Project Documentation
Gebäude-Dokumentation

1 Abstract / Zusammenfassung

Contemporary detached dwelling in Devon, UK

1.1 Data of building / Gebäudedaten

Year of construction/ Baujahr	2018	**Space heating / Heizwärmebedarf**	**13 kWh/(m²a)**
U-value external wall/ U-Wert Außenwand	Rendered 0.112 W/(m²K) Brick 0.083 W/(m²K) Basement 0.102 W/(m²K)		
U-value floor/ U-Wert boden	Lower grd floor 0.086 W/(m²K) Ground floor 0.101 W/(m²K)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	26 kWh/(m²a)
U-value roof/ U-Wert Dach	0.108 W/(m²K)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	30 kWh/(m²a)
U-value window/ U-Wert Fenster	0.89 W/(m²K)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	66 kWh/(m²a)
Heat recovery/ Wärmerückgewinnung	88 %	Pressure test n_{50} / Drucktest n_{50}	0.56 h-1
Special features/ Besonderheiten	The design won planning permission under the ‘exceptional design’ clause of the UK National Planning Policy Framework.		

1.2 Brief Description ...

The Walled Garden

A historic Georgian high garden wall inspired this contemporary Passivhaus in Devon. Extending at 90 degrees from the original wall, a new brick wall makes the façade of the single-storey-house with a partial basement. An open honeycomb brick bond pattern at each end of the facade shelters terraces behind, and a modest doorway at the centre leads into the house itself. A glazed courtyard makes the heart of the home, with living spaces bathed in daylight surrounding it.

The house and its garden are an inspiring muse for the client, a keen photographer. The material palette inside is tactile and textured: reclaimed terracotta, rough sawn oak, and clay plaster ensure that internally, the building feels connected to the garden that inspired it - now planted with 100 new trees including birches, acers, espaliered hornbeam, over 300 meters of hedging and much more. The original walled garden has been restored into a productive kitchen garden.

The building is constructed primarily from locally manufactured SIPS panels wrapped in an additional layer of insulation to achieve the required u-values.

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1.3 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	McLean Quinlan www.mcleanquinlan.com
Building systems/ Haustechnik	WARM: Low Energy Building Practice www.peterwarm.co.uk
Passive House project planning/ Passivhaus-Projektierung	WARM: Low Energy Building Practice www.peterwarm.co.uk
Construction management/ Bauleitung	Goulden & Sons www.gouldenandsons.co.uk

Certifying body/ Zertifizierungsstelle	Cocreate Consulting www.passivhaus.etude.uk		
Certification ID/ Zertifizierungs ID	20797_Cocreate_PH_20190410_WS	Project-ID (www.passivehouse-database.org)	6343

Author of project documentation / Verfasser der Gebäude-Dokumentation	Caroline Martin www.peterwarm.co.uk
Date, Signature/ Datum, Unterschrift	

