Project Documentation

Abstract

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Retrofit of Dwelling at 74 Sea Road

Data of building

Year of construction	2020	**Space heating**	**19 kWh/(m²a)**
U-value external wall	0.166 W/(m²K)		
U-value basement	0,131 W/(m²K)	Primary Energy Renewable (PER)	72 kWh/(m²a)
U-value roof	0,090 W/(m²K)	Generation of renewable Energy	17 kWh/(m²a)
U-value window	0,77 W/(m²K)	Non-renewable Primary Energy (PE)	168 kWh/(m²a)
Heat recovery	91%	Pressurization test n_{50}	0,48 h^{-1}
Special features	Embodied carbon calculated for the project using PH ribbon concluded at 136 $kgCO_2e/m^2$. Comparison with existing energy consumption		

Brief Description

74 Sea Road

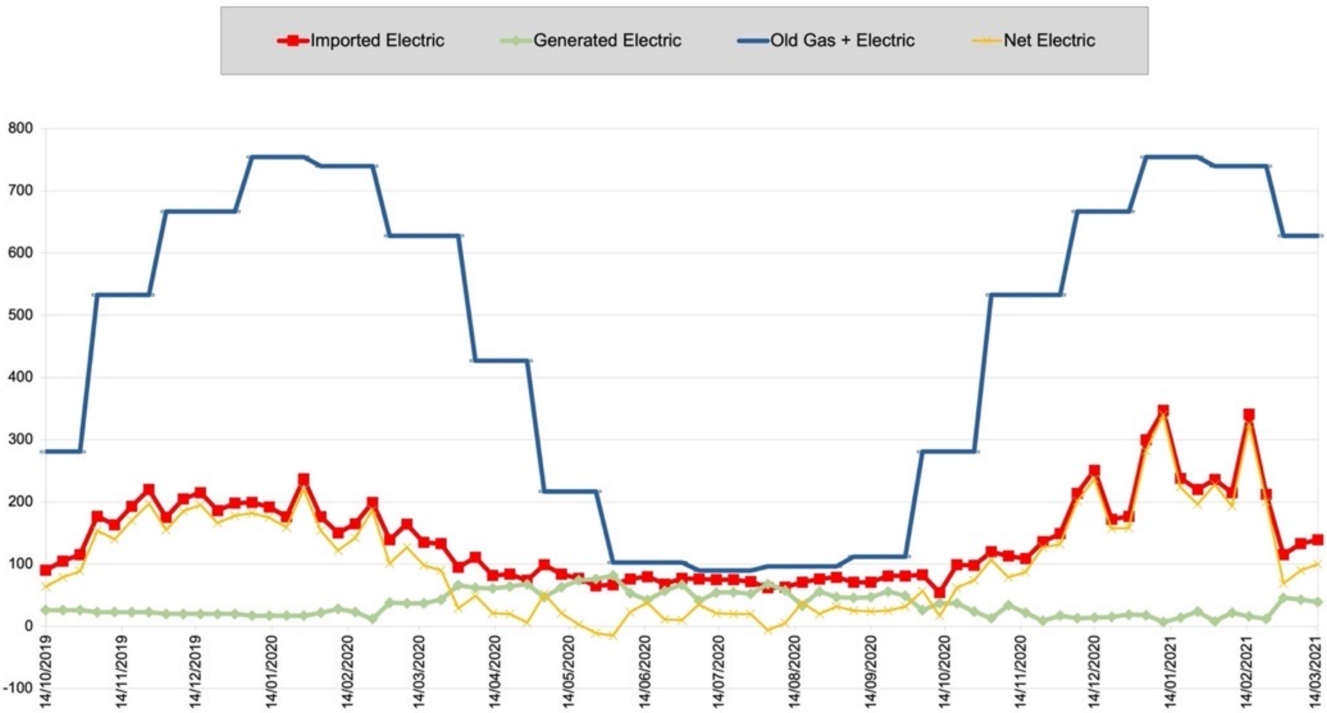
This 1930's house, located within 500m of the coast, has undergone a deep retrofit to Passivhaus EnerPHit standard. The interior has been remodelled to create contemporary open-plan living filled with daylight.

Large bi-folding doors connect the living spaces to a covered terrace and south-facing garden beyond. The arbour is planted with deciduous plants, to provide summertime shading and a pleasant place to sit.

