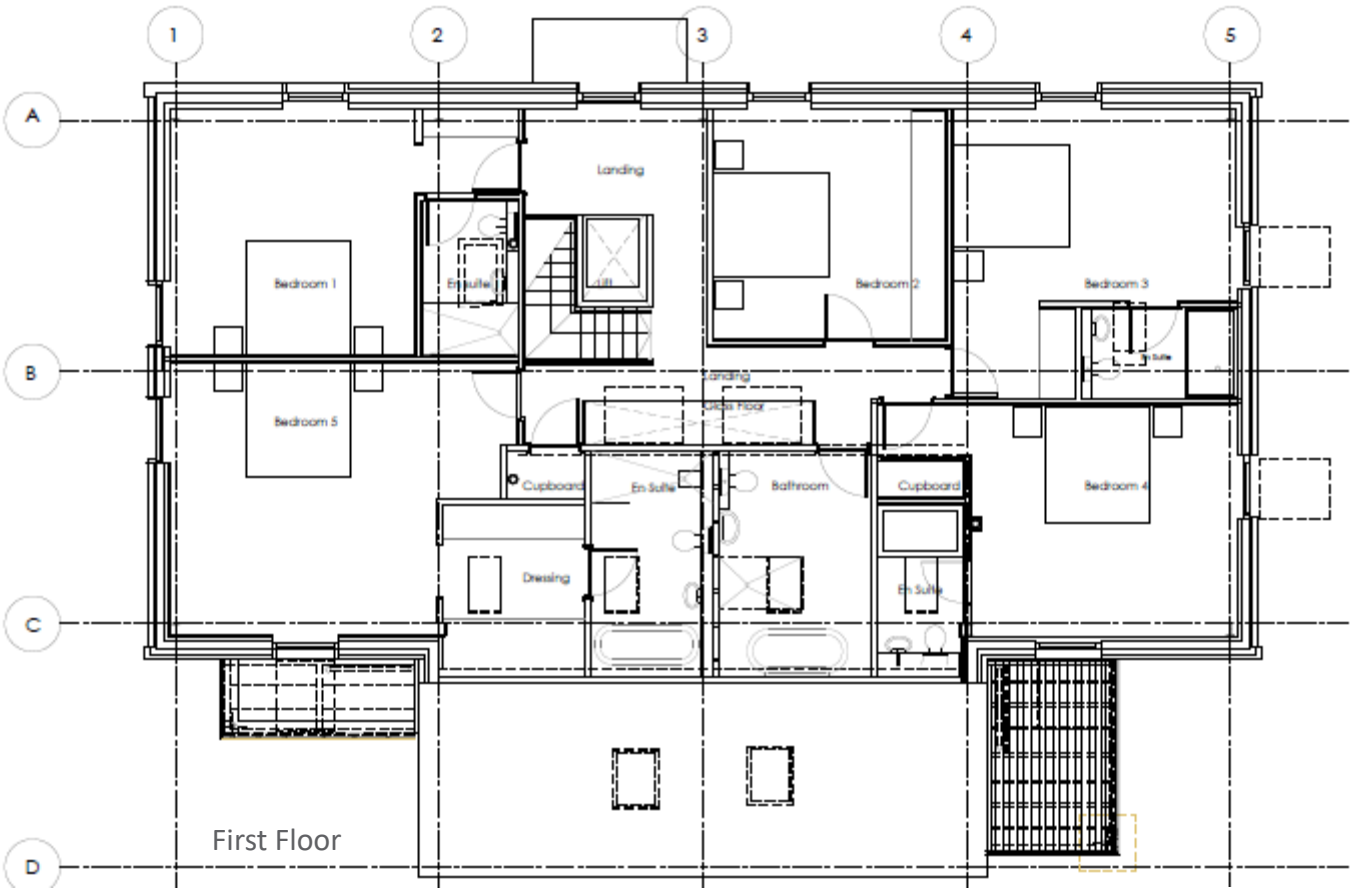
The North Elevation and site section below illustrates the reduced levels around the building in order to meet planning requirements to maintain the existing ridge height of the former barn.



