Passivhaus Project Documentation
Howe Park Passivhaus, Milton Keynes, UK

Abstract

Single family detached five bedroom home in Milton Keynes, England

Building data

Year of Construction	2012	Space Heating	**14** kWh/(m^{2}a)
U-Value external wall	0.136 W/(m^{2}K)		
U-Value floor	0.09 W/(m^{2}K)	Heating Load	10 W/m^2
U-Value roof	0.111 W/(m^{2}K)	Primary Energy Demand	120 kWh/(m^{2}a)
U-Value window (avg.)	0.85 W/(m^{2}K)	Treat Floor Area	175 m^2
Heat Recovery Efficiency	82.5%	Pressure test (n_{50})	0.07 h-1
Special Features	Probably most airtight building in UK, PV & solar thermal		

Alan Budden
Architect, RIBA, ARB, Certified Passivhaus Designer,
Eco Design Consultants, www.ecodesignconsultants.co.uk

1.0 Brief description

Designed for Milton Keynes Parks Trust, and completed in July 2012, Howe Park Passive House is the first Passive House to be certified in Milton Keynes. The house is privately rented with the funds helping to maintain Milton Keynes's Parks. This 5 bedroom family home replaces a burnt out derelict house with a new one, which is truly environmentally sustainable and at the same time aesthetically pleasing. It has been constructed from and clad with sustainable timber, the exterior cladding is Kebony. It has high levels of insulation, high performance triple glazing, exceptional attention to detail and minimal cold bridging. In addition, low VOC paints have been used on the interior to provide a healthy and comfortable home and the building orientation and form have been maximised for solar gain. Ventilation is provided using mechanical ventilation with heat recovery ensuring fresh air to the house, with minimal heat lost.

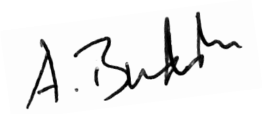
Electricity providing Photo Voltaic roof panels are used to offset electricity demand for the heating, lighting and ventilation system. Solar hot water panels provide hot water, which is supplemented with an emersion heater. A water butt collects rainwater and overflow drains to pond in wood. Materials used for the house where possible have been selected for their environmental credentials such as sustainably sourced timber for the timber frame and cladding. VOC free natural paints have been used throughout except the feature wall that used 50% recycled paint. Specialist ecological advice was sort to ensure that existing wildlife, fauna and flora was protected and encouraged, the neighbouring orchard and meadow are to be revitalized. The kerbs and road gullies were lowered to make it safer for newts to cross the road. Reduction in car use is encouraged by the provision of a secure cycle store and home office to allow residents to work from home.

1.1 Responsible project participants

Architect:	Alan Budden – Eco Design Consultants
Structural Engineer:	Andy Allan - Allan Consult Ltd
Contractor:	Parkway Construction
Building Physics and PHPP:	Alan Budden – Eco Design Consultants
Certifier:	John Trinick - WARM
Project manager	Dene Ares - Jackson Coles
CDM Coordinator	Jackson Coles
Certification body:	Passivhaus Institut, Darmstadt
Certification ID:	4665_Warm_PH_20120717_JT
Passive House Database ID,	ID: 2456

Author of the project documentation

Alan Budden



30th October 2016

2.0 Views of the Building

Front entrance elevation, north facing with smaller windows, and slate hung second floor to reduce visual height.

Approach to the house from west, showing narrow slit windows to give view of those approaching but also privacy.