The external envelope of the building (walls, roof, ground floor) is highly insulated and airtight. A new integrated ventilation system with heat recovery has been fitted. The end result is a healthy, comfortable and draught-free home that exceeds the clients aspirations.

Two-years of post-occupancy monitoring (undertaken by the client) shows a 75% reduction in heating energy. In addition, an analysis in PHribbon calculated the embodied carbon of the retrofit at 105 kgCO2e per square metre, for building life cycle stages A (product stage) through to C (end of life). This smashes the RIBA 2030 target for new build homes of 600 kgCO2e, emphasising the importance of preserving existing structures.

The project was a Passivhaus Trust Awards finalist in 2021.



Retrofitted house energy use (yellow line) is 75% less than existing house energy use (blue line)

Responsible project participants	
Architect	Ruth Butler Architects
Implementation planning	N/A
Building systems	Cundall
Structural engineering	Andrew Waring Associates
Building physics	Julian Sutherland Cundall
Passive House project planning	Julian Sutherland Cundall
Construction management	Tuakana Construction

Certifying body
Mead Consulting

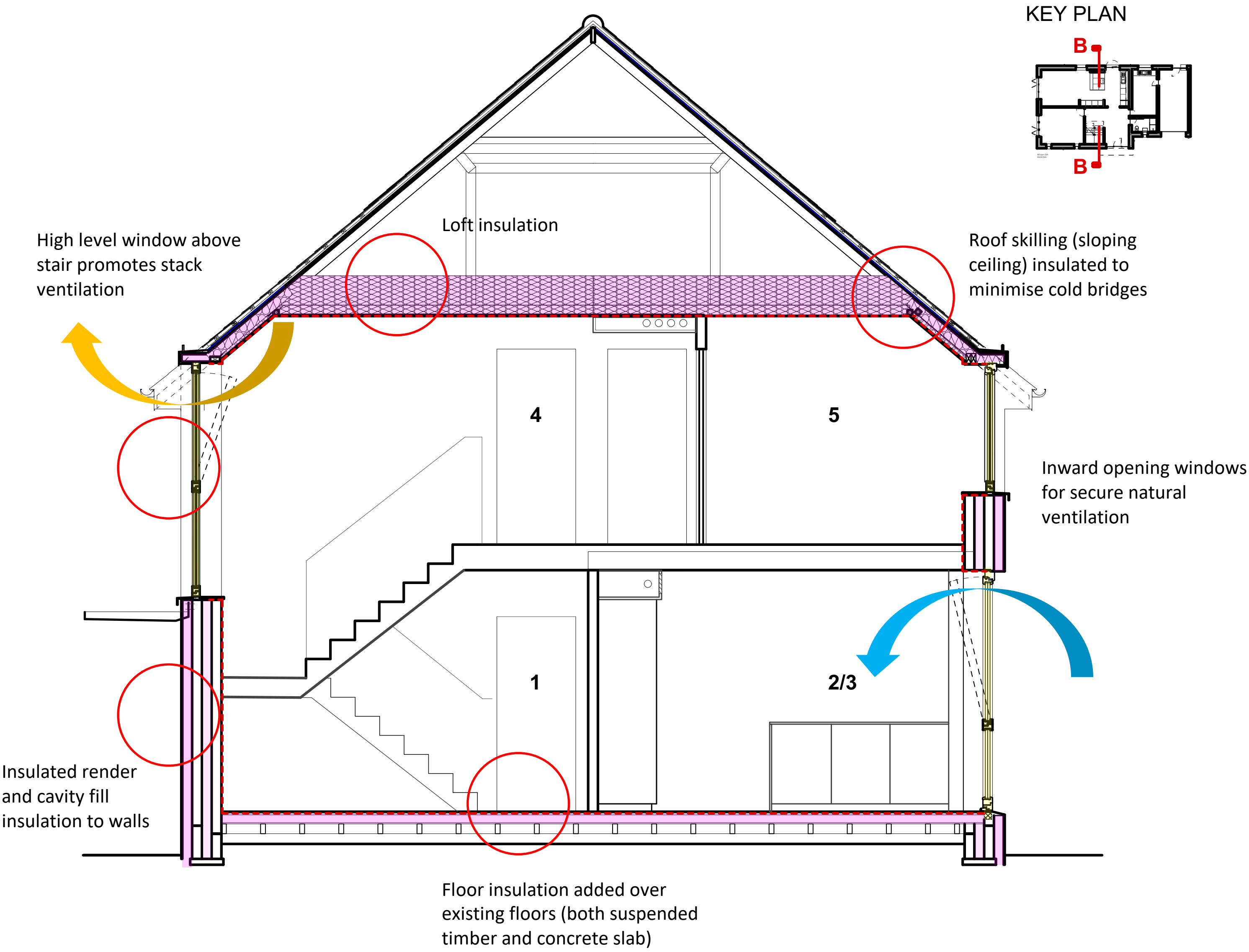
Certification ID	
6421	Project-ID (www.passivehouse-database.org)

