Passivhaus Project Documentation
Hiley Road Retrofit Passivhaus, London, UK

Abstract

Single family semi-detached four-bedroom home in London, England

Building data

Year of Construction	2016	Space Heating	**15** kWh/(m^{2}a)
U-Value external wall	0.076 W/(m^{2}K)/ 0.135W/(m^{2}K)		
U-Value floor	0.075 W/(m^{2}K)	Heating Load	17 W/m^2
U-Value roof	0.11 W/(m^{2}K)	Primary Energy Demand	113 kWh/(m^{2}a)
U-Value window (avg.)	0.91 W/(m^{2}K)	Treat Floor Area	111.4 m^2
Heat Recovery Efficiency	89%	Pressure test (n_{50})	0.54 h-1
Special Features	Waste water heat recovery system, 4kWp PV Array		

Patrick Osborne
Architect, RIBA, ARB, Certified Passivhaus Designer,
Eco Design Consultants,
www.ecodesignconsultants.co.uk

1.0 Brief description

Eco Design Consultants were approached by the client in 2014, with a view of retrofitting his house in West London. It was used as a student let, and had significant mould problems in the wet areas, and around the single glazing. The client's brief was that the house was to be retrofitted to as close to Passivhaus as possible, and then sold to fund his own retrofit in Devon.

As well as the deep retrofit required for achieving the low energy consumption, the design increases the TFA to 111.4m^2, with a rear dormer extension, which was given approval through permitted development in December 2014. The project started on site in February 2015, and Practical Completion was achieved in April 2016, after Passivhaus certification and Building Control were signed off. The house was sold, and in June 2016 the new owners moved in.

This is the first Passivhaus in the London borough of Brent, and one of the first retrofits in London to achieve the Passivhaus standard. The project has featured in Passivhaus Plus Magazine (edition 17), part of a presentation at the UK Passivhaus Conference in 2015, and was accepted as a poster presentation at the 2016 International Passivhaus Conference

1.1 Responsible project participants

Architect:	Patrick Osborne	Eco Design Consultants
Structural Engineer:	Godfrey Hallam	Watson Hallam Structural Engineers
Contractor:	Bowtie Construction	
Building Physics and PHPP:	Patrick Osborne	Eco Design Consultants
Certifier:	Pete Warm	Warm Low Energy Building

Certification body:	Passivhaus Institut, Darmstadt
Certification ID:	13603_WARM_PH_20160527_PW
Passive House Database ID,	ID: 5164