4. Floor Plan



Ground Floor



First Floor

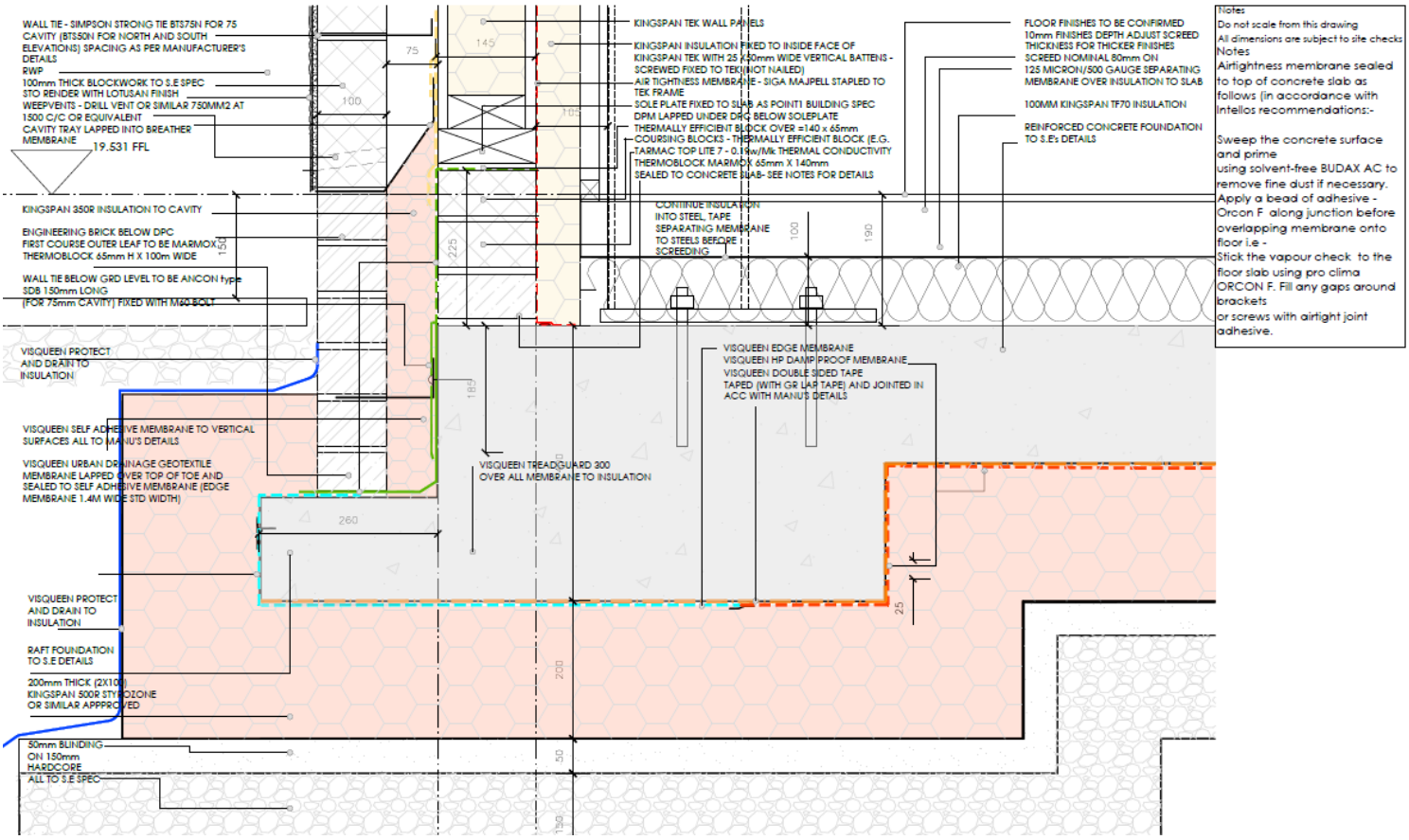
SCALE

0m 1m 2m 3m 4m 5m

5. Ground Floor construction

The ground floor is a raft foundation, which completely replaced the existing slab at a reduced site level, to create greater headroom within the dwelling. The steel portal frame was temporarily supported with additional steel framing as the steel columns were extended and the new raft was cast on site.
The majority of the insulation is under the slab, with a visqueen membrane on top. The extended columns are bolted to the slab within an additional layer of insulation and the ground floor is finished with a screed.

See below the existing barn and the temporary support to the frame.



5. Ground Floor construction

Kingspan Styrozone 500R insulation in 2 layers of 100mm thick insulation was used under the slab, with Visqueen membrane over.
The photos below show the thickened edge of the slab under the structural zone and the concrete reinforcement being placed ready for the concrete to be poured.

The wall to ground floor junction was carefully considered to prevent thermal bridging and a Marmox Thermoblock was used as the first row of blocks under the SIPs panels sole plate in order to improve performance at this junction.

Assembly no.			Interior insulation?
07ud	Ground Floor		

Heat transmission resistance [m²K/W]

Orientation of building element	3-Floor	interior R_{si}:	0.17
Adjacent to	2-Ground	exterior R_{se}:	0.00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Screed	1.400					90
kingspan TR70 insul	0.022					100
Reinforced concrete	2.100					200
Styrozone 500R	0.040					200

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			59.0 cm

U-value supplement: W/(m²K)

U-value: 0.101 W/(m²K)