Author of project documentation	
Julian Sutherland	
Date Datum	Signature Unterschrift
03 Apr 2023	

1. Exterior Photographs

2. Interior Photographs

3. Section

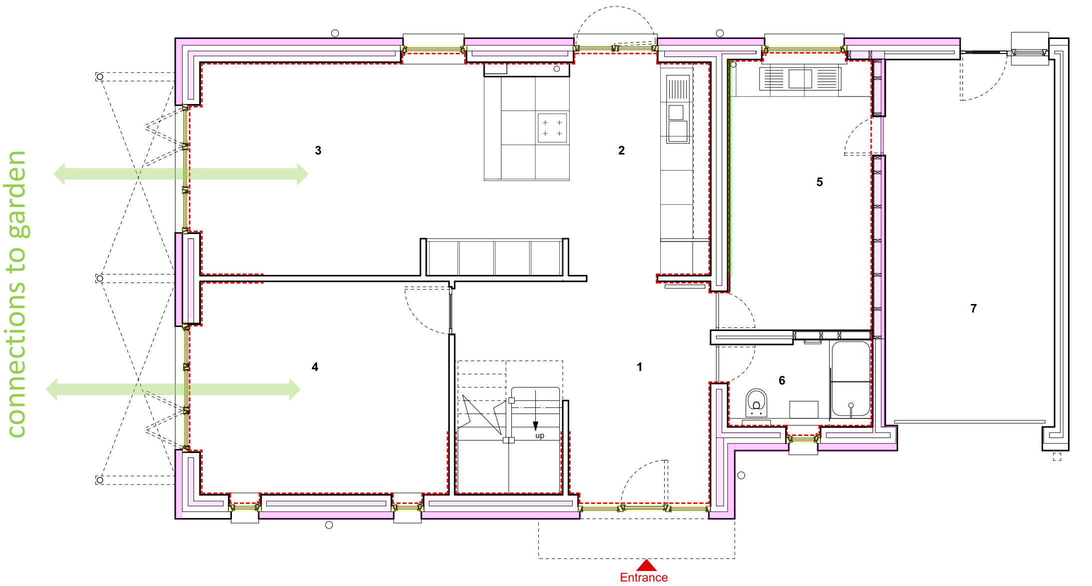


Section B-B

KEY

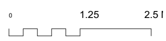
1	Stairwell and Hall
2/3	Kitchen-Dining room
4	Landing
5	Family Bathroom

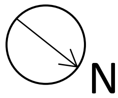
3. Ground Floor



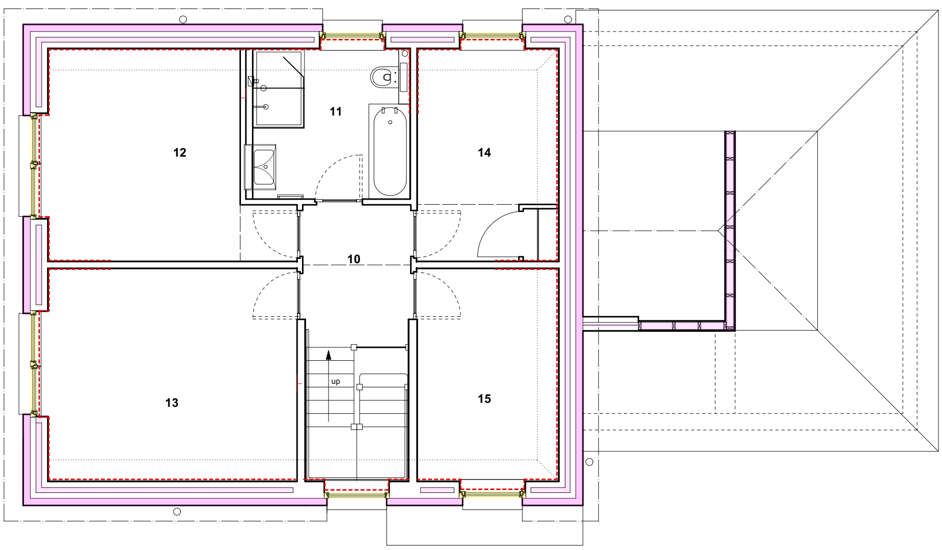
1. Entrance
2. Kitchen
3. Dining
4. Living
5. Utility / Plant
6. Cloakroom
7. Garage
10. Landing
11. Bathroom
12.-15. Bedroom