Author of the project documentation

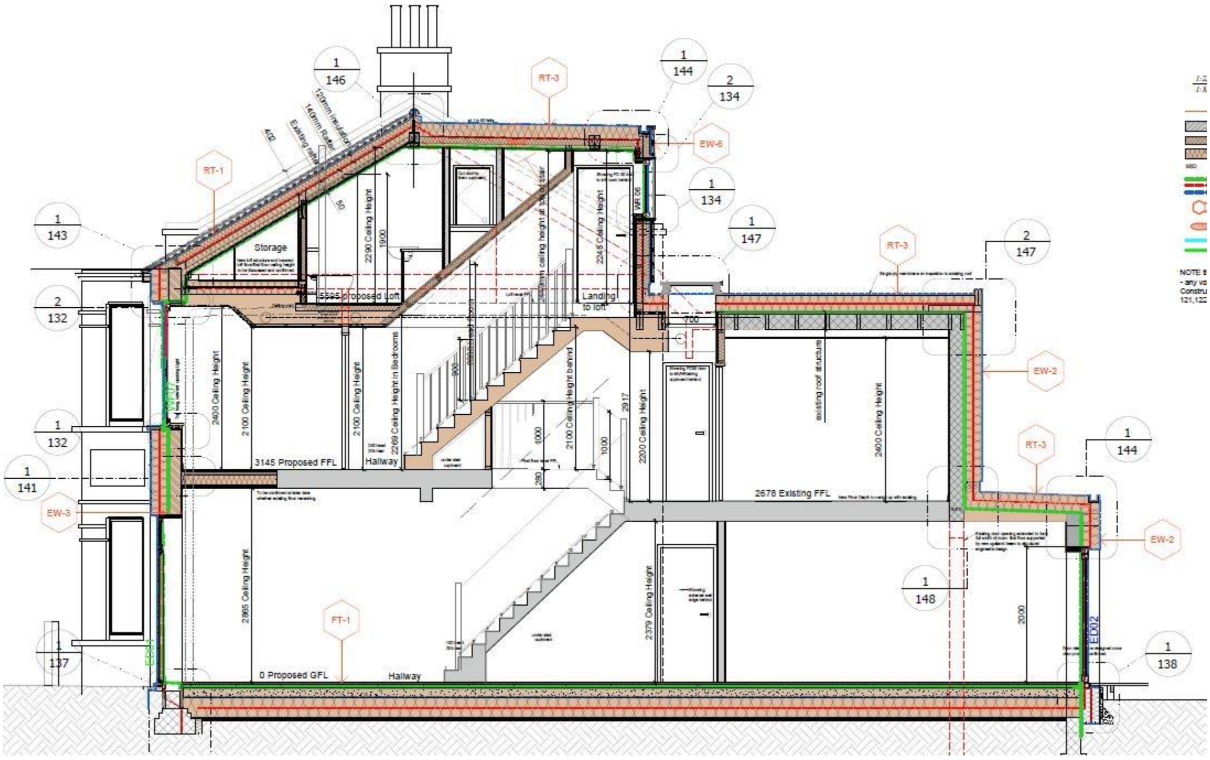
Patrick Osborne

20th April 2017

2.0 Views of the Building

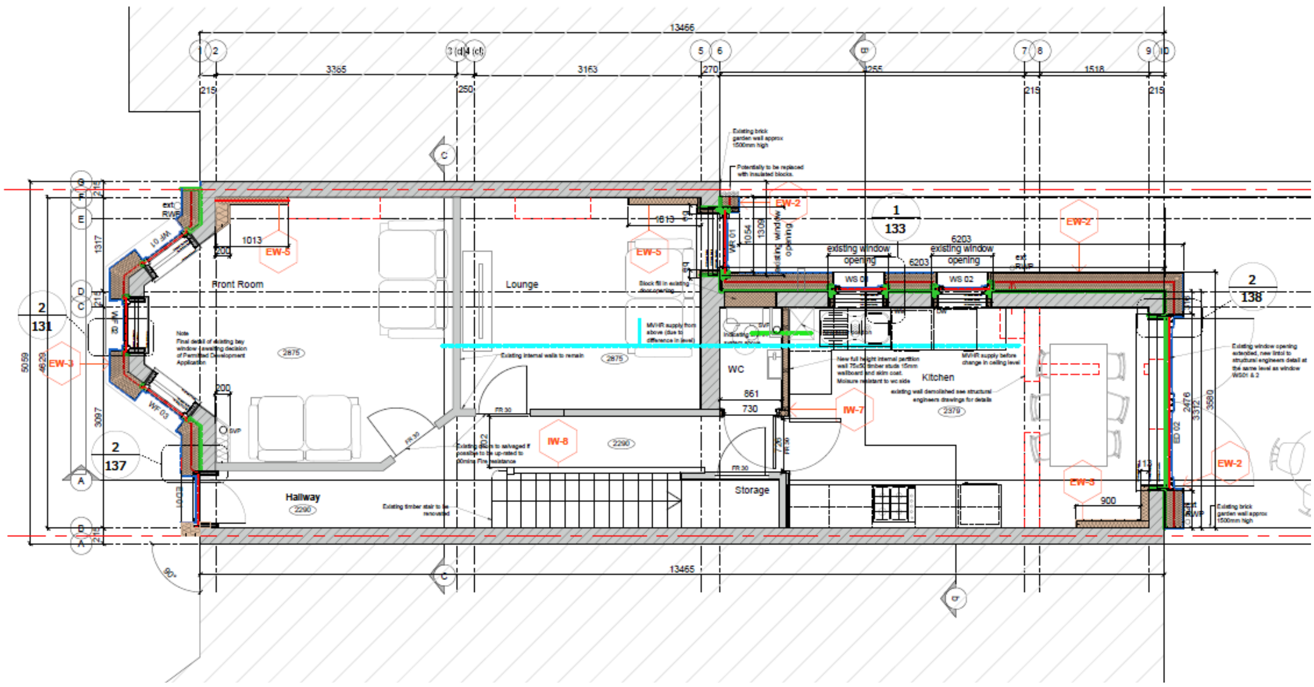
3.0 Sectional drawing

Longitudinal Section

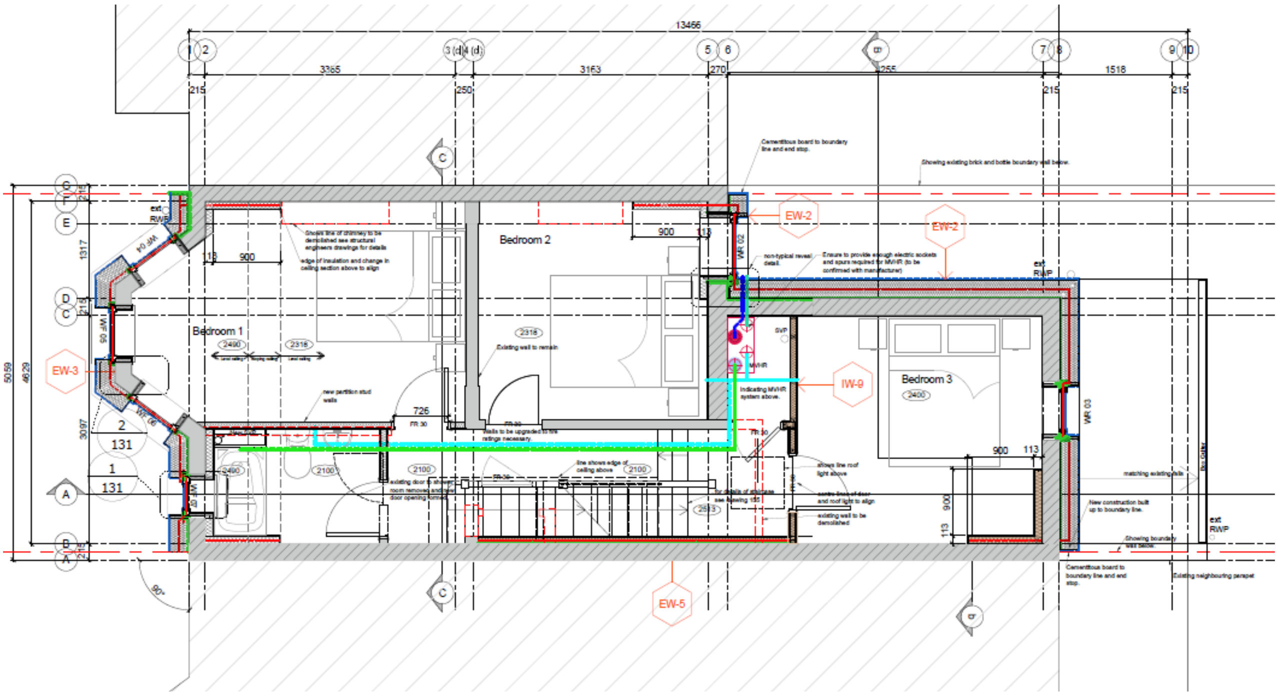


4.0 Floor plans

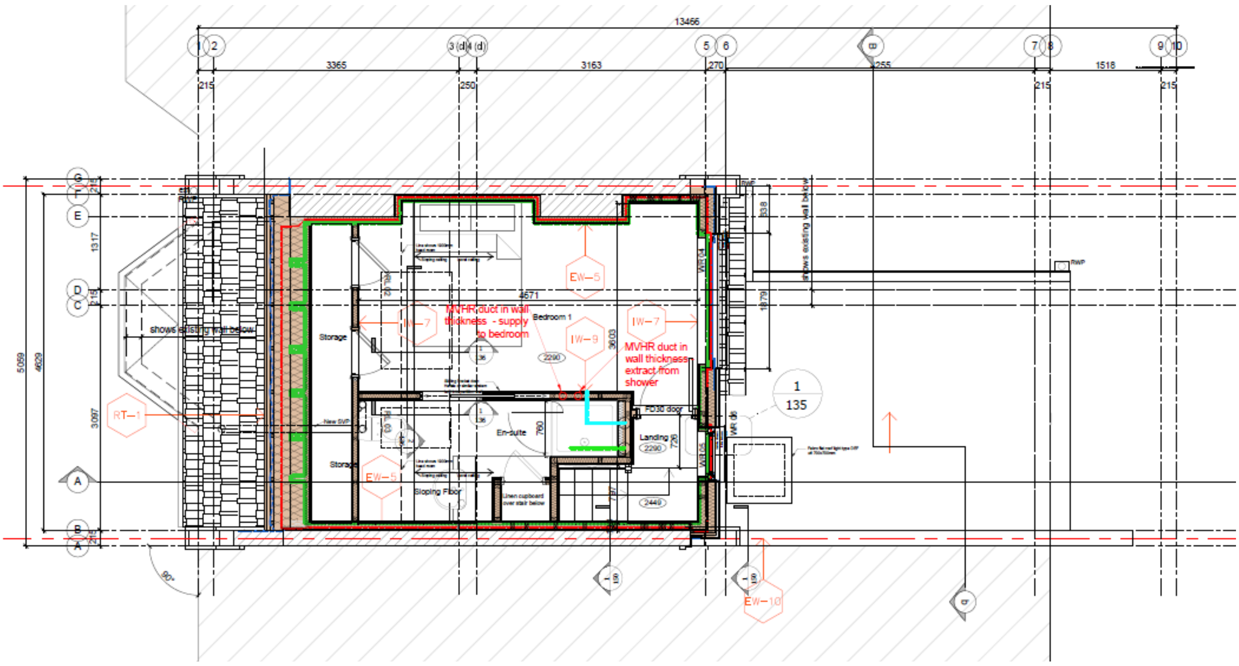
Ground Floor Plan



First Floor Plan



Loft Plan



5.0 Description of the construction

For a retrofit with a terrace, the thermal bridges are a key consideration for deciding on the best construction methods. There are a number of thermal bridge calculations that were required in order to ensure that the Passivhaus Standard was met, notably the party walls and ground floor junctions.

5.1 Ground floor slab

The exiting suspended timber floor was uninsulated, and it was considered in poor condition. The simplest way to achieve the levels of insulation required was decided to be a new concrete floor slab, with 300mm of phenolic insulation below. The slab would then act as both thermal mass, with underfloor heating pipes installed, and as the floor finish.

Ground Floor Construction:

- 300mm Reinforced Concrete Slab
- 300mm Ecotherm Ecoversal (lambda=0.023W/mK)

U Value = 0.075W/m^{2}K

5.2 Exterior walls

The building was constructed in around 1900, and the walls are of a solid brick construction. The walls showed no signs of damp or moisture damage, and were considered to be of good repair. The render finish externally was in poorer condition, so this provided an opportunity to repair and insulate further.

The current Permitted Development Rights allows for insulating walls externally without the requirement for planning permission, and this was the route chosen to streamline the retrofit process. There is no limit to the amount of insulation that can be installed, bar the physical and economical barriers, so 250mm of Kingspan K5 was specified to achieve a U Value of 0.078W/m^{2}K.

