Passivhaus Project Documentation

Step by step refurbishment to Enerphit Standard

EnerPHit Retrofit Plan Pre-certified Passive House Institute

155 Corporation Street, London E15 3DY

Single family, mid-terraced three bedroom home in London, England - ID.7562

1 - abstract

This project is a phased Enerphit retrofit. The client was clear in her demand for a certified energy efficient renovation project.

Finances determined the project would be done in phases; the original house being a classic Victorian single brick terraced 3-bedroom house. The house had not been renovated for many years, and therefore suffered from the usual problems, extreme discomfort, mould, damp, high running costs.

Phase 1 consisted of doing renovations to the upper levels of the main house, so all three bedrooms would be done and complete. In conjunction a thermal enclosure was made in the loft to contain the MVHR, as well as to create high quality additional storage. So major thermal upgrades were included in Phase 1, including fully functioning MVHR system, and external wall insulation (EWI). Chimney breasts were also removed as part of Phase 1.

Phase 2 will consist of constructing a rear extension for a family kitchen/ dining with good access to the garden. A new bathroom and additional WC is to be located in the middle darker space of the ground floor, thereby maintaining the three bedrooms.

The heating system will be new ASHP, it is still to be decided whether this is to be done as part of the Phase 2 extension, or done before.

Step 4 - Phase 2 (new extension)_Pre-Certification - DATA			
Construction	**2022-2026**	**Space heating 13 kWh/(m²a)**	
Treated Floor Area	87 sqm	Heating Load	11.2 W/m²K
Airtest n50	1 h -1 (required)	Primary Energy Demand	51.5 kWh/(m²a)

1.2 Phased Programme - Steps

1 - Appx Year of original Construction	**1880**
2 - Phase 1 - (gas boiler retained)	**commenced 2022, completed 2024**
3 - Phase 2 - (new ASHP)	**anticipated completion 2025**
4 - Phase 2 - new extension	**anticipated completion 2026**
5 - Phase 3 - solar panels	**anticipated completion 2026**

Step 1 - Existing House, prior to works - DATA

1- Appx Year of original Construction	**YEAR 1880**	**EXISTING** Space heating **343** kWh/(m²a)	
U-value external wall (solid brick)	2.6 W/(m²K)	Heating Load	115 W/m²K
U-value floor (uninsulated)	1.96 W/(m²K)	Primary Energy Demand	689 kWh/(m²a)
U-value roof (insulated 2022)	0.1 W/(m²K)	Treated Floor Area	72 sqm
U-value window (replaced 1990's)	2.8 W/(m²K)	Airtest (2022) n50	6.6 h -1

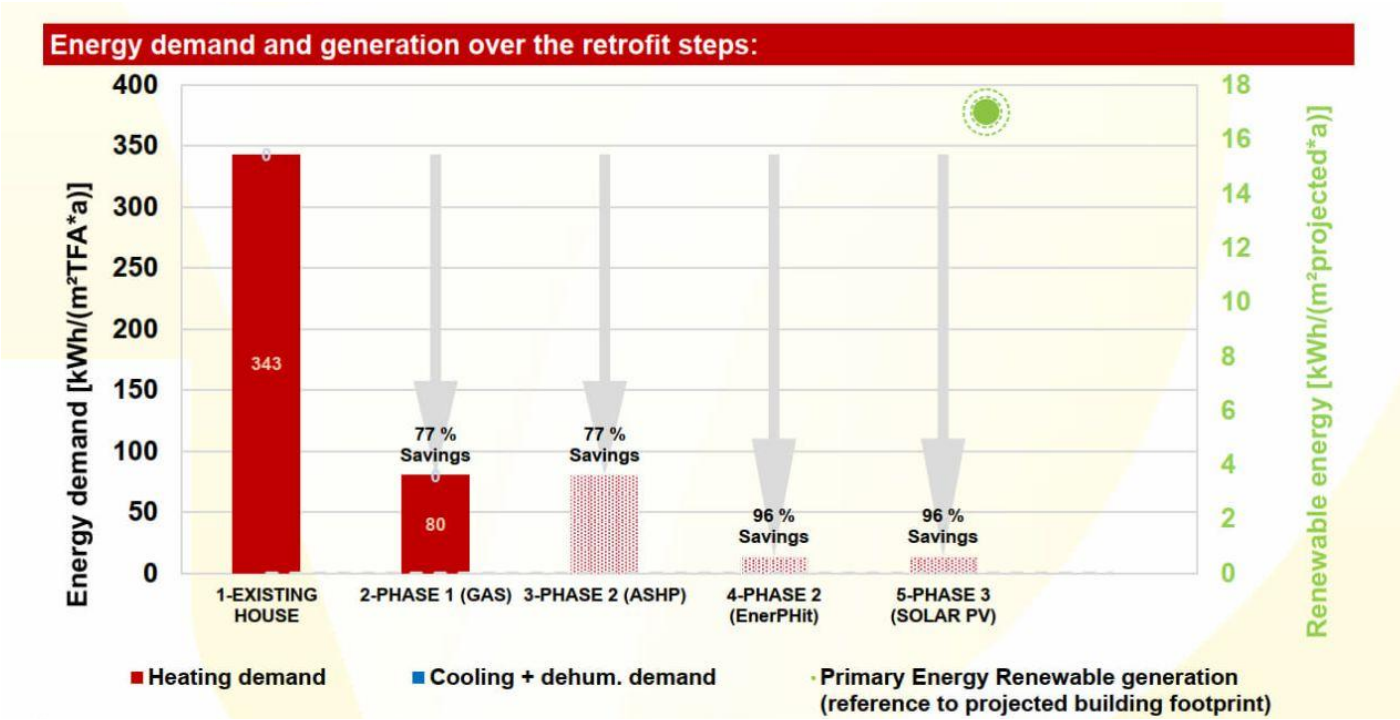
Step 2 - Phase 1 (gas boiler retained)_Pre-Certification - DATA

Commencement	**YEAR commenced 2022, completed 2024**	**STEP 2** Space heating **74** kWh/(m²a)	
U-value external wall (solid brick + EWI)	0.25 W/(m²K) FRONT 0.20 W/(m²K) REAR	Heating Load	36 W/m²K
U-value floor (uninsulated)	1.96 W/(m²K)	Primary Energy Demand	222 kWh/(m²a)
U-value roof (insulated 2022)	0.11 W/(m²K)	Treated Floor Area	72 sqm
U-value window (new triple glazed)	0.94 W/(m²K)	Airtest (2024) n50	3.64 h -1

Step 3 - Phase 2 (New ASHP)_Pre-Certification - DATA

Commencement	**YEAR anticipated completion 2025**	**STEP 3** Space heating **52** kWh/(m²a)	
U-value external wall (solid brick + EWI)	0.25 W/(m²K) FRONT 0.20 W/(m²K) REAR	Heating Load	20 W/m²K
U-value floor (uninsulated)	1.96 W/(m²K)	Primary Energy Demand	75 kWh/(m²a)
U-value roof (insulated 2022)	0.11 W/(m²K)	Treated Floor Area	72 sqm
U-value window (new triple glazed)	0.94 W/(m²K)	Airtest (2024) n50	3.64 h -1

Step 4 - Phase 2 (new extension)_Pre-Certification - DATA			
Commencement	**YEAR anticipated completion 2026**	**STEP 4** **Space heating 13 kWh/(m²a)**	
U-value external wall (extension)	0.12 W/(m²K)	Heating Load	11.2 W/m²K
U-value floor existing house (insulated)	0.12 W/(m²K)	Primary Energy Demand	51.5 kWh/(m²a)
U-value floor new extension (insulated)	0.13 W/(m²K)	Treated Floor Area	87 sqm
U-value roof new extension (insulated)	0.06 W/(m²K)	Airtest n50	1 h -1 (required)
U-value windows extension (triple glazed)	0.7 W/(m²K)		
U-value rooflights extension (triple glazed)	0.92 W/(m²K)		



1.3 Responsible Project Participants

Architect	Paul Cayford - Cayford Design
Building Physics & PHPP	Paul Cayford - Cayford Design
Thermal Bridge calculations	Guillermo Fernández Camacho
Structural Engineer	Ahmad Chaudhry - Articlus Ltd
MVHR design	Rod Williams - Williams Energy Design
MVHR installation	Reuben Wilkinson - Mango Projects
Main Contractor	Monogreen Renovation
Construction Manager	Hannah Martin (owner)
Certifier	Jesus Menendez - Zero Energy + Passivhaus
Certification Body	Passivhaus Institut, Darmstadt
Passivhaus Database ID	**7562**

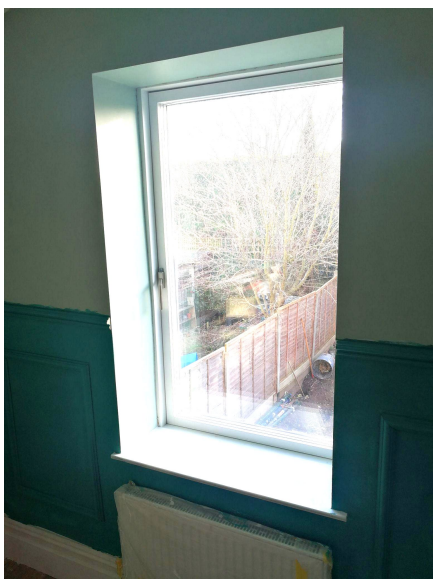
2 Elevation view of the building (photo)

PHASE 1 AS COMPLETED

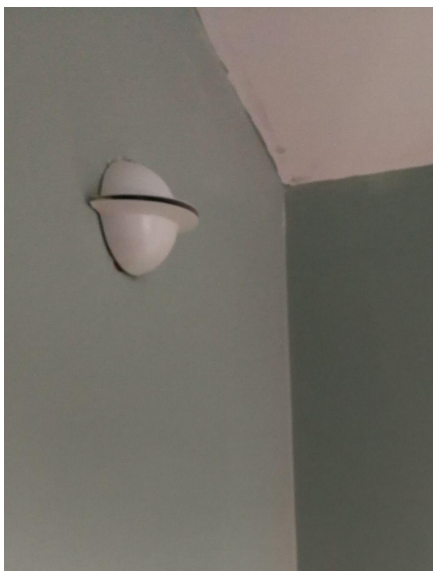
EXISTING

original door arch surround - to be replicated in Phase 2

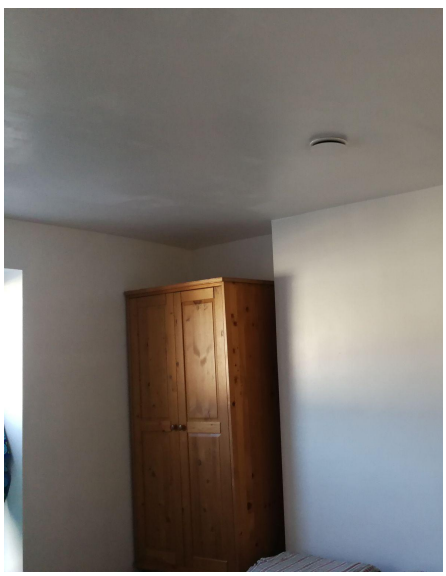
3 Exemplary photo from the inside of the building



