

# Retrofitting Towards our Dream Home

Stuart Dyer (Home-owner)  
Margaret Reynolds (Architect)

Thu 10 Oct 2024, 7:30pm - 8:30pm



Mole



INCLUME



# Agenda

7:30 pm	Introduction
7:35 pm	Stuart - Background, Aims, Costs, Timeline, Lessons
7:50 pm	Q&A
8:00 pm	Margaret – Digging into the Details
8:15 pm	Q&A
8:30 pm	Thanks and feedback



Mole



INCLUME



# Background & Aims

Engineer by background, had participated in Transition Energy & AECB meetups for many years, interest in Eco, Retrofit & Energy.

Bought 4 bed 1930s property in 2016.

Original Home as purchased:



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- 2) Extend over patio – more space, playroom / sunroom
- 3) Retrofit for comfort



# Retrofit for Comfort

- 1) Insulate
- 2) Improve Airtightness
- 3) Ventilate
- 4) Decarbonise - electrification to get off gas
- 5) Minimise wasted heat
- 6) Control temperature – minimise overheating



# Retrofit for Comfort

## 1) Insulate

- 1) Loft insulation
- 2) External Wall Insulation
- 3) Floor Insulation
- 4) Insulate all hot & cold pipe runs – except heating pipes

## 2) Improve Airtightness

## 3) Ventilate

- 1) Mechanical Ventilation with Heat Recovery (MVHR)

## 4) Decarbonise - electrification to get off gas

- 1) Heating – Air Source Heat Pump (backup log burner)
- 2) Induction Hob
- 3) Solar PV (no battery)

## 5) Minimise wasted heat

- 1) Waste Water Heat Recovery System

## 6) Control temperature

- 1) Passive – design overhangs over windows, optimal glazing
- 2) Active – external blinds on Fakro roof lights

# Decarbonise – Electrification to Remove Gas

- 1) Heating – Air Source Heat Pump – should cut CO<sub>2</sub> by 77-85% vs gas boiler
- 2) Induction Hob
- 3) Solar PV (no battery)



# Decarbonise - ASHP – Install Cost

Cost of Samsung HTQ 8kW ASHP (excluding radiators):

Description	Quantity	Sell	VAT	Total (Ex VAT)
Goods – Heating ancillaries.	1.00	£1,100.00	0.00%	£1,100.00
Goods – Electrical ancillaries.	1.00	£320.00	0.00%	£320.00
Goods – Samsung 8kw HTQ heat Pump & 300l hot water cylinder Kit.	1.00	£6,709.20	0.00%	£6,509.20
Goods – Additional to estimate  pre insulated pipework from heat pump to main building	1.00	£240.00	0.00%	£240.00
Services – Heating installation	1.00	£4,700.00	0.00%	£4,700.00
Services – Electrical installation	1.00	£1,500.00	0.00%	£1,500.00

**Total Excluding VAT:** £14,369.20

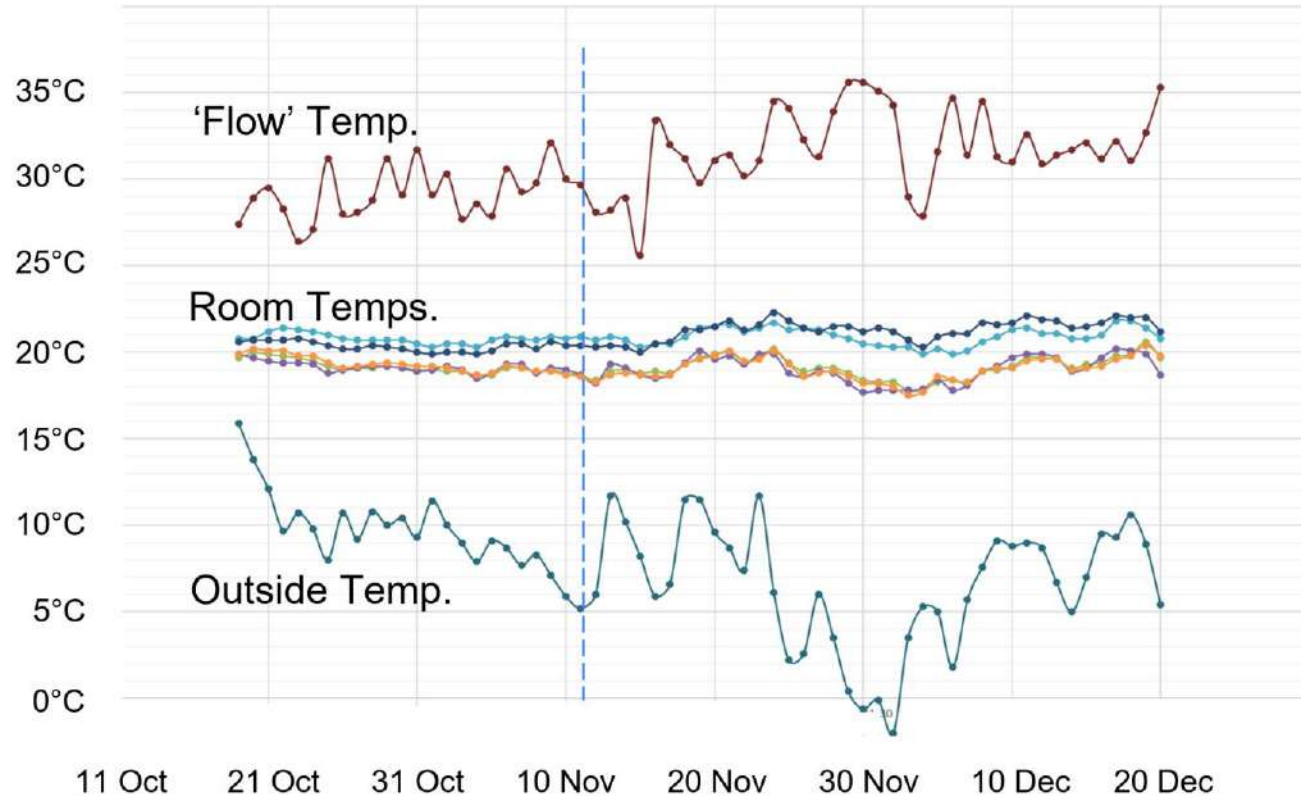
**BUS VOUCHER:** £5,000.00

**VAT Amount:** £0.00

**Total Including VAT:** £9,369.20

# Decarbonise - ASHP – Comfort

Constant, steady heat  
=  
Constant, steady  
temperature



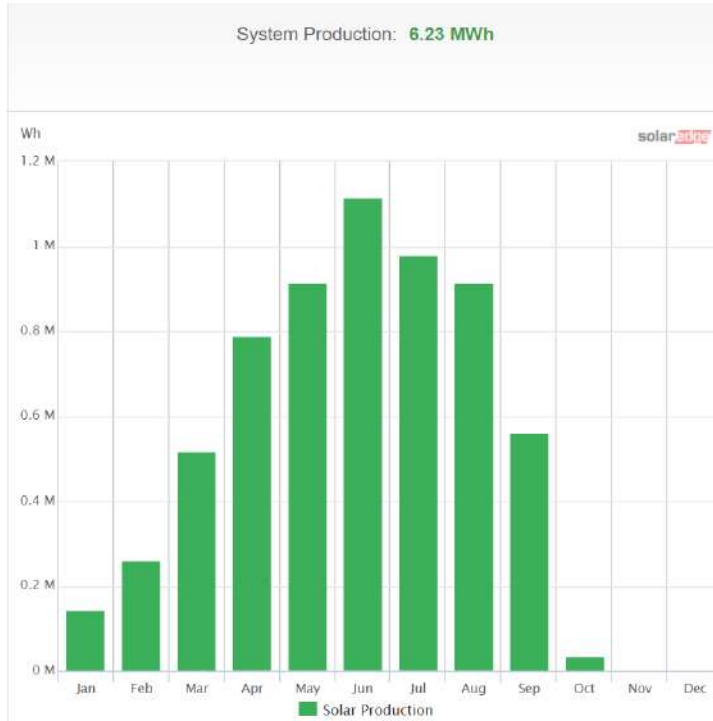


# Decarbonise - ASHP – Running Cost

- ASHP COP = 4.4 (i.e. 1 unit of electricity = 4.4 kWh of heat)
- Gas price = 6.99 p/kWh
- Electricity = 19.9 p/kWh (avg)
- So cost of ASHP heating =  $19.9 / 4.4 = 4.5$  p/kWh or 36% cheaper
  - Assumes gas 100% efficient – it's more like 85%
  - Gas removed – no standing charge at 31p/day = £113 p.a.

# Decarbonise – Solar PV

- 1) 21 x 405W panels = 8.505kW
- 2) 5kW inverter



# Induction Hob

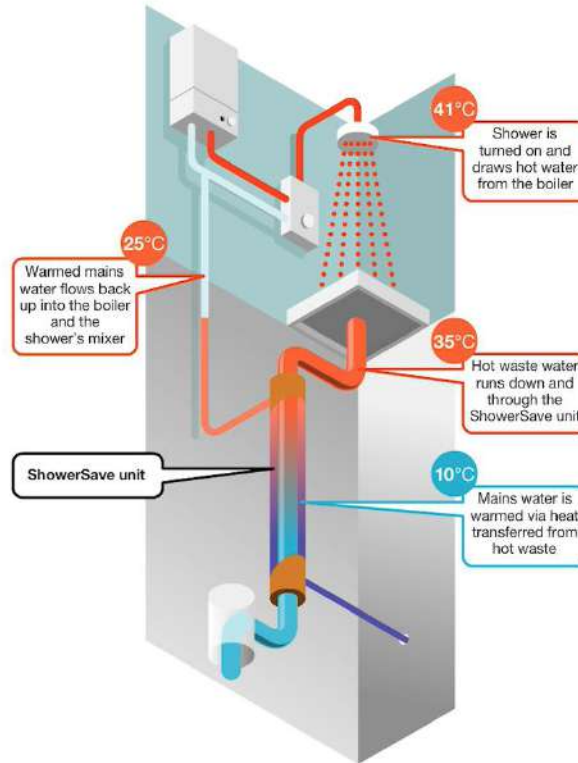
- 1) Novy Panorama – significant IAQ improvement
- 2) Hard to work out whether to vent internally or externally



# Minimise Wasted Heat

The more efficient a home, the higher the percentage of energy used to heat water – hence WWHRS fitted.

Grand name for something very simple – a pipe inside a pipe!





# Costs

Big ticket items:

	Builder
£44k	Triple Glazing
£34k	Kitchen
	Architect
	Moving Twice & Renting for 12 months
£16k	MVHR
£14.5k	Solar PV
£ 9k	ASHP
£ 4k	Structural Engineer

# Timescales

Very Long – but we were not in a hurry!

- July 2016 – Bought house & moved in
- Jun 2017 – Met 3 architects
- Aug 2017 – Appointed architect, PHPP modelling, kitchen & bathroom quotes etc
- Aug 2021 – Tender out to builders
- April 2022 – Minor Works contract signed with Green Hat Construction
- June 2022 – Foundation works start
- July 2022 – Move to rented property
- May 2023 – Move back into house
- Sept 2023 – Finished work (23 weeks late)
- Oct(?) 2024 – Snagging still to be done!