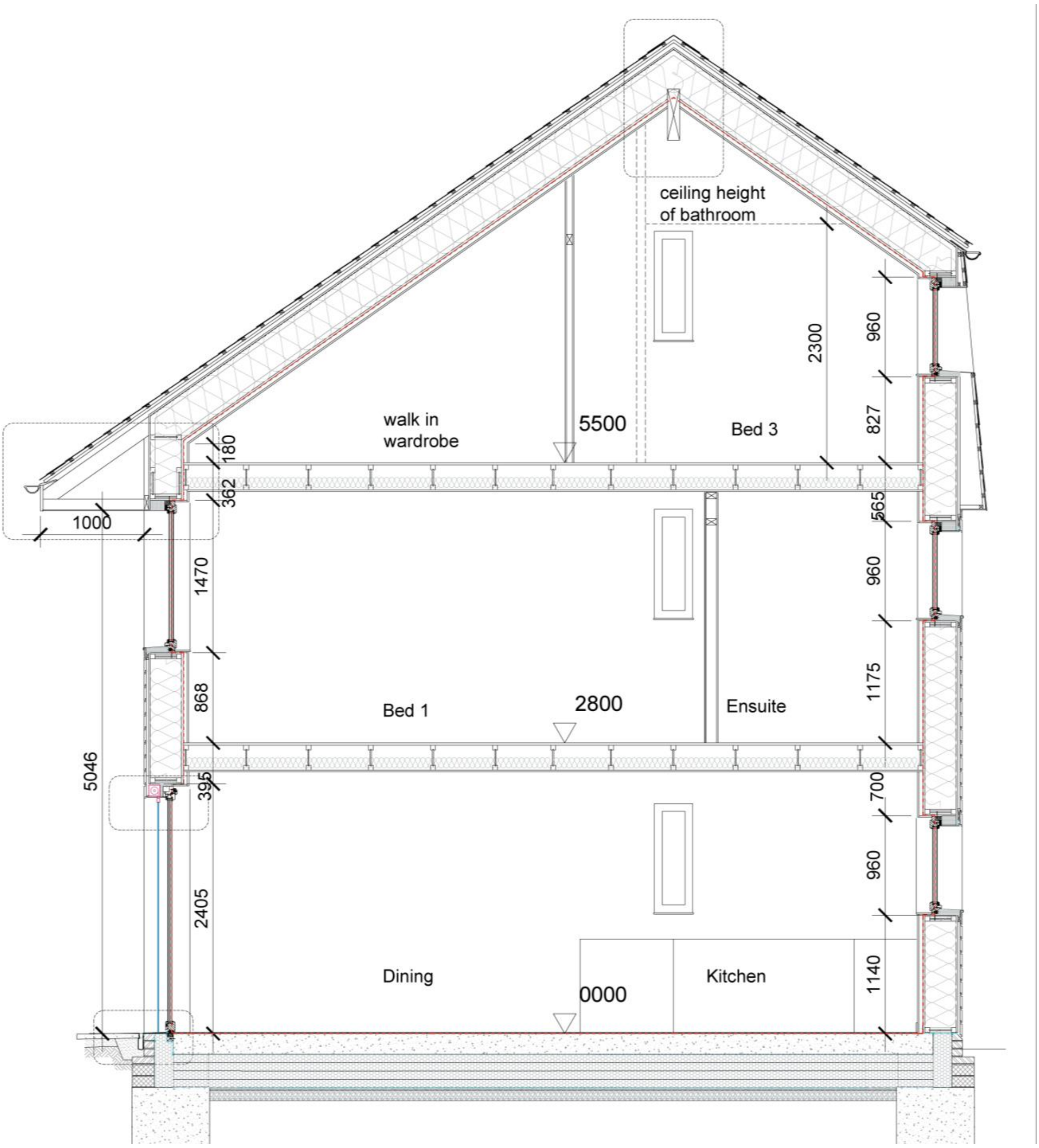
Rear South Elevation facing garden with larger windows. External blinds are used in summer.

East elevation, showing rain water butt, and long slit windows providing views out of the children's rooms at low level.

Interior of main living space looking towards kitchen and dining area, and stairs to first floor, notice the electric panel heater on the right used to heat the house (also supplemented with electrical towel rails in bathrooms).