Bed 3 window

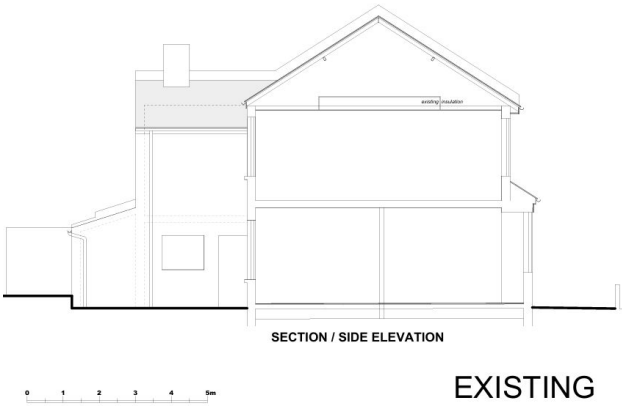


Bed 3 air-inlet



Bed 1 air-inlet

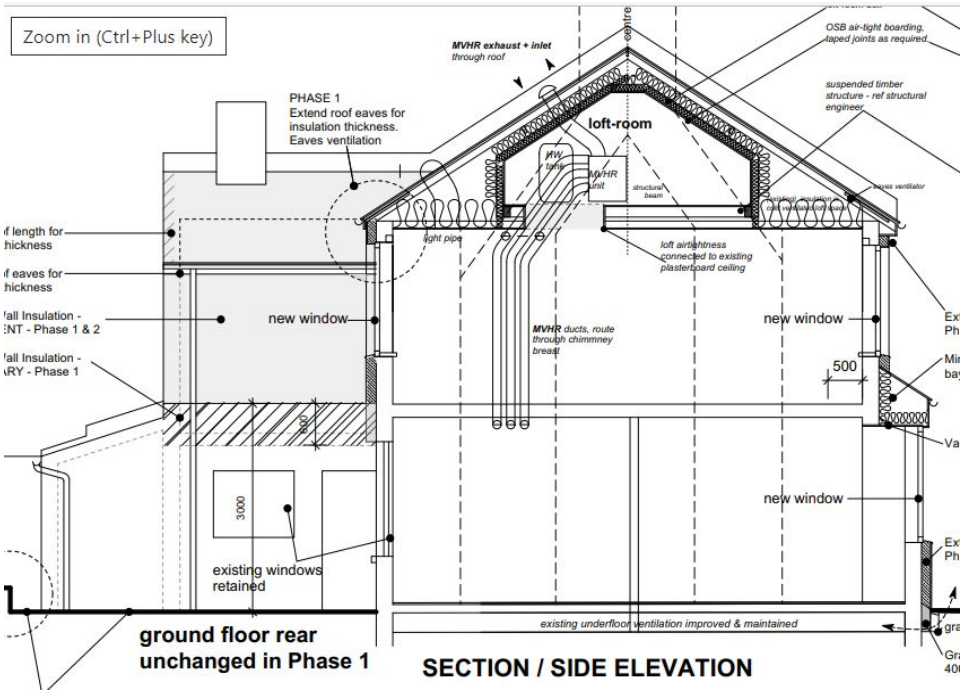
4 Sectional view of the building



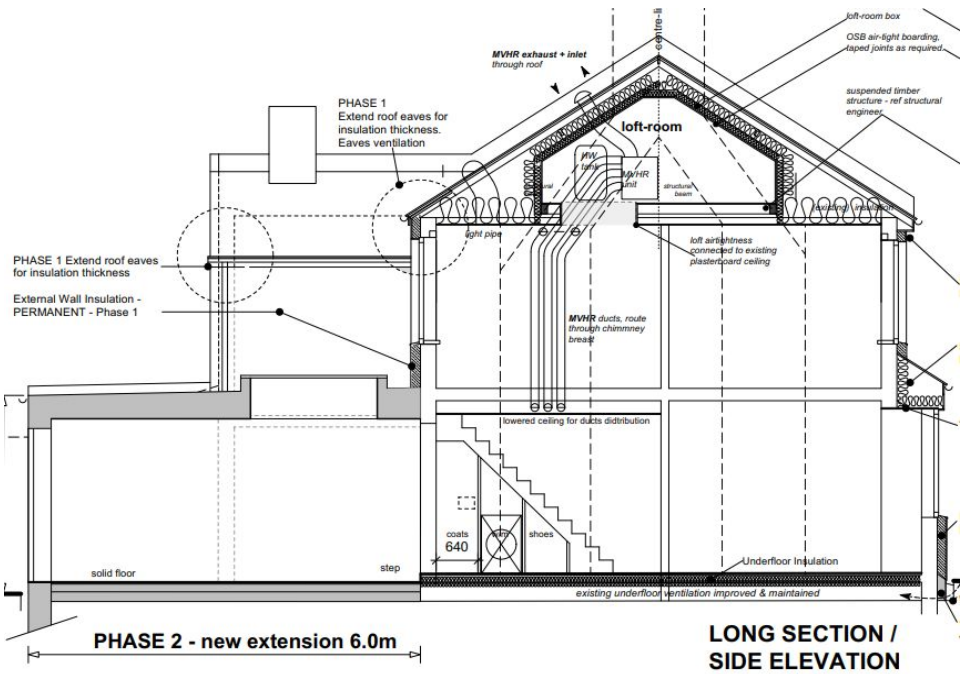
EXISTING

EXISTING

An insulated airtight loft space was created to house the MVHR unit. This was done to optimise the space efficiency of the house, and due to the phased nature of the project there was not a suitable external wall location for the MVHR unit.