External Wall Construction (Solid Brick):

- 13mm Plaster
- 215mm Solid Brick
- 250mm Kingspan K5 (lambda=0.020W/mK)
- 10mm Silicone Render

U Value 0.078W/m^{2}K

External Wall Construction (Timber frame):

- 15mm Plasterboard
- 25mm Service Void
- 100mm Isothane Duratherm insulation between timber studs (lambda=0.026W/mK)
- 9mm Ply
- 100mm Ecotherm Ecoversal (lambda=0.023W/mK)
- 15mm Ply with GRP finish

U Value=0.135W/m^{2}K

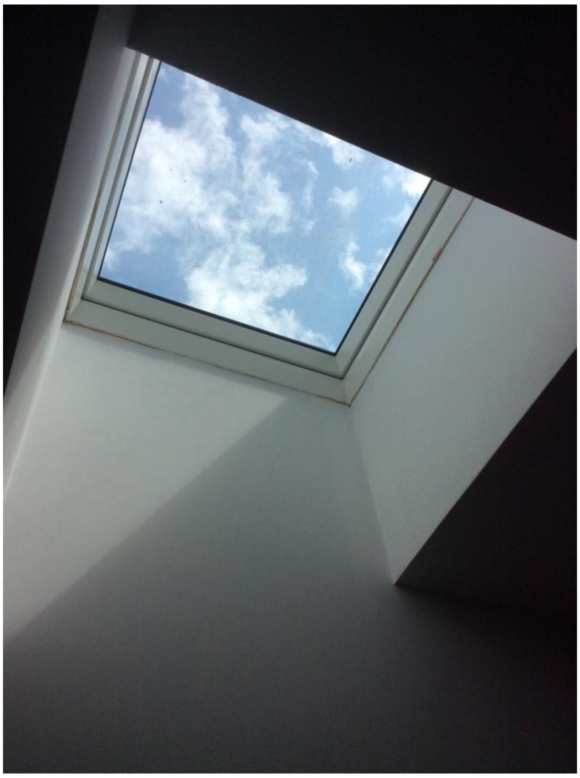
5.3 Roof

The existing roof was found to be in poor condition, so it was removed and replaced with additional insulation between and above the rafters to achieve a U-Value of 0.11W/m^{2}K. The existing tiles were saved where possible, and used to reroof to reduce waste and to retain a similar appearance to the adjoining terrace buildings.

Roof Construction:

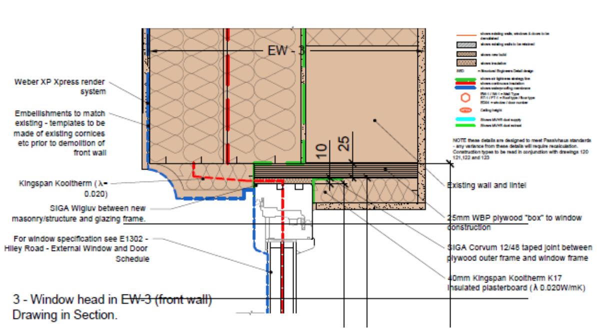
- 15mm Plasterboard and skim
- 25mm Service voide
- 150mm Icynene sprayfoam insulation (lambda=0.030W/mK), between rafters
- 120mm Ecotherm Ecoversal (lambda=0.023W/mK)

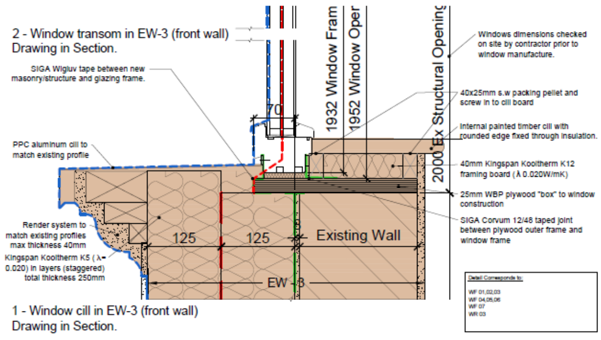
U Value=0.11W/m^{2}K



5.4 Windows

The windows selected were Passivhaus Certified timber frames with a thermal break, installed with triple glazing. The 'EcoContract Ultra' (now named 'Ultra') windows have a frame U-Value of 0.84W/m^{2}K for head and jambs, and 0.82W/m^{2}K for the cill.





The glass specified for the windows was a combination of Glastrosch triple glazing (Ug-value=0.65W/m^{2}K, g-value=0.53) and Planibel toughened triple glazing (Ug-value=0.55W/m^{2}K, g-value=0.52). The lower pane of the bay window glass was below 800mm, so were required to have the Planibel safety glass installed.

Because the windows were externally opening, insulation on the inside of the frame was installed to improve the psi value of the installation. As part of the PHPP calculations, we completed psi values for this, achieving between 0.015 and 0.020W/mK; an improvement of our conservative assumption of 0.04W/mK.

The rooflights specified for the pitched roof construction were Fakro FTT U6 triple glazed (Ug-value=0.5W/m^{2}K, and a window U-Value=0.8W/m^{2}K) with an EHV-AT Thermo flashing kit. On the flat roof above the stairwell, a DXF DU6 Fakro rooflight was installed (Ug-value=0.5W/m^{2}K, and a window U-Value=0.88W/m^{2}K).

6.0 Airtight envelope

The existing building was not tested for airtightness before the retrofit, but it is common for buildings similar to that at Hiley Road, being of solid wall and suspended timber floor construction, to have air change rates of 15ach @50Pa. The main routes were identified as through the floor, window and door junctions, party walls, and eaves, so additional detail was considered here. The existing ground floor staircase was designed to be kept to reduce the cost and to provide access to the upper floors during construction.

The final airtest result was 0.54ACH @50Pa.