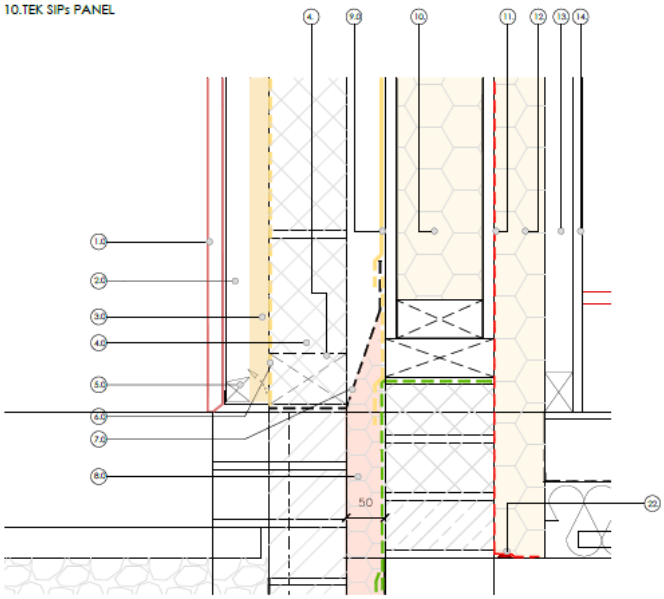
6. External wall construction

The external walls comprise Kingspan TEK panels, that wrap the existing steel portal frame of the barn. The SIPs are a standard 145mm width (112mm core of insulation). The SIP wall panels form an independent thermal layer around the steel portal frame. In order to meet the required U value, we considered using a thicker SIPs panel, however as this was not necessary structurally, it was more economical to specify an additional layer of insulation internally to increase the overall U value. The homogeneous layer also performs better without timber bridging and was detailed to be continuous through the floor zone behind the steel columns.

Externally, the balconies are independent of the SIPS structure avoiding thermal bridges; the outer leaf of masonry supports the edge of the steel framed balconies and entrance canopies without penetrating the insulation layer.

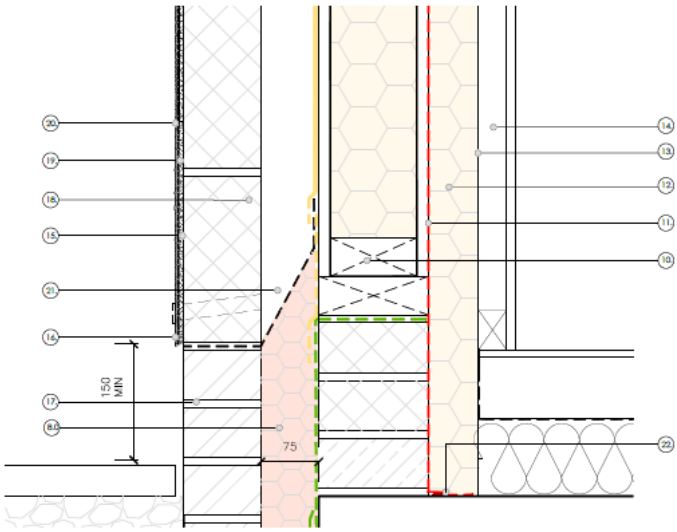
The SIPs panels are enclosed with a ventilated cavity and blockwork. A Sto render finish was applied to the blockwork leaf and in other areas, a western red cedar cladding is the external finish.

1.0 WESTERN RED CEDAR CLADDING
2.0 38X50mm HORIZONTAL BATTEN CHAMFERED TOP AT MAX 600mm C/C
3.0 25X50mm TREATED VERTICAL BATTENS FIXED TO BLOCKWORK AT MAX 600 C/C
4.0 100mm BLOCKWORK WITH WEEPVENTS
5.0 INSECT MESH TO BASE OF TIMBER CLADDING
6.0 BREATHER MEMBRANE TO BLOCKWORK
7.0 STEPPED DPC/CAVITY TRAY LAPPED INTO BREATHER MEMBRANE
8.0 CAVITY INSULATION KINGSPAN SYTROZONE
9.0 BREATHER MEMBRANE TO TEK SIPs PANEL
10.TEK SIPs PANEL
11.0 AIR TIGHNTESS MEMBRANE
12. 65mm INTERNAL INSULATION TO TEK PANEL
13. SERVICES CAVITY 25X50 BATTENS SCREWED TO KINGSPAN TEK TO HOLD INSULATION IN PLACE
14. 15mm FIRELINE PLASTERBOARD LINING



WALL BASE DETAIL - TIMBER GABLES NORTH + SOUTH

15 STOLEVELL COTE MIN 6mm THICK BASE COAT TO NBS SPEC ALL IN ACCORDANCE WITH MANU'S DETAILS
16. STO REND STOP BEAD
17. BLUE ENGINEERING BRICK BELOW DPC
18. 100mm BLOCKWORK
19. STO ARMAT CLASSIC MIN 3mm TK WITH STO GLASS FIBRE MESH EMBEDDED IN WET ARMAT CLASSIC
20. STO LOTUSAN K 1.5 - DECORATIVE WALL FINISH - TO MATCH GARAGE BLOCK
21. CAVITY WALL TRAY LAPPED INTO BREATHER MEMBRANE TO SIPs PANELS
22. AIR TIGHTNESS MEMBRANE SIGA MAJPELL TAKEN DOWN TO SLAB LEVEL AND SEALED TO CONCRETE SLAB WITH SIGA PRIMUR (LIQUID OR ROLL OR FENTRIM 20 50 / 85 TO SIGA SPEC
23. DRILL VENT CAVITY VENTILATOR OR EQUIVALENT APPROVED



WALL BASE DETAIL - RENDERED WALLS

6. External wall construction

The images below show the first lift of Kingspan TEK panels wrapping the steel columns.