2 ELEVATION VIEW OF THE BUILDING

South east (front) elevation

South west elevation

South west and North west elevation

North east elevation

3 EXEMPLARY PHOTOS FROM THE INSIDE OF THE BUILDING

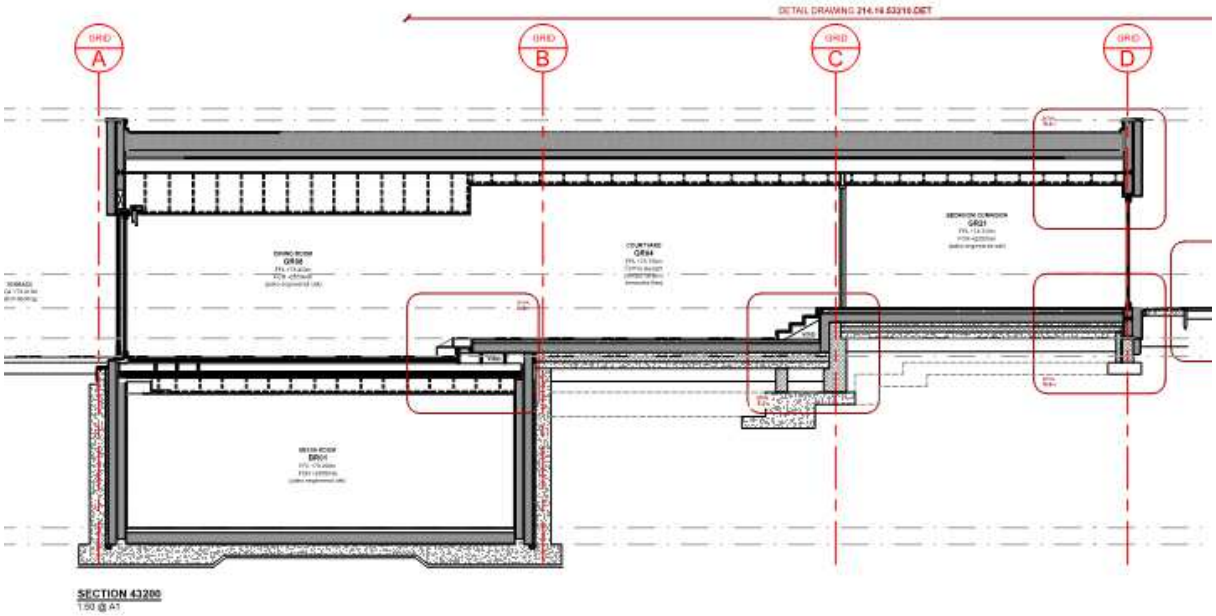
Internal courtyard

Open plan living area

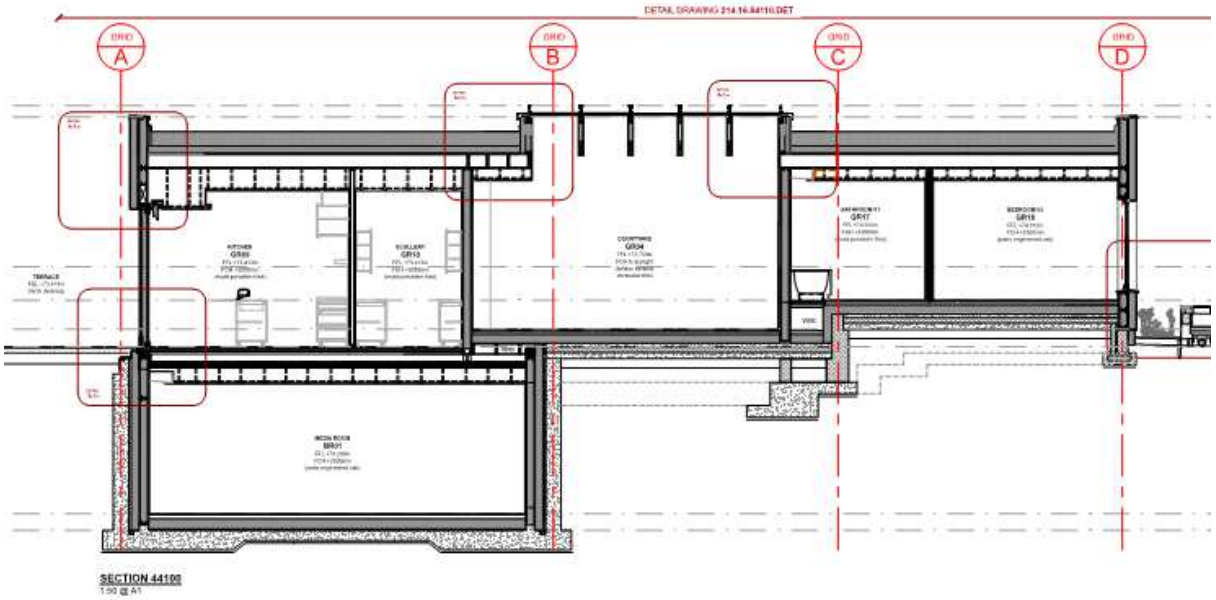
Master bedroom

Basement

4 SECTIONAL VIEW OF THE BUILDING



Section 43200



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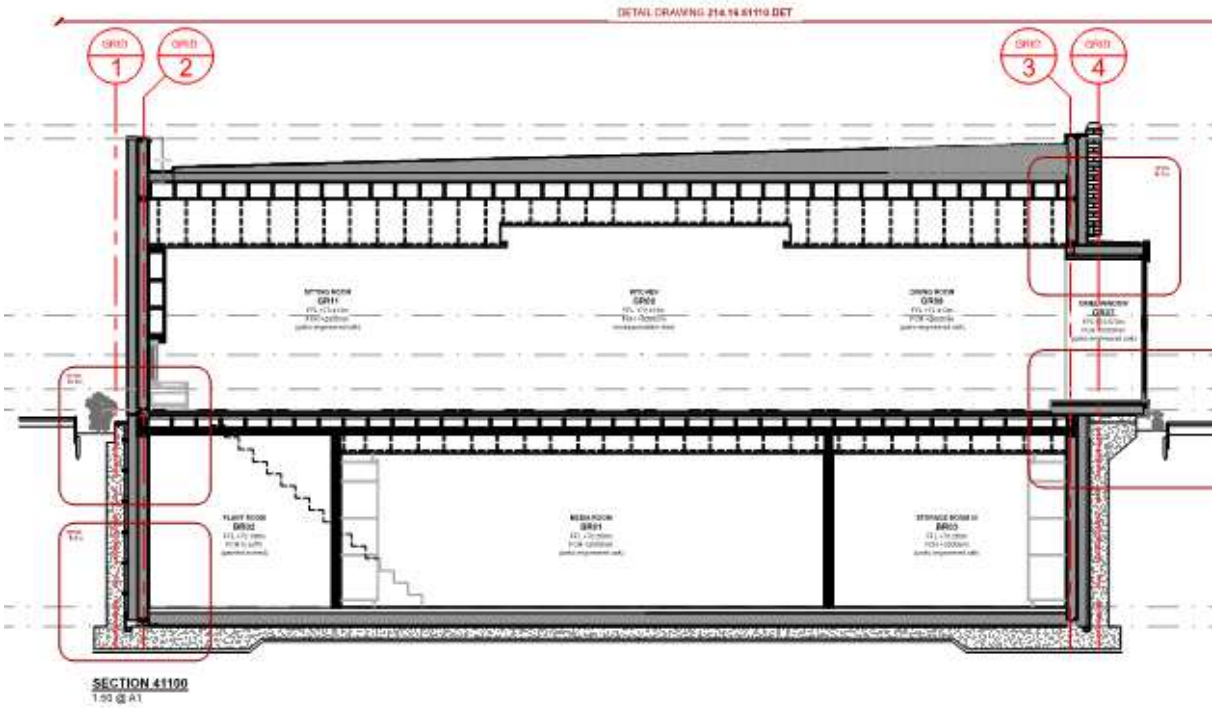
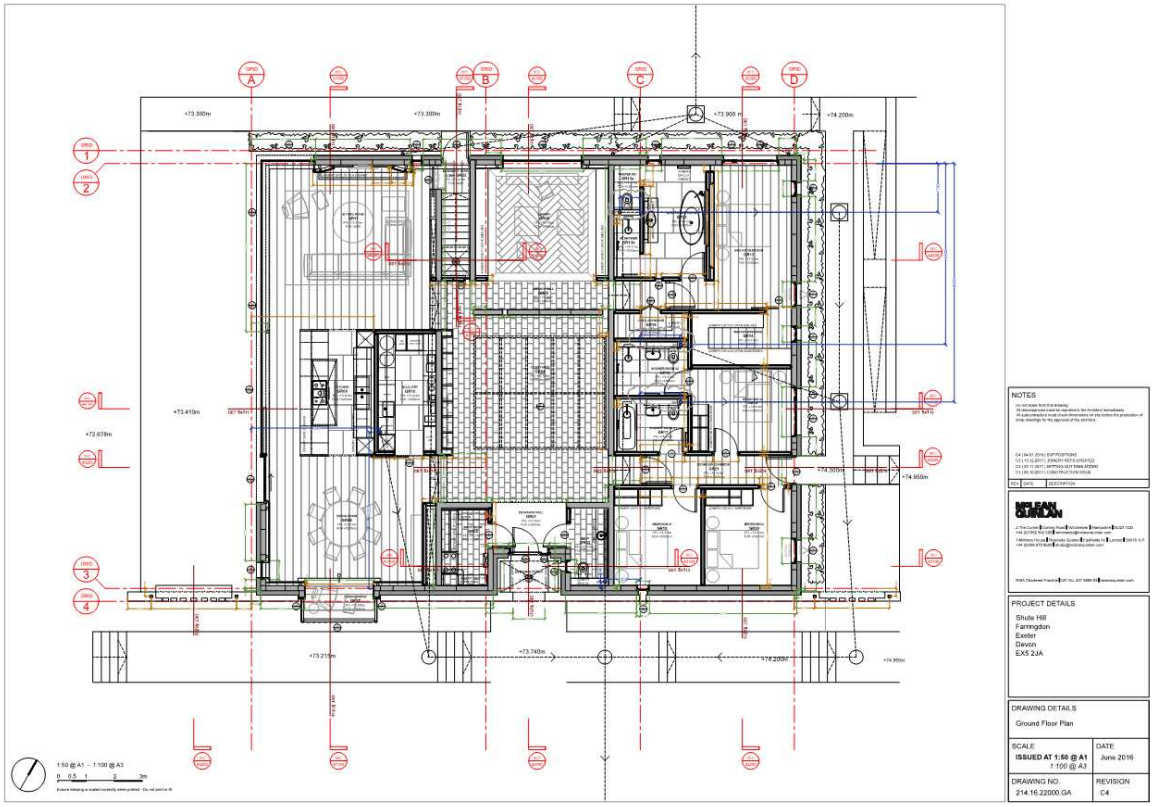
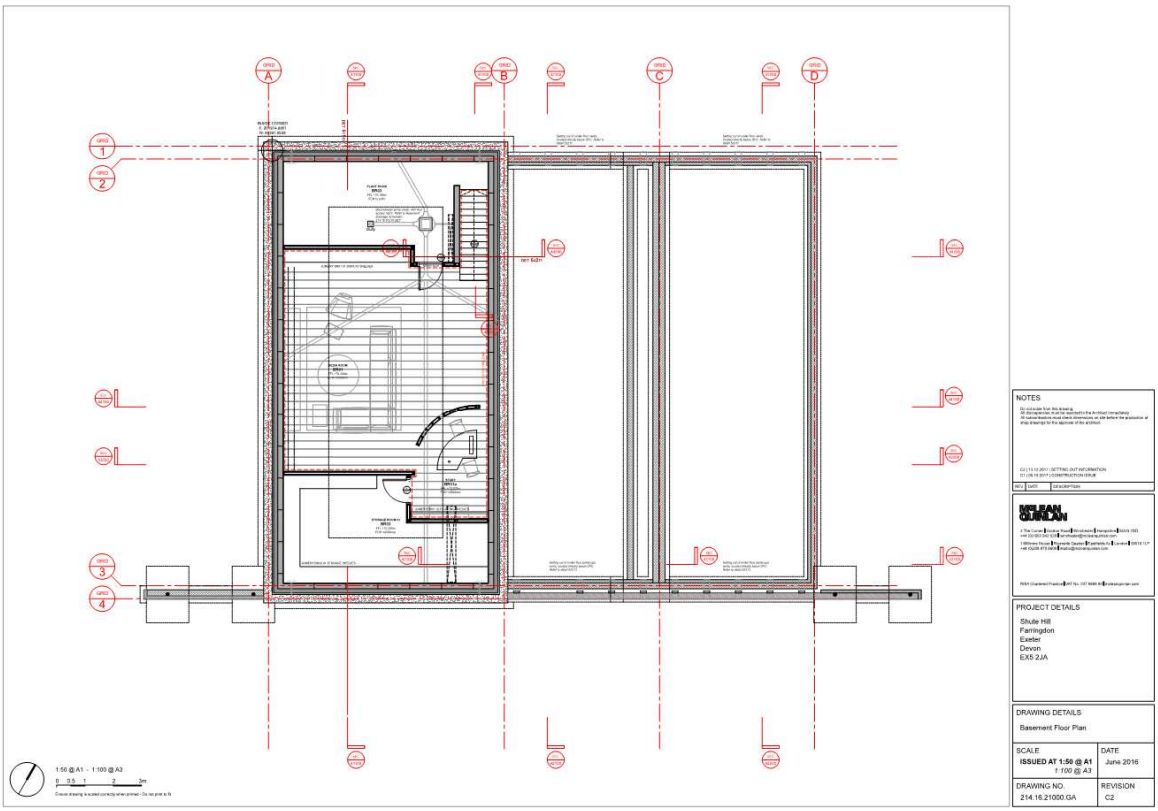