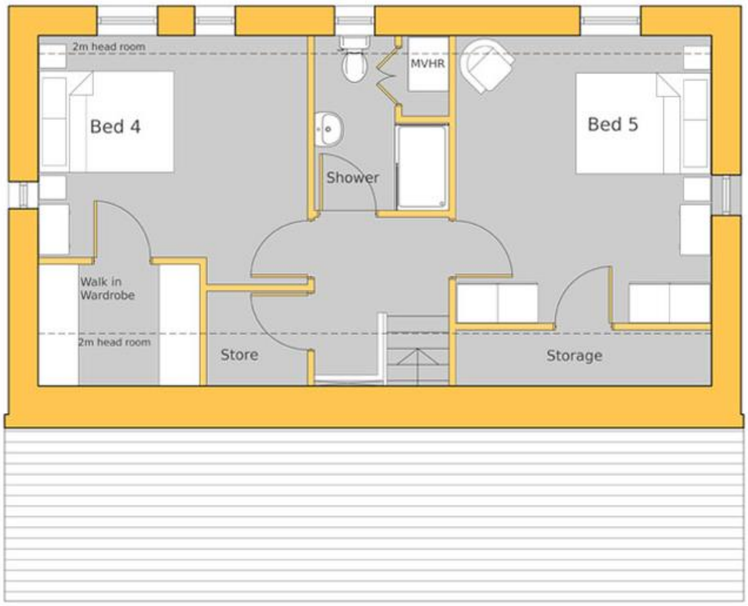
Further interior views, showing bedroom 2, main bathroom and second floor shower room, with MVHR cupboard.

3.0 Sectional drawing



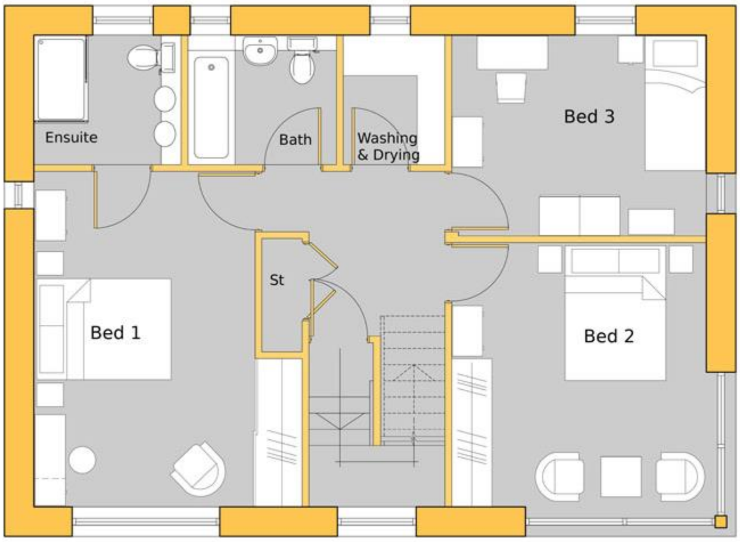
This typical section, this shows the continuous layer of insulation around the building, and the air tightness layer on the inside in red. The unequal roof allows more space for renewables of the south slope, whilst also making it appear 2 storeys from the street. Notice the large 1m overhang on the south that provides shading from the high summer sun. The north side has more of the ancillary spaces such as the kitchen and bath rooms. Note the additional mansard roof on the north side to reduce the visual height of the building and how the insulation and structure maintains a simpler vertical path.

4.0 Floor plans



Second Floor Plan

The second floor provides 2 bedrooms, storage and shower room. The shower room also contains the MVHR unit with intake through the wall and extract out of the roof. No roof lights were included on the Southside as at the time they were difficult to install in Passivhaus's due to high thermal bridging.



First Floor Plan

The first floor has the master bedroom and en-suite, two further bedrooms and family bathroom. Also included on this floor is a washing drying room, removing the need for a washing machine in the kitchen and allowing efficient drying via the MVHR extract, The Solar hot water tank is also situated here allowing additional heating to dry clothes. Originally bedroom 2 was to be a study balcony area with double height space to the living room below.