A SIGA Majpell airtightness membrane was fitted to the internal face of the panels with an additional layer of insulation and battened service zone over the membrane (right hand photo).

The airtightness membrane is draped over the head of the SIP panel (middle photo) and the first floor boarding extends into the wall over the panels before the next lift of SIPs panels to the first floor are lifted into place and the airtightness membrane to the first floor is connected at the junction.

Assembly no.						Interior insulation?
02ud	Wall Construction north					

Heat transmission resistance [m²K/W]

Orientation of building element	2-Wall	interior R_{si}	0.13
Adjacent to	1-Outdoor air	exterior R_{se}	0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plasterboard	0.250					13
services void + battens	0.140			timber	0.130	25
Insulation TW55	0.022					65
OSB	0.130					15
Kingspan TEK core	0.023	spline	0.130	timber bridges	0.130	15
Kingspan TEK core	0.023			timber bridges	0.130	82
Kingspan TEK core	0.023	spline	0.130	timber bridges	0.130	15
OSB	0.130					15

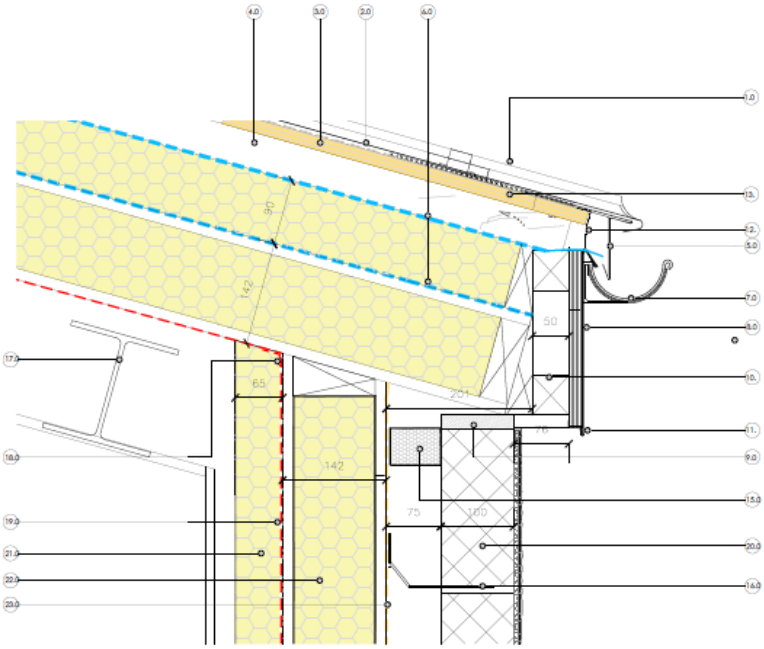
Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
77%	9.0%	14.0%	24.5 cm

U-value supplement 0.01 W/(m²K)

U-value: 0.155 W/(m²K)

7. Construction of Roof

The roof construction comprises Kingspan TEK SIPs panels supported on steel purlins over the steel portal frame. The roof build up has the additional layer of insulation installed on the outside of the panels, for buildability reasons. The TEK panels are protected with a breather membrane until the additional insulation is added. This also allows work to continue inside the dwelling until the roofers are on site. The roof finish is a Rheinzink standing steam Zinc roof on OSB vented at the eaves and ridge. An additional breather membrane was fitted over the insulation layer and the rooflights were installed before the roof finish and sealed with tapes to the breather membrane (wind proof) on the outside and the airtightness membrane on the inside.



detail A - EXTERNAL WALL HEAD DETAIL

1.0 RHEINZINK DOUBLE STANDING SEAM ROOF CLADDING
2.0 VAPOZINK STRUCTURED UNDERLAY
3.0 18mm OSB BOARD
4.0 50X50 TREATED BATTENS FIXED THROUGH INSULATION TO SIPS PANELS
5.0 PREFORMED RHEINZINK EAVES PROFILE FLASHING ON GLAV STEEL ANGLE SUPPORT PROFILE
6.0 BREATHER MEMBRANE
7.0 HALF ROUND GUTTER FIXED TO FASCIA
8.0 ZINC CLAD FASCIA
9.0 MOVEMENT JOINT - COMPRESSION JOINT
10. 50X50 BATTEN FIXED TO TIMBER EAVES RAFTER EXTENSION TO TEK KIT
11.0 ZINC DRIP
12.0 PERFORATED STRIP/INSECT MESH
13.0 12mm tk PLY EDGE BOARD 150mm WIDE
14.0 RIDGE FLASHING DOUBLE RIDGE ROOF
15. PROPRIETARY CAVITY CLOSER TO HEAD OF WALL
16. SIMPSON STRONG WALL TIE FIXED TO OUTER FACE OF SIPS TO 15mm TK OSB
17 STEEL BEAM FOR BRACING TO S.E DETAILS
18. MAJPELL AIR TIGHTNESS MEMBRANE TAPED TO WALL MEMBRANE WITH SIGA SICRALL TO MANU'S DETAILS
19. SIGA MAJPELL MEMBRANE TO WALL PANELS
20. RENDERED BLOCKWORK
21. 65mm INSULATION KINGSPAN TW55
22. KINGSPAN TEK PANEL
23. BREATHER MEMBRANE