Section 41100

5 FLOOR PLANS



Ground floor plan

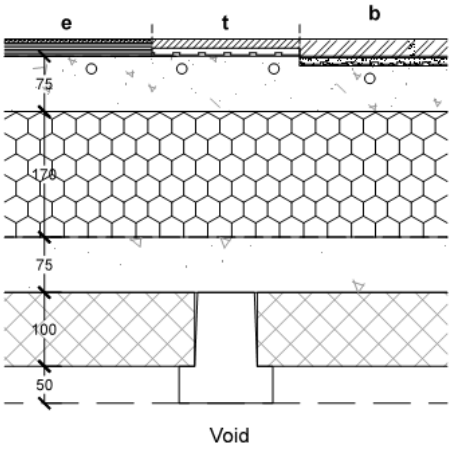


Basement floor plan

6 CONSTRUCTION OF FLOOR SLAB

The insulation used in both the basement and ground floor was rigid thermoset phenolic insulation with a thermal conductivity of 0.018 W/m.K. The basement floor was slab on grade and the ground floor was suspended floor above a ventilated cavity (beam and block).

F03: GROUND FLOOR
Beam & Block Ground Floor



- **e** : 20mm engineered timber flooring. 3mm marldon mxa200 flexible adhesive.

- **t** : 12mm porcelain tile, 6mm ardex x7001 adhesive, 3mm schulter ditra uncoupling membrane, 2mm ardex AF200 adhesive.

- **b** : 25mm brick slips on 6mm Ardex adhesive, 3mm schluter ditra uncoupling membrane, 2mm ardex AF200 adhesive to substrate - Stretcher bond with 8mm joints as per drawings (Spec ref: M40/110C)

- 75mm sand:cement screed reinforced with a142 mesh placed on purpose made spacers, with U/F heating pipes

- 500 Gauge Polyethylene Protection layer

- 170mm Kingspan K3 insulation

- 1200 Gague Polyethylene DPM

- 75mm reinforced concrete slab to engineer's details and specification

- Concrete beam and block structural floor

Ground floor build-up

Assembly no.	Building assembly description					Interior insulation?
01ud	**Ground floor**					

Heat transmission resistance [m²K/W]

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

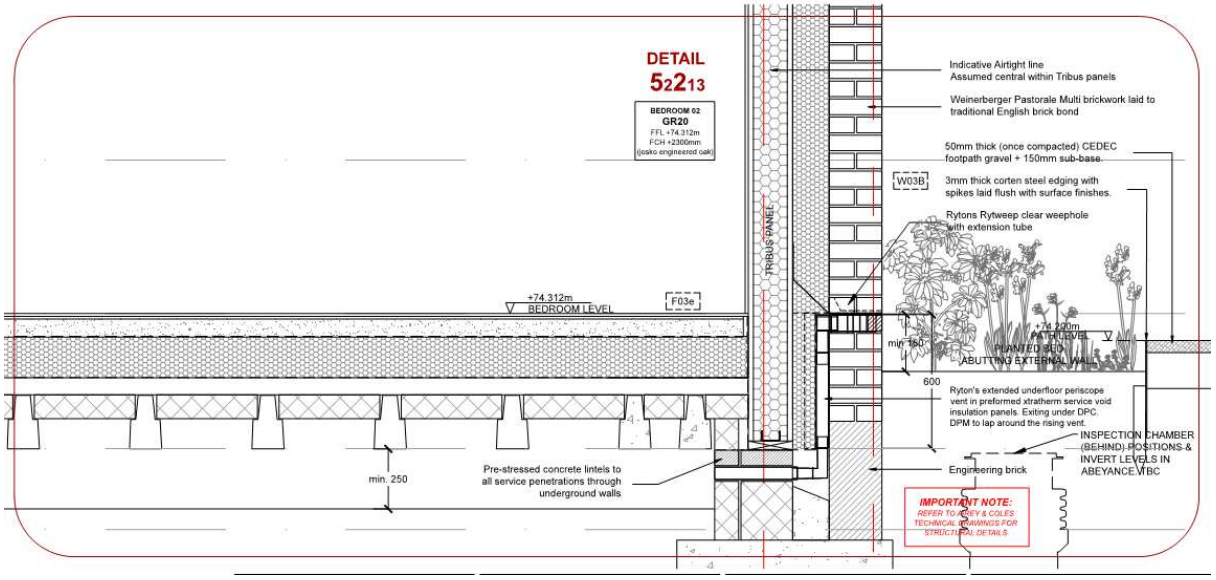
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
screed	1.400					75
Kooltherm K103	0.018					170
concrete	2.100					75
Beam & block	2.100					100

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			42.0 cm

U-value supplement W/(m²K)

U-value: 0.101 W/(m²K)

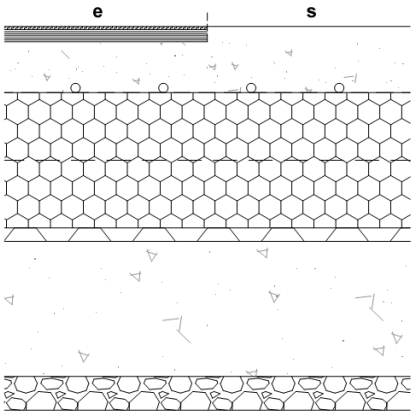
Ground floor u-value



Ground floor wall to floor detail.

F01: BASEMENT FLOOR

Concrete slab



- **e** : 20mm engineered timber flooring. 3mm Marldon mxa200 flexible adhesive.
(see finishes schedule for timber specification)

- **s** : Painted screed (increased thickness 98mm)
(see finishes schedule for paint spec)

- 75mm sand:cement screed reinforced with a142 mesh placed on purpose made spacers, with U/F heating pipes stapled through to insulation layer using 'OMNIE Staple' system.