# What Went Well, What Could Have Been Better

- 1) Very happy with end result
- 2) Largest issue - roof over sunroom went badly – should have got 3 quotes!
- 3) Annoying small things:
  - 1) Toilets not where they should be
  - 2) MVHR vent in master bedroom
  - 3) Missing light switches
  - 4) Boxing for MVHR ducts
- 4) MVHR good
- 5) ASHP great
- 6) Low running cost, low energy use, very comfortable, good indoor air quality

Main takeaway –

You need to constantly monitor what's going on and ensure it's what you want!



## Questions (+ photos!)

Please put your questions into the chat





# The End Result - outside



# The End Result - inside



Hall



Sunroom

# The End Result - inside

Lounge



# The End Result - inside



One of the  
boys' identical  
bedrooms





# The End Result - inside



**Spare room**



**Master bedroom**

# The End Result - inside

Kitchen







# Questions

Please put your questions into the chat



# Contacts, Resources, Links

More details in the Cambridge Carbon Footprint [case study](#)

Builder [Green Hat Company](#)

Architect [Margaret Reynolds](#)

Triple Glazing [Green Building Store / 21 Degrees](#)

Kitchen [Nicholas Hythe Kitchens](#)

MVHR [Green Building Store / 21 Degrees](#) (Zehnder)

WWHRS [Showersave](#)

Solar PV [Cambridge Solar](#)

ASHP [Infinite Heating and Energy](#)

ASHP controls [Homely Energy](#)

ASHP Heat Loss Calculation software [Heat Punk](#)

Modelling software [Passive House Planning Package](#)

[Association for Environment Conscious Building](#)

[Transition Cambridge](#)

[National Self Build and Renovation Centre](#)

# Hills Road Retrofit

For Open Eco Homes

10 October 2024

Margaret Reynolds,  
Architect & Retrofit Coordinator (retired)

M Reynolds RIBA

[mrriba2018@gmail.com](mailto:mrriba2018@gmail.com)

<http://uk.linkedin.com/in/margaretreynoldsriba>

# Hills Road Retrofit — 2017 to 2024



**BEFORE – FRONT - 2017**



**BEFORE – REAR - 2017**



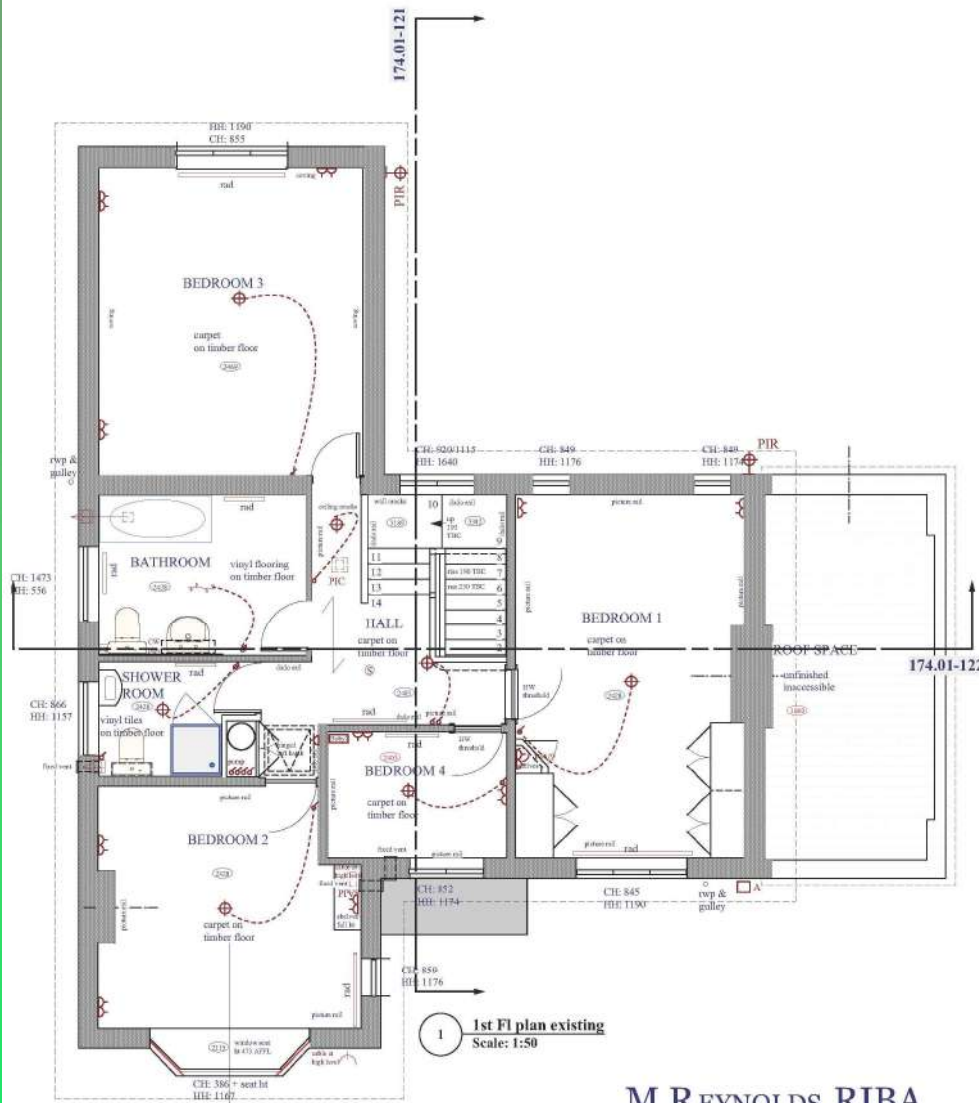
**AFTER – FRONT - 2023**



**AFTER – REAR - 2023**



# Hills Rd Retrofit — Plans upstairs



**Existing - 1<sup>st</sup> Fl**



**M REYNOLDS RIBA**

59 OXFORD ROAD, CAMBRIDGE CB4 3PH

ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

FIRST FLOOR PLAN AS EXISTING

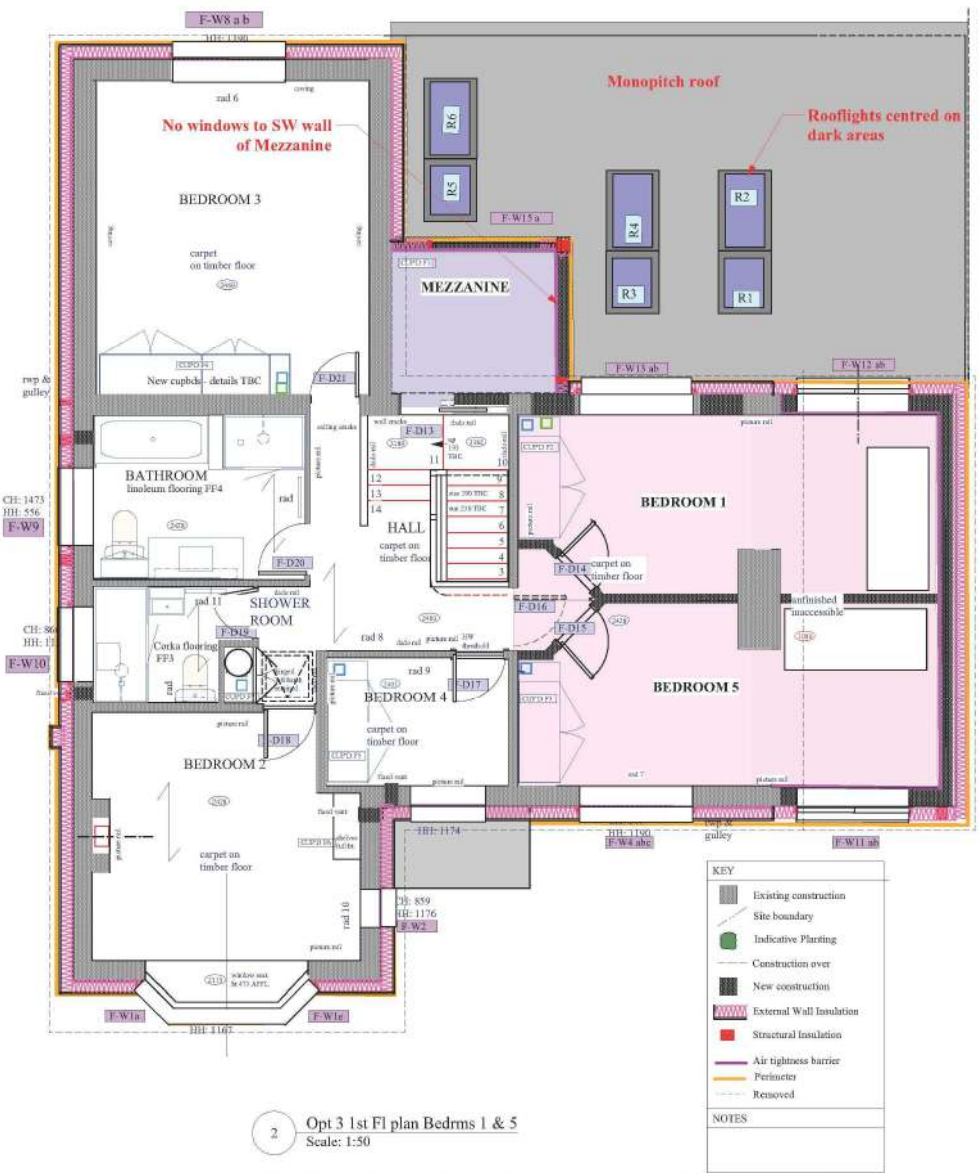
27.174.01 - 100 B

October 2017

Scale 1:50

Rev	Description	Date
A	Preliminary	10/04/2017
B	Updated: All annotations added	18/02/2019