AIRTIGHTNESS MEMBRANE INSTALLATION SEQUENCE

SIGA MAJPELL AIR TIGHTNESS MEMBRANE STAPLED TO INSIDE FACE OF SIPS WALL PANELS - WALL PANELS AND AIRTIGHTNESS MEMBRANE INSTALLED FIRST

ROOF
AIRTIGHTNESS MEMBRANE TO BE DRAPED OVER Z PURLINS FOR THE LENGTH OF THE BUILDING AND TAPED TOGETHER, IF REQUIRED, PRIOR TO ROOF PANELS BEING CRANED INTO PLACE.
SIGA MAJPELL MEMBRANE TO BE STAPLED BACK TO SIPS PANELS AND TAPED TOGETHER BETWEEN PURLINS POSITIONS

ROOF TO WALL CONNECTION
LAP ROOF MEMBRANE DOWN EDGE OF WALL AND TAPE TO WALL MEMBRANE WITH SIGA SICRALL TAPE - ALL IN ACCORDANCE WITH MANUFACTURER'S DETAILS

7. Construction of Roof

Assembly no.	Building assembly description					Interior insulation?
01ud	Roof					

Heat transmission resistance [m²K/W]

Orientation of building element: 1-Roof — interior R_{si}: 0.10

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
OSB	0.130					15
Kingspan TEK core	0.023	Spline	0.130	timber studs	0.130	15
Kingspan TEK core	0.023			timber studs	0.130	82
Kingspan TEK core	0.023	Spline	0.130	timber studs	0.130	15
OSB	0.130					15
Kingspan Thermapitch TP10	0.022					90

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
87%	9.0%	4.0%	23.2 cm

U-value supplement: 0.01 W/(m²K)

U-value: 0.126 W/(m²K)