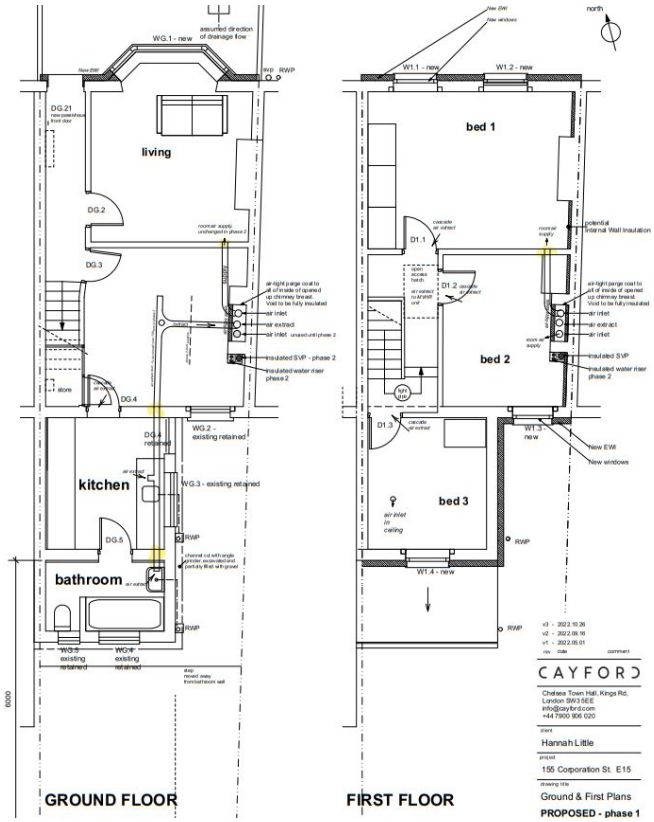
PHASE 1



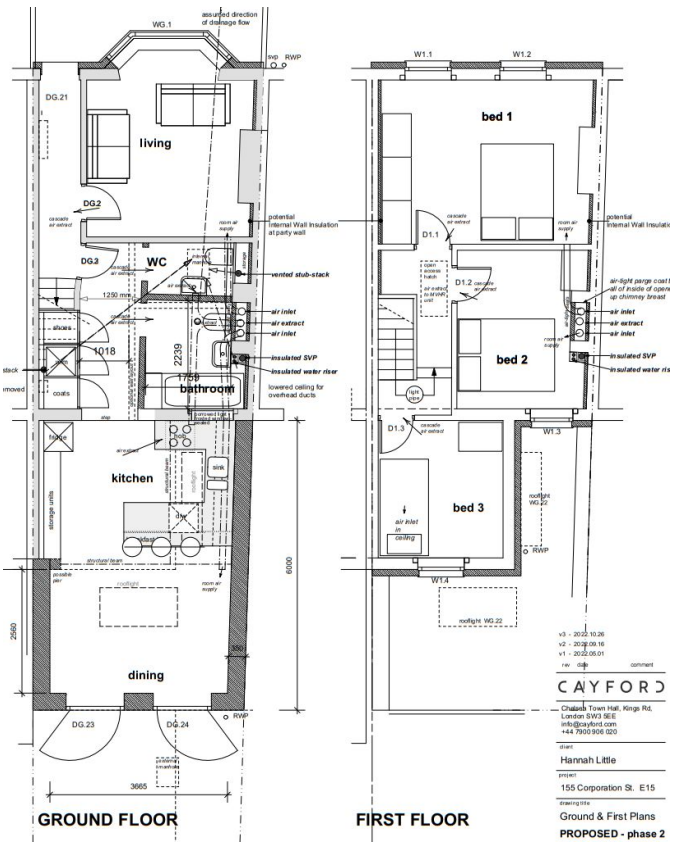
PHASE 2

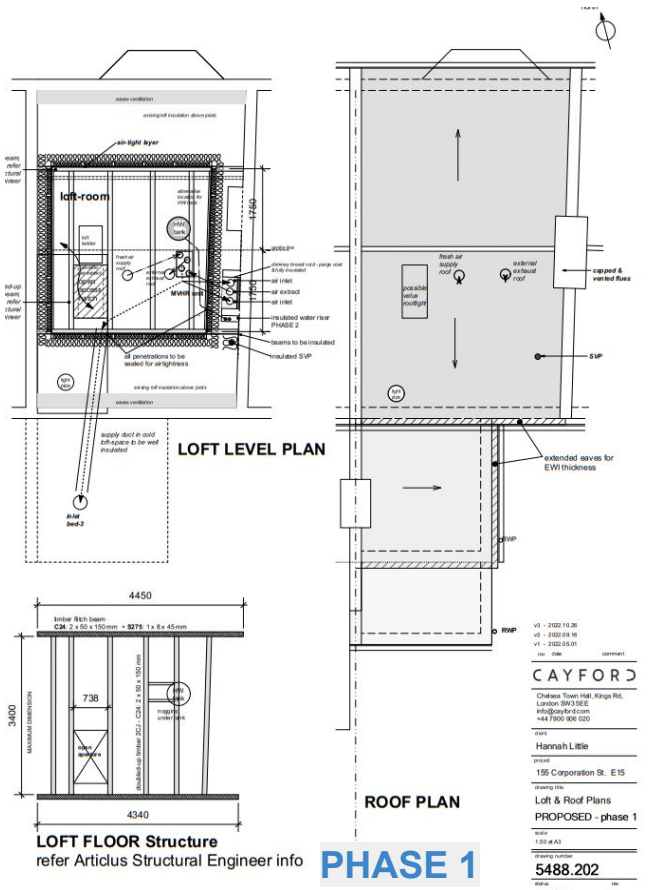
5 Floor plans

PHASE 1

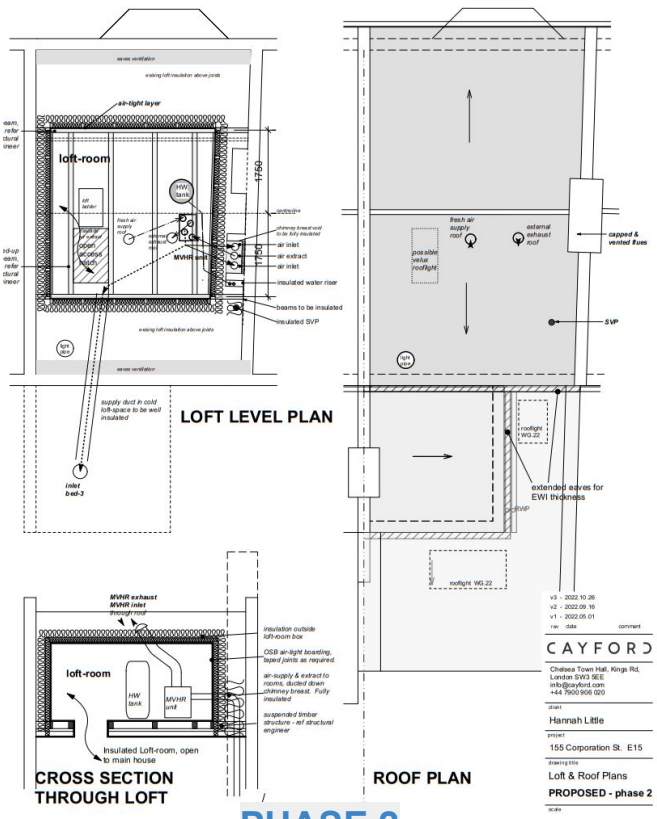


PHASE 2





PHASE 1

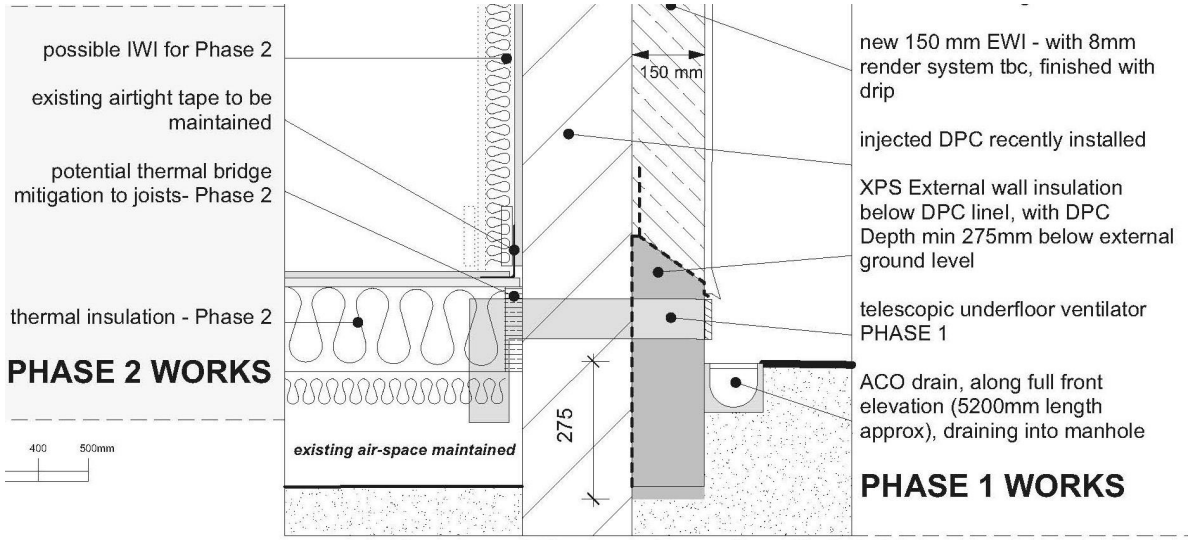


PHASE 2

6 Construction of floor slab / basement ceiling

6.1 PHASE 1

Moisture resistant XPS extends the EWI below ground level, to minimise thermal bridging. Periscope air-vents allow underfloor ventilation to be maintained through the underfloor void.



proposed ground floor external wall detail

6.2 PHASE 2

a - main house floor construction

The existing floor of the main house will be insulated and made airtight with the Phase 2 drainage works

Description of building assembly						Assembly no.
Floor_main house_phase 2						04ud
Orientation of building assembly (or R_{si})	3-Floor				Interior insulation?	
Adjacent to (or R_{se})	3-Ventilated				U-value supplement [W/(m²K)]	
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
laminate floor finish	0.070					12
OSB	0.130					16
PIR insulation 170mm	0.034	battens 50x150mm	0.120			200
XPS insulation	0.034					100
Percentage of sec. 1:	90%	Percentage of sec. 2:	10.0%	Percentage of sec. 3:		

Heat transmission resistance coefficients

Interior R_{si}: 0.17 m²K/W

Exterior R_{se}: 0.17 m²K/W

Total thickness [cm]: 32.8

U-value [W/(m²K)]: 0.117

b - new extension

A provisional construction has been selected for the Phase 2 floor.

Description of building assembly						Assembly no.
Floor_extension_phase 2						03ud
Orientation of building assembly (or R_{si})	3-Floor				Interior insulation?	
Adjacent to (or R_{se})	3-Ventilated				U-value supplement [W/(m²K)]	
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
tile	15.000					15
board	0.130					16
MW + joists	0.034	50 x 200 joist	0.120			200
XPS	0.034					100
Percentage of sec. 1:	80%	Percentage of sec. 2:	20.0%	Percentage of sec. 3:		

Heat transmission resistance coefficients

Interior R_{si}: 0.17 m²K/W

Exterior R_{se}: 0.17 m²K/W

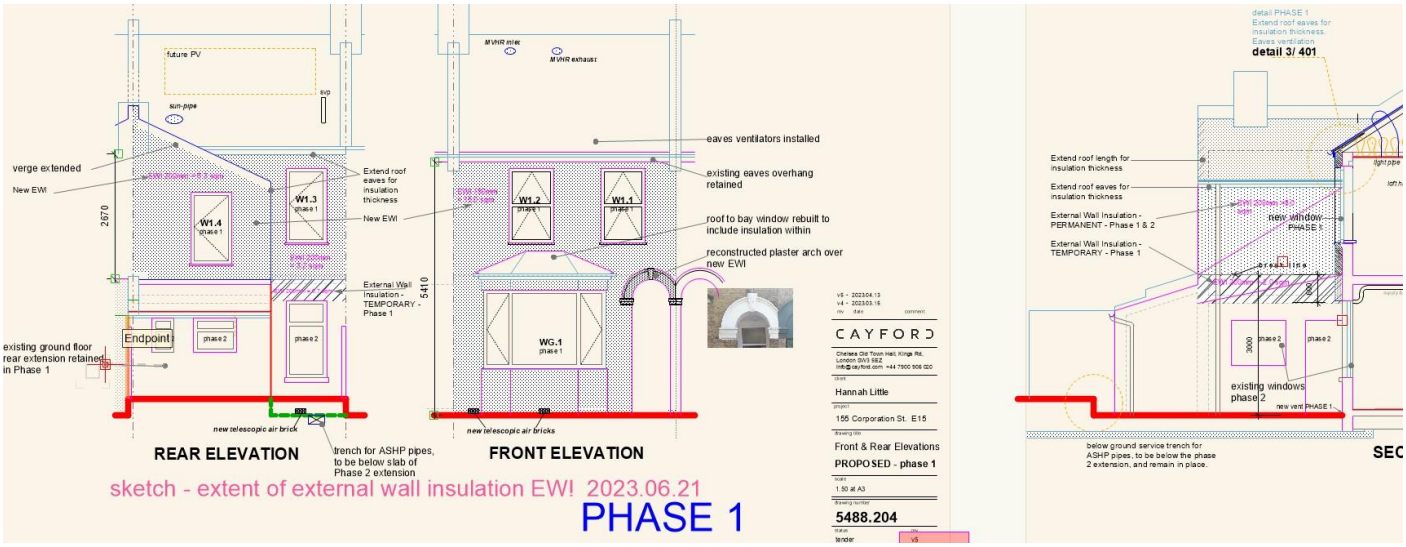
Total thickness [cm]: 33.1

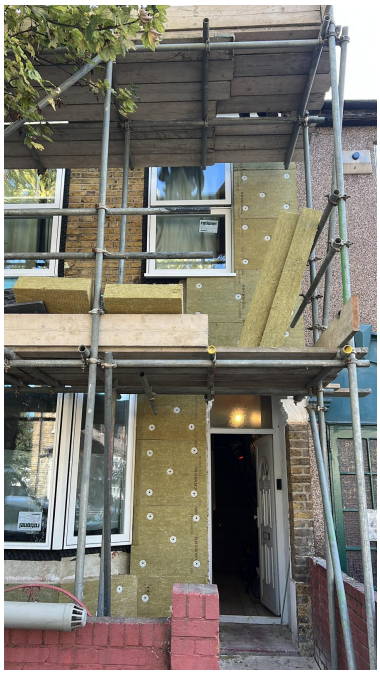
U-value [W/(m²K)]: 0.131

7 Construction of the exterior walls

7.1 PHASE 1

The walls are solid single brick as is common for this type of house. Due to the highly variegated nature of the elevations of the terrace houses in the street (paint/ render/ EWI etc) it was felt EWI was an acceptable solution. The client wanted the brick effect render to the front elevation; the rear has plain silicone render over the mineral wool.





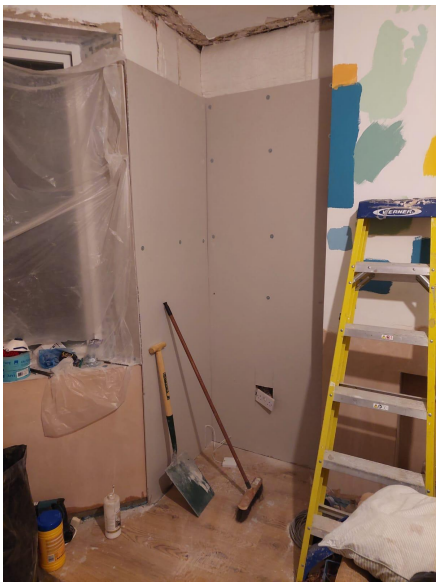
Description of building assembly					Assembly no.
Wall_EWI_rear					09ud

Orientation of building assembly (or R_{si})	2-Wall			Interior insulation?	
Adjacent to (or R_{se})	1-Outdoor air			U-value supplement [W/(m²K)]	0.030
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plaster	0.500					15
existing brick wall	1.200					220
Rockwool EWI	0.036					200
Render	0.700					8
Percentage of sec. 1:	100%	Percentage of sec. 2:		Percentage of sec. 3:		

Heat transmission resistance coefficients				
			Total thickness [cm]:	44.3
Interior R_{si}:	0.13	m²K/W		
Exterior R_{se}:	0.04	m²K/W	U-value [W/(m²K)]:	0.198