MERRIBA email: merriba@btinternet.com Mob: 01861 998775 Tel: 01223 362528



**As Built - 1<sup>st</sup> Fl**



JANUARY 2022 REVISIONS NOTED IN RED

**M REYNOLDS RIBA**

59 OXFORD ROAD, CAMBRIDGE CB4 3PH

ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

FIRST FLOOR PLAN - REVISED

21.174.02 - 405 A

January 2022

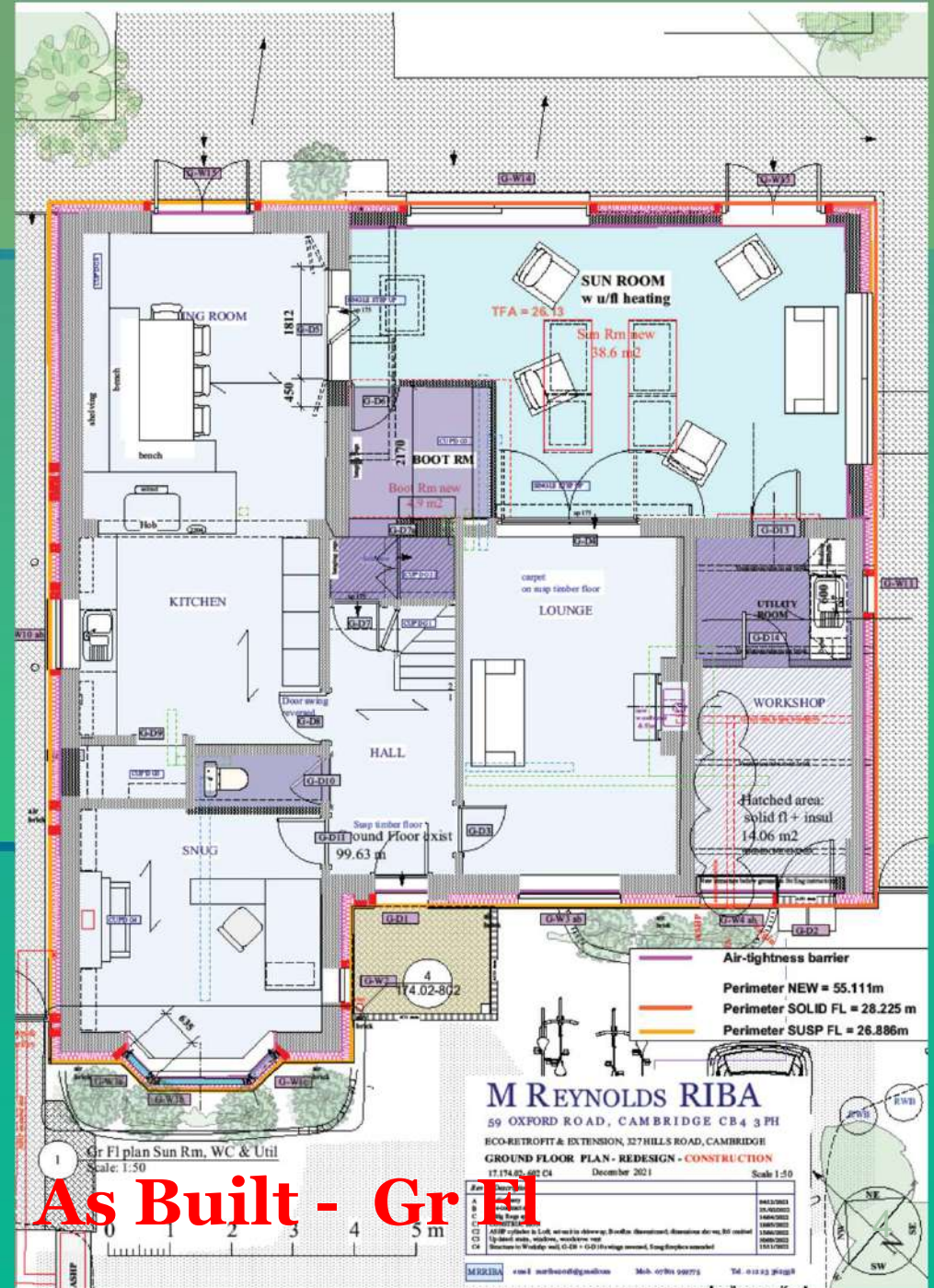
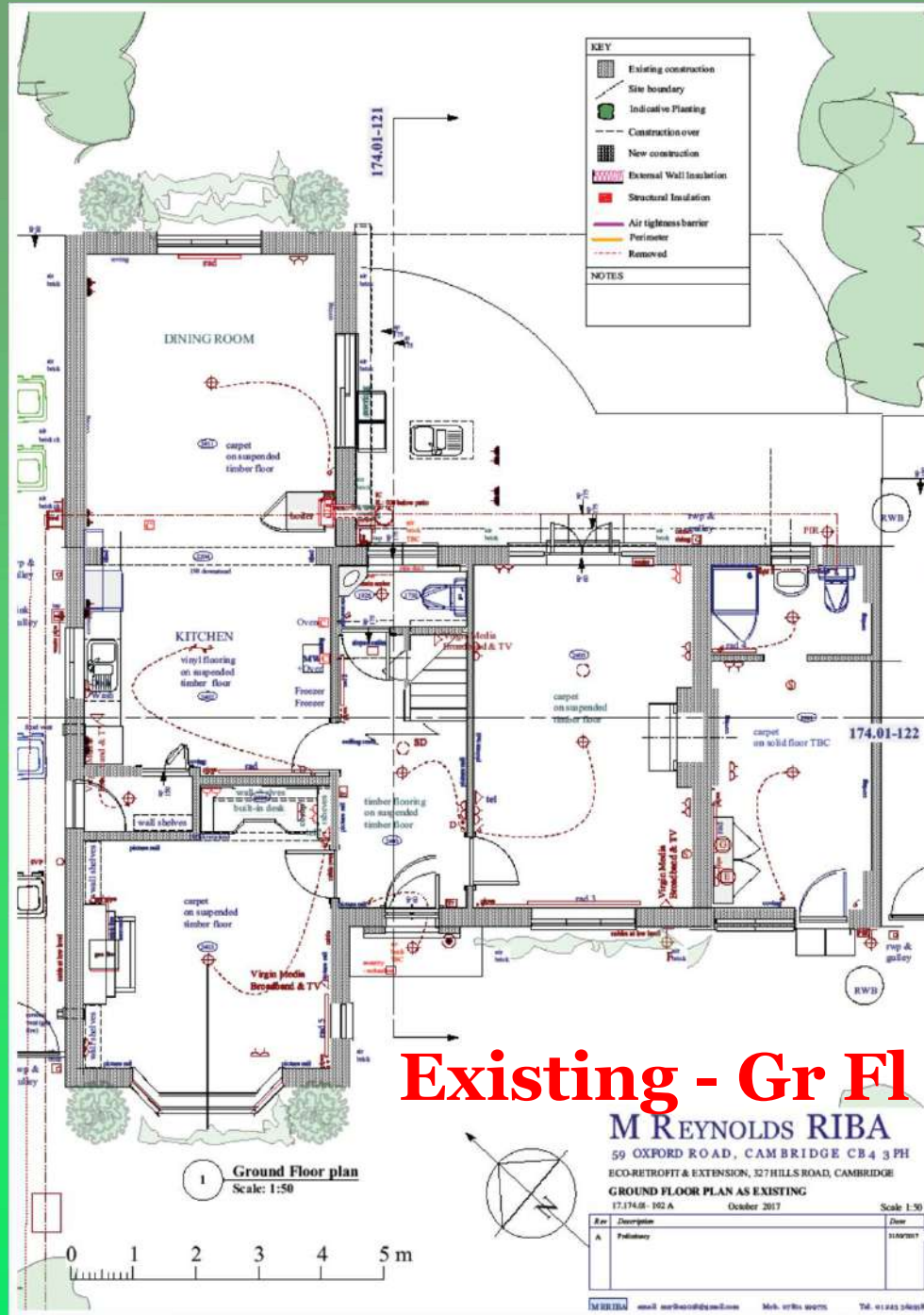
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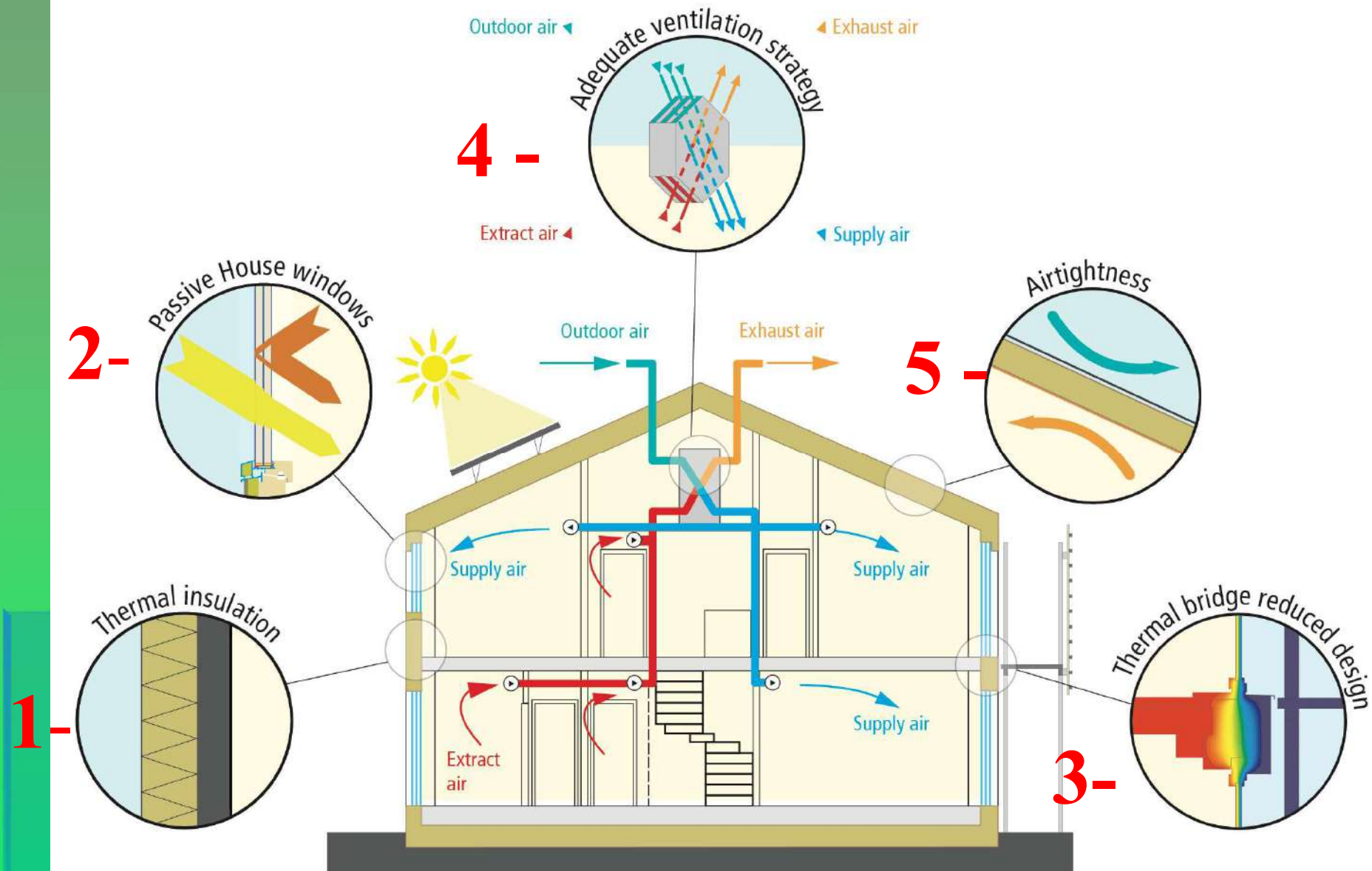


# Hills Rd Retrofit — Plans downstairs





# Hills Rd Retrofit – Passiv Haus



# Hills Rd Retrofit – Passiv Haus

## WHY?

- Low-energy buildings in UK since 2008
- PHPP modelling for EnerPHit retrofit
- Testing: EWI, below DPC, floors, Loft, windows, lower carbon materials
- PHPP model required for EnerPHit and AECB Standard.