Exterior Walls

The airtightness strategy was originally designed to be positioned on the external face of the solid brick walls, and the warm side of the external wall insulation. This would need to overlap with the concrete floor slab and timber roof construction, and presented some concerns on site for meeting the airtightness target. Because of the potential air routes around the party walls, the airtightness layer was moved internally, to reduce the potential for air leakage around these areas, but created additional work for the contractor to perform. In particular, the internal joists running into the external wall would have been easier to make airtight externally, but internally this required the use of structural grout to fill in the joints where access was difficult or impossible.

The walls were parge coated to create a continuous air barrier from the concrete floor slab to the ceiling, where membrane was connected to the plaster. For the timber frame extension in the loft, the exterior walls were constructed with an intelligent membrane to continue the airtightness barrier to the roof construction.

Windows

The existing single glazing was removed from the solid brick walls, and the brickwork replaced where necessary. To ensure that the windows were positioned within the thermal envelope, and to make the airtightness layer continuous, plywood boxes were constructed and inserted into the window openings. The internal plaster could then be finished to a solid edge. The new Passivhaus certified windows were installed into the plywood boxes, and taped to create a continuous air barrier.

Floor

The concrete slab acts as the airtightness layer in the floor construction, and connects to the plaster on the walls by proprietary airtightness tape using a primer.

Roof

The roof, being of timber construction, has an intelligent membrane installed internally, and a wind tight membrane externally beneath the tiles.

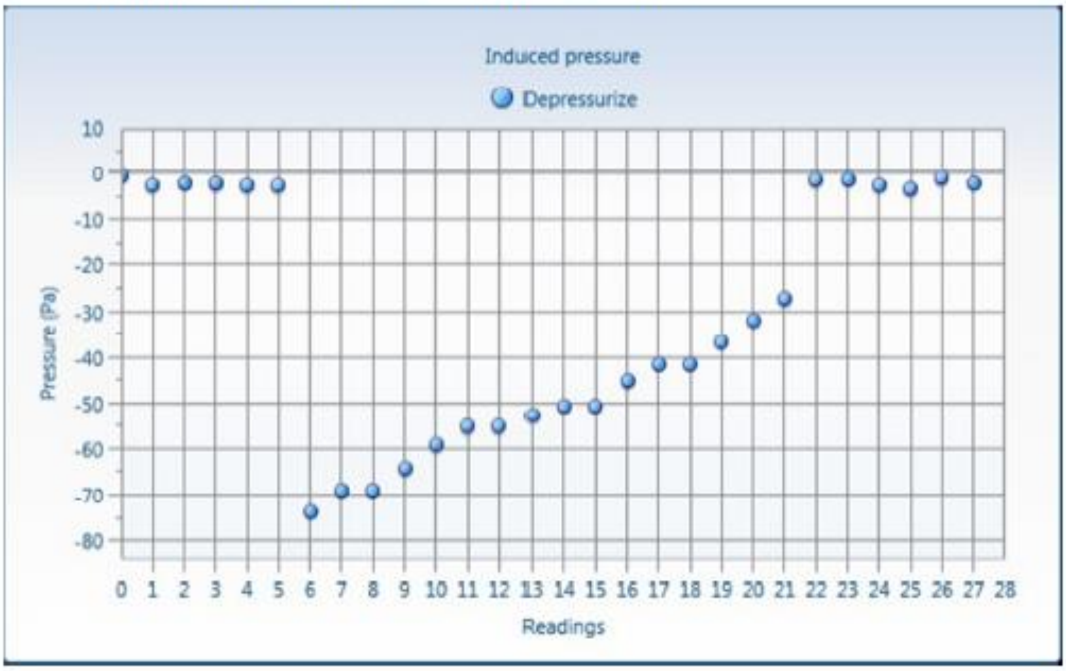
Report on the Acceptance Air Leakage Testing of 4 Hiley Road, in Kensal Rise, in compliance with ATTMA TSL1 (2010)