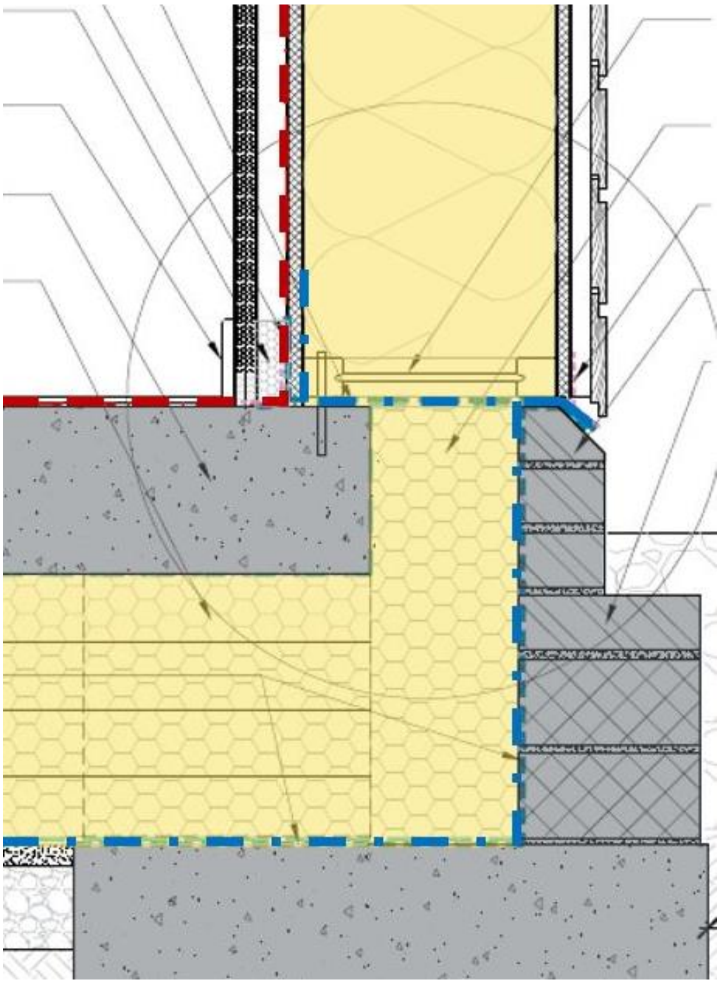
Entrance

Ground Floor Plan

The ground floor plan contains the living spaces, study dinning and kitchen along with the entrance hall, coat storage and WC. Note all the wet areas are located in on the north side, to reduce pipe and duct lengths.

5.0 Description of the construction

5.1 Ground floor slab



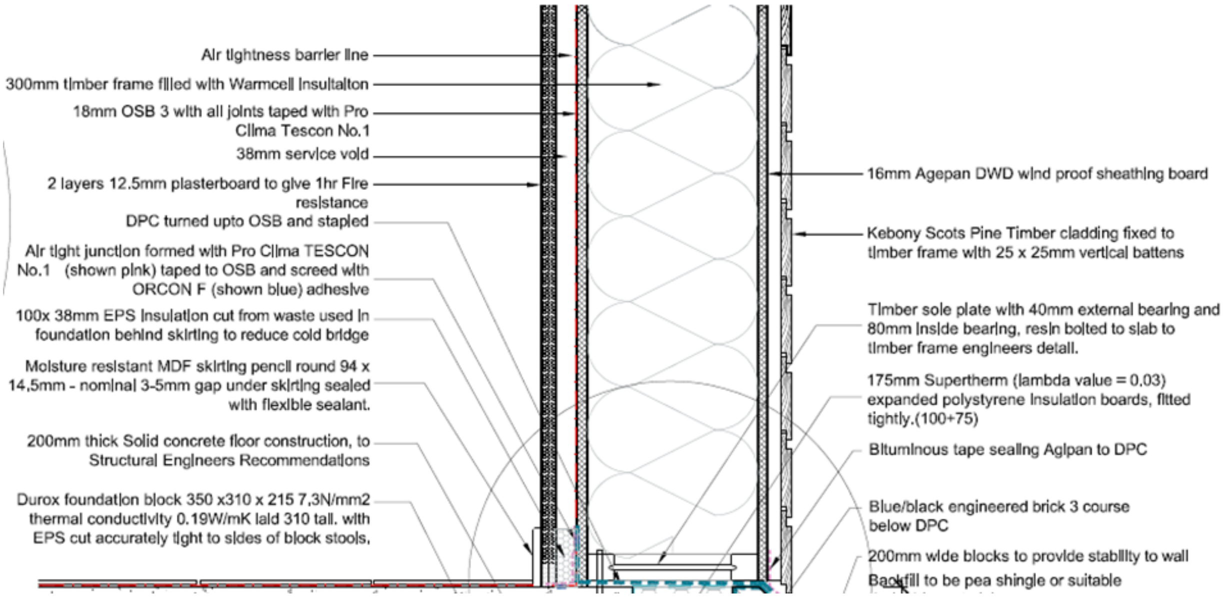
The ground floor is constructed of a 200mm concrete slab floating on 325mm of EPS insulation. Individual light weight insulating blocks are used as secondary support for the slab at pre-determined load points around the perimeter. The need for a timber sole plate was illuminated and replace with an I beam – reducing thermal bridging and potential settlement. The heavy patio and front doors are supported on GRP angles supported on bolts cast into the slab.