# PHPP: Areas + Therm Br – Constrn

Area Input													
Area no.	Building assembly description	To group No.	Assigned to group	Quantity	a [m]	b [m]	c [m]	d [m]	User determined [m²]	User subtraction [m²]	Subtraction window areas [m²]	Area [m²]	
	Projected building footprint	0	Projected building footprint	1								0.0	
	Treated floor area	1	Treated floor area	1								0.0	
	Exterior door	2	Exterior door	1	4.00	1.10						4.4	
1				1							0.0		
2	TFA_ground floor +Optd	1	Treated floor area	1					94.91	-38.72	0.0	133.7	
3	TFA_1st floor	1	Treated floor area	1					74.88	-18.98	0.0	94.5	
4	TFA_1st floor	1	Treated floor area	1					13.89		0.0	13.9	
5	Masonry wall NE-1	8	External wall - Ambient	1	13.02	4.04					2.4	83.5	
6	To DPC wall NE-1	8	External wall - Ground	1	13.02	0.82					0.0	7.1	
7	Masonry wall SE-1	8	External wall - Ambient	1	4.89	4.04			18.64		0.0	38.3	
8	To DPC wall SE-1	8	External wall - Ground	1	4.89	0.82					0.0	2.4	
9	Masonry wall SE-2 (reduc.)	8	External wall - Ambient	1	8.00	1.18					1.7	1.8	
10	To DPC wall SE-2	8	External wall - Ground	1	8.00	0.82					0.0	0.0	
11	Masonry wall SW-1 g(new)	8	External wall - Ambient	1	5.00	1.20					1.8	-1.9	
12	To DPC wall SW-1	8	External wall - Ground	1	2.78	0.82					0.0	1.4	
13	Masonry wall SW-2(reduc.)	8	External wall - Ambient	1					7.90		0.0	7.0	
14	To DPC wall SW-2	8	External wall - Ground	1	8.77	0.82					0.0	6.0	

- EACH floor, wall, roof area is assigned a U-Value:
- THIS CAN BE CHANGED TO FINE-TUNE the design
- (Every surface type must be numbered, eg SE-3)

Sort: By ID							
Selection building assembly / Building system	U-value [W/m²K]	Deviation from Norm	Angle of inclination from the horizontal	Orientation	Reduction factor shading	Exterior absorptivity	Exterior emissivity
Exterior door	2.20						
Flashed-clay tile pitched roof 300 total + new truss	0.188						
Flashed-rendered masonry wall	0.148	47	90	East	0.70	0.90	0.90
Flashed-Wall to DPC	0.172	47	90	East	0.70	0.90	0.90
Flashed-rendered cavity masonry wall	0.441	197	90	South	0.70	0.90	0.90
Flashed-Wall to DPC	0.172	197	90	South	0.70	0.90	0.90
Flashed-rendered masonry wall	0.148	197	90	South	0.70	0.90	0.90
Flashed-Wall to DPC	0.172	197	90	South	0.70	0.90	0.90
Flashed-rendered masonry wall	0.148	197	90	South	0.70	0.90	0.90
Flashed-Wall to DPC	0.172	197	90	South	0.70	0.90	0.90
Flashed-rendered cavity masonry wall	0.441	207	90	West	0.70	0.90	0.90

# Hills Rd Retrofit – Passiv Haus

EnerPHit Verification			
Photo or Drawing		Building: <u>Residence</u>	
		Street: <u>123 Someplace Road</u>	
		Postcode/City: <u>Cambridge CB8 8QT</u>	
		Province/Country: <u>Cambridgeshire</u> <u>GB-United Kingdom/ Britain</u>	
		Building type: <u>dwelling house</u>	
		Climate data set: <u>GB0008a-Fairfield</u>	
		Climate zone: <u>3- Cool-temperate</u>	Altitude of location: <u>24 m</u>
Home owner / Client: <u>GREEN Mr + Mrs</u>		Street: <u>123 Someplace Road</u>	
		Postcode/City: <u>Cambridge CB8 8QT</u>	
		Province/Country: <u>Cambridgeshire</u> <u>GB-United Kingdom/ Britain</u>	
Architecture: <u>M Reynolds RIBA</u>		Mechanical engineer: <u>TBC</u>	
Street: <u>88 Oxford Road</u>		Street:	
Postcode/City: <u>Cambridge CB4 3PH</u>		Postcode/City:	
Province/Country: <u>Cambridgeshire</u> <u>GB-United Kingdom/ Britain</u>		Province/Country:	
Energy consultancy: <u>TBC</u>		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Province/Country:		Province/Country:	
Year of construction: <u>2018</u>	Interior temperature winter (°C): <u>20.0</u>	Interior temp. summer (°C): <u>25.0</u>	
No. of dwelling units: <u>1</u>	Internal heat gains (IHG) heating case (W/m²): <u>2.3</u>	IHG cooling case (W/m²): <u>2.3</u>	
No. of occupants: <u>3.1</u>	Specific capacity (W/m²K per m² TFA): <u>132</u>	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area				The PHPP has not been filled completely; it is not valid as verification		
	Treated floor area m²			Criteria	Alternative criteria	Fulfilled? <sup>2</sup>
Space heating	Heating demand kWh/(m²a)	<u>123.2</u>	≤	25	-	no
	Heating load W/m²	<u>40.7</u>	≤	-	-	-
	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	-
Space cooling	Cooling load W/m²	-	≤	-	-	-
	Frequency of overheating (> 25 °C) %	<u>0</u>	≤	10	-	yes
	Frequency of excessively high humidity (> 12 g/kg) %	<u>0</u>	≤	20	-	yes
Airtightness	Pressurization test result n <sub>50</sub> 1/h	<u>7.0</u>	≤	1.0	-	no
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	<u>194</u>	≤	265	-	yes
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	<u>247</u>	≤	-	-	-
	Generation of renewable energy (in relation to projected building footprint area) kWh/(m²a)	-	≥	-	-	-

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?	<u>no</u>
Task:	First name:	Surname:	Signature:	
	Issued on:	City:		

Building Type:  
dwelling house  
Existing Base  
File:

- Heating demand:  
**123 kWh/m²/yr**
- Air tightness  
**7 m³/m²h  
(5 ACH)**



# PHPP: “Verification” – Construction

EnerPHit Verification			
Photo or Drawing		Building: <b>Residence</b>	
		Street: <b>123 Somewhere Road</b>	
Postcode/City: <b>Cambridge CB9 0QT</b>		Provincial/Country: <b>Cambridgeshire GB-United Kingdom/ Britain</b>	
Building type: <b>dwelling house</b>		Climate data set: <b>GB0013a-Hensby</b>	
Climate zone: <b>3: Cool-temperate</b>		Altitude of location: <b>24 m</b>	
Home owner / Client: <b>GREEN Mr &amp; Mrs</b>		Street: <b>123 Somewhere Road</b>	
Postcode/City: <b>Cambridge CB9 0QT</b>		Provincial/Country: <b>Cambridgeshire GB-United Kingdom/ Britain</b>	
Mechanical engineer: <b>TBC</b>		Street: <b></b>	
Postcode/City: <b></b>		Provincial/Country: <b></b>	
Certification: <b></b>		Street: <b></b>	
Postcode/City: <b></b>		Provincial/Country: <b></b>	
Year of construction: <b>2022</b>		Interior temperature winter [°C]: <b>20.0</b>	
No. of dwelling units: <b>1</b>		Internal heat gains (IHG) heating case (W/m²): <b>2.3</b>	
No. of occupants: <b>3.1</b>		Specific capacity (Wh/K per m² TFA): <b>132</b>	
Energy consultancy: <b>M Reynolds RIBA</b>		Interior temp. summer [°C]: <b>26.0</b>	
Street: <b>55 Oxford Road</b>		IHG cooling case (W/m²): <b>2.3</b>	
Postcode/City: <b>Cambridge CB4 3PH</b>		Mechanical cooling: <b></b>	
Provincial/Country: <b>Cambridgeshire GB-United Kingdom/ Britain</b>			
Specific building characteristics with reference to the treated floor area			
The PHPP has not been filled completely. It is not valid as verification			
Treated floor area m²		241.8	
Space heating	Heating demand kWh/(m²a)	14.1	≤ 25
	Heating load W/m²	10.4	≤ -
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤ -
	Cooling load W/m²	-	≤ -
	Frequency of overheating (> 25 °C) %	0	≤ 10
	Frequency of excessively high humidity (> 12 g/kg) %	0	≤ 20
Airtightness	Pressurization test result n <sub>50</sub> 1/h	1.0	≤ 1.0
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	34	≤ -
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	14	≤ 60
	Generation of renewable energy (in relation to pro- kWh/(m²a) heated building footprint area)	-	≥ -
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.			
Task: <b></b>		EnerPHit Classic? <b>yes</b>	
First name: <b></b>		Signature: <b></b>	
Surname: <b></b>			
Issued on: <b></b>		City: <b></b>	

## Construction File:

- Heating + DHW demand:

**14.1 kWh/m²**

- Air tightness

**( 1 m³/m²h )**

**1 ACH**

# Hills Rd Retrofit — Passiv Haus

## Testing w PHPP

- EWI materials, thickness, below DPC
- Susp Timb floor, keep or replace w concrete
- Loft: insulated? Materials + positions
- New window + door attributes from mfr
- MVHR: Zehnder attributes from mfr
- Lower carbon material  $\lambda$  values, thickness
- Design stage, in construction, back in use



# Low-carbon strategies

- Insulation
- Ventilation
- Air tightness

SOLAR PV PANELS: on East, South and West roofs, Spec 12.28 and Appx W

MEZZANINE ROOF: as Sun Rm roof, Soprema bitumen membrane (Colourcoat Urban steel OMITTED) @ approx 12 deg, Spec 7.11, details AMENDED Appx K, continuous with existing 39deg clay tile roof at top

MEZZANINE WINDOW: Triple-glazed, installed in insulation zone, means of escape @ max 1050 AFFL, Spec 9.01 and Appx N. ROOFLIGHTS @ 15 deg at min 200 from roof upstand: Fakro, Spec 7.16, schedule Appx L

SUN RM ROOF: Soprema bitumen membrane (Colourcoat Urban steel OMITTED) @ approx 12 deg, Spec 7.11, details AMENDED Appx K, continuous with existing 39deg clay tile roof at top

**New Wall  
EWI**

SUN ROOM & BOOT ROOM FLOOR: insulated slab: refer to Str Eng drawings, Spec 4.06 and Appx G-2 and G-3; screed with underfloor heating, Spec 4.11; Floor finish, Spec 11.01.