- Polythene protection layer

- 200mm Kingspan Kooltherm K103 floor insulation (non-standard insulation thickness may be made up by layering 2No. insulation boards - thicker board should be to bottom, joints should be staggered)

- 20mm Delta membrane MS20

- 200mm reinforced concrete slab to engineer's details and specification

- 50mm blinding layer

Basement floor build-up

Assembly no.						Interior insulation?
06ud	Basement 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

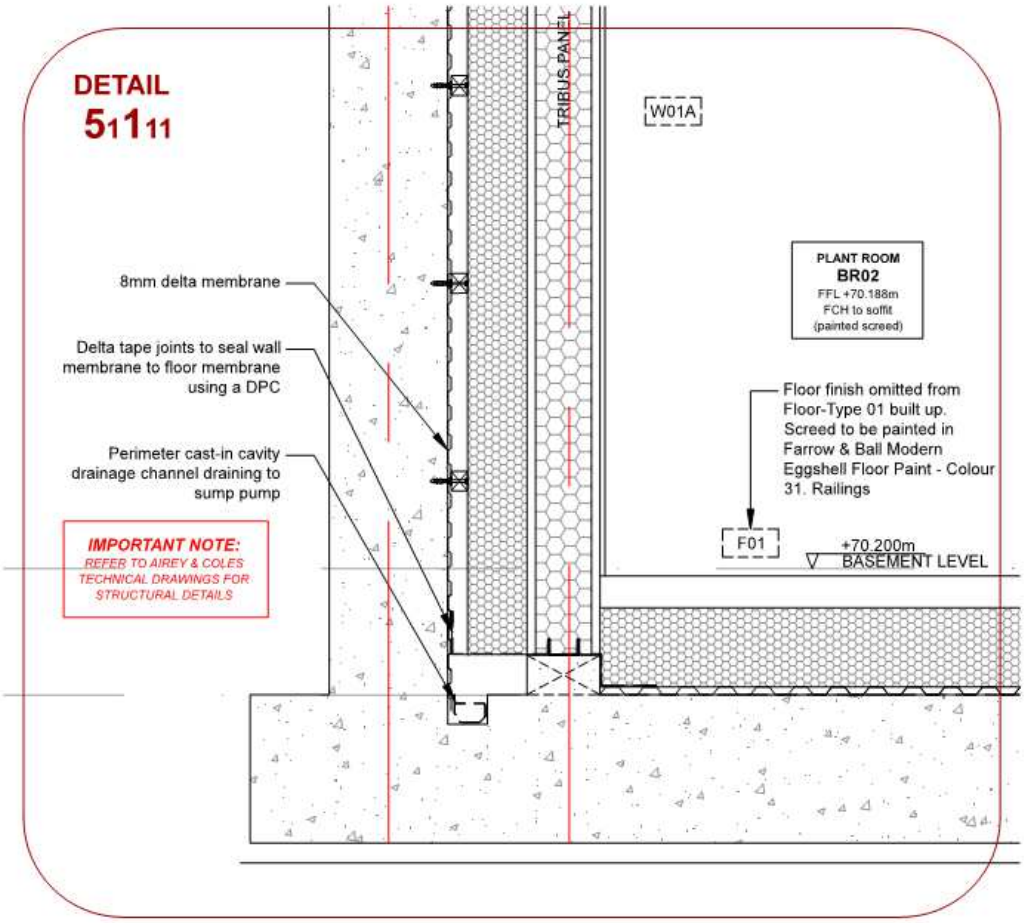
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
timber flooring	0.130					20
screed	1.400					98
Kooltherm K103	0.018					200
concrete	2.100					200

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			51.8 cm

U-value supplement: W/(m²K)

U-value: 0.086 W/(m²K)

Basement floor u-value



Basement floor wall to floor detail.

7 CONSTRUCTION OF THE EXTERIOR WALLS

The exterior walls used SIPs panels manufactured by Tribus. The basement walls and rendered ground floor walls had an additional outer wrap of 150mm EPS insulation. The Ground floor brick faced walls had 150mm full fill PIR insulation between the SIPs panels and the outer brick.

The thermal bridging caused by the metal in the connections between panels was not included in the manufacturers published conductivity value, so an equivalent conductivity value of 0.201W/mK was calculated to account for this.

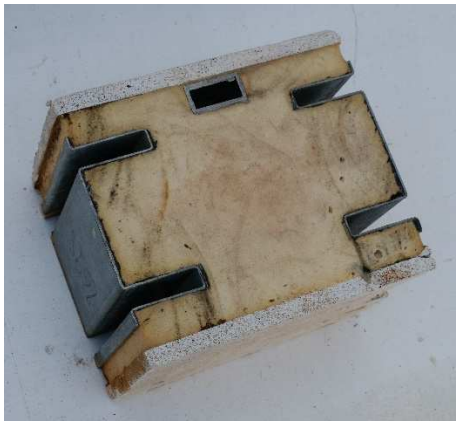
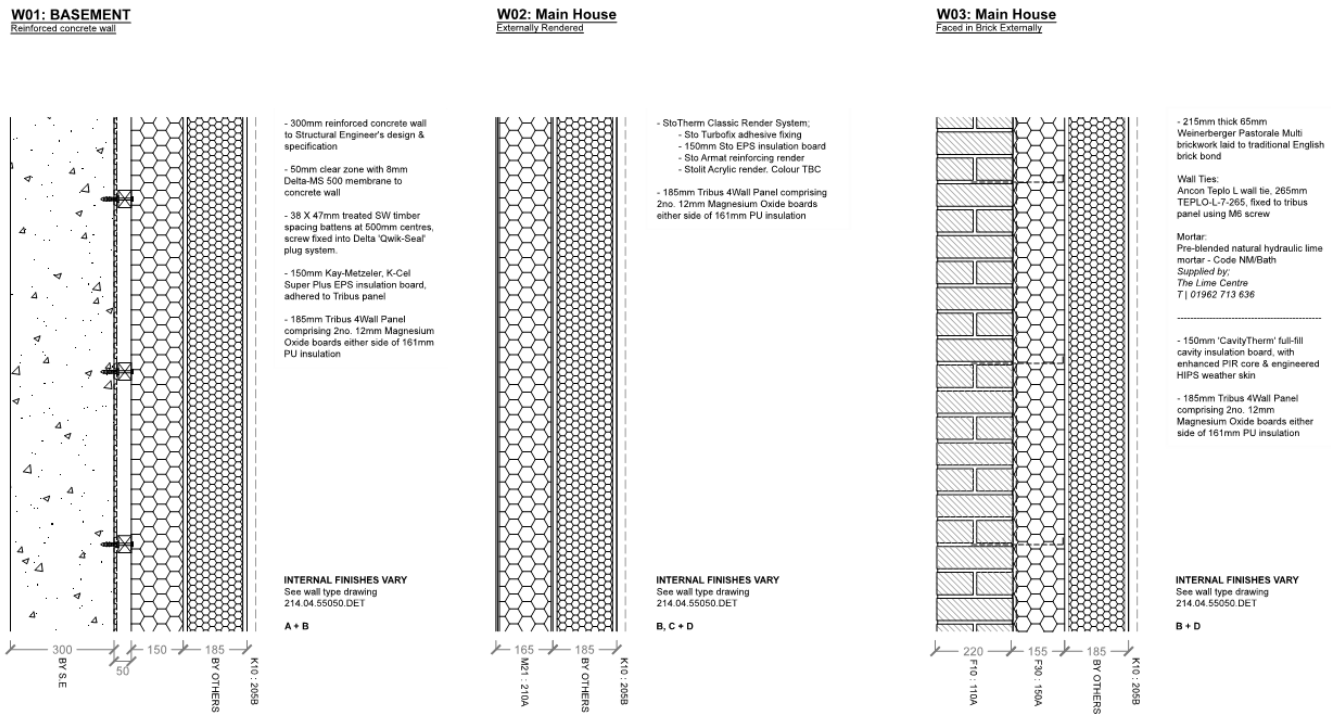
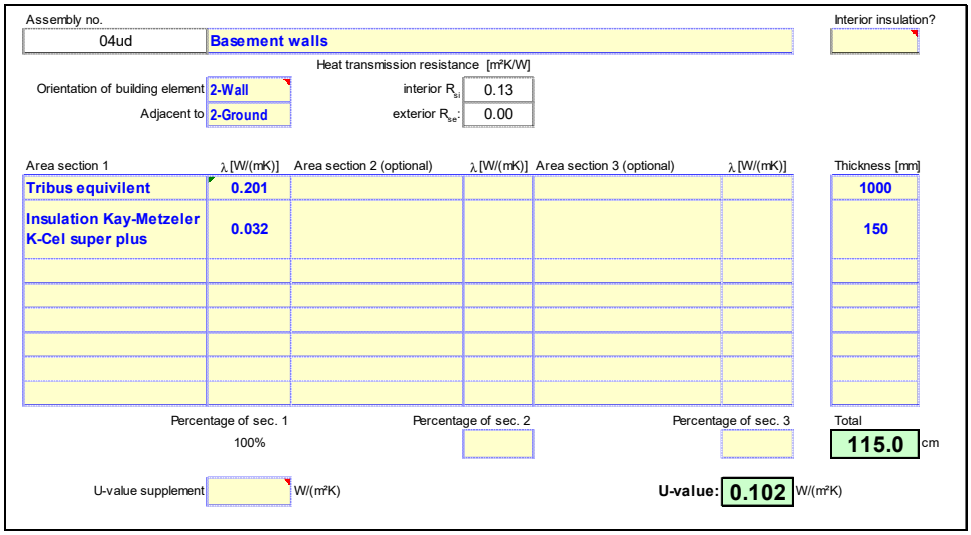