Construction Build up:

Power Floated Concrete Floor slab, 200mm thick
Springvale premium EPS 325mm thick,
including Durox lightweight block around perimeter at load points.
DPM
Sand blinding

U-value = 0.09 W/(m^{2}K)

5.2 Exterior walls



The external walls were constructed by Touchwood homes, using 300mm ‘I’ beams filled with Warmcell (recycled newspaper) insulation. An inner finish of taped OSB formed the airtightness barrier and care was taken at the first floor junction to ensure the continuity of the airtightness layer (grey membrane) and minimising cold bridging.

Construction Build up:

15mm Plasterboard
38mm Service void, formed with battens
18mm OSB3 as airtightness layer
300mm ‘I’ Beams filled with Warmcell insulation
Agepan DWD wind tight, exterior protection board.
38mm timber battens
21mm Kebony timber cladding

U-value = 0.136 W/(m^{2}K)

5.3 Roof

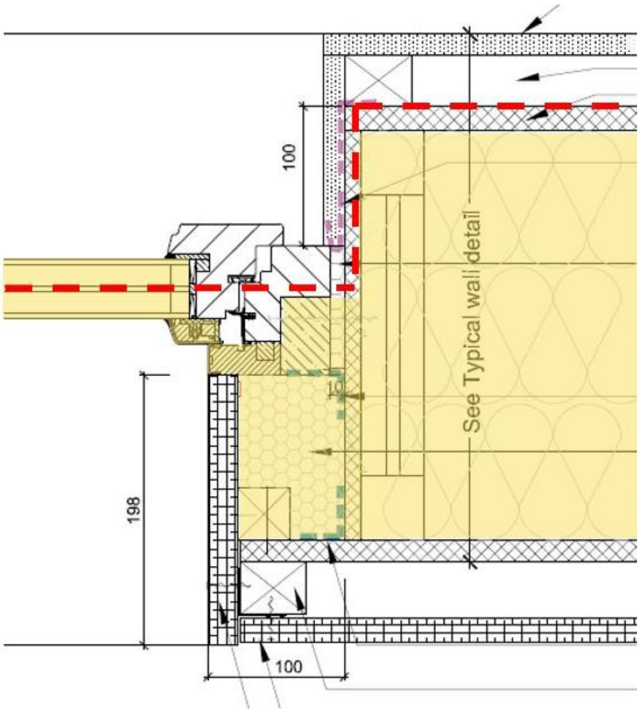
The roof was constructed like the walls with I beams spanning from the eaves to a ridge beam, and filled with Warmcell insulation. An inner finish of taped OSB formed the airtightness barrier, followed by a service void and plasterboard. Care was taken to select slim LED lights that fitted into the service void. Careful detailing at the eaves also kept the thermal bridging to a minimum.

Construction Build up:

15mm Plasterboard
38mm Service void, formed with battens
18mm OSB3 as airtightness layer
400mm ‘I’ Beams filled with Warmcell insulation
Agepan DWD wind tight, exterior protection board.
Roofing felt
Battens & Counter battens
Eternit Slates

U-value = 0.111 W/(m^2K)

5.4 Windows



The windows selected for this project were the Optiwin, Alu2wood, Wood / aluminium having thermally broken frames, the U value of the frame was 1.03 W/(m^{2}K). Thermoseal super black spacers were used with a variety of triple glazed glass specifications, including laminated safety glass and others with a white coating providing higher g values. The Ug varied from 0.55 to 0.69 and the g value from 48% to 64%.