Insulation
Airtightness

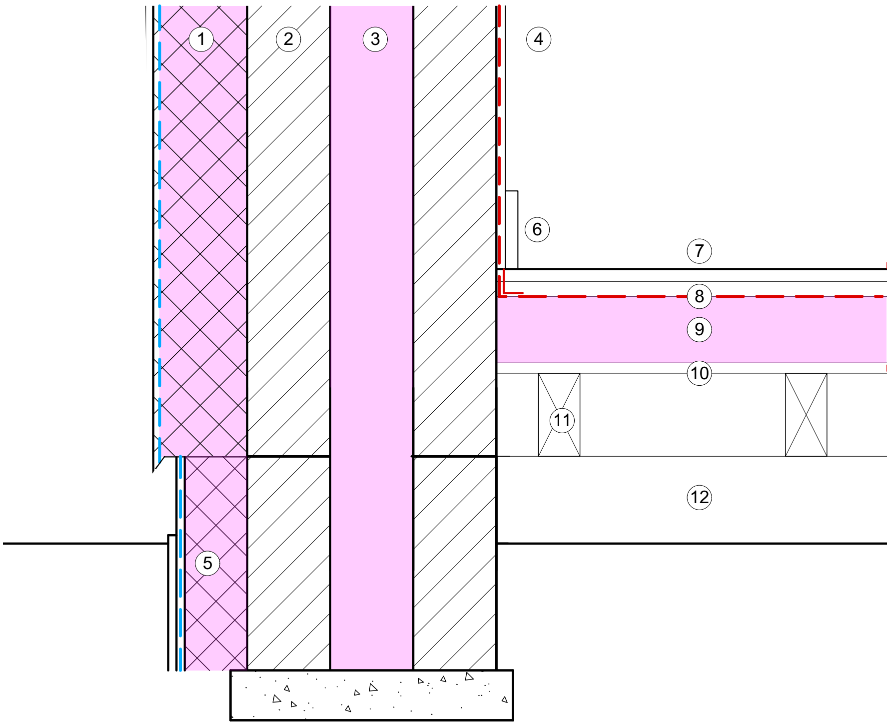




4. Upper Floor



5. Construction of Ground Floor



KEY

1. 100mm EPS Graphite self-coloured insulated render (Permarock)
2. Existing masonry cavity construction
3. Cavity fill insulation (EPS)
4. Plaster parge finish as airtightness layer
5. Insulated plinth, drainage sheet (Permarock)
6. Skirting board
7. Engineered timber floor with underlay on T&G Chipboard joint-sealed
8. Airtightness membrane, taped (Contega Solido SL) into plaster parge coat
9. 80mm PUR T&G boards
10. Existing floor boards
11. Existing suspended floor joists
12. Void ventilated to NHBC requirements

Wind tightness line

Air tightness line

The existing ground floor was a mix of suspended timber and concrete slab.

This was overlaid by a insulated floating floor of 80mm PUR insulation, T&G boards and engineered timber floor finish.