Image of panel sample showing metal connectors.



Wall build ups.



Assembly no.			Interior insulation?
04ud	Basement walls		

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 2-Ground — exterior R_{se}: 0.00

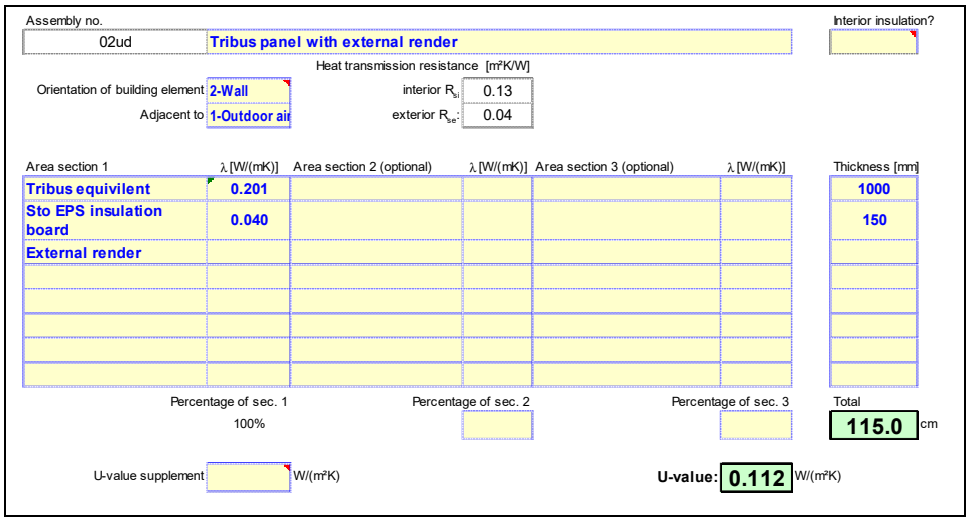
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Tribus equivilent	0.201					1000
Insulation Kay-Metzeler K-Cel super plus	0.032					150

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total: 115.0 cm

U-value supplement: W/(m²K)

U-value: 0.102 W/(m²K)

Basement wall u-value.



Assembly no.			Interior insulation?
02ud	Tribus panel with external render		

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

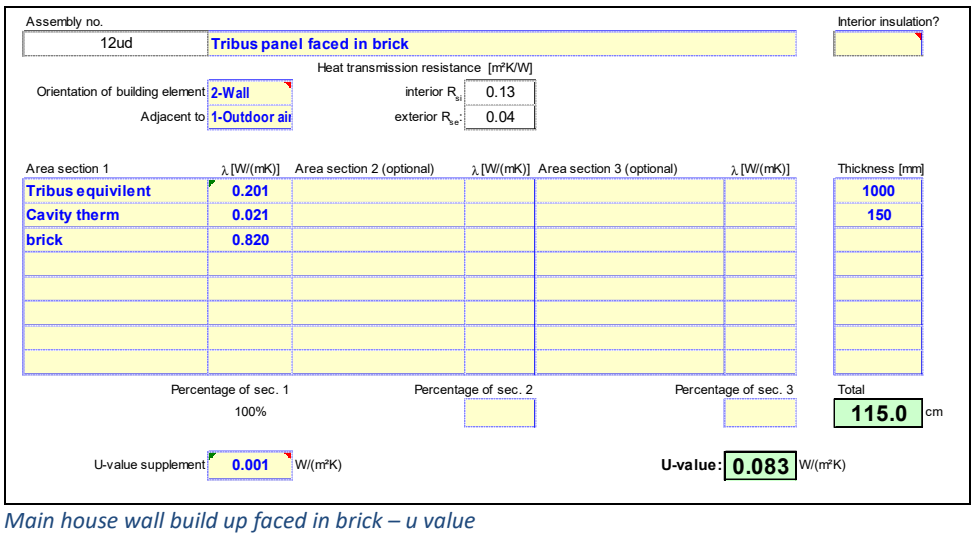
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Tribus equivilent	0.201					1000
Sto EPS insulation board	0.040					150
External render						

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total: 115.0 cm

U-value supplement: W/(m²K)

U-value: 0.112 W/(m²K)

Main house wall build up externally rendered – u value



Assembly no.			Interior insulation?
12ud	Tribus panel faced in brick		

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]
Tribus equivilent	0.201					1000
Cavity therm	0.021					150
brick	0.820					

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total: 115.0 cm

U-value supplement: 0.001 W/(m²K)

U-value: 0.083 W/(m²K)

Main house wall build up faced in brick – u value

SIPS panels on walls of basement.

Basement walls, SIPs panel and insulation installation.

8 CONSTRUCTION ROOF / CEILING OF THE TOP FLOOR

The roof used 140mm of Rigid EPS insulation with a conductivity of 0.040 W/mK overlaid with PIR insulation laid to fall with thickness varying from 80mm to 119mm with a conductivity of 0.026 W/mk. The overall U value was 0.132W/m^{2}K.