Wall thermal bridging

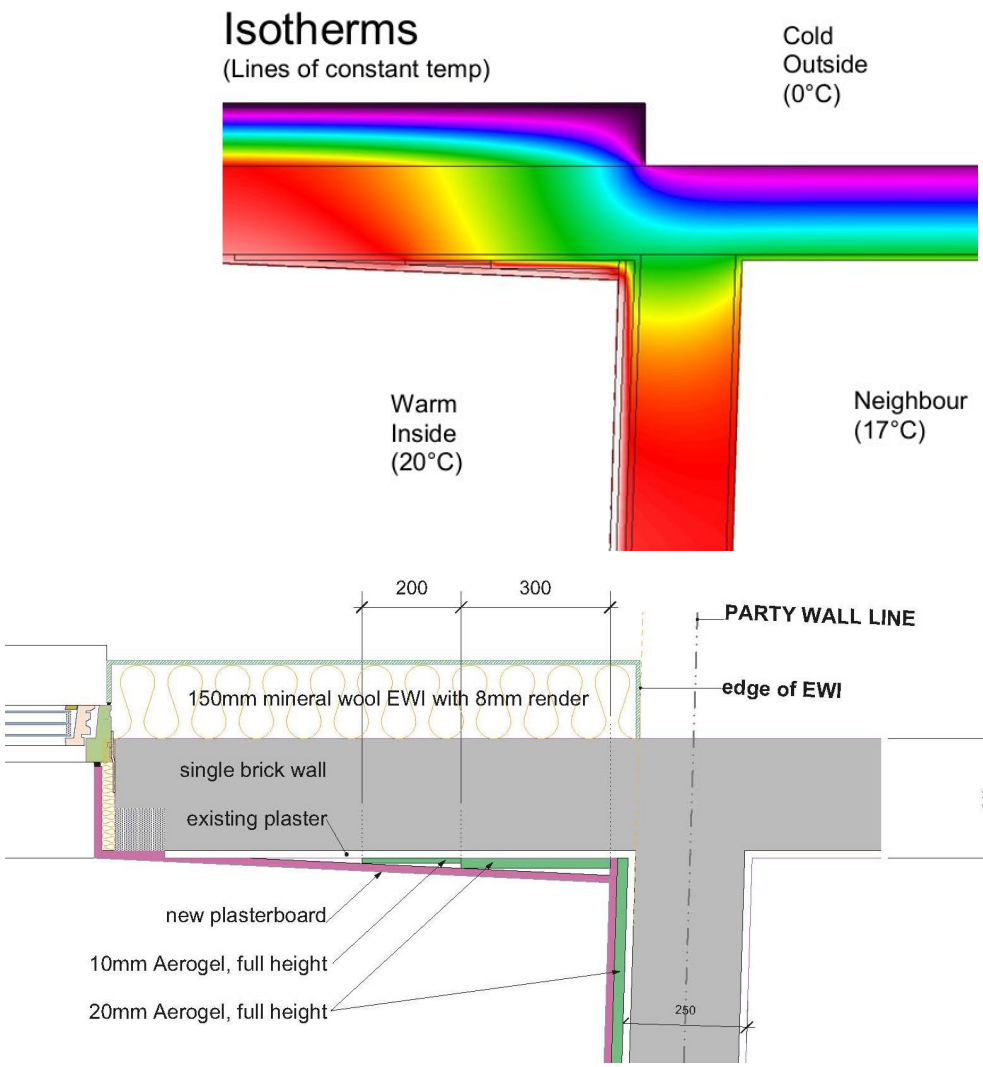
Care was taken to mitigate thermal bridges, especially at party walls, where the insulation stops on the party wall line. Party walls, eaves and ground floor junction details were calculated, with values entered into PHPP.



NE corner - Aerogel IWI required on party wall + front wall to mitigate thermal bridge

front elevation (NE)
insulation short of party wall mid-line

front elevation (NW)
insulation is on party wall mid-line



Proctor Spacetherm (A rated) Aerogel 10mm sheets [0.0195W/mK]

7.2 PHASE 2

A provisional construction has been selected for the Phase 2 walls.

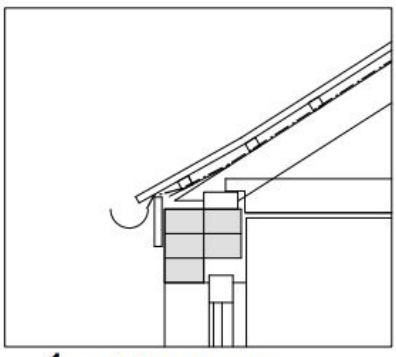
Description of building assembly						Assembly no.
Wall_extension_phase 2						02ud

Orientation of building assembly (or R_{si})	2-Wall			Interior insulation?		
Adjacent to (or R_{se})	1-Outdoor air			U-value supplement [W/(m²K)]		0.030
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
plaster	0.500					15
service void	0.500					25
OSB	0.130					16
MW insulation + stud	0.024	50 x 100 stud	0.120			170
OSB	0.130					16
EWI - MW	0.024					150
render	0.700					8
Percentage of sec. 1:	80%	Percentage of sec. 2:	20.0%	Percentage of sec. 3:		

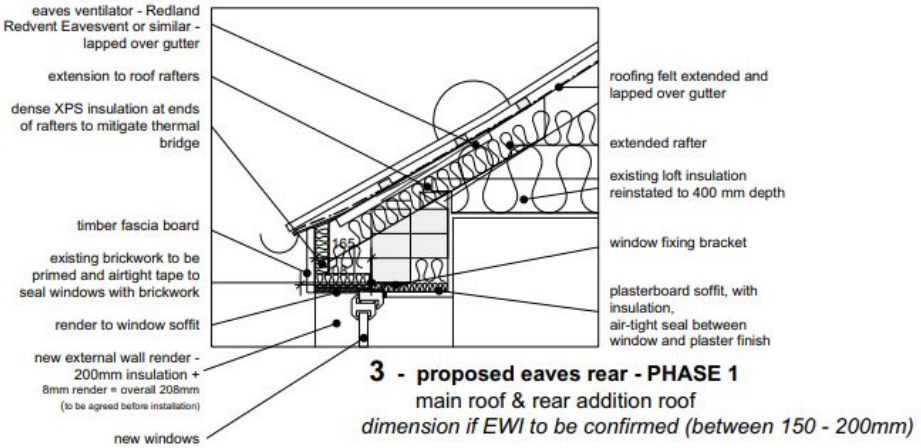
Heat transmission resistance coefficients			Total thickness [cm]:	40.0
Interior R_{si}:	0.13	m²K/W		
Exterior R_{se}:	0.04	m²K/W	U-value [W/(m²K)]:	0.118

8 Construction roof / ceiling of the top floor

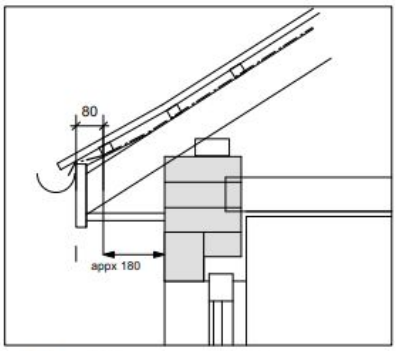
8.1 PHASE 1 - roof



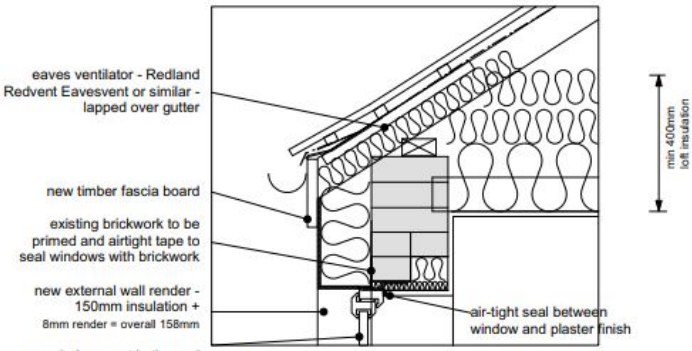
1 - existing eaves rear



3 - proposed eaves rear - PHASE 1
main roof & rear addition roof
dimension if EWI to be confirmed (between 150 - 200mm)



2 - existing eaves front



4 - proposed eaves front - PHASE 1

v2 - 2023.04.13
v1 - 2023.03.03
rev date comment

CAYFORD

Chelsea Old Town Hall, Kings Rd, London SW3 5EZ
info@cayford.com +44 7900 906 020

client
Hannah Little

project
155 Corporation St. E15

drawing title
EAVES DETAILS

scale
1:10 at A3

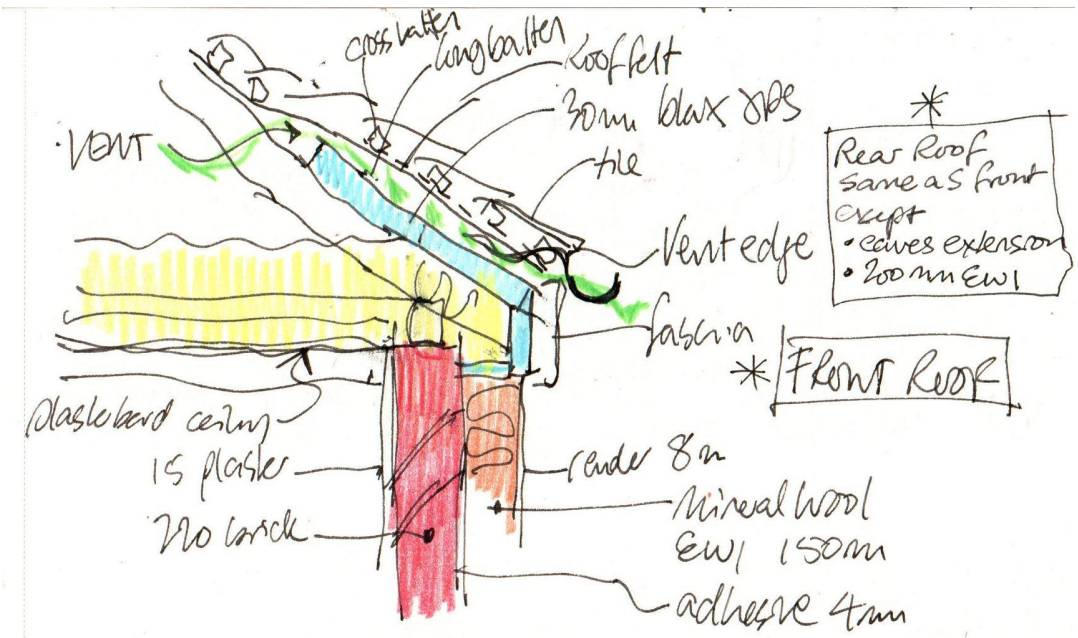
drawing number
5488.401

status rev
tender v2

a - Main Roof - wall/ eaves

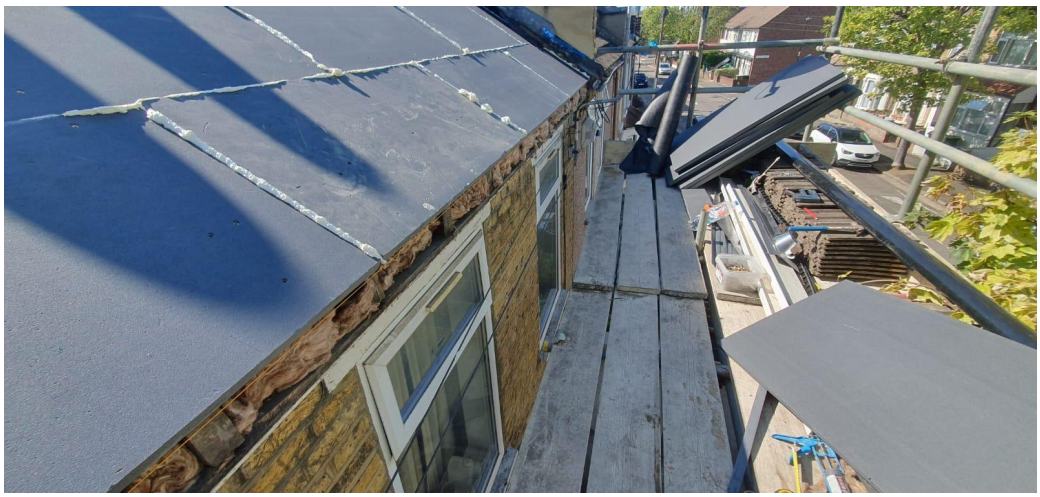
The main loft needs to be ventilated, outside of the new MVHR loft enclosure.