Site address: **4 Hiley Road, Kensal Rise, London NW10 5PS**

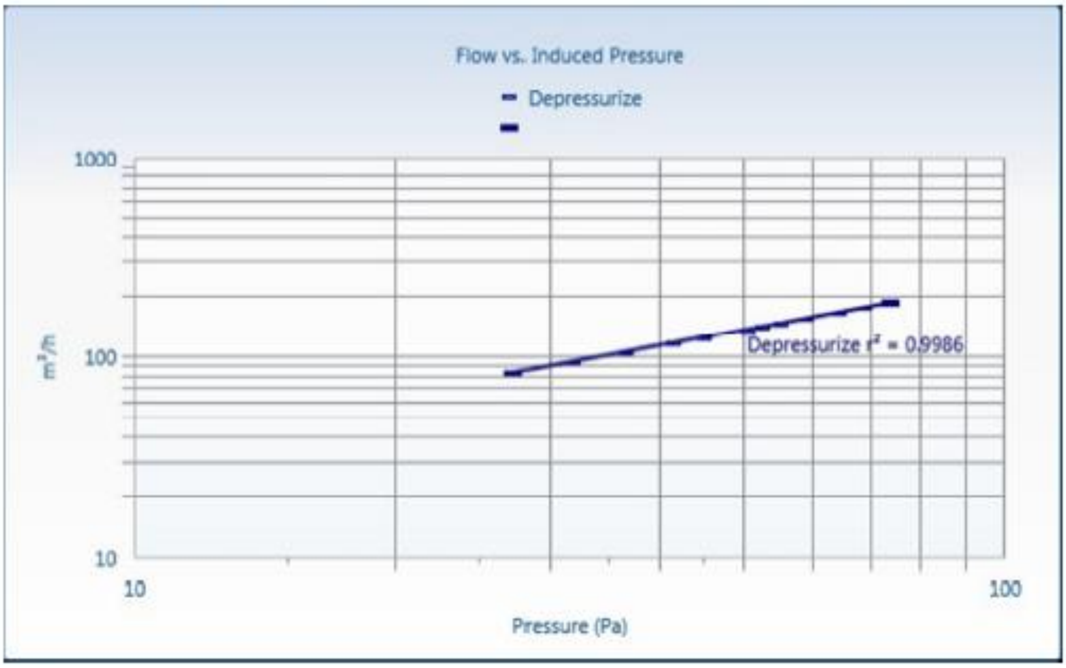
Test Reference No.:		**JA5194-T02**
Test Date:		**29th July 2015**
Testing carried out for:	**Client:**	**Bowtie Construction**
Testing carried out by:	**Test Engineer:**	**Paul Jennings**
	Company:	**Aldas**
	Contact Tel:	**01452 532878/07758 929041**
	Contact E-mail:	**jennings.aldas@gmail.com**
Target Air Changes, ACH^{-1} @ 50 Pa:		**≤ 1.0 (EnerPHit)**
Achieved Air Changes, ACH^{-1} @ 50 Pa:		**0.54**
Achieved Air Permeability, $m^3/hr/m^2$ @ 50 Pa:		**0.46**
Data consistency, r^2 (requirement, $r^2 \geq 0.98$):		**0.999**
Slope, n (requirement, $0.5 \leq n \leq 1.0$):		**0.74**

Aldas, 54 Melville Road, Churchdown, Gloucester, GL3 2RG
Aldas is a trading name of Jennings Aldas Limited, Co. Reg 8409614
Director: Clare Corley
Air Leakage Specialist: Paul Jennings, BSc, MSc
doorfanman@hotmail.com 07866 948200

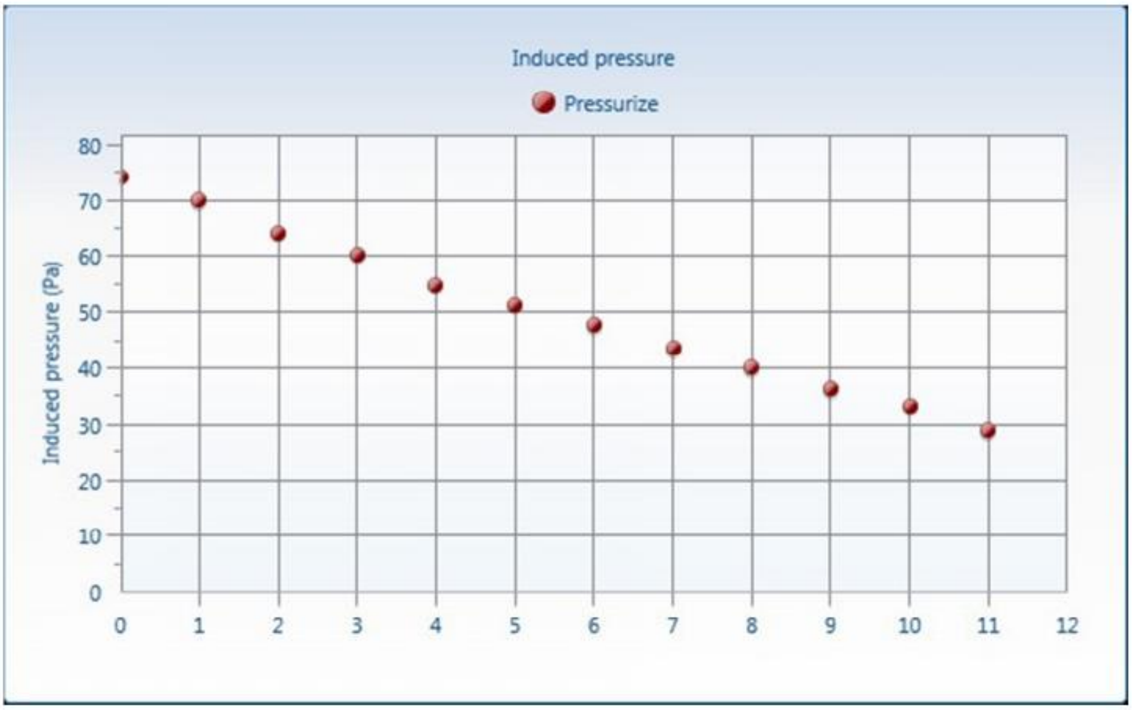
G1: Graph of imposed pressure differentials, Depressurize:



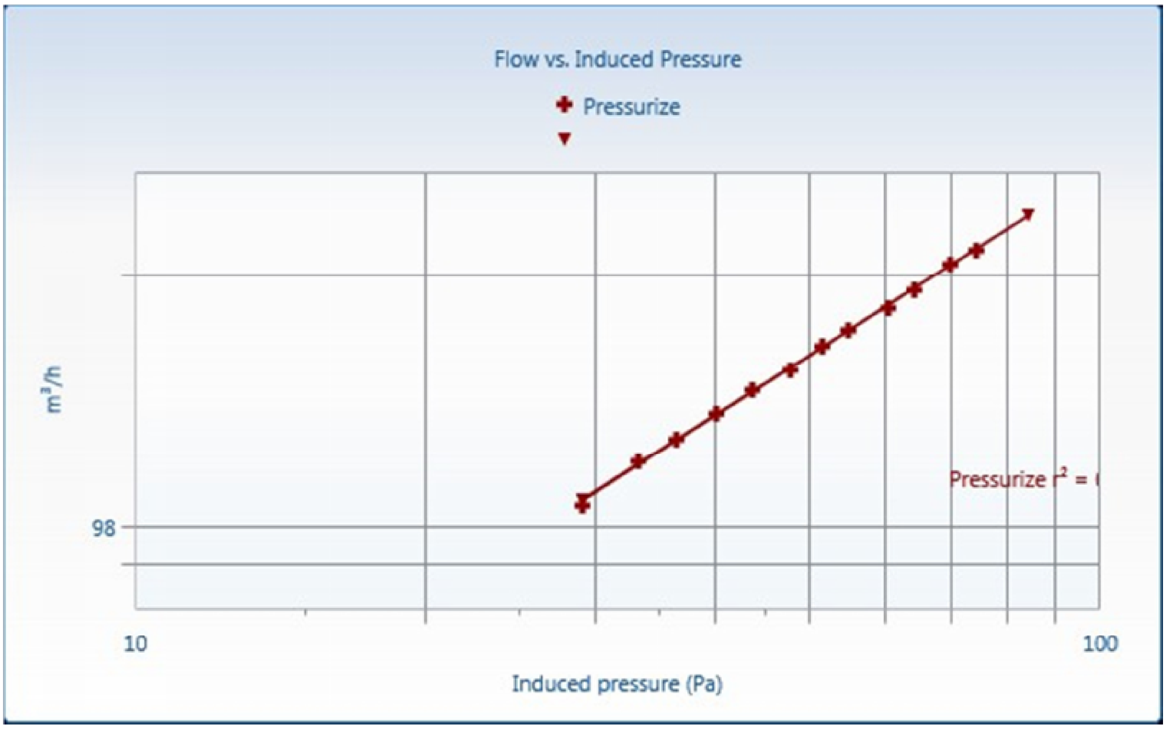
G2: Graph of imposed pressure differential against airflow, Depressurize:



G3: Graph of imposed pressure differentials, Pressurize:

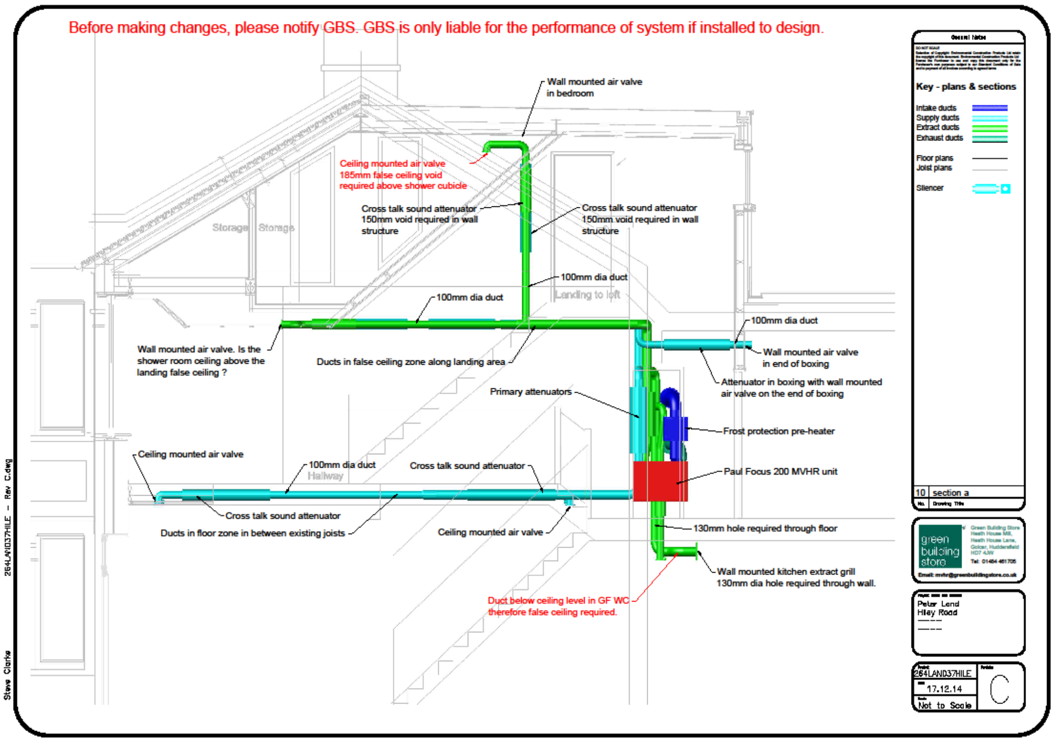


G4: Graph of imposed pressure differential against airflow, Pressurize:



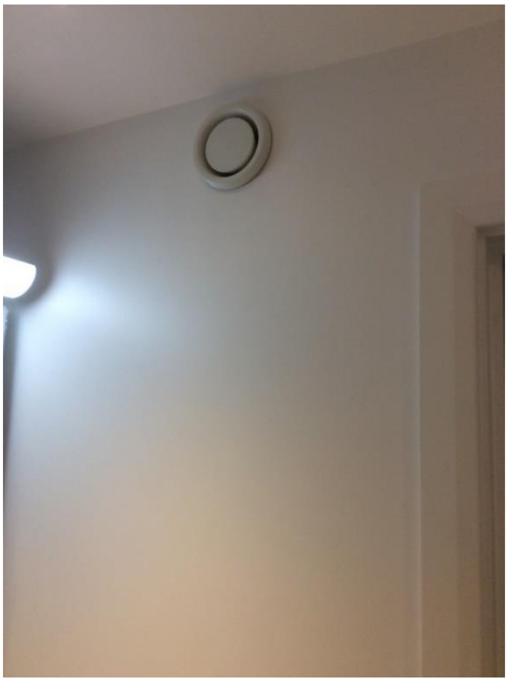
7.0 Ventilation System

The ventilation system was designed, supplied and commissioned by the Green Building Store, with the ductwork and unit installed by the main contractor, Bowtie Construction. The unit specified was a Paul Focus 200, with a unit efficiency of 91%, and an effective (installed) efficiency of 89.8%. The effective electrical efficiency is 0.31Wh/m^3.



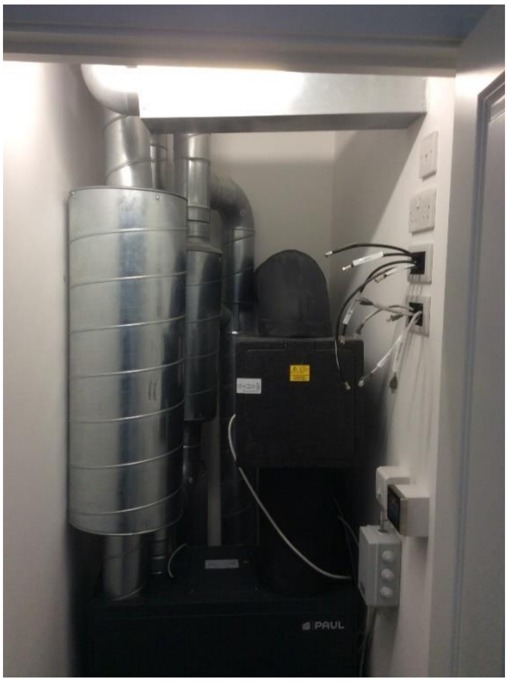
7.1 Ventilation ductwork

The design of the ductwork supplies air to the bedrooms, living room and dining room, and extracts from the kitchen, bathroom and en-suite on the second floor.
Air transfer is designed for the hallway and corridors, with doors undercut to allow air movement.



7.2 Ventilation Unit

The fresh air intake was positioned at the rear of the property, to avoid traffic particulates being drawn into the building. The unit itself was positioned in a dedicated cupboard on the first floor. The exhaust air, and the gas boiler flue, are positioned at a clear distance from the intake to ensure that the air is as clean as possible before filtering.



8.0 Heat supply system

The heat supply for the building was designed to be simple and cost effective. The ground floor slab has underfloor heating pipes installed, and small radiators in the upper floors provide heat to the bedrooms and bathrooms. The existing gas boiler was serviced and retained.

9.0 PHPP Key results

The results of the PHPP show that it meets the requirements for certification.

Passive House verification

Building:							
Street:	Hiley Road						
Postcode / City:	NW10 5PS						
Country:	England						
Building type:	Retrofit						
Climate:	[UK] - Thames valley (Silsoe)					Altitude of building site (in [m] above sea level):	48
Home owner / Client:	Mr Peter Land						
Street:							
Postcode/City:							
Architecture:	Eco Design Consultants						
Street:							
Postcode / City:							
Mechanical system:	Green Building Store						
Street:							
Postcode / City:							
Year of construction:	2015		Interior temperature winter:	20.0	°C	Enclosed volume V_e m³:	288.1
No. of dwelling units:	1		Interior temperature summer:	25.0	°C	Mechanical cooling:	
No. of occupants:	3.2		Internal heat sources winter:	2.1	W/m²		
Spec. capacity:	132	Wh/K per m² TFA	Ditto summer:	2.7	W/m²		

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	111.4	m²		
Space heating	Heating demand	**15**	**kWh/(m²a)**	15 kWh/(m²a)	**yes**
	Heating load	**17**	**W/m²**	10 W/m²	**-**
Space cooling	Overall specif. space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 25 °C)	10.0	%	-	**-**
Primary energy	Heating, cooling, dehumidification, DHW, auxiliary electricity, lighting, electrical appliances	**113**	**kWh/(m²a)**	120 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	48	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**0.5**	**1/h**	0.6 1/h	**yes**

* empty field: data missing; '-': no requirement

Passive House?	**yes**

10.0 Construction Costs

The total construction cost for the project was approximately £230,000 including VAT, or £2,065/m^2 of useful floor area (TFA). This included increasing the useful floor area with a dormer extension, and the deep retrofit and replacement of structural elements.

11.0 Architect & Building Physics

The Architect and Building Physics consultant for the project was Patrick Osborne from Eco Design Consultants, Milton Keynes, who were selected for their experience in low energy building. The building's MVHR was designed by Green Building Store, Huddersfield.

11.1 User satisfaction

The house was purchased by new owners in July 2016, and have fed back to the architects, suggesting high levels of comfort and low heating bills for the first winter.

12.0 References

Passivhaus Plus Magazine Issue 17

UK Passivhaus Conference 2015 Presentation

20th International Passivhaus Conference Proceedings 2016