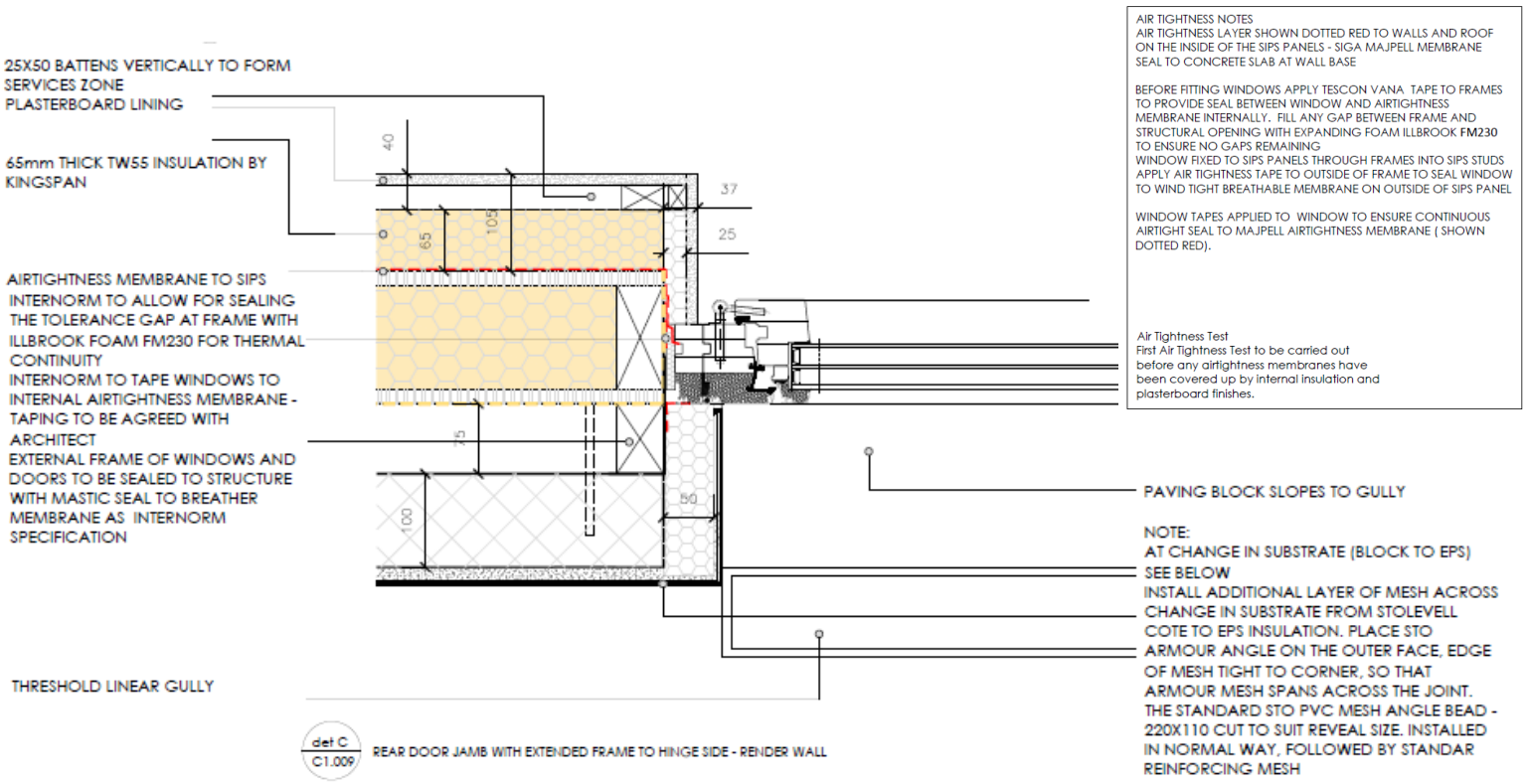
8. Windows and window installation

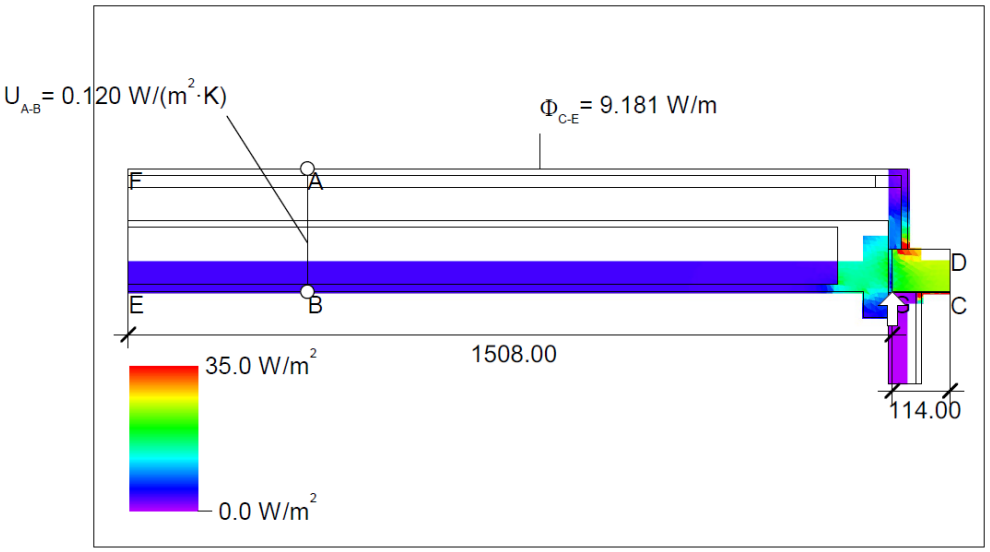
Internorm windows were selected for their timber appearance on the inside; also the product is a certified component and Internorm offer an integral blind system for opening casements. The integral blinds provide high levels of shading which were required, particularly on the south west elevation, to eliminate the risk of overheating in the summer.

Description of window (frame) construction, manufacturer	**Internorm, Aluminium clad timber frame**
Window Product Name(s)	Home Pure HV350, HF310
Frame-U-value Uf	0.87, 0.72 W/(m²K)
Type of Glazing	Triple Argon filled; HV350 4btoughened/10Ar/4/10Ar/b4 (0.8W/m²K, 31dB) (37M-IL_) HF310 4b/18Ar/4btoughened/18Ar/#4 (0.5W/m²K, 34dB) (34RILS)
Glass-U-Value Ug	0.7 W/(m²K) (units with blinds) and 0.5 W/(m²K)
g-Value of glazing	0,47 and 0.49

8. Windows and window installation

The window installation details were modelled in THERM by WARM and results input into the PHPP rather than using the default psi values. Externally insulation is used to overlap the frame by 50mm and the render was applied from the blockwork background onto the insulation to the reveals with a reinforcement at the junction.
On the inside an insulated plasterboard was used to insulate over the window frame and also over the timber studs to the SIPs panels at the window positions. The result of the THERM calculation is shown below.
Window tapes (Tescon Profil) were applied the window frame prior to installation to provide a seal to the SIGA airtight membrane internally.



