Passivhaus Documentation

Ranulf Road, single family house, London UK
(Passivhaus database number: 1777)

Technical drawings in this document are not drawn to scale

2.1 Project Overview

Architects: bere:architects Project Architect: Sarah Lewis www.bere.co.uk

Ranulf Road is a single family house located in Camden, London, UK. The concrete substructure was constructed on site in 2009 and over 2009-2010 the timber superstructure was prefabricated in Austria and then installed on site. The project was certified as London's first Passivhaus in April 2010 by Peter Warm.

Key environmental strategies: Solar thermal panel for hot water, rainwater harvesting for irrigation, natural construction materials, orientation to maximise solar gains, wild flower meadow roofs

U-value lower external walls:	0.122 W/(m²K)	**PHPP Space Heat Demand:**	**13kWh/(m²a)**
U-value upper external walls:	0.110 W/(m²K)	PHPP Primary Energy Demand:	97kWh/(m²a)
U-value ground floor slab:	0.103 W/(m²K)	Air test:	$0.44h^{-1}$
U-value flat roof:	0.067 W/(m²K)	Heat Recovery Unit Efficiency:	92%
U-value sloping roof:	0.110W/(m²K)		
U-value terrace:	0.140W/(m²K)		

NOTE: as you will be aware there is an international issue with regard to the method used to calculation thermal conductivities. We have used the EN standard, the PHI assessment used the DIN so the U-vlaues vary between the two.

Ranulf Road, single family house, London UK

2.2 Brief Project Description

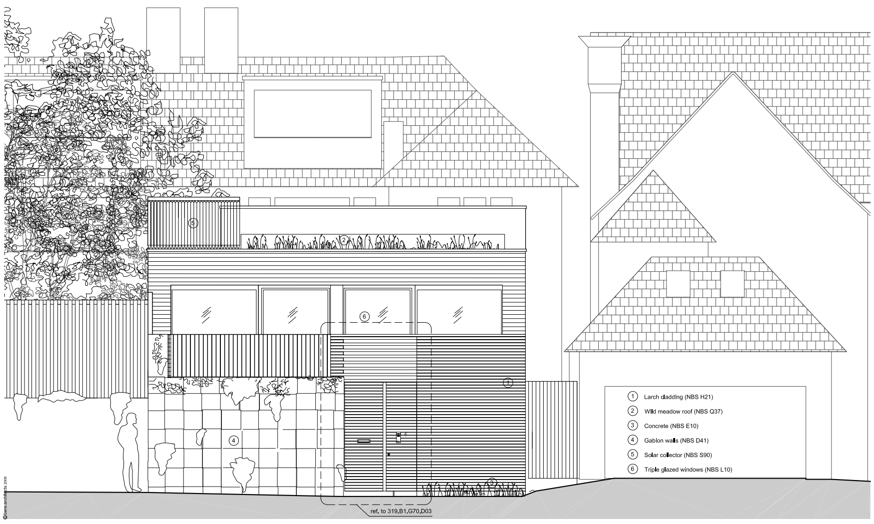
Designed by bere:architects, the timber frame 99m² two bedroom home has predicted annual heating bills of less than £65 (at standard occupancy maintained at 20°C in winter). This is achieved by high levels of insulation, overall negative psi values, triple glazing, Passivhaus sliding windows, draught free construction, and 92% efficient heat recovery ventilation. Summer temperatures are controlled by blinds, a well insulated structure, and two green roofs.

The site is located in London which means that the over-shadowing of adjacent buildings had a major impact on the energy balance and design decisions. The PHPP was used from the very start of the project to determine the optimum position for the house on the site and the optimum percentage and orientation of the glazing.

Biodiversity was very important for this project which incorporates two wild flower meadow green roofs, a south facing planted garden and an Ivy wall (which replaced the original gabion wall shown in the drawings).

This project is the first certified Passivhaus in London, setting a new high standard for energy efficient design for the city. The house has already been opened to the public for the Camden Passivhaus Conference (Feb. 2010) and has featured in a number of lectures and articles on Passivhaus design.