**New Floor**

SUSPENDED TIMBER FLOORS: to be airtight and insulated, Spec 8.23. Gr Fl Hall joists to be lowered when insulated, to suit recycled parquet floor and matwell @ existing FFL, AMENDED Spec 11.15

**Old Floor**

**M REYNOLDS RIBA**

59 OXFORD ROAD, CAMBRIDGE CB4 3PH

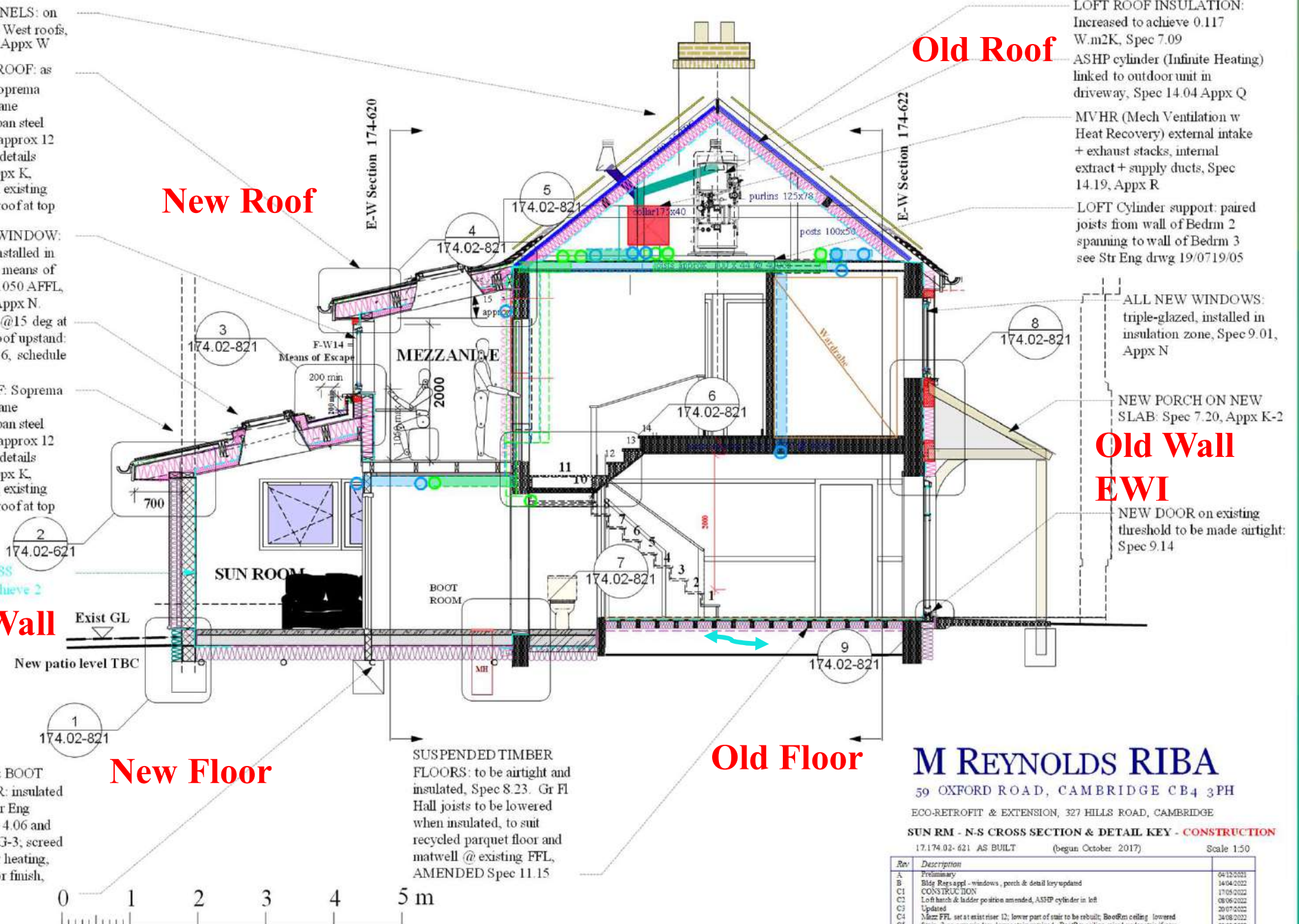
ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

SUN RM - N-S CROSS SECTION & DETAIL KEY - CONSTRUCTION

17.174.02-621 AS BUILT (begun October 2017) Scale 1:50

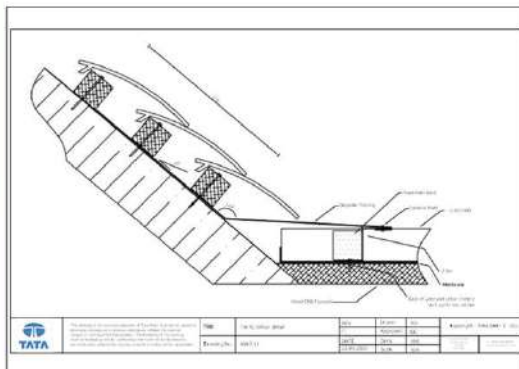
Rev	Description	Date
A	Preliminary	04/12/2021
B	Blind Regs appl - windows, porch & detail key updated	14/04/2022
C1	CONSTRUCTION	17/05/2022
C2	Loft hatch & ladder position amended, ASHP cylinder in loft	08/06/2022
C3	Updated	20/07/2022
C4	Move FFL set at exist riser 12; lower part of stair to be rebuilt; BootRm ceiling lowered	24/08/2022
C5	Stair: 2 new windows, lower stairs retained; BootRm ceiling raised under stair if poss	30/09/2022
C6	Updated solar PV's + MVHR ducts; loft cylinder support shown; SunRm sashes dimensioned, AS BUILT	09/12/2022
		18/09/2023

MRRIBA email mribac08@gmail.com Mob. 07801999775 Tel. 01223 360558



# Insulation Strategies

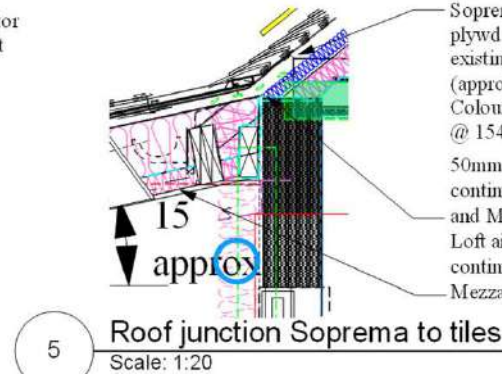




10 Soprema junction similar to Colourcoat-Urban tile  
Scale: NTS



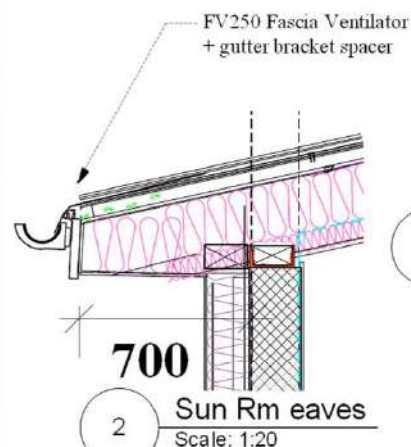
4 Mezzanine eaves  
Scale: 1:20



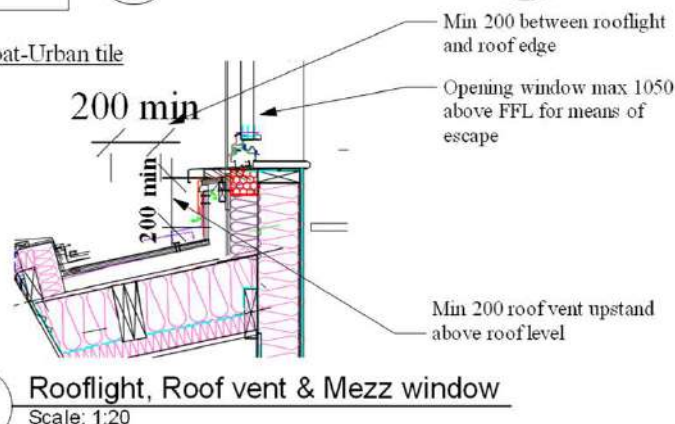
5 Roof junction Soprema to tiles  
Scale: 1:20

Soprema roof on 18mm plywd carried up under existing plain tile roof (approx 39 deg); Soprema / Colourcoat-Urban flashing @ 154 deg, see detail 10.  
50mm air gap maintained continuous between Loft and Mezzanine roofs  
Loft airtightness layer continued and lapped to Mezzanine airtightness

New structural insulation set in EW insulation zone to support new porch roof

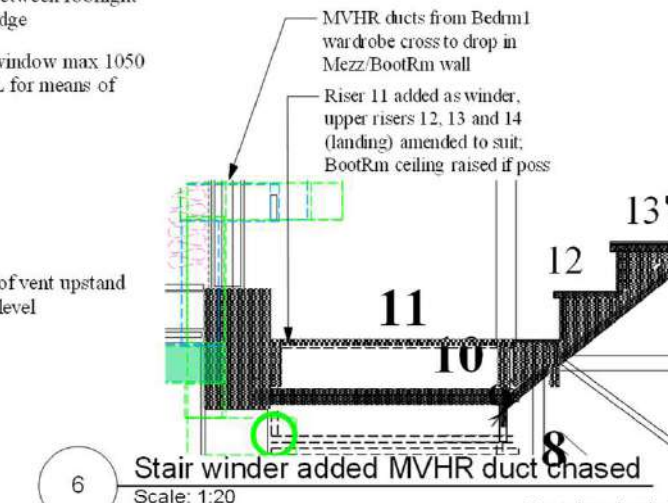


2 Sun Rm eaves  
Scale: 1:20



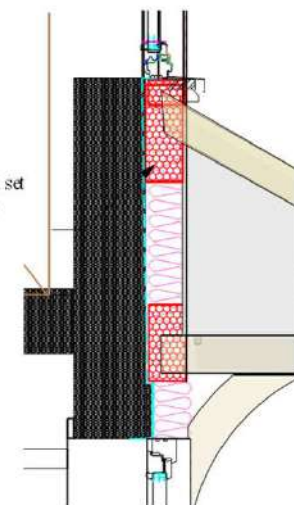
3 Rooflight, Roof vent & Mezz window  
Scale: 1:20

Min 200 between rooflight and roof edge  
Opening window max 1050 above FFL for means of escape  
Min 200 roof vent upstand above roof level

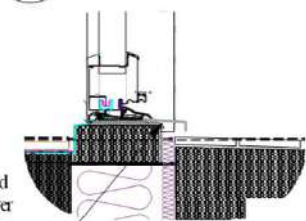


6 Stair winder added MVHR duct chased  
Scale: 1:20

MVHR ducts from Bedrm1 wardrobe cross to drop in Mezz/BootRm wall  
Riser 11 added as winder, upper risers 12, 13 and 14 (landing) amended to suit; BootRm ceiling raised if poss

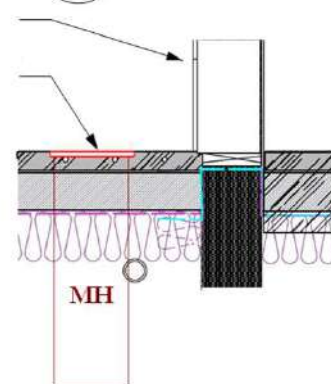


8 New porch fixing  
Scale: 1:20



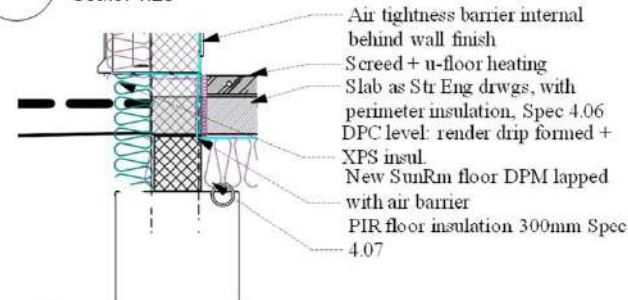
9 Front door threshold  
Scale: 1:10

Front door threshold extended w extra aluminium L-drip over insulation + sandstone paving slabs



7 New BootRm doorway + MH cover  
Scale: 1:20

New door set in former external wall.  
New floor finish set into new cover to existing manhole



1 Founds to SunRm  
Scale: 1:20

Air tightness barrier internal behind wall finish  
Screed + u-floor heating Slab as Str Eng drwgs, with perimeter insulation, Spec 4.06  
DPC level: render drip formed + XPS insul.  
New SunRm floor DPM lapped with air barrier  
PIR floor insulation 300mm Spec 4.07