Sliding doors were selected over bifold due to their superior air tightness, and a fully glazed front door was selected for its good thermal performance. The windows selected open to the inside allowing additional insulation to be added around the frame on the outside, reducing the area of visible frame and consequential heat losses considerably. Internal comfort around the windows is high enabling siting and reading by them even on the coldest days.

The overall average U value for the windows was 0.85 W/(m^{2}K).

6.0 Airtight envelope

A continuous air tight layer is essential in keeping draughts out and meeting the Passivhaus standard. All detailed drawings showed the airtightness layer in red, this included, the concrete slab, OSB3 boards, tapes, window frames and glass.

The Airtightness strategy involved lining the inside of the external walls and the roof with 18mm OSB3 taped with Pro Clima airtightness tapes at all joints and junction with the concrete slab, window openings and service penetrations. At intermediate floor junctions an airtightness membrane was used to link together the OSB on the walls above and below. In addition to this a good wind tight barrier was formed on the outside using the Agepan DWD board sealed with non-setting mastic.

The resulting air pressure tests carried out by Peter Williams of Stroma, provided an air change rate of just 0.07 h^{-1}@50 Pa, depressurised and 0.06 h^{-1}@50 Pa. Which we believe is one of the lowest ever in the UK.

Certificate of Air Test

Issued By Stroma Technology Ltd

UKAS TESTING 2731

Details of Test

Dwelling tested:	Howe Park Wood, Hengistbury Lane, Tattenhoe, Milton Keynes, MK4 3OB	Nett Floor Area, A_F: Envelope Area, A_E: Volume, V:	72.70 m^2 400.34 m^2 497.33 m^3
On behalf of:	Parkway Construction	Geometry Prepared by:	Jonathon Teale of Stroma
Test Date:	23rd May 2012	Geometry Verified by:	Barry White of Parkway Construction
Certificate Date:	24th May 2012	Certificate No.:	PW 05-12-28691 T1

Test Conditions and Temporary Sealing at the Time of Both Tests

	Response
All external doors and windows closed?	Yes
All internal doors open?	Yes
All extracts sealed? Inc. kitchen and bathroom(s) extracts and the oven hood.	Yes
Temporary seals to drains, plugs, or overflows?	No
Combustion appliances turned off, and sealed? If located in the conditioned space of the dwelling and it is not a balanced?	Yes
Trickle vents and/or passive ventilation temporary sealed?	No
Fireplace temporary sealed?	N/A
All building works completed to the air boundary envelope?	Yes

Deviation(s) from ATTMA TS1

None

Test Result and Performance Characteristics

This is to certify that the above named building has been tested for air permeability in accordance with ATTMA TS1 undertaken with the conditions stated above.

The Key Leakage Characteristics of the dwelling are:

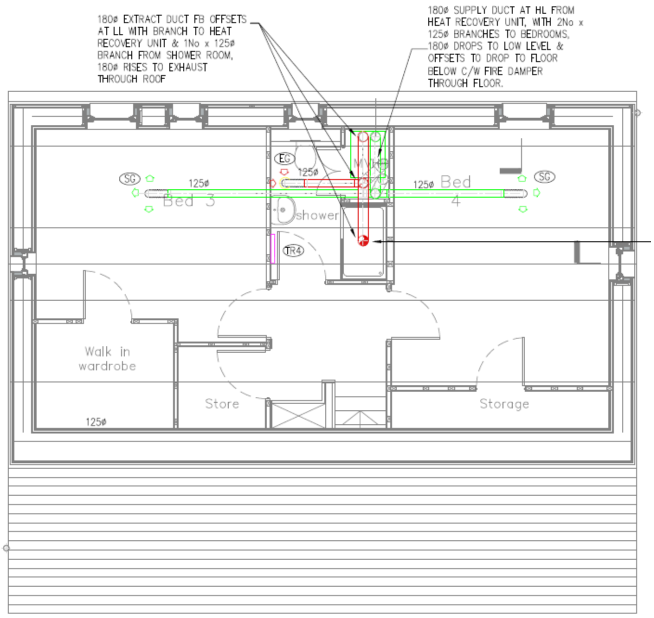
	Depressurisation	*Pressurisation*
Air Change Rate, n_{50}:	**0.07 h^{-1} @ 50 Pa**	**0.06 h^{-1} @ 50 Pa**
Air Permeability, AP_{50}:	*0.09 $m^3.h^{-1}.m^{-2}$ @ 50 Pa*	*0.09 $m^3.h^{-1}.m^{-2}$ @ 50 Pa*
Effective Leakage Area:	0.002 m^2 @ 50 Pa	0.002 m^2 @ 50 Pa
Correlation of results, r^2:	0.9974	0.9865
Slope, n:	0.60	0.67
Air Flow Coefficient, C_{env}:	3.50 $m^3.h^{-1}.Pa^{-n}$	2.29 $m^3.h^{-1}.Pa^{-n}$
Intercept, C_L:	3.49 $m^3.h^{-1}.Pa^{-n}$	2.28 $m^3.h^{-1}.Pa^{-n}$

Signed: ____________ Name: Peter Williams Position: Engineer

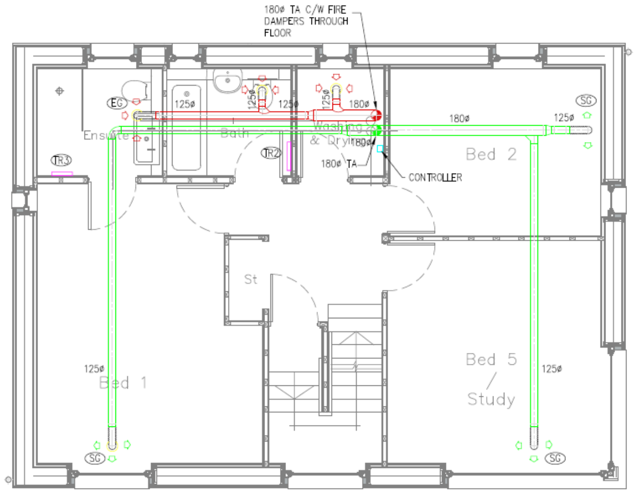
On Behalf of Stroma Technology Ltd.

7.0 Ventilation System

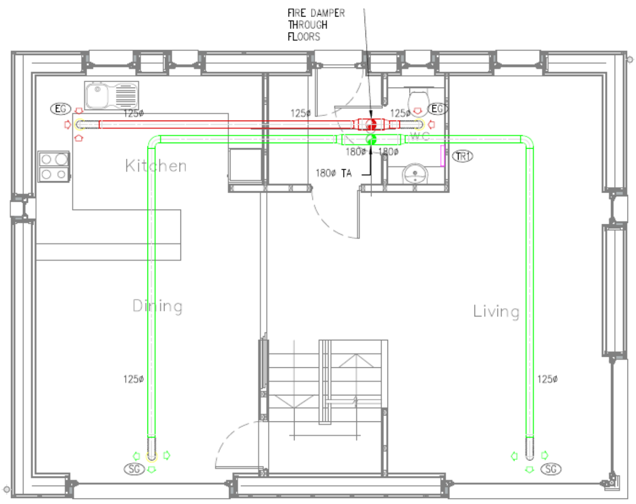
7.1 Ventilation ductwork



Second Floor Plan



First Floor Plan



Ground Floor Plan

The MVHR unit is located in the second floor shower room in its own cupboard with fresh air intake taken straight in through the wall on the north, cooler shaded side, and the exhaust leaves through the roof above. All ductwork is in ridged galvanised steel, with sound attenuators as necessary.

As can been seen the duct roots are kept to a minimum with the wet rooms have extracts stacked above each other.