2.3 Elevations

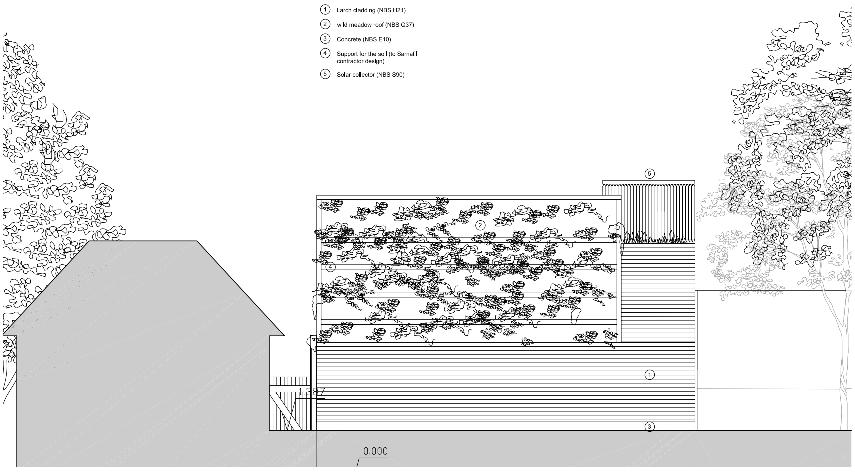


Front elevation

The front of the house faces south west

view of front elevation

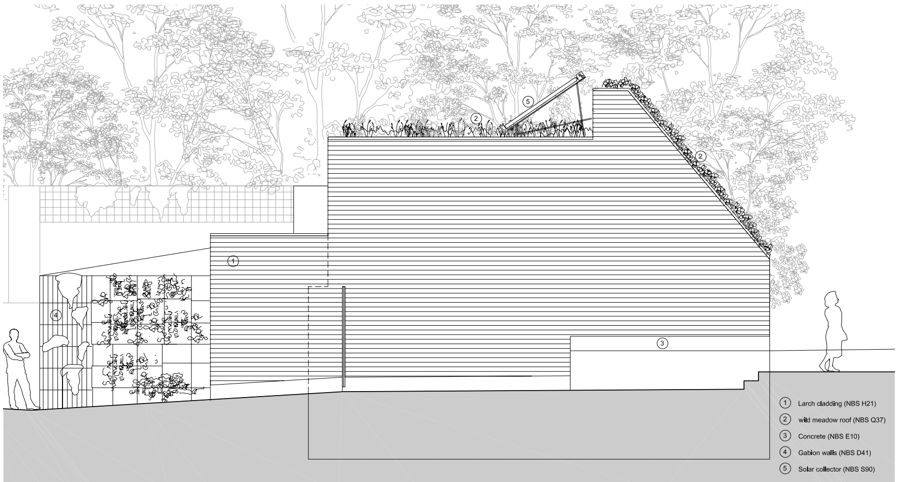
2.3 Elevations continued



Rear elevation

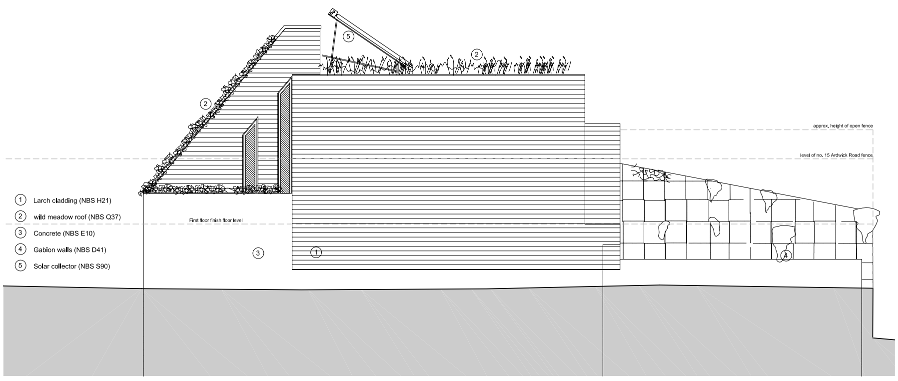
The rear elevation of the house faces north east

sloping green roof of rear elevation



The south east side elevation

view of side elevation



The north west side elevation

view of front garden (as access for side view not possible)

2.4 Internal Design

The materials specified for inside the house are all natural paints, glues and timber. All of the lighting is LED and florescent low energy lighting.