Eaves are a potential for thermal bridging. This has been mitigated by wrapping 30mm XPS around the eaves; the XPS is laid over the top of the joists for a distance of appx 1 metre - longitudinal battens under the breathable roofing-felt allow open flow of ventilation into the roof-space, high level roof-tile vents allow for constant flow. (in future we would specify pre-tapered XPS).



Main Roof - PHOTOS

rear main roof with eaves extension



front main roof without eaves extension

continuous 30mm black XPS on lower 1.5m of roof, wrapped around eaves for thermal continuity

longitudinal battens over XPS, to provide continuous ventilation into the loft space

front elevation EWI with brick-effect render

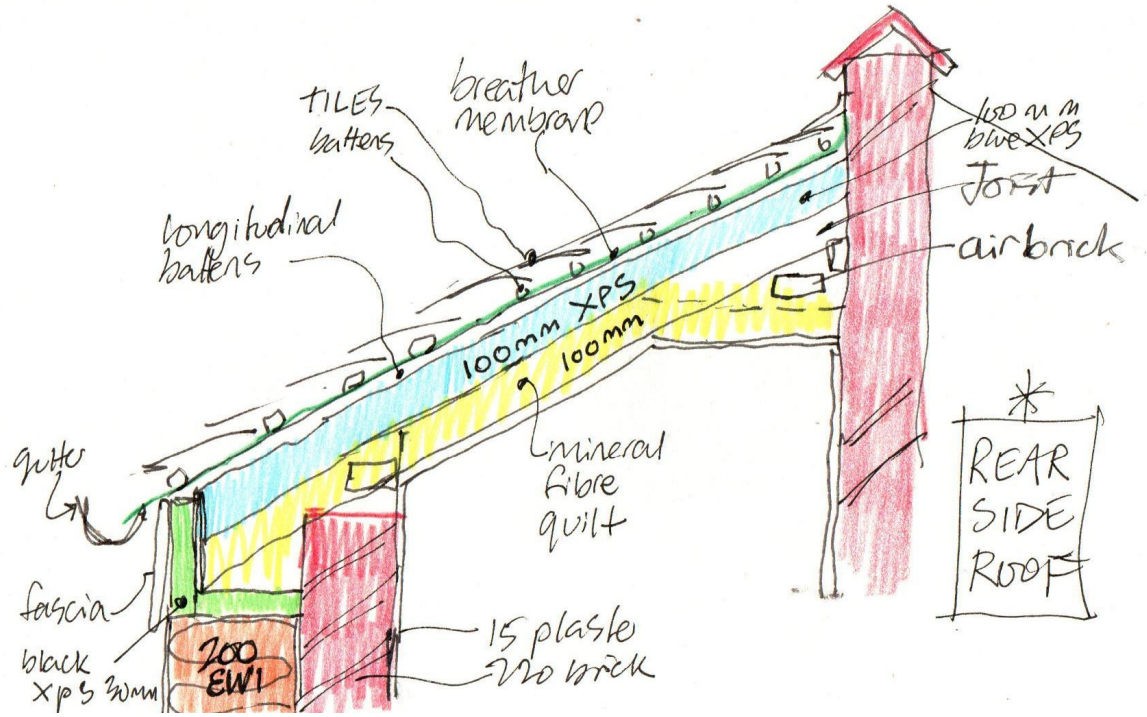
rear elevation EWI with silicone render

b - Rear addition roof - wall/ eaves & verge

The rear main roof follows the same principles of thermal bridge mitigation and ventilation as the front roof.

The 'rear outrigger' roof has the eaves and verge extension wrapped in 30mm XPS as the main roof. However due to the 'skeiling' of 100mm thickness, additional insulation was required. 100mm XPS is laid over the roof, giving contiguous insulation and avoiding thermal bridging. Longitudinal battens and breathable roof-felt allow ventilation below the roof tiles, while airbrick in rear gable elevation connects with the main-roof ventilation, thereby ventilating the small airspace above this roof.

eaves

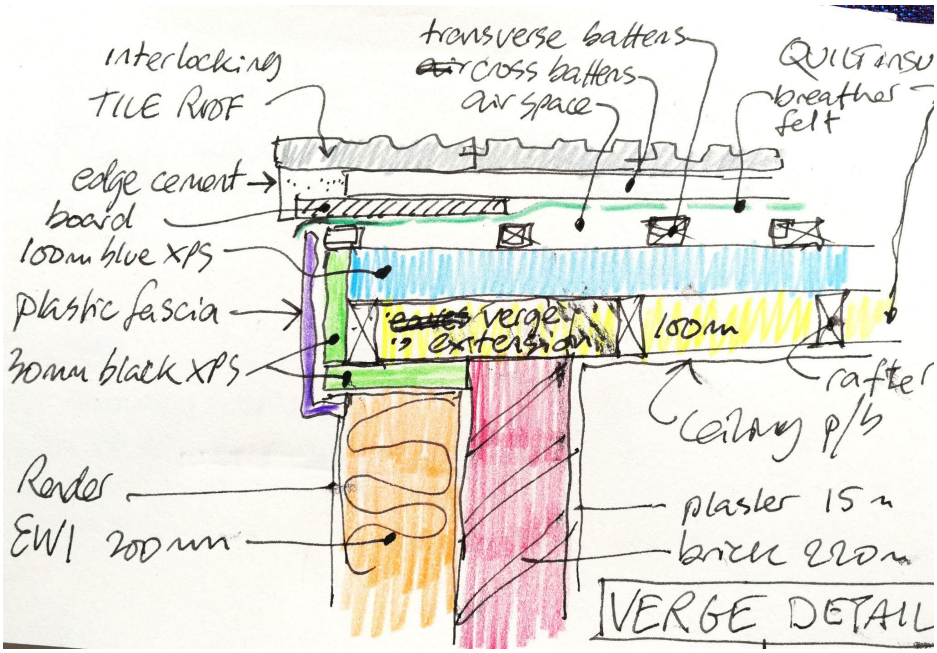


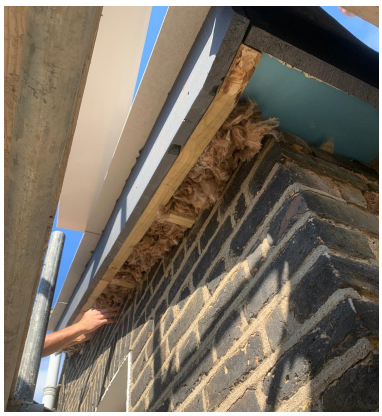
verge & eaves timber extension

100mm blue XPS over rafters insulated roof.

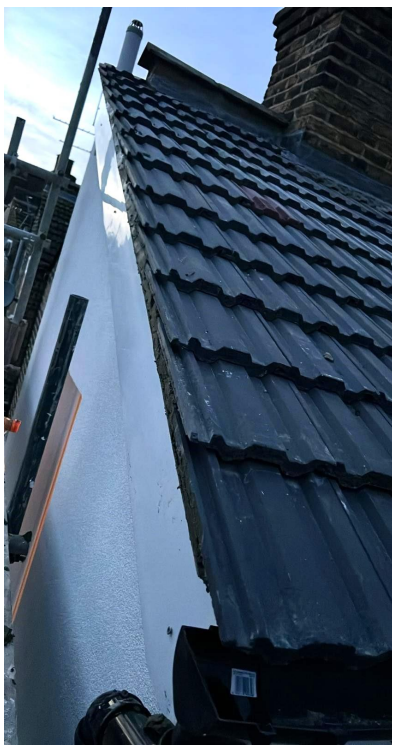
thermal continuity with eaves, verge & EWI

verge





Rafters & verge extension to allow for EWI. 100mm blue XPS over rafters insulated roof. Longitudinal battens to allow for ventilation, under roofing felt. Black XPS on face and underside of verge extension



8.2 PHASE 2

A provisional construction has been selected for the Phase 2 extension roof.

Description of building assembly						Assembly no.
Roof_extension_phase 2						05ud

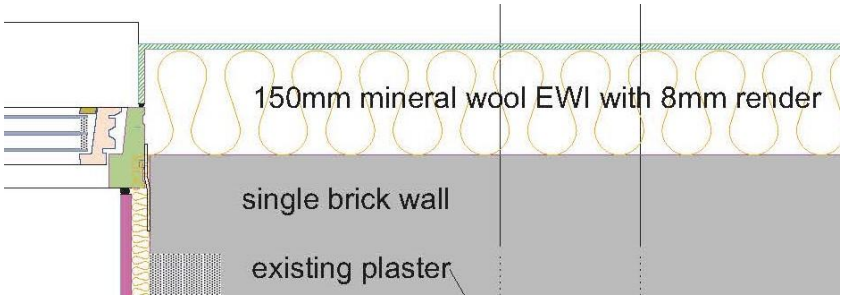
Orientation of building assembly (or R_{si})	1-Roof				Interior insulation?	
Adjacent to (or R_{se})	1-Outdoor air				U-value supplement [W/(m²K)]	
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
12mm plasterboard	0.350					13
mineral wool insulation	0.022	battens 50x175mm	0.120			200
OSB	0.130					16
PIR insulation	0.022					200
roof membrane						0
Percentage of sec. 1:	90%	Percentage of sec. 2:	10.0%	Percentage of sec. 3:		

Heat transmission resistance coefficients			**Total thickness [cm]:**	**42.9**
Interior R_{si}:	0.10	m²K/W		
Exterior R_{se}:	0.04	m²K/W	**U-value [W/(m²K)]:**	**0.061**

9 Windows and installation of the window

New windows were installed for the Phase 1 works - outward opening Rationel Auraplus. The windows were set forward to ensure thermal continuity with the EWI.