## M REYNOLDS RIBA

59 OXFORD ROAD, CAMBRIDGE CB4 3PH

ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

### SUN ROOM - S-N SECTION DETAILS

121.174.02.821 AS BUILT (begun December 2021) Scale 1:50

Rev	Description	Date
A	Preliminary	25/02/2022
B	Updated	15/06/2022
C1	GBS ULTRA window details; front door threshold	04/07/2022
C2	Updated	20/07/2022
C3	Updated w Colourcoat-Urban instructions (5) & details (10)	26/07/2022
C4	MVHR ducts shown, chase d at Mezz/ BootRm wall, stair amended at Mezz door AS BUILT	01/12/2022
		12/09/2023

MRRIBA email mrriba2018@gmail.com Mob. 07801 999775 Tel. 01223 366558



# Insulation - EWI



**SB exp polystyrene**  
**EPS 0.031 W/mK**



**Kingspan Kooltherm**  
**Phenolic 0.021 W/mK**



**EPS over Phenolic**



**New wall: chose**  
**masonry lined with**  
**old for EWI**



**Wall surface made**  
**even for EWI**



**Plastic brick slips**  
**NOT USED**



**Some exist cavity**  
**wall insulation;**  
**void to be closed**



**Front concrete**  
**canopy removed**



**More insulation**  
**added to eaves**



# Insulation – roof + floors



**Loft roof: 50 Rockwool Flexi ( $\lambda = 0.035$ )  
+ 150 PIR Celotex ( $\lambda = 0.022$ ) + airtight OSB**



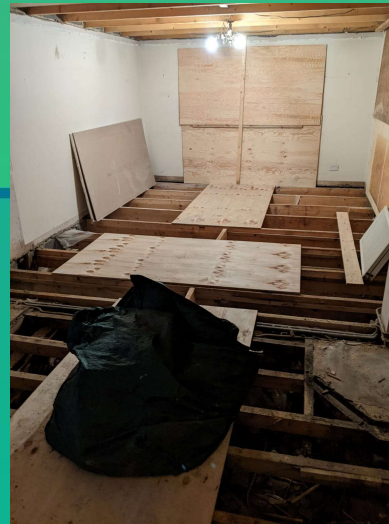
**New SunRm solid fl  
250mm IKO Enertherm  
PIR insulation**



**EWI (XPS)  
below DPC to  
foundations**



**Service penetrations  
made airtight**



**Kitchen floorboards lifted to  
insulate**



**Rockwool Flexi 100  
( $\lambda = 0.038$ ) in  
Lounge floor**





# Windows



**Trial window installed w Struct Insulation  
in External Wall insulation zone**



**Structural Insulation supporting  
windows in External Wall insulation  
zone, temporary rain covers**



**Structural insulation  
- Partel Alma Vert –  
from recycled bottles**



**Windows Green Building Store  
Ultra 0.6 kWh/m<sup>2</sup>K  
(Passiv Haus standard)**

**Old windows sold on eBay**





# Windows in EXTERNAL Insulation Zone

MVHR ducts run above exist ceiling joists, w ceiling drops  
Continuous airtightness barrier maintained at eaves from Loft ceiling to EWI

Exist main roof insul 100mm continuous with EWI at eaves

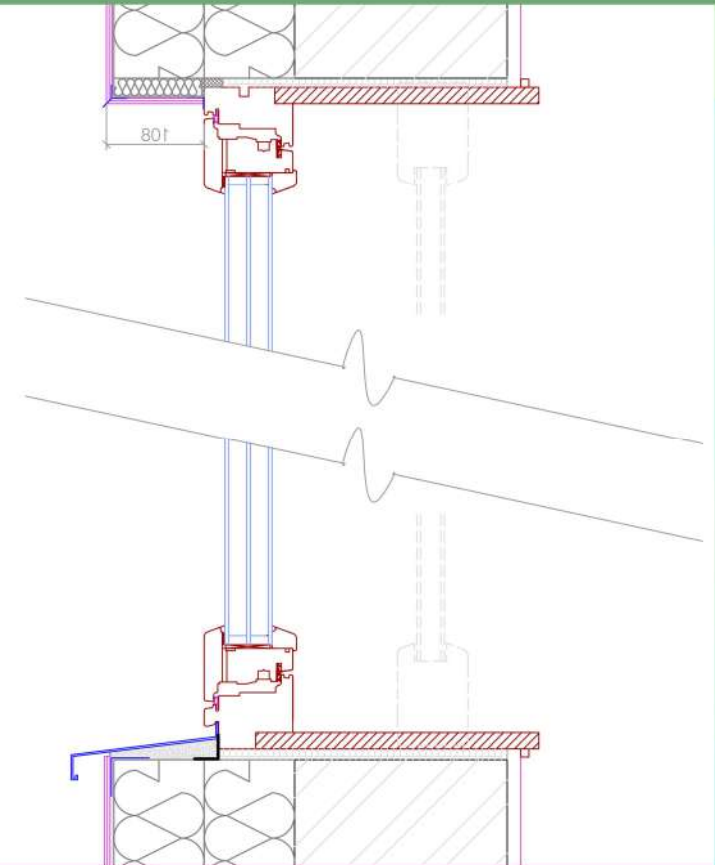
Continuous 50 ventilation gap maintained above insul

Insul continuous above soffit

Render drip at window head

New windows in EW insulation zone, refer to Str Eng info for structural insulation

3 EWI exist @ eaves + window support  
Scale: 1:25



Structural insulation  
support

New window to EWI, retrofit installation

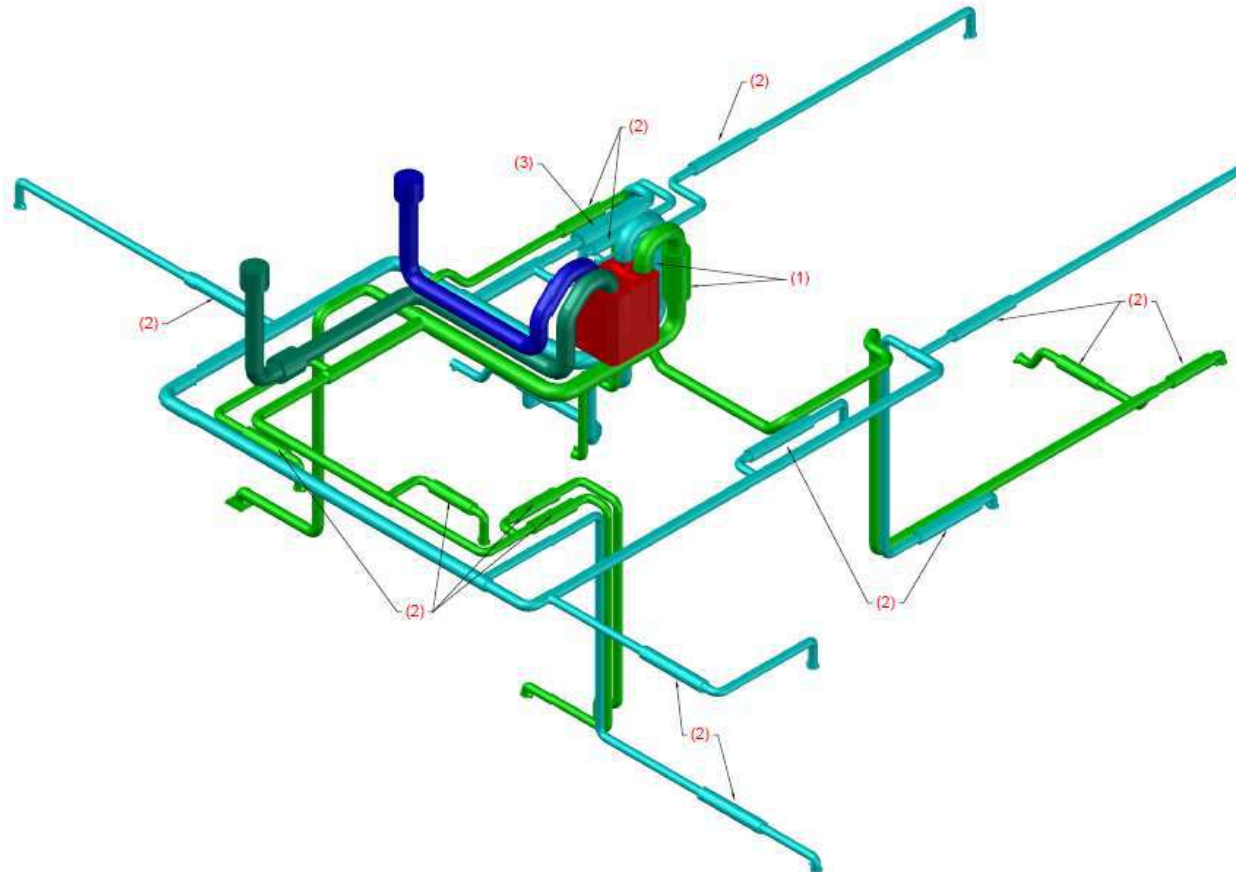
**Retrofit Pattern Book**

<https://retrofit.support/detail/75/>

# Ventilation Strategy: MVHR - ACTIVE

Before making changes, please notify GBS. GBS is only liable for the performance of system if installed to design.

Straight lengths of duct are supplied in 3.0mtr lengths to be cut to size on site.



## General Notes

DO NOT SCALE  
Drawing is Copyright Green Building Store. It shall remain the property of Green Building Store. It shall not be used for any other purpose without the written permission of Green Building Store. It shall not be used for any other purpose without the written permission of Green Building Store.

## Key - plans & sections

Intake ducts	
Supply ducts	
Extract ducts	
Exhaust ducts	
Floor plans	
Joist plans	
Silencer	

## Primary and cross talk attenuation:

Where primary attenuation (1) is represented, please add 100mm onto diameter of ductwork.



Where cross talk attenuation (2) is represented, the silencer is in reality a square cross-section. Please add 50mm onto diameter of ductwork to give the square dimensions.