Building assembly description

01kf	Roof

Heat transmission resistance [m²K/W]

Orientation of building element	1-Roof	interior R_{si}	0.10
Adjacent to	1-Outdoor	exterior R_{se} :	0.04

A parallel building assembly layers

Area section 1	λ[W/(mK)]	Area section 2 (optional)	λ[W/(mK)]	Area section 3 (optional)	λ[W/(mK)]	Total width Thickness t_0 [mm]
Rigid insulation	0.026					80
Rigid insulation	0.040					140
Plywood deck	0.140					18

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			23.8 cm

U_0:	0.146	W/(m²K)
R_0:	6.845	(m²K)/W

B wedge-shaped building assembly

Area section 1	λ[W/(mK)]	Area section 2 (optional)	λ[W/(mK)]	Area section 3 (optional)	λ[W/(mK)]	Thickness t_1 [mm]
PIR insulation to fall	0.026					39

Percentage of sec. 2	Percentage of sec. 3	Thickness t_1 [cm]
		3.9 cm

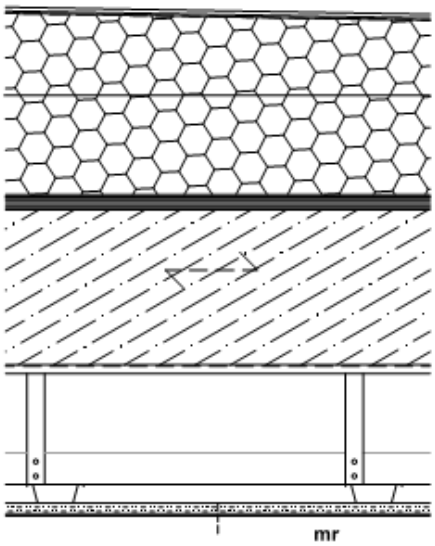
U_1:	0.667	W/(m²K)
R_1:	1.500	(m²K)/W
U-value rectangular area:	**0.132**	W/(m²K)
U-value of triangular area with the max thickness at the apex:	**0.136**	W/(m²K)
U-value of triangular area with the min thickness at the apex:	**0.128**	W/(m²K)

Roof build up – u value

R01: MAIN ROOF

- Concrete beam and block structural floor

3° PITCH - 0.1W/m2k



Roof covering:
- PVC High Performance Single Ply Membrane
- PIR insulation to falls (80-119mm)
- Rigid insulation 140mm
- 3.5mm Vapour barrier

- 18mm class 2 plywood deck

- 219mm timber joists to engineer's detail and specification

- ProClima DA vapour check and airtightness membrane, with overlaps and junctions taped using appropriate ProClima ancillary products (Tescon Vana)

- 15mm class 3 plywood boarding

- Service void with mechanical ventilation

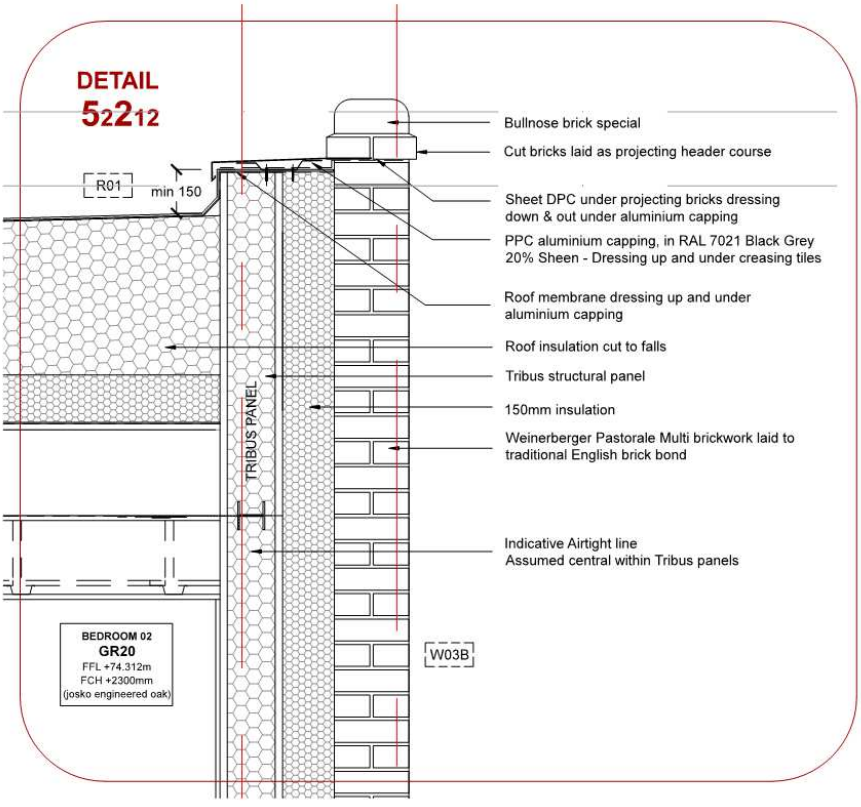
- British Gypsum Casoline MF system to suit ceiling height

- 15mm British Gypsum Gyproc Soundbloc, 3mm plaster skim for paint finish

OR

- **mr** - 15mm British Gypsum Moisture Resistant Gyproc Soundbloc, 3mm plaster skim for paint finish. *For use in Kicthen, Scullery, WC & all bathrooms.*

Main roof build up



Connection of roof to exterior wall

Roof plywood deck below insulation

Vapour barrier on top of plywood deck

Roof Insulation on top of plywood deck.

9 WINDOWS AND INSTALLATION OF THE WINDOW

Josko Windows were used in the project.

- The large South and West windows to the living area were frameless.
- There was also a large lift and slide door on the south elevation.
- The majority of the windows used the Platin Passiv frames and were either fixed or inward opening.
- There were four inward opening windows that used the non-certified Platin 82 window frame.

Frame reference	Uf left	Uf right	Uf bottom	Uf top
Josko: Fixframe 104 (1SIDE frameless, fixed)	0.98	0.98	0.93	0.98
Josko: Fixframe 104 (2 SIDES frameless, fixed)	0.98	0.98	0.93	0.98
Josko: Lift and Slide Door Opening Frame with swiss spacer	1.39	2.40	0.95	1.79
Josko: Lift and Slide Door Fixed Frame with swiss spacer	2.40	1.14	0.68	0.99
Josko: Platin Passiv (inward opening window)	0.84	0.84	0.82	0.84
Josko: Platin Passiv (fixed)	0.84	0.84	0.82	0.84
Josko: Platin 82 (non PH) inward opening window	1.10	1.10	1.10	1.10

All the glazing was triple glazed with the following glazing Ug and g values:

Description	**g-Value**	**U_g-Value W/(m²K)**
large Rooflight	0.48	1.00
modular rooflight	0.51	0.83
Type A: 4-18-b4-18-b4-ZERO-glace	0.46	0.50
Type B: 8-18-b6-20-b8-ZERO-glace	0.44	0.50
Type C: 8-20-b8-20-b8-ZERO-glace	0.44	0.49
Type D: 12-18-b8-16-b10-ZERO-glace	0.43	0.52