A higher standard of passivhaus certified windows are specified and modelled for the patio doors for the Phase 2 extension. Lamilux certified passivhaus rooflights are specified for the ceilings.



new rationel auraplus triple glazed windows

new windows, set forward to allow for EWI. External airtight tape for weather-seal

internal airtight tape for airtightness

Phase 1 windows - Rationel Aura Plus
Phase 2 windows - Aluron - GEMINI Passiv
Phase 2 rooflights - Lamilux

PHPP- windows

Quantity	Pos. no.	Description	Deviation from north	Angle of inclination from the horizontal	Orientation	Dimensions windows, doors etc. Width	Height	Installed in Selection from 'Areas' worksheet	Glazing/panel Selection list in 'Components' worksheet	Frame Selection list in 'Components' worksheet	Thermal parameters U_f frame (mean)	g-value glazing	U_g glazing	$\Psi_{Glazing\ edge}$	$\Psi_{installation}$ (Avg.)	Results Window area	Glazing area	Glazing fraction per window	U_w	U_w installed
			°	°		m	m		1-Sort as list	1-Sort as list	W/(m²K)	-	W/(m²K)	W/(mK)	W/(mK)	m²	m²	%	W/(m²K)	W/(m²K)
1	6	F6 - bed 1 window	6.1	90	North	0.93	1.65	1-Wall_01_N	02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening	1.09	0.53	0.52	0.038	0.035	1.5	1.0	64%	0.855	0.951
0									02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening		0.53	0.52	0.038						
1	7	F7 - bed 1 window	6.1	90	North	0.93	1.65	1-Wall_01_N	02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening	1.09	0.53	0.52	0.038	0.035	1.5	1.0	64%	0.855	0.951
0	7		6.1	90	North			1-North wall	02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening		0.53	0.52	0.038						
1	4	F4 - bed 2 window	184	90	South	0.88	1.62	2-Wall_02_S	02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening	1.17	0.53	0.52	0.038	0.035	1.4	1.0	70%	0.830	0.953
1	5	F5 - bed 3 window	184	90	South	0.89	1.47	2-Wall_02_S	02ud-ph glazing - Triple Glazed	09ud-Rationel AURAPLUS window - opening	1.17	0.53	0.52	0.038	0.035	1.3	0.9	69%	0.837	0.964
1	2	F3 - side bay window	320	90	North	0.77	1.69	14-Wall_14_NW_bay	05ud-Intelligent Windows glazing	10ud-Rationel AURAPLUS window - fixed	1.08	0.60	0.53	0.036	0.035	1.3	1.1	82%	0.755	0.887
1	1	F1 - central bay window	6.1	90	North	1.23	1.69	1-Wall_01_N	05ud-Intelligent Windows glazing	10ud-Rationel AURAPLUS window - fixed	1.08	0.60	0.53	0.036	0.035	2.1	1.8	86%	0.699	0.797
1	3	F2 - side bay window	50	90	East	0.77	1.69	13-Wall_13_NE_bay	05ud-Intelligent Windows glazing	10ud-Rationel AURAPLUS window - fixed	1.08	0.60	0.53	0.036	0.035	1.3	1.1	82%	0.755	0.887
1		F25 - roof light extension	0	0	Horizontal	0.42	1.80	7-Roof_07_(main)_horizontal	03ud-Light pipe	07ud-Lamilux Rooflight	0.69	0.70	0.60	0.022	0.040	0.8	0.6	83%	0.738	0.973
1		F24 - roof light extension	0	0	Horizontal	1.60	0.80	7-Roof_07_(main)_horizontal	03ud-Light pipe	07ud-Lamilux Rooflight	0.69	0.70	0.60	0.022	0.040	1.3	1.1	89%	0.688	0.838
1		F8 - light pipe	184	33	South	0.30	0.30	8-Roof_08_(main)_angled_south	03ud-Light pipe	03ud-Light Pipe_Aluron Sp. z o.o. - GEMINI Passiv Ultra	0.68	0.70	0.60	0.021	0.040	0.1	0.1	75%	0.863	1.396
1	10	F26 - S - ext - opening	184	90	South	1.17	2.39	2-Wall_02_S	02ud-ph glazing - Triple Glazed	15ZGW03-Aluron Sp. z o.o. - GEMINI	0.69	0.53	0.52	0.026	0.040	2.8	2.0	71%	0.627	0.695
1	10	F27 - S - ext - opening	184	90	South	1.17	2.39	2-Wall_02_S	02ud-ph glazing - Triple Glazed	15ZGW03-Aluron Sp. z o.o. - GEMINI	0.69	0.53	0.52	0.026	0.040	2.8	2.0	71%	0.627	0.660
1	10	F28 - S - ext - fixed	184	90	South	1.14	2.39	2-Wall_02_S	02ud-ph glazing - Triple Glazed	02ud-Aluron Sp. z o.o. - GEMINI	0.68	0.53	0.52	0.021	0.021	2.7	1.9	70%	0.615	0.651

10 Airtight Building Envelope

The airtightness was tested at Step 1 (existing) and at Step 2 -renovation to Enerphit standard of the main house, with the existing rear kitchen/ bathroom annexe unrenovated.

The Phase 2 Enerphit target is 1 ACH. The airtightness measures in Phase 1 were the walls/ windows/ loft of the main house. The vulnerability is the junction between the main house and the existing kitchen with existing joists etc; also the ground floor will be insulated and made airtight in Phase 2.

The airtest revealed reassuringly good airtightness of the new Phase 1 work, with the main leaks being in the zones which would be replaced for Phase 2.

10.1 Summary - airtightness

Low Energy Summary of Air Permeability Tests

ATTMA The Air Tightness Testing & Measurement Association

Test Undertaken By	Tom Gregory of Air Leakage Testing Ltd

Building Details

Building identifier:	155 (Kitchen door sealed, understairs doors sealed, gaps in loft opening sealed)			
Site address:	Corporation Street, London, E15 3DY			
Size:	Footprint (m^2)	Envelope (m^2)	Volume (m^3)	Storey
	37.7	222.19	191.85	2

Test Details

Report reference:	C231392-1F-Hannah Martin		
Date:	23/01/2024	Build progress:	Final
Temporary sealing:	All No. MVHR Vents, 4 No. Trickle Vents		

Air Permeability — Failed

Target:		<= 1.00	$m^3.h^{-1}.m^{-2}$@50Pa
Pressurisation Test:	+	3.18	$m^3.h^{-1}.m^{-2}$@50Pa
Depressurisation Test:	−	3.10	$m^3.h^{-1}.m^{-2}$@50Pa

3.14 $m^3.h^{-1}.m^{-2}$@50Pa

Air Changes Per Hour — Failed

Target:		<= 1.0	$m^3.h^{-1}.m^{-3}$@50Pa
Pressurisation Test:	+	3.68	$m^3.h^{-1}.m^{-3}$@50Pa
Depressurisation Test:	−	3.59	$m^3.h^{-1}.m^{-3}$@50Pa

3.64 $m^3.h^{-1}.m^{-3}$@50Pa

BCTA

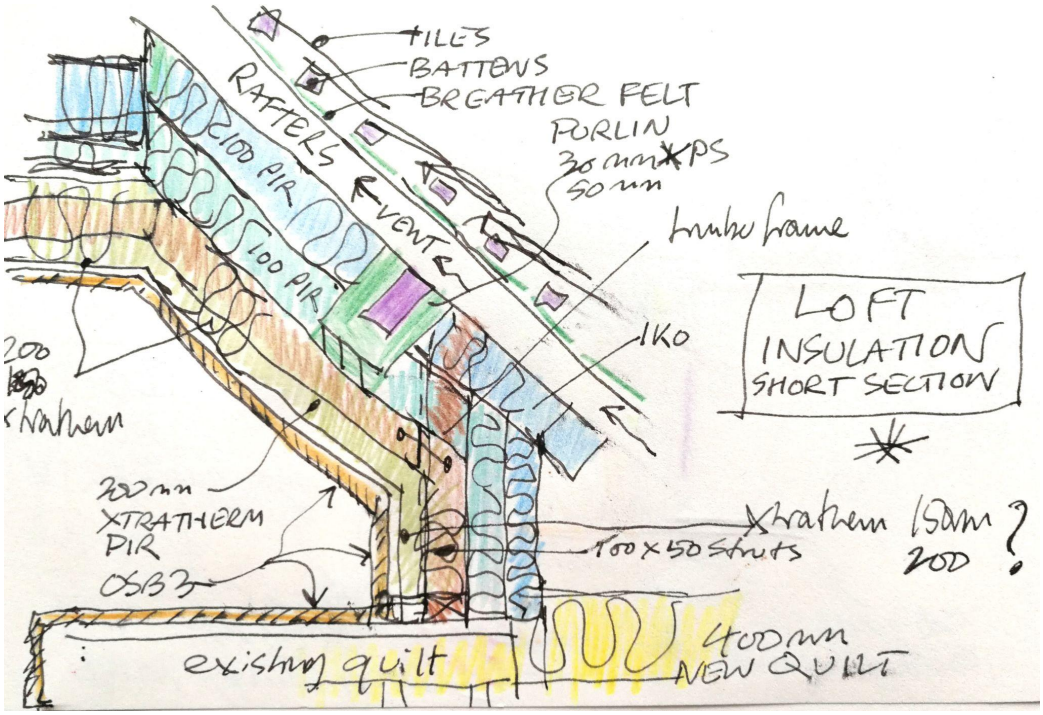
ATTMA is part of the Building Compliance Testers Association (BCTA). The BCTA is a trade association for companies that conduct on-site testing and operate within controlled, audited schemes.

Enquiries should be made to: BCTA, Unit 3, Tannery Road, Loudwater, Buckinghamshire, HP13 7EQ or visit www.bcta.group

10.2 Airtightness - loft

A new enclosure was created in the existing loft space, for the MVHR unit and quality storage.

Airtightness was achieved by the OSB-3 lining, over the thermal insulation. Joints were sealed with airtight tape. Duct penetrations were sealed by the MVHR installer, with expanding foam. Additional layers of PurplePassiv paint were applied for additional protection.



OSB3 board over PIR insulation, and all joints taped, including purlin struts.

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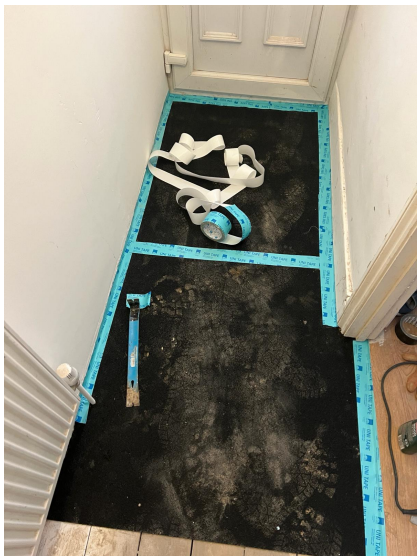
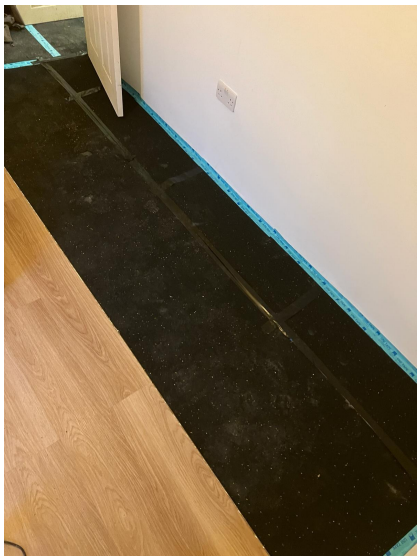
MVHR penetrations through loft floor fully sealed with airtight foam, by MVHR installer. Additional purplepassiv treatment

10.3 - temporary airtightness to ground floor (main house Phase 1)





10.4 - airtightness to ground floor (main house Phase 2)

In Phase 2, the main house floor will be insulated and made airtight, (in conjunction with drainage and other works). The airtight layer will be OSB-3 board taped to the plaster walls, with the finish being some kind of laminated board.