## 01 Isometric

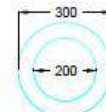
Green Building Store  
Health House Ltd.  
Health House Lane,  
Oxford, Oxfordshire  
OX1 4BB  
Tel: 01494 461795  
Email: info@greenbuildingstore.co.uk

Project location  
HILLS ROAD  
327 HILLS ROAD  
CAMBRIDGE  
CB2 9QT

Page  
833DYE005HILL  
Date  
18.11.2022  
Not to Scale

	Fan Speed 1	Fan Speed 2	Fan Speed 3
Supply and Extract pressure	14	12	27
Intake and Exhaust pressure	3	4	5
Total in / out pressure	17	16	32
Ave. externally available pressure	17	32	36
Select AHU	ComfoAir Q 450		
Power consumption of AHU (W)	17	38	43
Average cost per Annum (£)		£50	
I.E. efficiency		88%	
Reduction in I.E. efficiency due to intake and exhaust ducts		3.4%	

(1) Primary Silencers  
Supply: 900mm long, circular, 200mm duct,  
50mm wall, overall diameter = 300mm  
Extract: 600mm long, same as above



(2) Cross-Talk Silencers  
Supply: 900mm long, rectangular,  
25mm wall, 150x150  
Extract: 600mm long, same as above



(3) Cross-Talk Silencers  
Supply: 900mm long, rectangular,  
125mm duct, 25mm wall, 175x175  
Extract: 600mm long, same as above

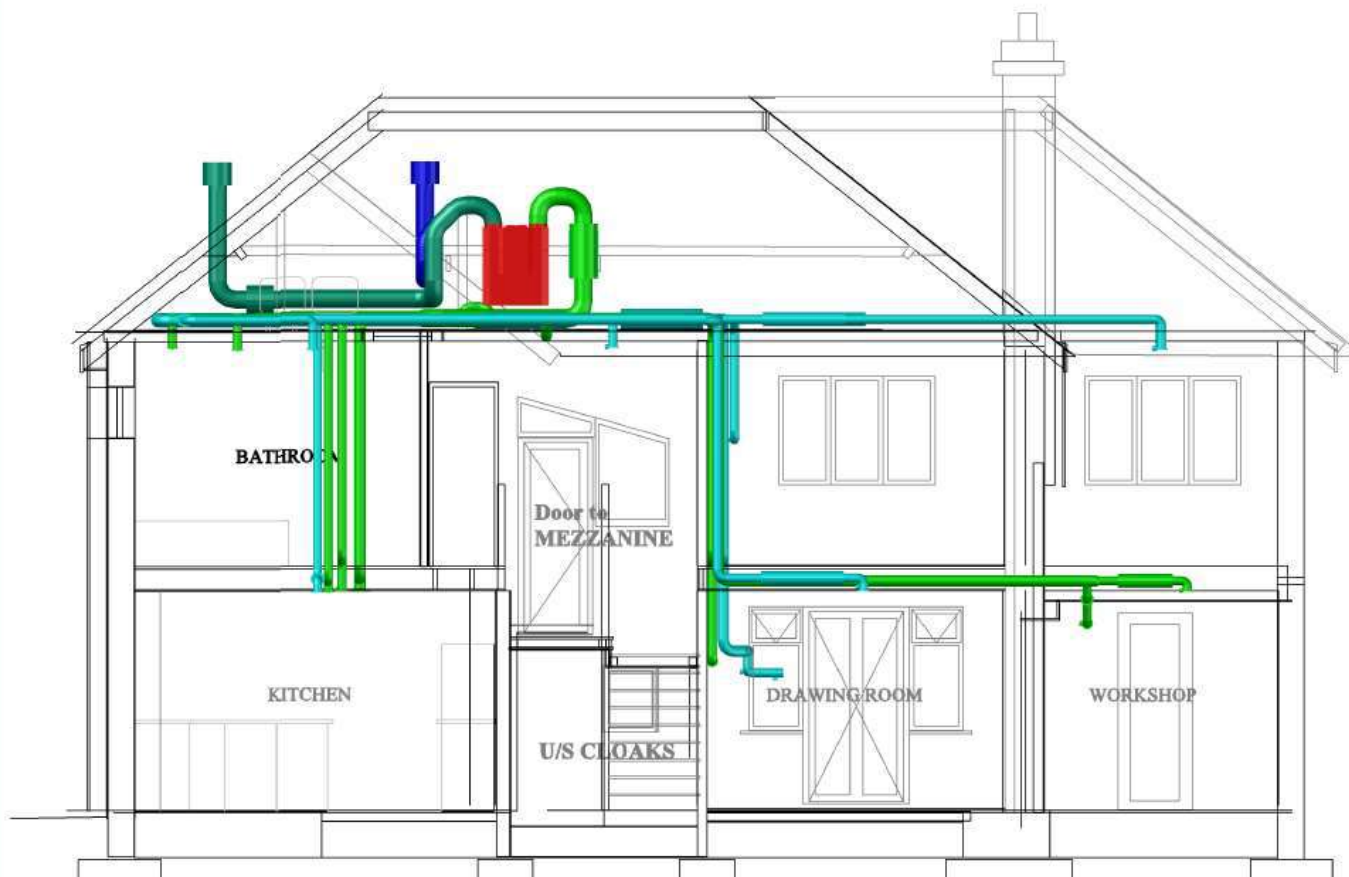


833DYE005HILL RevF.dwg

Andrew Dunlop

**Wall Mounted air Valves:**

Where wall mounted air valves have been shown it is important to ensure that the duct on which they are mounted is at least a 100mm offset from center to the ceiling finish for commissioning and air flow purposes.



See generic air valve mounting drawing for guidance on how to fix the air valves and associated mounting rings.

Key - plans & sections

- Intake ducts
- Supply ducts
- Extract ducts
- Exhaust ducts

Floor plans  
Joist plans

Silencer

10	Section A
----	-----------

**green  
building  
store**  
Green Building Store  
Heath House Mill,  
Heath House Lane,  
Glebe, Huddersfield  
HD7 4JW  
Tel: 01484 461705  
Email: [myinfo@greenbuildingstore.co.uk](mailto:myinfo@greenbuildingstore.co.uk)

HILLS ROAD  
327 HILLS ROAD  
CAMBRIDGE  
CB2 0QT

833DYE005HILL

Date: 18.11.2022

Not to Scale

Review	
--------	--

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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# Ventilation ACTIVE

LOFT



WALLS



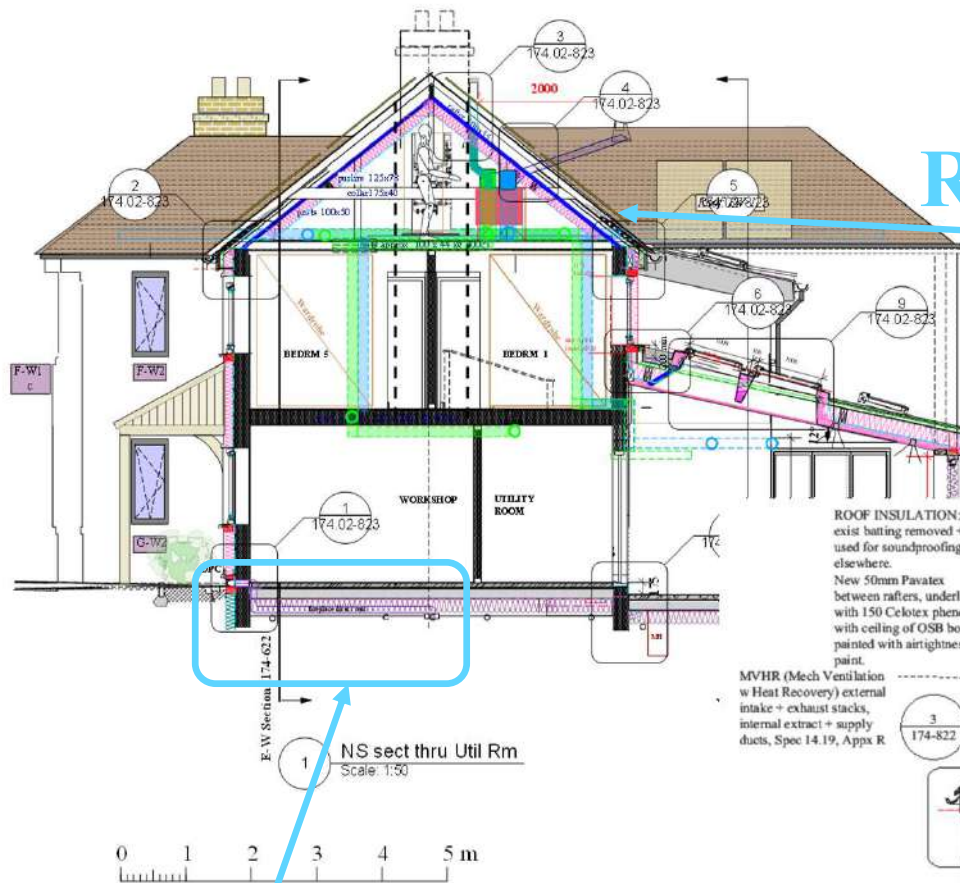
MVHR ducts tunnelled  
thru old fabric



SUPPLY  
OUTLETS/  
EXTRACTS



# Ventilation: PASSIVE



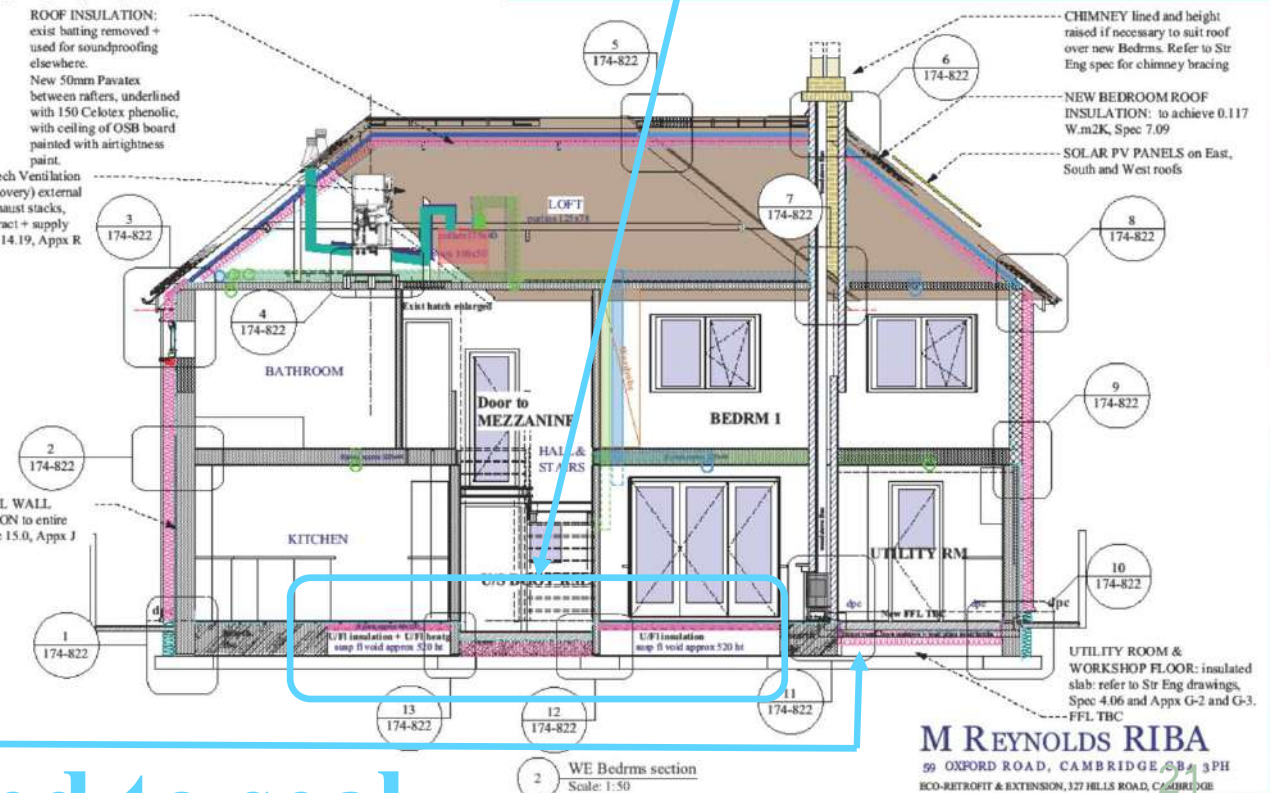
Roof voids

Air bricks +  
floor void  
- sealed

ROOF INSULATION:  
exist batts removed +  
used for soundproofing  
elsewhere.  
New 50mm Pavatex  
between rafters, underlined  
with 150 Celotex phenolic,  
with ceiling of OSB board  
painted with airtightness  
paint.