WINDOWS

Window delivery

Window installation

Window installation

ROOFLIGHTS

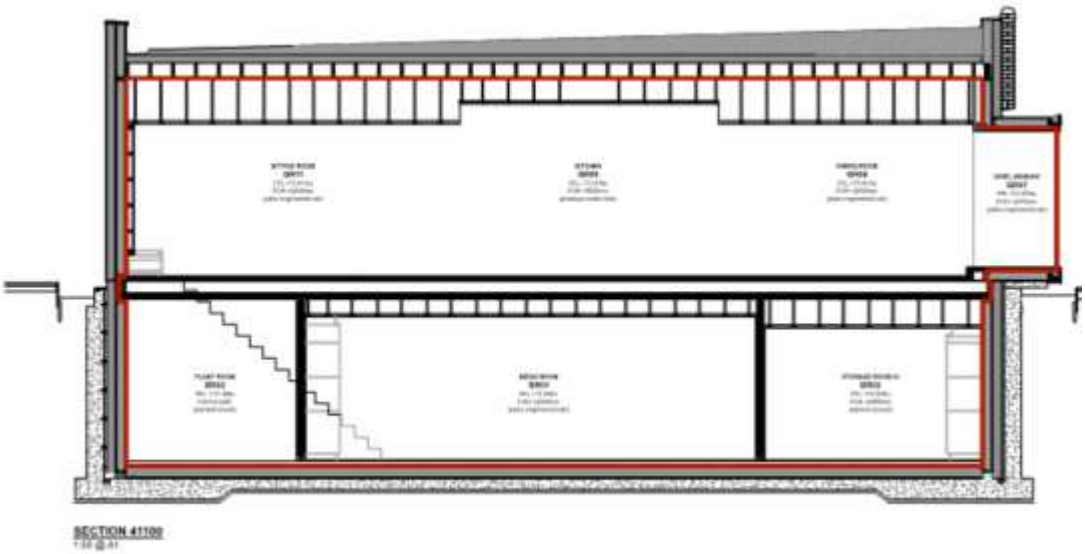
Large rooflight framing

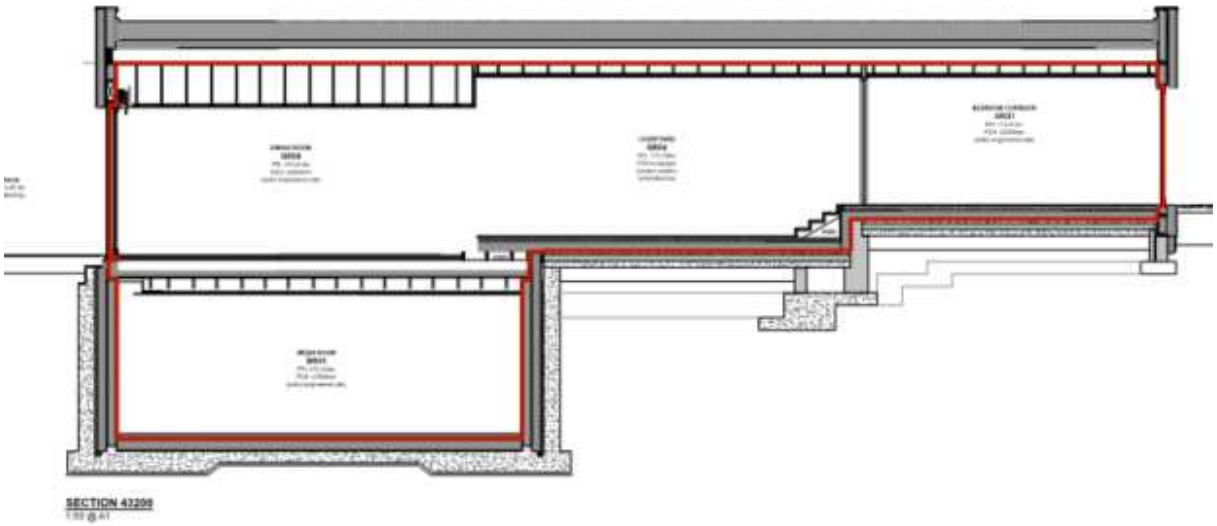
Roof light installation prior to insulation being added.

10 AIRTIGHT BUILDING ENVELOPE

The Air tightness of 0.56h^{-1} was achieved using the following products:

- Ceiling – Smartply OSB
- Walls – Integral to Tribus panels
- Floor – Structural screed
- Tapes at junctions - Proclima Tescon Vana tape





Sections showing air tightness line in red

BUILDING LEAKAGE TEST

Maurizio Assante
MGA Consultancy Ltd
Oaks End
Lower Broad Oak Road
West Hill, Devon EX11 1XH
Phone: 01404 811 590

Date of Test: 29th October 2018
Test File:

Technician: MAURIZIO ASSANTE

Customer: Goulden & Sons
2 The Old Workshops
St Johns Terrace
Totnes, Devon TQ5 5JH
Phone: 07592 678 369
Fax:

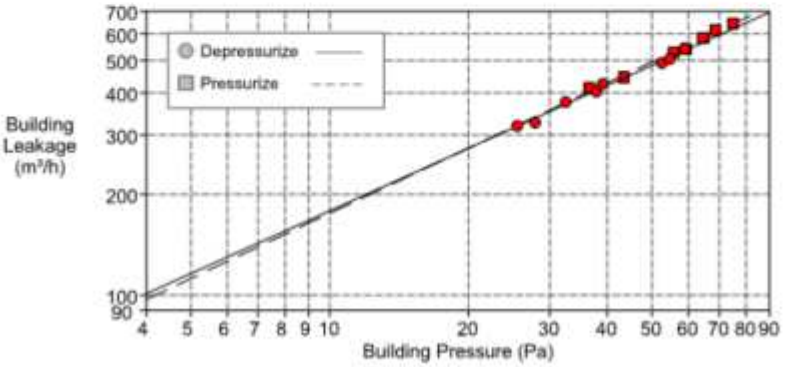
Building Address: The Walled Garden
Shute Hill
Farringdon

	Depressurization	Pressurization	Average
Test Results at 50 Pascals:			
V50: Airflow (m³/h)	483 (+/- 0.7 %)	494 (+/- 0.8 %)	489
n50: Air Changes per Hour (1/h)	0.49	0.50	0.50
w50: m³/(h*m²) Floor Area	1.35	1.39	1.37
q50: m³/(h*m²) Surface Area	0.55	0.56	0.56
Leakage Areas:			
Canadian EqLA @ 10 Pa (cm²)	198.9 (+/- 3.5 %)	196.0 (+/- 5.0 %)	197.4
cm²/m² Surface Area	0.23	0.22	0.22
LBL ELA @ 4 Pa (cm²)	108.8 (+/- 5.6 %)	104.9 (+/- 7.5 %)	106.8
cm²/m² Surface Area	0.12	0.12	0.12
Building Leakage Curve:			
Air Flow Coefficient (Cenv)	42.1 (+/- 8.9 %)	39.6 (+/- 11.3 %)	
Air Leakage Coefficient (CL)	42.8 (+/- 8.9 %)	39.9 (+/- 11.3 %)	
Exponent (n)	0.619 (+/- 0.023)	0.643 (+/- 0.028)	
Correlation Coefficient	0.99572	0.99542	

Test Standard: EN 13829
Type of Test Method: B
Equipment: Model 3 Minneapolis Blower Door, S/N 12525

Regulation complied with: APPROVED DOCUMENT L

Inside Temperature:	15 °C	Volume:	982 m³
Outside Temperature:	8 °C	Surface Area:	879 m²
Barometric Pressure:	102040 Pa	Floor Area:	357 m²
Wind Class:	0 Calm	Uncertainty of Building Dimensions:	%
Building Wind Exposure:	Highly Protected Building	Year of Construction:	2018
Type of Heating:	ASHP		
Type of Air Conditioning:	NA		
Type of Ventilation:	NATURAL BACKGROUND VENTILATION		