Description of building assembly						Assembly no.
Floor_main house_phase 2						04ud

Orientation of building assembly (or R_{si})	3-Floor			Interior insulation?		
Adjacent to (or R_{se})	3-Ventilated			U-value supplement [W/(m²K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
laminate floor finish	0.070					12
OSB	0.130					16
PIR insulation 170mm	0.034	battens 50x150mm	0.120			200
XPS insulation	0.034					100
Percentage of sec. 1:	90%	Percentage of sec. 2:	10.0%	Percentage of sec. 3:		

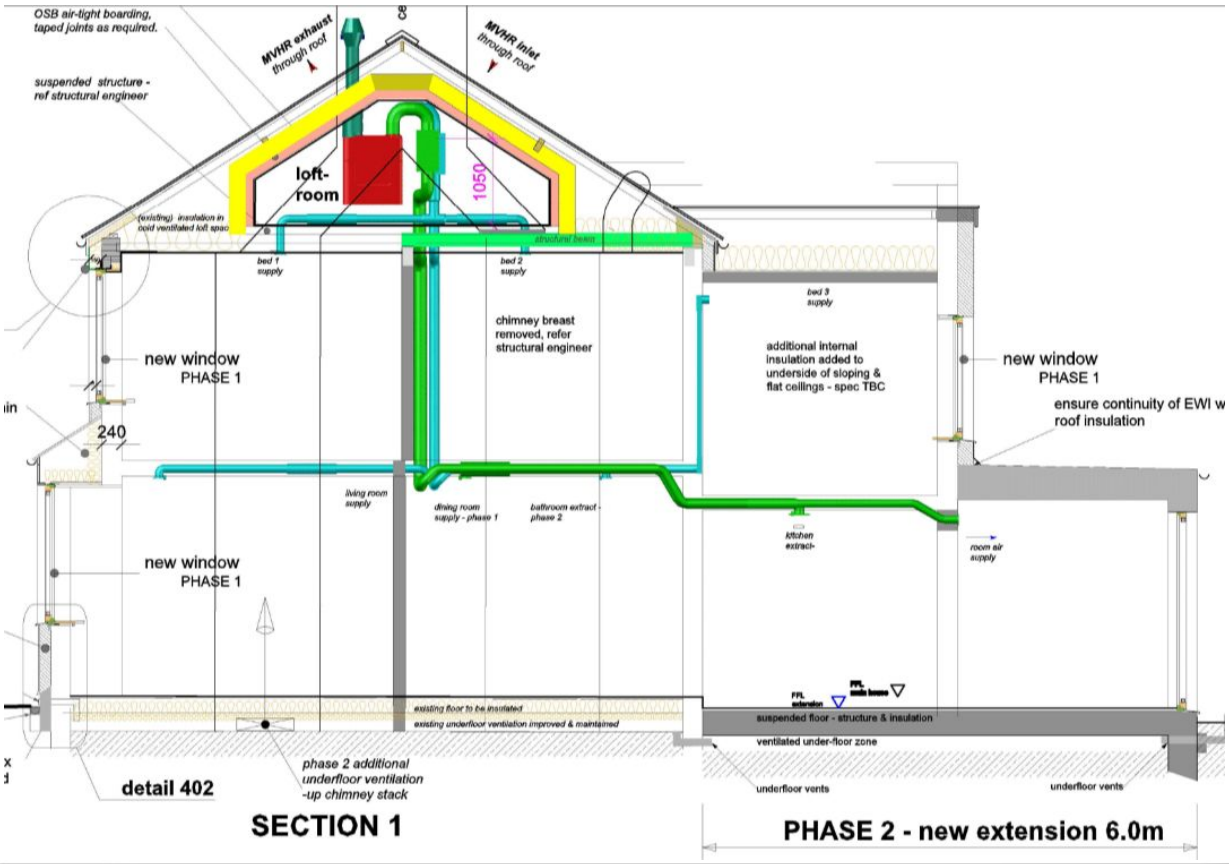
Heat transmission resistance coefficients			Total thickness [cm]:	32.8
Interior R_{si}:	0.17	m²K/W		
Exterior R_{se}:	0.17	m²K/W	U-value [W/(m²K)]:	0.117

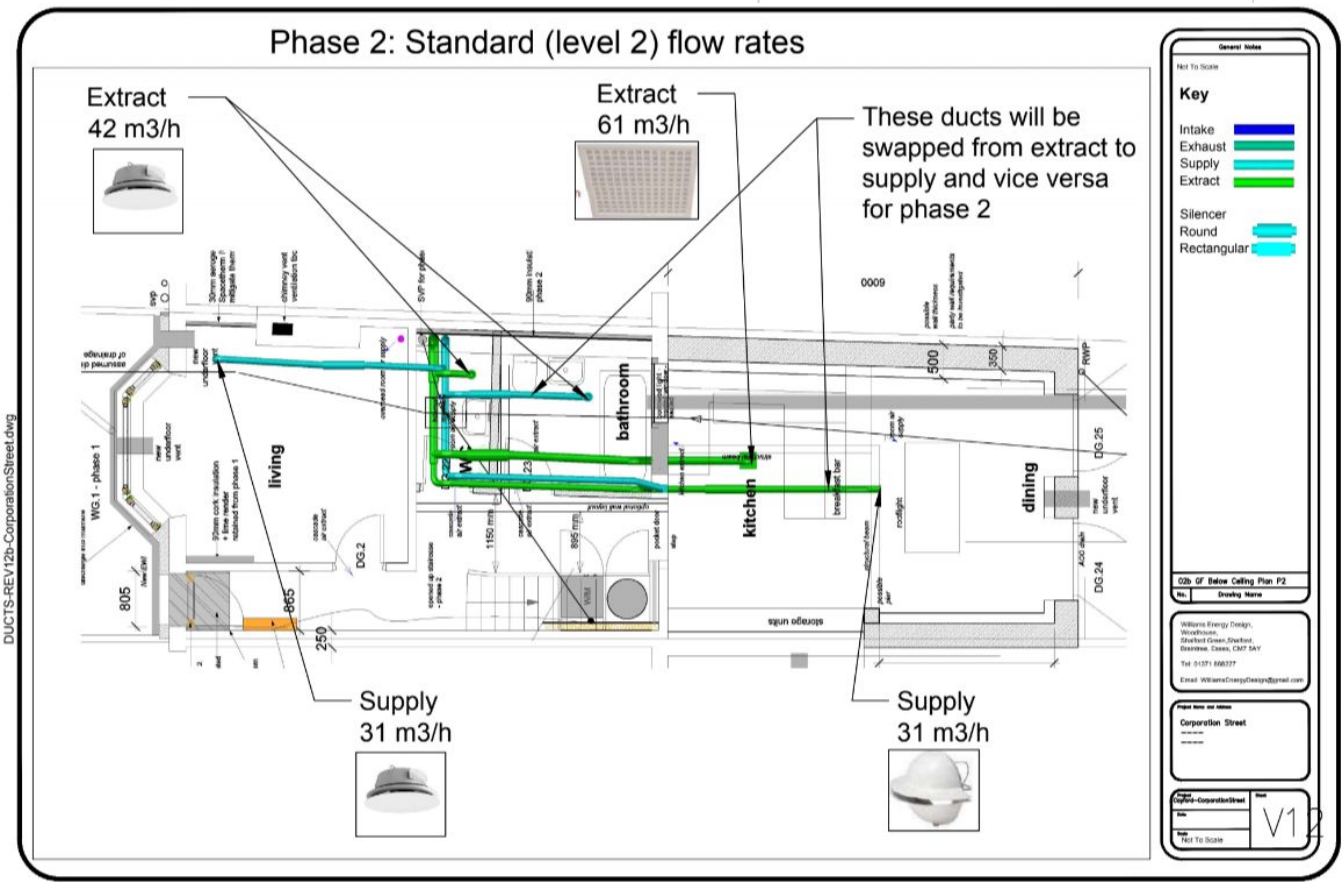
11 Layout of the ventilation system ducting

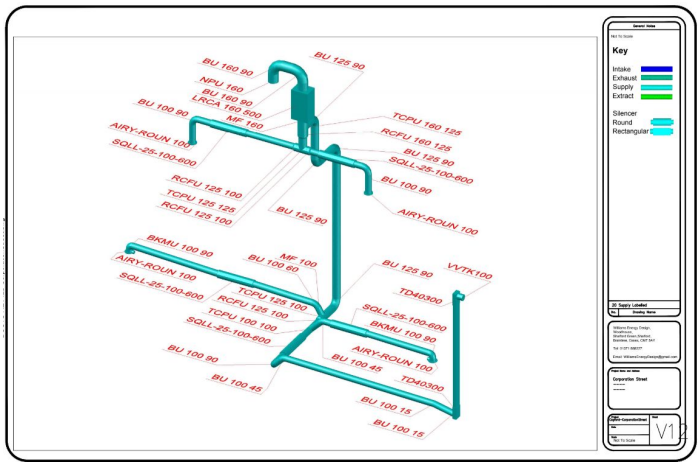
The ventilation system is installed as Phase 1. The challenge was to design and install a system which would require minimal adaption when the Phase 2 works are implemented.

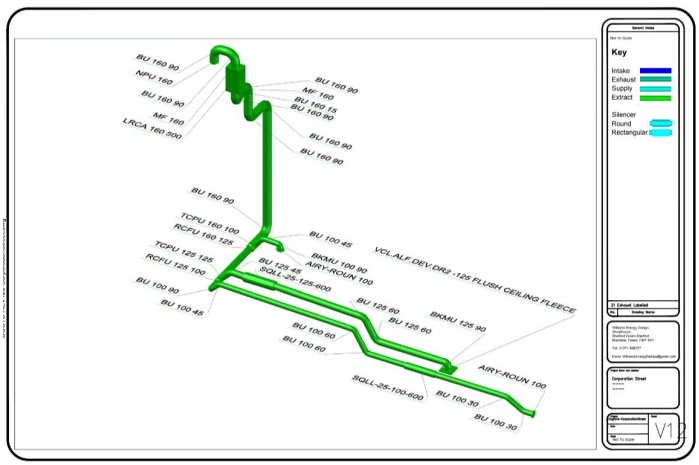
This has been successfully designed, with minimal changes required for the Phase 2 works.

a - MVHR ducting - CAD drawings









b - MVHR ducting - installation photos

supply & extract ducts for kitchen & bathroom below joists

lowered ceiling portion for crossover & silencer in dining room
(bath & shower rooms in phase 2).
Most ducts are within joist space

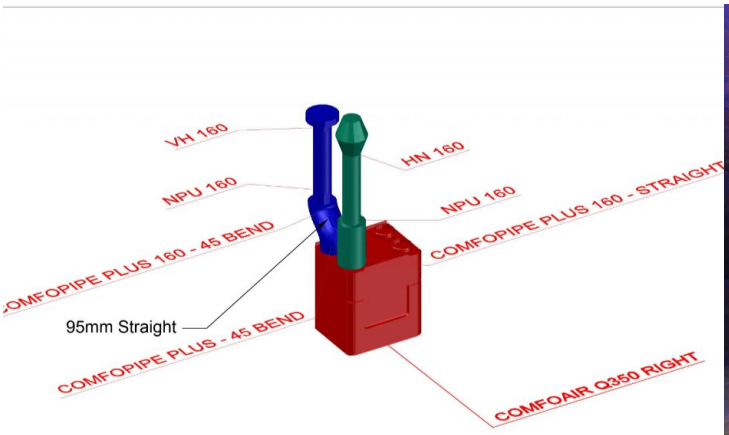
lowered ceiling portion for crossover & silencer in dining room. note condensate drain