Photograph of ground floor under construction

Photograph of completed house with engineered timber floor finish

Assembly no.		Interior insulation?
04ud	Suspended 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

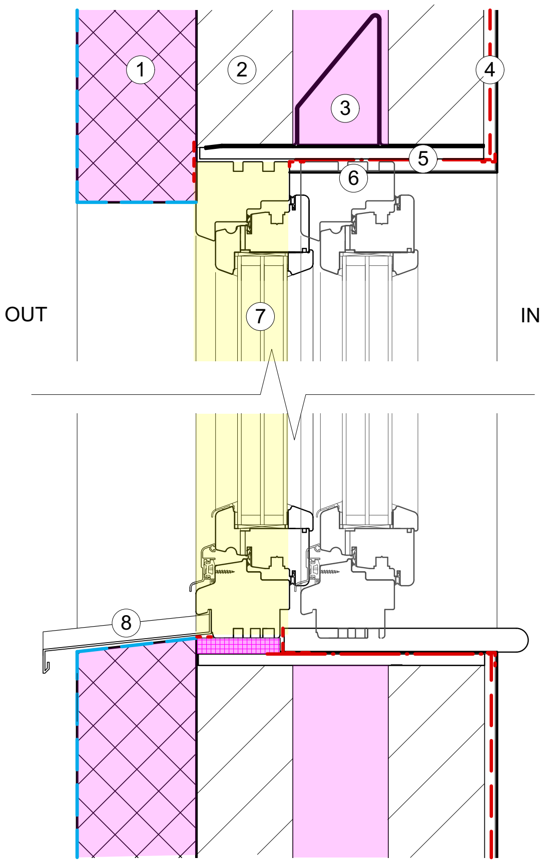
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Timber	0.070					25
PUR insulation	0.025					80
Timber	0.070					25
Timber	0.070					125

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%			25.5 cm

U-value supplement W/(m²K)

U-value: 0.166 W/(m²K)

6. Construction of External Wall



KEY

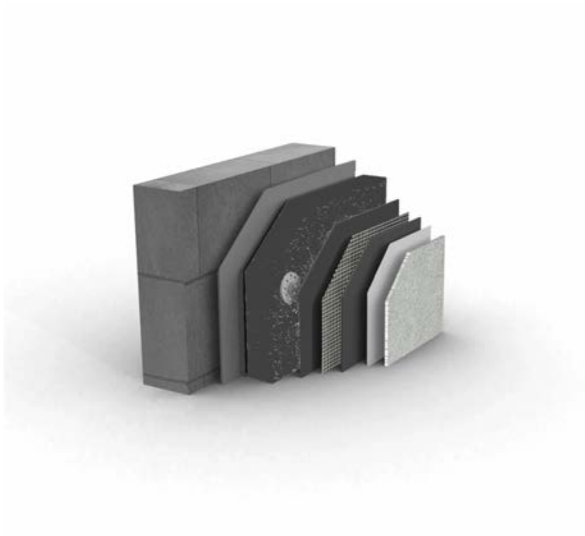
1. 100mm EPS Graphite self-coloured insulated render (Permarock)
2. Existing masonry cavity construction
3. Insulated lintol and cavity fill insulation (EPS)
4. Plaster parge finish as airtightness layer
5. Plywood box for window installation
6. Airtightness membrane and tapes (Pro Clima Intello range)
7. GBS Ultra Windows (existing location shown in grey)
8. Window cills with sliding closures by GBS

Wind tightness line

Air tightness line

The existing house was a masonry cavity construction with render finish.

A self-coloured insulated render was added together with cavity fill insulation.



100mm EPS Insulated render build-up

Assembly no.	Building assembly description	Interior insulation?
01ud	External Wall (original walls upgraded)	x

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]
Plaster	0.560					25
Brick (PHPP Guide)	0.800					75
Cavity fill	0.033					0
Brick (PHPP Guide)	0.800					75
EPS Grey	0.030					100
Render	1.400					5