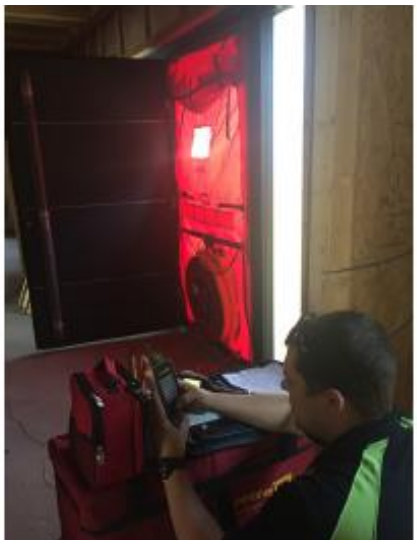


Window Psi Value & Heat Flux

$$\psi_{-,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{9.181}{30.000} - 0.870 \cdot 0.114 - 0.120 \cdot 1.508 = 0.026 \text{ W/(m·K)}$$

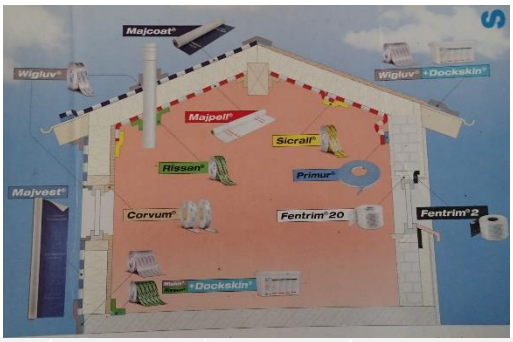
9. Description of airtightness strategy

The first (successful) air pressure test was carried out by E2 Consultants after completion of the airtight SIPs shell on the 12.06.2017. We used an airtightness membrane internally as a physical reminder to follow on trades of the importance of not penetrating the airtight line, as most of the sub contractors were not familiar with this method of passive house construction.



Airtightness Strategy

Walls: Airtightness membrane – Siga Majpell, Siga Sicrall tape
Ground Floor: Concrete Siga Rissan Tape + Dockskin Primer
Window Junction: Tescon Profil Tape, Illbruck Foam FM230
Roof: Membrane – Siga Majell



Measurement	50 Pa pressure test air changes n_{50} h^{-1}
Test 1 shell 12.06.2017	0,39
Test 2 25.09.2017	0,36
Test 3 30.09.2019	0,37

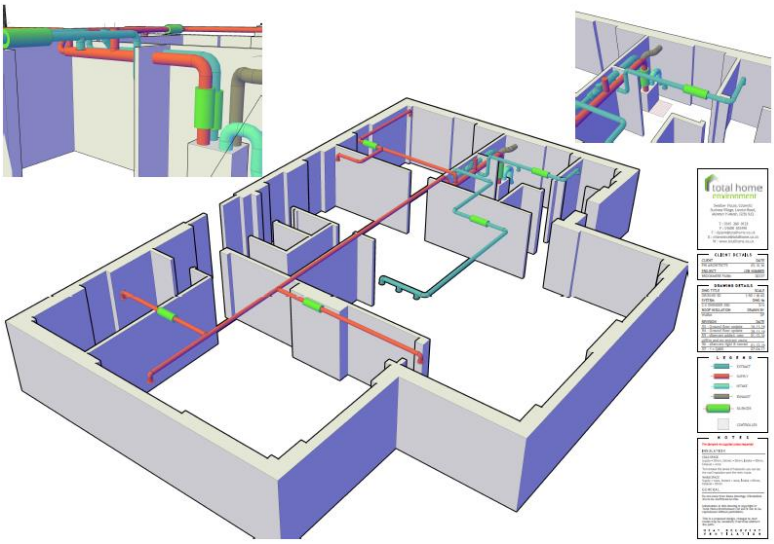
Adjacent to	Ground Floor	Roof	services	External walls
Roof	n/a	Sicrall tape to joints of Majpell membrane	Siga Rissen	Siga Majpell membrane+ Sicrall tape
External walls	Siga Rissen + Dockskin	Siga Majpell membrane+S icrall tape	Siga Rissen	Sicrall tape to joints
Frame Window Or door	Tescon Profil Tape, Illbruck FoamFM230	Tescon Profil Tape to rooflights	Siga Rissen	Tescon Profil Tape, Illbruck FoamFM230 SIGA Wigluv to breather membrane (external)

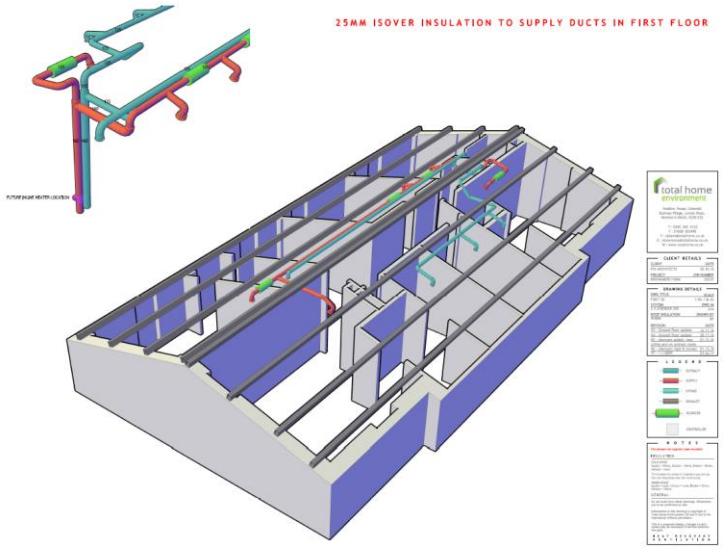
10. Ventilation unit

The Zehnder unit was chosen for its efficiency and quiet running. (Acoustic levels were checked during commissioning. The insulation on the intake and exhaust duct is Armaflex