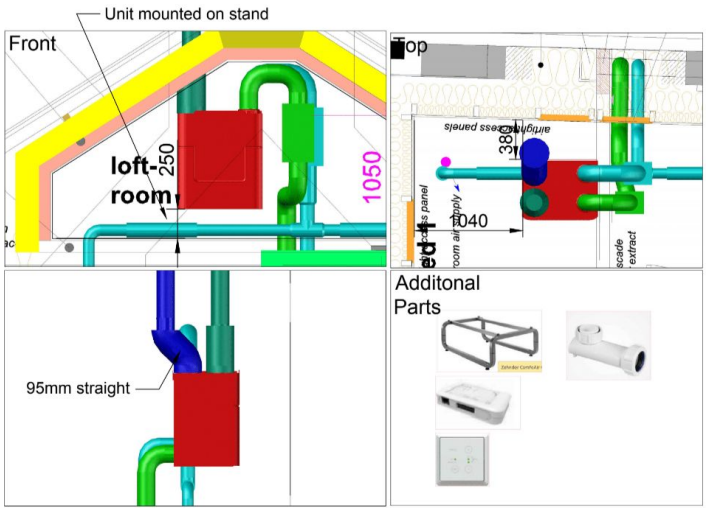
ducts passing from dining room into kitchen through wall (with condensate drain)

supply ducts for kitchen and bed 3, and extract from bathroom and kitchen passing through wall

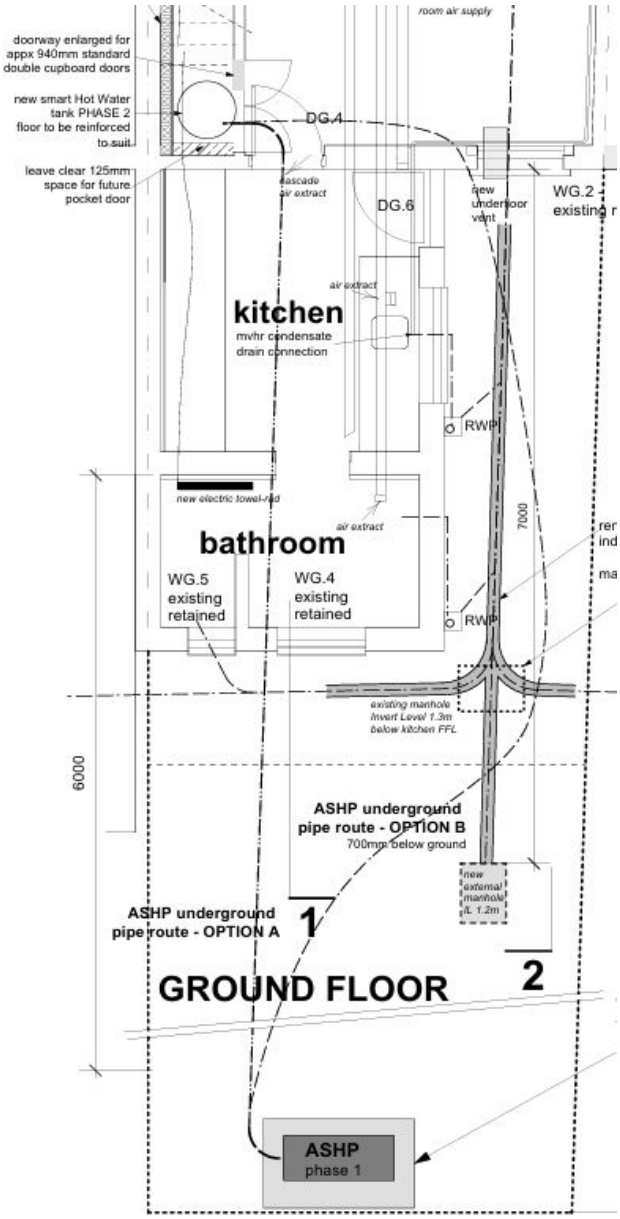
12 Ventilation unit / central ventilation unit

Passivhaus certified Zehnder ComfoAir Q350 HRV Heat Recovery Ventilation unit was selected to run the MVHR system. It has an effective heat recovery efficiency of 91%, and electric efficiency of 0.24 Wh/m3. The unit is located in the newly created loft space in order to save space, and create additional storage space in the house.

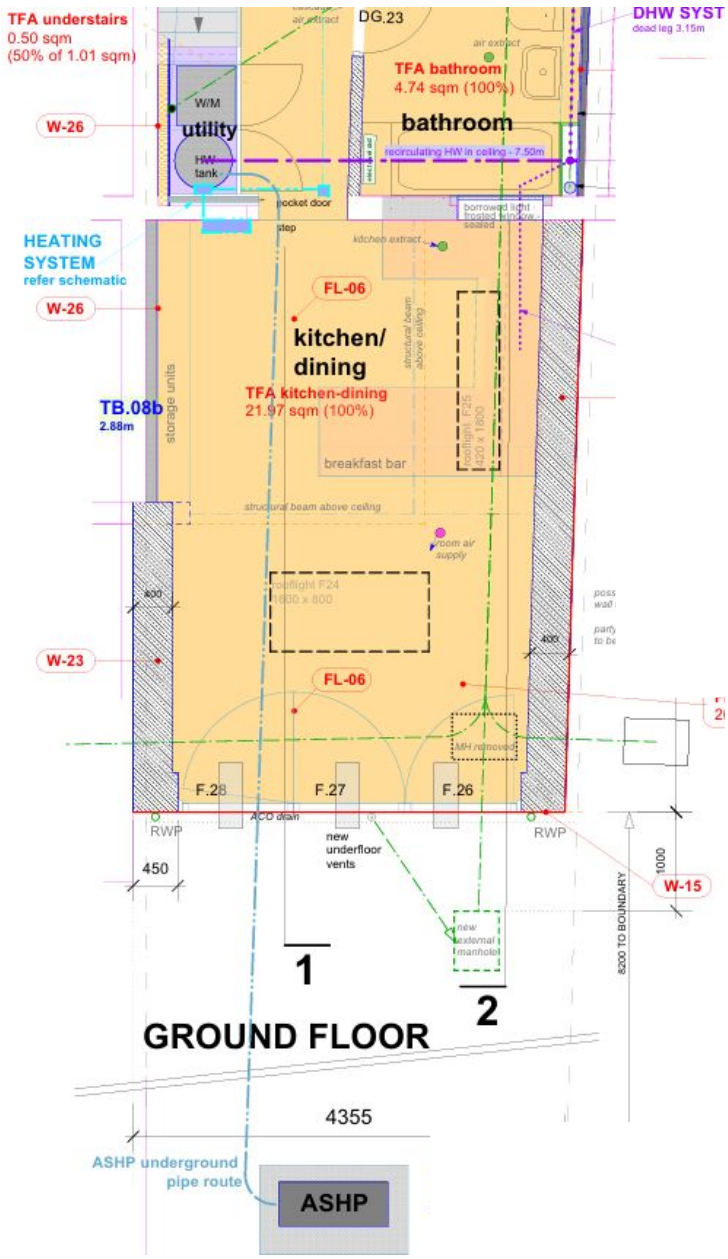




Phase 1 - the gas boiler remains



Phase 2 - ASHP installed



STEP 3 - Phase 2 ashp

Whether the ASHP is installed as Step 3 depends on timescale of the Phase 2 rear extension:

If the extension is to be delayed by a number of years, the ASHP will be installed in conjunction with moving the drainage manhole.

STEP 4 - Phase 2 new rear extension

However, the most efficient route for the underground ASHP supply pipes can be achieved if it is installed in conjunction with the rear extension, as Step 4. (Step 3 will then only consist of relocating the rear manhole.)

This can ensure the most efficient low GWP monobloc ASHP system can be installed, with the shortest route.

14 Short Documentation of PHPP-Results (verification sheet)

The PHPP verification of the proposed full Retrofit at stage 2 shows an extremely good reduction of heat demand of 96%

EnerPHit-Verification (staged)

10.4 EN

Calculated step: 4-PHASE 2 (EnerPHit)

Building:	EnerPHit 155 - Phase One		
Street:	155 Corporation Street		
Postcode/City:	E15 3DY	London	
Province/Country:	Greater London	GB-United Kingdom/ Britain	
Building type:	4-Row house		
Climate data set:	GB0001a-London (Central), Altitude corrected		
Climate zone:	4: Warm-temperate	Altitude of location:	3 m
Home owner / Client:	Hannah Martin		
Street:	155 Corporation Street		
Postcode/City:	E15 3DY	London	
Province/Country:	Greater London	GB-United Kingdom/ Britain	

Architecture:	Cayford Design		
Street:	K&C Co-works, Chelsea Town Hall, Kings Road		
Postcode/City:	SW3 5EZ	London	
Province/Country:	Greater London	GB-United Kingdom/ Britain	
Energy consultancy:	Cayford Design		
Street:	K&C Co-works, Chelsea Town Hall, Kings Road		
Postcode/City:	SW3 5EZ	London	
Province/Country:	Greater London	GB-United Kingdom/ Britain	

Mechanical engineer:	Cayford Design		
Street:	K&C Co-works, Chelsea Town Hall, Kings Road		
Postcode/City:	SW3 5EZ	London	
Province/Country:	Greater London	GB-United Kingdom/ Britain	
Certification:	ZE Passivhaus Services Ltd		
Street:	3 Elm Grove (Suite 6)		
Postcode/City:	M20 6PL	Manchester	
Province/Country:	Greater Manchester	GB-Reino Unido	

Year of construction:	2024	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	2.7	IHG summer [W/m²]:	3.2
No. of occupants:	2.2	Specific heat capacity [Wh/K per m² TFA]:	132	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	86.8				
Space heating	Heating demand	kWh/(m²a)	13	≤	20	-	Yes
	Heating load	W/m²	11	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-		-
	Frequency of overheating (> 25 °C)	%	0	≤	10		Yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		Yes
Airtightness	Pressurisation test result n_{50}	1/h	1.0	≤	1.0		Yes
Moisture protection							
	Smallest temperature factor $f_{Rsi=0.25\ m^2K/W}$	-	-	≥	0.35	0.16	-
Thermal comfort	All requirements fulfilled?	-					Yes
	U-value	W/(m²K)		≤	1.26		
	U-value	W/(m²K)		≤	1.51		
	U-value	W/(m²K)		≤	1.64		
	U-value	W/(m²K)		≤	0.69		
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	63	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	51	≤	60	60	Yes
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	0	≥	-	-	

I confirm that the values given here 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 (Energy demand method) Classic? Yes

Task:	First name:	Surname:	Signature:
2-Certification	Dr Jesus	Menendez	
Certificate-ID	Issued on:	City:	
	04.05.2024	Manchester	

15 Costs

Cost information has been withheld until the completion of Phase 2 - Step 4.