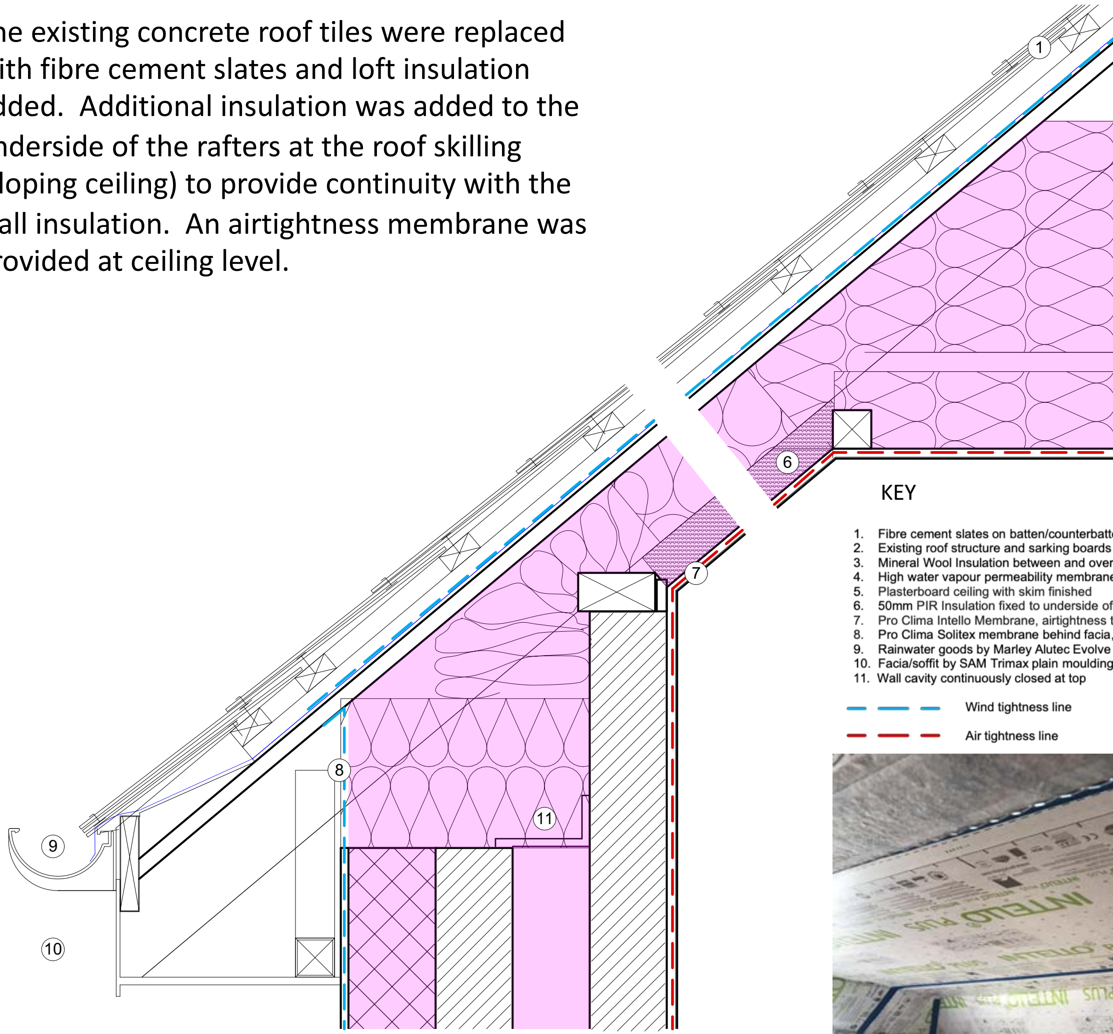
Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
100%	0.0%		28.0 cm

U-value supplement: W/(m²K)

U-value: 0.267 W/(m²K)

7. Construction of Roof

The existing concrete roof tiles were replaced with fibre cement slates and loft insulation added. Additional insulation was added to the underside of the rafters at the roof skilling (sloping ceiling) to provide continuity with the wall insulation. An airtightness membrane was provided at ceiling level.



Photograph of roof airtightness layer at ceiling level

Assembly no. 05ud — **Insulated Roof** — Interior insulation?

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]
Mineral Wool Insulation (over clg joists)	**0.035**					**300**
Mineral Wool Insulation (bt clg joists at 400 cts)	**0.035**	**Joist**	**0.130**			**100**
Plasterboard Ceiling (PHPP Guide)	**0.250**					**50**

Percentage of sec. 1	Percentage of sec. 2	Percentage of sec. 3	Total
88%	**12.0%**		**45.0** cm