Manufacturer of Unit	**Zehnder ComfoAir Q 600**
Heat recovery efficiency unit	87 % (system effective heat recovery efficiency = 85.6%)
Electrical efficiency	0,24 Wh/m³

11. Ventilation system – duct layout

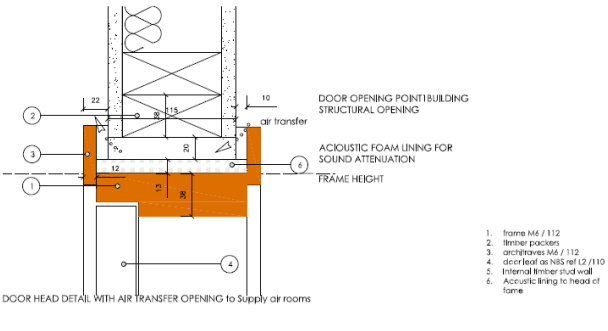




Supply air ducts (shown in red): living rooms, office, sitting room, dining room and bedrooms.

Extract air ducts (green) from bathrooms, toilets, utility and the kitchen.

The air is transferred through an acoustically attenuated opening in the architrave at the head of the internal doors (see detail below) into the hallway and the staircase. From there via openings above the doors into the wet rooms. The warm air is extracted from the wet rooms back to the heat exchanger via an exhaust air duct network (in green).



Acoustic attenuators are shown in light green, two on the primary ducts from the unit and other placed to prevent cross talk between rooms.

12. Heat Supply

A new gas supply was installed to the barn and a gas boiler was used for heating the hot water and a small number of radiators on the ground floor with heated towel rails on the first floor.

The boiler is a Viessman W200 19kW (A rated)– it was selected to meet the hot water demand in 5 bathrooms when the barn is fully occupied but also modulates down to 1.9kw for a small amount of heating.

The hot water cylinder is
ThermaQ Evocyl Air (Indirect)
Manufacturer's declared loss factor = 1.81 kWh/day
Insulation 50mm
Design Flow temp = 60deg C

Boiler and Cylinder shown right during construction prior to fitting pipework insulation.

Controls:
Motorised control valves, 7day electronic programmer, room stats and cylinder stats to provide control of both hot water and central heating / towel radiator requirements

Photos right showing the insulated pipework quality in the first floor zone.

13. Construction Costs

The client managed the build, which helped to keep the costs down. The approximate cost per metre squared is £1800/m2.

15. PHPP-Results

Passive House Verification

Building:	Brookmere Farm Passivhaus		
Street:	Hall Lane,		
Postcode/City:	L40 2QY	Ormskirk, Mawdesley	
Province/Country:	Lancashire	GB-United Kingdom/ Britain	
Building type:	Detached House		
Climate data set:	GB0008a-Fairfield		
Climate zone:	3: Cool-temperate	Altitude of location:	24 m
Home owner / Client:	Mr and Mrs Tinsey		
Street:	Brookmere Farm Hall Lane, Ormskirk, Mawdesley		
Postcode/City:	L40 2QY	Ormskirk, Mawdesley	
Province/Country:	Lancashire	GB-United Kingdom/ Britain	

Architecture:	PHI Architects		
Street:	31 Hawthorn Grove		
Postcode/City:	SK4 4HZ		
Province/Country:	UK	GB-United Kingdom/ Britain	
Energy consultancy:	PHI Architects		
Street:	31 Hawthorn Grove		
Postcode/City:	SK4 4HZ		
Province/Country:	Cheshire	GB-United Kingdom/ Britain	

Mechanical engineer:	Total Home Environment		
Street:	Swallow House		
Postcode/City:	Cotsworld B		
Province/Country:	Gloucestershire		
Certification:	WARM: Low Energy Building Practice		
Street:	3 Admirals Hard		
Postcode/City:	PL1 3RJ	PLYMOUTH	
Province/Country:	Devon	GB-United Kingdom/ Britain	

Year of construction:	2017	Interior temperature winter [°C]:	20.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.2
No. of occupants:	3.2	Specific capacity [Wh/K per m² TFA]:	72
		Interior temp. summer [°C]:	25.0
		IHG cooling case [W/m²]:	2.2
		Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area m²	348.9				
Space heating	Heating demand kWh/(m²a)	14.4	≤	15	-	yes
	Heating load W/m²	8.5	≤	-	10	
	Frequency of overheating (> 25 °C) %	4	≤	10		yes
Airtightness	Pressurization test result n_{50} 1/h	0.4	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	54	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	49	≤	60	60	yes
	Generation of renewable energy (in relation to pro-jected building footprint area) kWh/(m²a)	0	≥	-	-	

[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	Michael	Roe	

Certificate ID	Issued on:	City:	
		Plymouth	