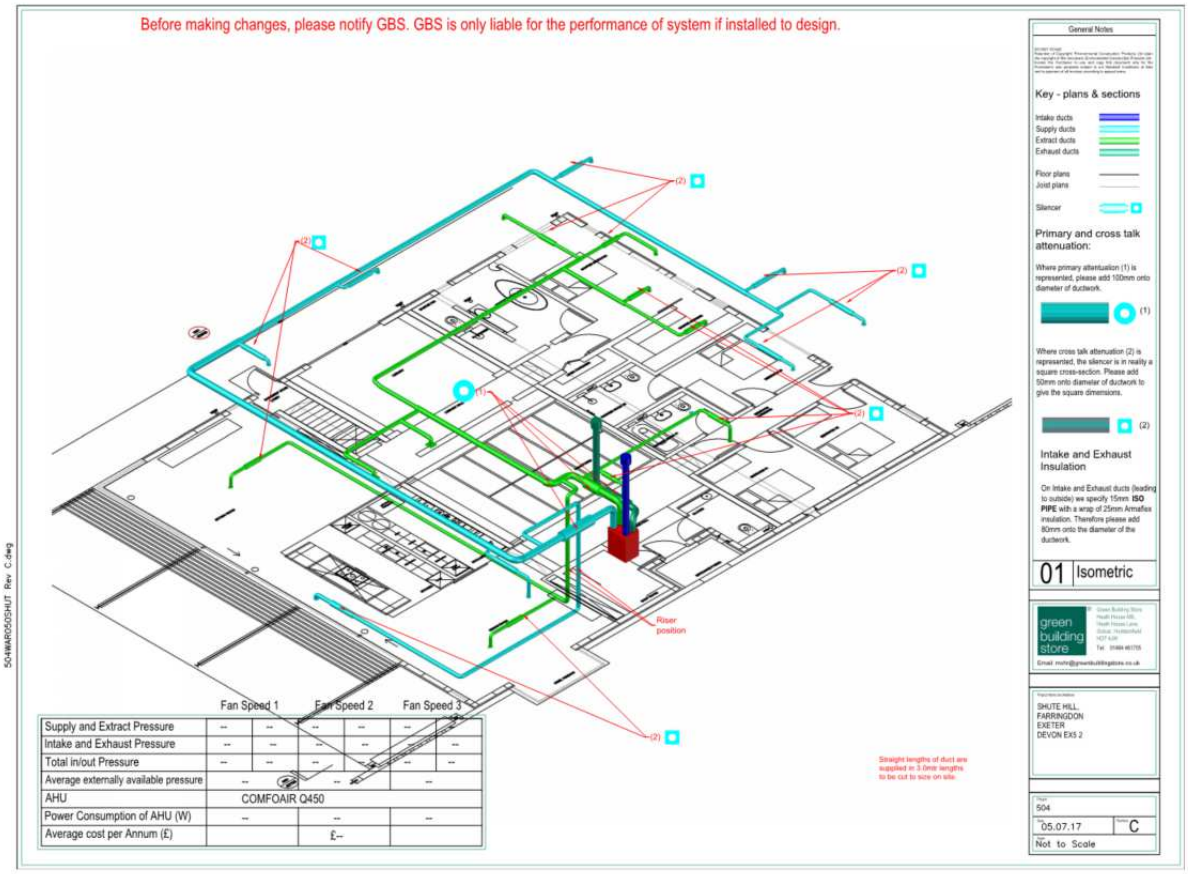
Air test in progress

11 LAYOUT OF THE VENTILATION SYSTEM DUCTING

Spiral wound ductwork was specified to ensure installation quality and acoustic performance.

The following table summarises the rooms which have supply, extract and though ventilation. Door undercuts allowed for transfer paths between rooms. A re-circulating cooker hood is fitted in order to remove grease from the air from cooking

Room	Air Volume Flow Rate		
	V_{SU}	V_{EX}	$V_{THROUGH}$
	m^3/h	m^3/h	m^3/h
KITCHEN		51	
SCULLERY		27	
BOOT ROOM		21	
CLOAK		21	
SHOWER ROOM 01		25	
SHOWER ROOM 02		25	
MASTER Dressing Room		25	
MASTER BathR		27	
STORE ROOM 01		27	
PLANT ROOM		27	
SITTING ROOM	28		
DINING ROOM	28		
BEDROOM 01	35		
BEDROOM 02	35		
BEDROOM 03	34		
LIBRARY	28		
MASTER BEDROOM	34		
MEDIA ROOM	54		
Bedroom corridor			x
Library hall			x
Entrance hall			x
Courtyard			x



Ventilation design drawing

12 VENTILATION UNIT / CENTRAL VENTILATION UNIT

A Passivhaus certified MVHR unit, the Zehnder Comfoair Q450, was specified, with a unit efficiency of 88% and electrical efficiency of 0.21 Wh/m³.

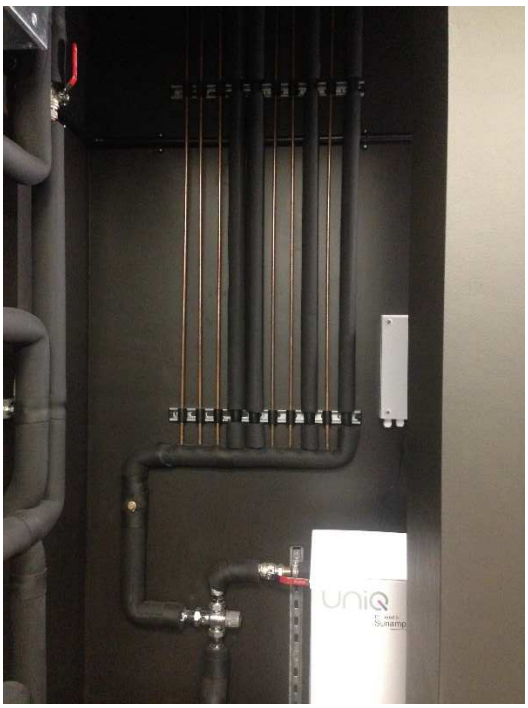
Zehnder ComfoAir Q450 installed prior to duct insulation being installed on intake/exhaust ductwork.

13 HEAT SUPPLY

The heating was supplied via a 6kW Daikin Split air source heat pump.


ASHP external and internal units

Heat is stored using 2 sunamp Dual 4 and a 1 UniQ eDual heat batteries.
Hot water is distributed using a radial small bore pipework system.

Sun amp phase change heat store and efficient small bore hot water distribution.

14 SHORT DOCUMENTATION OF PHPP-RESULTS

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	356.5				
Space heating	Heating demand	kWh/(m²a)	13	≤	15	-	yes
	Heating load	W/m²	10	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	7	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.6	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	66	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	26	≤	60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	30	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

PHPP results as published on Passive House database

15 BUILDING COSTS

Undisclosed

16 CONSTRUCTION COSTS

Undisclosed

17 USER'S EXPERIENCES

"We are energy positive, with power generated exceeding power consumed by 40%, and CO2 negative. In the summer months the house generated 3,500kwh of electricity whilst only using 60kwh, with the remaining power fed back into the grid"

The owners have been collecting performance data, using Solaredge monitoring and stats kept by various devices. Over the first year of occupancy, with its air source heat pump, photovoltaic panels and battery storage, the house produced 40% more energy than it used. 7.5 MWh of energy was consumed, of which 4.95 was self-generated and used directly or via the battery, and 2.55 imported from the grid. The total solar generation was 10.45 MWh, of which 4.45 was exported to the grid.

Everything is electric, including a private borehole water supply and private sewage plant, and the net electricity bill was zero for the year, even with the final low feed-in tariff. In July-Sept 2019, the house consumed just 60kWh while the panels generated 3500kWh from the sun. It's so efficient that the owners were asked to send their energy suppliers a photo of the feed-in meter to prove that the numbers were correct.

LINKS TO ARTICLES

www.passivhaustrust.org.uk/news/detail/?nId=888

https://thewalledgardendevon.wordpress.com/

https://www.architectsjournal.co.uk/buildings/mclean-quinlan-creates-devon-passivhaus-home-under-para-79

AWARDS

- Shortlisted (one of 10) in the Architects Journal House of the Year 2021 for the Manser Medal.
- Longlisted (one of 20) for the RIBA House of The Year 2021 (as seen on episode 4 of Grand Designs coverage of the finalists on Dec 8th 2021)
- Shortlisted for the RIBA 2020 Awards for the South West region.
- Shortlisted for the international Dezeen 2020 architecture awards for a rural home (the only European house in the shortlist of 5).
- Shortlisted for the international Frame 2021 House of the Year awards (one of only two European house in the shortlist of 6).
- Long-listed for the international AR House awards 2020
- The architects were short-listed in 2020 for BD architect of the year for individual homes, including this one.
- Finalist in the UK Passivhaus Trust 2021 awards – one of 3 in “small projects”. We didn’t win, but being finalists was praised as a great achievement for first-time Passivhaus architects and builders.
- Finalist in the international Passive House awards 2021