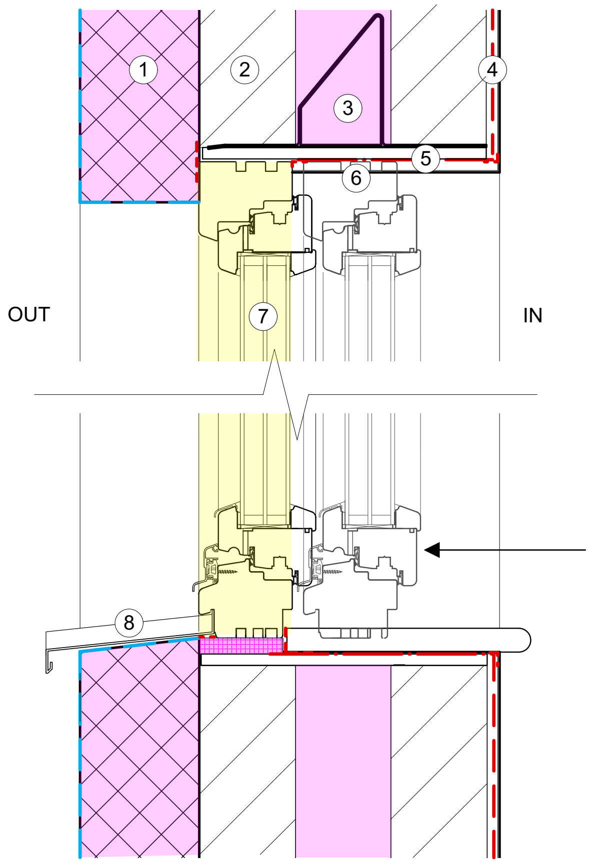
U-value supplement W/(m²K)

U-value: 0.089 W/(m²K)

8. Window and Window Installation

The existing house already had some triple glazed windows installed (from earlier DIY). These were moved outward and the frames wrapped with the external wall insulation.

Existing bay windows, an old conservatory and dormer window were removed to simplify the building form. New triple glazed bi-folding doors (by Lacuna) were added to the ground floor living spaces.



Existing triple glazed windows were relocated outward and wrapped with EWI

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— — — Wind tightness line

— — — Air tightness line

Photograph of airtightness (smoke gun) test of window installation by Simon Freeley, BRE

Photographs of window installation 1. Plywood box 2. Initial plaster base coat 3. Airtightness membrane and tape

9. Description of Air Tightness

Airtightness tests were carried out by Simon Freeley, Airtightness Manager at Building Research Establishment (BRE) at three key stages of the construction on 3rd July 2019, 7th August 2019 and the final test on 19th September 2019 .

The testing demonstrated the building achieved a final **Air change rate** (ACR) 0.48 which satisfies the target ACR for the EnerPHit Standard of less than 1.0.

bre

Air permeability results

Data collected from the tests is presented in full in Appendix 1 and is summarised in Table 1 below.

Test	Volume m^3	Envelope Area m^2	Air permeability Result $m^3.hr^{-1}.m^{-2}$ @ 50 Pa	Air change rate (ACR) $m^3.hr^{-1}.m^{-3}$ @ 50 Pa
Test 1 3rd July 2019	333.92	302.24	Positive 1.09 Negative 2.68	Positive 0.99 Negative 2.43
Test 2 7th August 2019	333.92	302.24	Positive 0.81 Negative 0.71	Positive 0.73 Negative 0.64
Test 3 (Final) 16th September 2019	333.92	302.24	Positive 0.54 Negative 0.51	Positive 0.49 Negative 0.46

Table 1: Results

Airtightness Concept
Walls: Interior plaster parge coat

Floors: Airtightness membrane taped (Contega Solido SL) into plaster parge coat
Window Junction: Airtightness membrane and tapes (Pro Clima Intello range)

Roof: Airtightness membrane and tapes (Pro Clima Intello range)

Photograph of airtightness testing, with Jason Harrison/Tuakana, Airtightness Champion on site

Airtightness training provided by Green Building Store on site

10. Ventilation System

MVHR (Mechanical Ventilation with Heat Recovery) provides balanced ventilation with heat recovery.

The system includes **Brink Flair 325** a high-efficiency mechanical ventilation with heat recovery appliance, with semi rigid ducting by **Ubbink**.

Manufacturer of ventilation system	Brink Flair 325 4/0 L EU
Effective degree of heat supply	91.0% (temperature fficiency)
Electric efficiency	0.21 Wh/m³ (SPI)

11. Ventilation Duct Network

Supply air – To living room, dining room and bedrooms

Exhaust air – To bathrooms, toilet and kitchen

Make-up air – Via undercut doors to bathrooms, toilet, kitchen and exhaust ducts to the heat exchanger

12. Renewable Technologies, Hot Water & Space Heating

Solar photovoltaic panels are located on the south-facing roof with an annual yield of 1715 kWh/a.