MVHR (Mech Ventilation  
w Heat Recovery) external  
intake + exhaust stacks,  
internal extract + supply  
ducts, Spec 14.19, Appx R

EXTERNAL WALL  
INSULATION to entire  
house: Spec 15.0, Appx J



CHIMNEY lined and height  
raised if necessary to suit roof  
over new Bedrms. Refer to Str  
Eng spec for chimney bracing

NEW BEDROOM ROOF  
INSULATION: to achieve 0.117  
W.m2K, Spec 7.09  
SOLAR PV PANELS on East,  
South and West roofs

UTILITY ROOM &  
WORKSHOP FLOOR: insulated  
slab: refer to Str Eng drawings,  
Spec 4.06 and Appx G-2 and G-3.  
- FFL TBC

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ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

BEDROOMS - W-E LONG SECTION & DETAIL KEY - CONSTRUCTION

17174-02 - 022 AS BUILT (Begin February 2022) Scale 1:50

Rev	Description	Date
A	Issue	20/02/2022
B	Revised	20/02/2022
C	Revised	20/02/2022
D	Revised	20/02/2022
E	Revised	20/02/2022
F	Revised	20/02/2022
G	Revised	20/02/2022
H	Revised	20/02/2022
I	Revised	20/02/2022
J	Revised	20/02/2022
K	Revised	20/02/2022
L	Revised	20/02/2022
M	Revised	20/02/2022
N	Revised	20/02/2022
O	Revised	20/02/2022
P	Revised	20/02/2022
Q	Revised	20/02/2022
R	Revised	20/02/2022
S	Revised	20/02/2022
T	Revised	20/02/2022
U	Revised	20/02/2022
V	Revised	20/02/2022
W	Revised	20/02/2022
X	Revised	20/02/2022
Y	Revised	20/02/2022
Z	Revised	20/02/2022

Wood Stove  
Direct Vent,  
Chimney repointed to seal



# Ventilation – PASSIVE



**NEW ROOF**



**FLOOR**



**Air bricks to floor void**



**Airbricks in EWI  
below DPC to founds**



**Direct Vent hit-miss  
cover for vermin**



**Below concrete slab: vent pipes  
for susp floor running under  
direct vent pipe for wood stove**



**Direct vent to woodstove taking  
air from outside, but sealed  
inside for air tightness**



**Direct vent  
in place outside**



**Direct vent airtight  
hearth connection**



# Air Tightness specification

- Spec: - **Air Tightness < 2 ACH + testing**
- Training / Air Tightness “Manager”
- Intermediate tests

## Continuous A T Line

To warm side of insulation

SUN RM ROOF:  
Colourcoat Urban steel @  
approx 12 deg, Spec 7.11,  
details Appx K

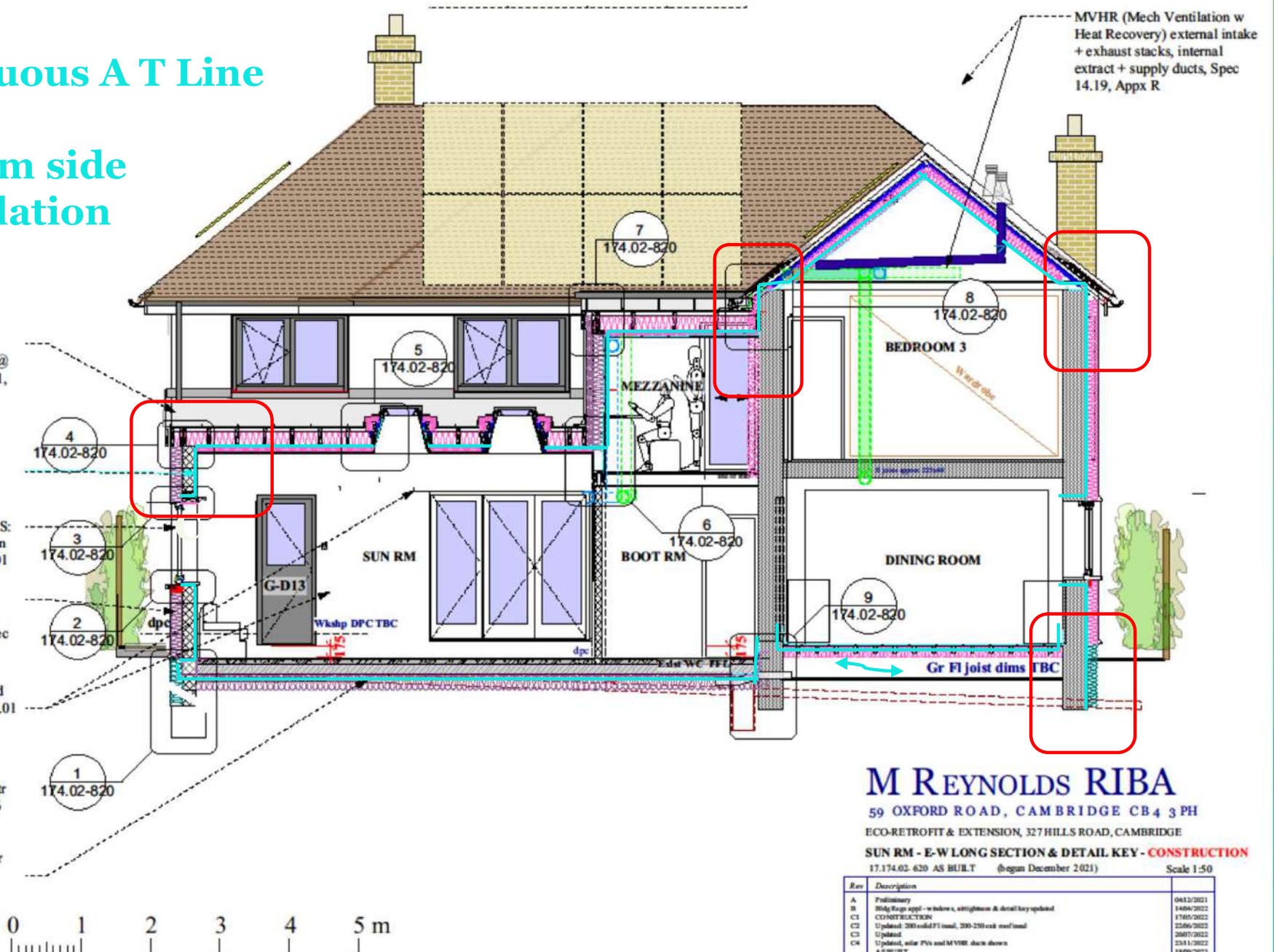
AIR TIGHTNESS  
BARRIER to achieve 2  
ACH @ 50 Pa

SUN ROOM WINDOWS:  
Triple-glazed, installed in  
insulation zone, Spec 9.01  
and Appx N.

SUN RM WALLS of  
externally insulated and  
rendered blockwork, Spec  
6.06-6.08, Appx H

EXISTING PLINTH +  
RENDER DRIPS hacked  
off before EWI, Spec 15.01

SUN ROOM FLOOR:  
insulated slab: refer to Str  
Eng drawings, Spec 4.06  
and Appx G-2 and G-3;  
screed with underfloor  
heating, Spec 4.11; Floor  
finish, Spec 11.01.



**M REYNOLDS RIBA**

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ECO-RETROFIT & EXTENSION, 327 HILLS ROAD, CAMBRIDGE

SUN RM - E-W LONG SECTION & DETAIL KEY - CONSTRUCTION

17.174.02.620 AS BUILT (began December 2021)

Scale 1:50

Rev	Description	
A	Preliminary	0813/2021
B	Wdly Regd appl - windows, air-tightness & detail key updated	1406/2022
C1	CO1007/2022/12/20	1705/2022
C2	Updated: 200 cold/21 mod, 200-250 cold mod/mod	2206/2022
C3	Updated	2807/2022
C4	Updated, solar PVs and MVHR duct shown	2311/2022
	AS BUILT	1809/2023

MERIBA

email meribatoth@gmail.com

Mob. 07801 999775

Tel. 01223 362958

# Air tightness strategies



# Roof AT



New bedrms roof: fibrous AT paint on steel chimney bracing



Loft: AT OSB Zero + foam



Exist bedrm 2: AT paint at eaves;  
(old insulation stored for reuse)



New bedrms roof: AT paint at eaves





New bedrms roof: tape, OSB  
Zero, AT paint + foam at eaves



Bedrm 3 exist roof: tape, OSB  
Zero, AT paint + foam at eaves



Bedrm 3 exist roof: tape, OSB  
Zero, AT paint + foam at eaves



New bedrms roof: OSB Zero,  
AT paint + foam at eaves

1sr Fl & roof: tape,  
OSB Zero, AT paint  
+ foam at eaves



ShowerRm: OSB Zero, AT  
paint + foam at eaves

# Hills Rd Retrofit — Passiv Haus model

- PHPP BASE FILE **2018**—

assumed **123.2** kWh/m<sup>2</sup> (total w HW: 155 kWh/m<sup>2</sup>)

existing airtightness: **4.98 ACH**

- PHPP model proposed **2022**:

reduction to **14.1** kWh/m<sup>2</sup>, AT: **<1 ACH**

- **AS-BUILT PHPP file 2024**:

shows **19.9** kWh/m<sup>2</sup>, with AT = **1.69 ACH** measured

- **MEASURED 2024**: **33** kWh/m<sup>2</sup> incl HW — say HW=15%, so **28** kWh/m<sup>2</sup>/ye [ = **23%** of existing ]



# Dyer Retrofit – OEH numbers

- *BEFORE renovation (if applicable)*
- Total (Gas & Elec) = **155** kWh/m<sup>2</sup> pa
- Electricity: **5,670** kWh pa
- Gas: **22,557** kWh pa (19,106 kWh + 3451 kWh for Hot Water)
- Other fuel : N/A kWh pa
- Water: **216** cubic metres pa (148 l per person per day).
- *AT PRESENT:*
- Total (Gas & Elec) = **33.7** kWh/m<sup>2</sup> pa [ **22%** of BEFORE -**78%** reduction ]
- Electricity: **8973** kWh pa (est. including PV self-consumption,  
removed EV charging)
- Gas: **0** kWh pa Gas appliances and meter removed from property
- Other fuel : 0 kWh pa N/A have a log burner but not yet used.
- Water: **167** cubic metres pa (115 l per person per day)  
[ **77%** of BEFORE ]

# Hills Road Retrofit

For Open Eco Homes

10 October 2024

Margaret Reynolds,  
Architect & Retrofit Coordinator (retired)

M Reynolds RIBA

[mrriba2018@gmail.com](mailto:mrriba2018@gmail.com)

<http://uk.linkedin.com/in/margaretreynoldsriba>

# Your next steps

- Find out how you can get started with your retrofit
- Book another tour or talk
- Research our past case studies
- Book a training session and borrow a thermal imaging camera
- Use Transition Cambridge's personalised home energy advice tool
- Please complete the event feedback at the end of this talk



# Can you help us?

Make a donation to help us run more Open Eco Homes tours:

[cambridgecarbonfootprint.org/donate](https://cambridgecarbonfootprint.org/donate)

Share your experiences on social media: #OEH2024

Thank you for your support!



Mole



INCLUME