Air is supplied to all 5 bedrooms, and the living room and dining areas. This air is then transferred under doors and through the hall to the kitchen extract, and extracts in the bathrooms, WC and drying room. Air transfer routes are provided under doors with timber thresholds used to ensure that carpet does not impede the air flow.

7.2 Ventilation Unit

Ventilation is provide by the Passivhaus Institute certified Zehnder, Comfoair 550. Located in a cupboard in the second floor shower room.

This supply and extract heat recovery system, has an effective heat recovery efficiency of 82.5% and an electrical efficiency of 0.29Wh/m^3.

8.0 Heat supply system

It was decided that installing mains gas on the site would be too expensive and so an electric only solution was sought and so is heating by direct electric. Hot water is heated with solar hot water tubes on the roof, and supplemented with an emersion heater. The introduction of a 4 kW peak Photo Voltaic panels on the roof helps in providing this electricity for the house but is not included in the PHPP calculations.

Heating is provided by a 2KW Dimplex Girona electric panel heater in the lounge and electric towel rails in bathrooms. Domestic hot water is provide by solar hot water systems consisting of 30 Baxi Solar hot water tubes on the roof supplying a 210 litre megaflow eco cylinder with an electrical immersion heater top up / backup.

30 Baxi evaluated solar hot water tubes on roof, feeding 210 litre Megafow hot water cylinder.

Dimplex Girona 2kW electric panel heater in lounge

9.0 PHPP Key results

The results of the PHPP show that it meet the requirements.

Passive House Verification

Building:	Howe Park Passivhaus	
Location and Climate:	Milton Keynes	Thames valley
Street:	Hengistbury Lane	
Postcode/City:	MK4 3BF Milton Keynes	
Country:	England	
Building Type:	Detached House	
Home Owner(s) / Client(s):	Milton Keynes Parks Trust Ltd	
Street:	Campbell Park Pavilion, 1300 Silbury Boulevard	
Postcode/City:	MK9 4AD, Central Milton Keynes	
Architect:	Eco Design Consultants Ltd	
Street:	3 Parklands, Great Linford	
Postcode/City:	MK14 5DZ, Milton Keynes	
Mechanical System:		
Street:		
Postcode/City:		

Year of Construction:	2012				
Number of Dwelling Units:	1		Interior Temperature:	20.0	°C
Enclosed Volume V_e:	718.0	m³	Internal Heat Gains:	2.1	W/m²
Number of Occupants:	5.0				

Specific Demands with Reference to the Treated Floor Area

	Applied:	Monthly method	PH Certificate:	Fulfilled?
Treated Floor Area:	174.9	m²		
Specific Space Heating Demand:	14	kWh/(m²a)	**15 kWh/(m²a)**	Yes
Heating Load:	10	W/m²	**10 W/m²**	
Pressurization Test Result:	0.07	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	120	kWh/(m²a)	120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	77	kWh/(m²a)		
Frequency of Overheating:	2	%	over 25 °C	

10.0 Construction Costs

Detailed construction costs are not available but the costs was approximately £2,000/m² of living/useful area

11.0 Architect & Building Physics

The Architect and Building Physics consultant for the project was Alan Budden from Eco Design Consultants, Milton Keynes, who were selected for their experience in low energy building. Alan started Eco design consultants in 2009, with the aim of combining Architecture and Environmental consultancy in a single joined up package. In 2011 he qualified as a European certified Passivhaus designer.

11.0 User satisfaction

The house is rented out and the first tennants occupied the house for 4 years. They have told me that their son is much healther and now does not have annual colds. They also told me that often chose to travel home from concerts rather than stay over due to the comforts of the house. The upper rooms have been found to be approximately 2 deg cooler than downstairs, this is probably due to reduced solar gain due to only having north facing windows, and heat not rising through the house as we had expected.

12.0 References

"Milton Keynes' Passivhaus: the most airtight house ever?"

Article in the Architects Journal 12th July 2012 by Sahiba Chadha

"Howe Park Passive House: Sealed tight"

Article in Building, 24th August 2012 Vern Pitt

Green Apple Award 2013, for work on the house