The hot water and space heating is provided by a 200L storage tank with immersion elementand one 1.5kW electric radiator in the hallway and one portable 1.5kW radiator in the lounge .

The hot water storage tank and space heating panel is equipped with a timer for control.

13. Build Costs

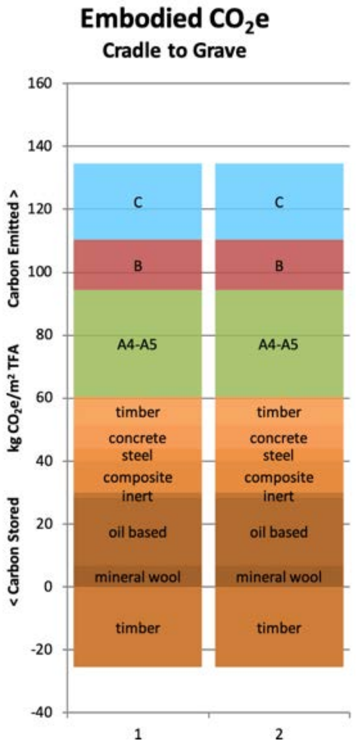
Construction completed in 2019, with an out-turn build cost of £2,000/m²

14. Embodied Carbon

The deep retrofit preserved as much of the existing building as possible, including floors, walls and the roof in order to reduce the embodied carbon of the build.

An analysis in PHribbon calculated the embodied carbon of the retrofit at 105 kgCO2e per square metre, for building life cycle stages A (product stage) through to C (end of life).

For comparison, this smashes the RIBA 2030 target for new build homes of 600 kgCO2e, emphasising the importance of preserving existing structures.



Passivhaus EnerPHit
105 kg CO2e/sqm TFA
(Tim Martel, PH Ribbon)

15. PHPP-Datasheet

EnerPHit Verification

Photo or Drawing

Building:	74 Sea Road Passive House		
Street:	74 Sea Raod		
Postcode/City:	BH25 7NQ	Barton on Sea	
Province/Country:	Hampshire	GB-United Kingdom/ Britain	
Building type:	Detached Dwelling		
Climate data set:	GB0005a-Exeter		
Climate zone:	4: Warm-temperate	Altitude of location:	10 m
Home owner / Client:	David Dacombe & Julie Botham		
Street:			
Postcode/City:			
Province/Country:			

Architecture:	Ruth Butler Architects	
Street:	7 Convent Lane	
Postcode/City:	PO10 7JJ	
Province/Country:	Hampshire	GB-United Kingdom/ Britain
Energy consultancy:	Cundall	
Street:	1 Carter Lane	
Postcode/City:	EC4V 5ER	
Province/Country:	London	GB-United Kingdom/ Britain

Mechanical engineer:	Cundall	
Street:	1 Carter Lane	
Postcode/City:	EC4V 5ER	London
Province/Country:		
Certification:		
Street:		
Postcode/City:		
Province/Country:		

Year of construction:	2017	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.4	IHG cooling case [W/m²]:	2.4
No. of occupants:	2.9	Specific capacity [Wh/K per m² TFA]:	132	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

		Unit	Value		Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	144.4				
Space heating	Heating demand	kWh/(m²a)	19	≤	20	-	yes
	Heating load	W/m²	13	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-	-	-
	Cooling load	W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C)	%	0	≤	10		yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		yes
Airtightness	Pressurization test result n_{50}	1/h	0.5	≤	1.0		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	168	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	72	≤	66	72	yes
	Generation of renewable energy (in relation to pro-jected building footprint area)	kWh/(m²a)	17	≥	-	8	

[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.

EnerPHit Classic? yes

Task:	First name:	Surname:	Signature:
Issued on:		City:	

The project was modelled in PHPP version 9.6a to demonstrate compliance with the EnerPHit standard.

The project was validated by Mead Consulting

16. Awards and Publications

The project was published in the Passivhaus Plus magazine (Issue 39).

The project was a finalist in the Small Project category of the UK Passivhaus Awards 2021