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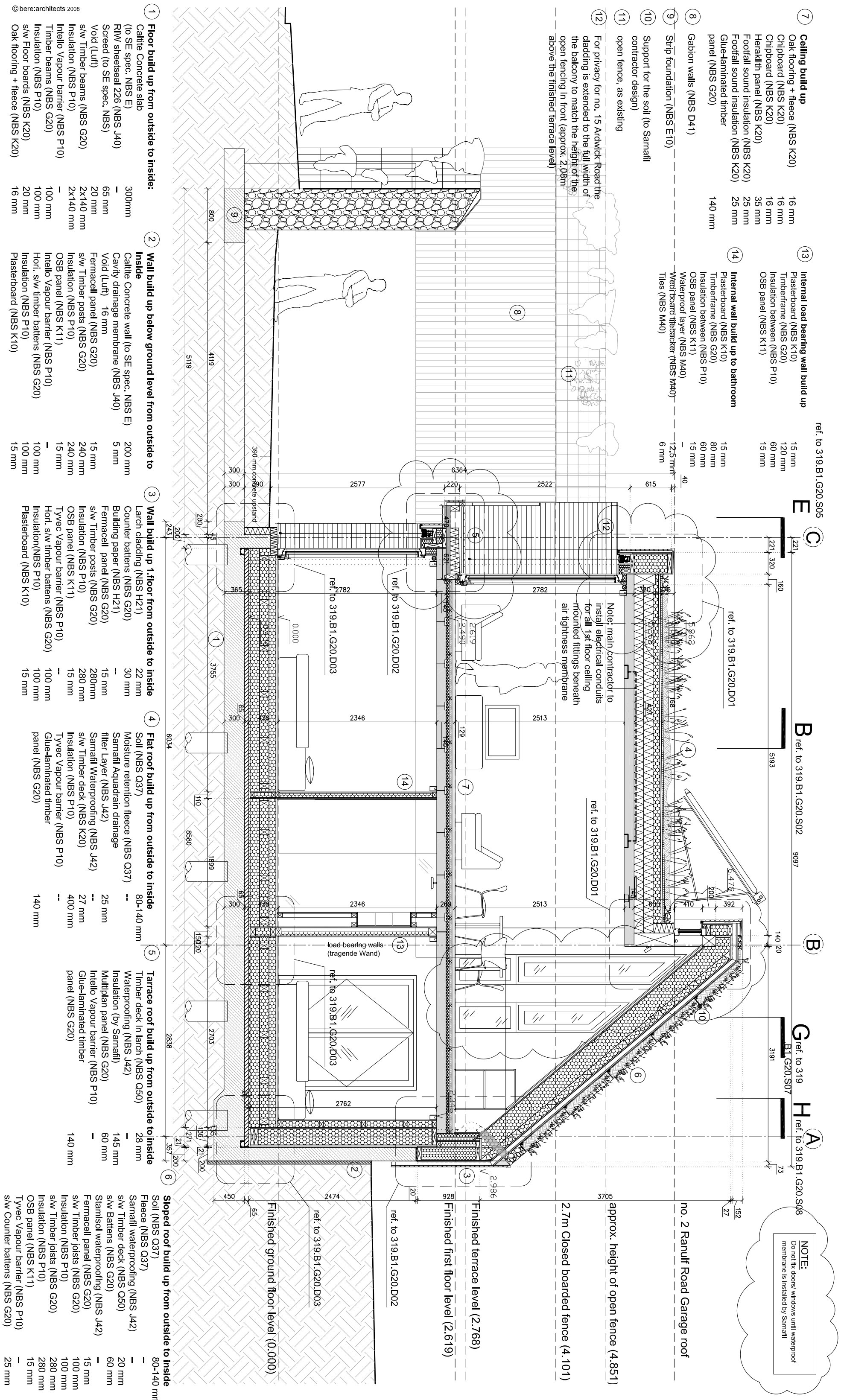
2.5 Section AA in detail

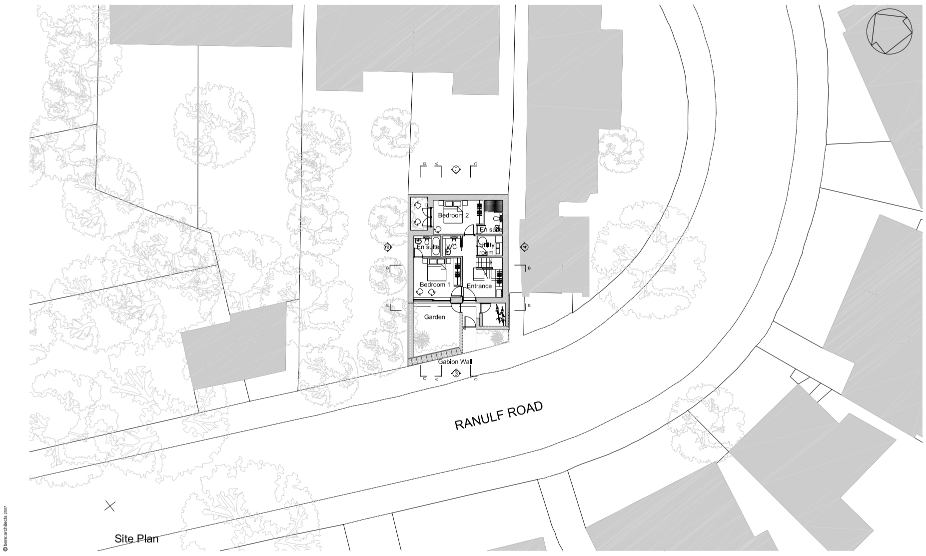
This is a typical section through the house. It is easy to see the thermal envelop because of the extremely high levels of insulation.

This section also shows how the house opens up towards the south with full height windows on the ground and first floor. To the north there is a sloping green roof to allow light into the garden behind.

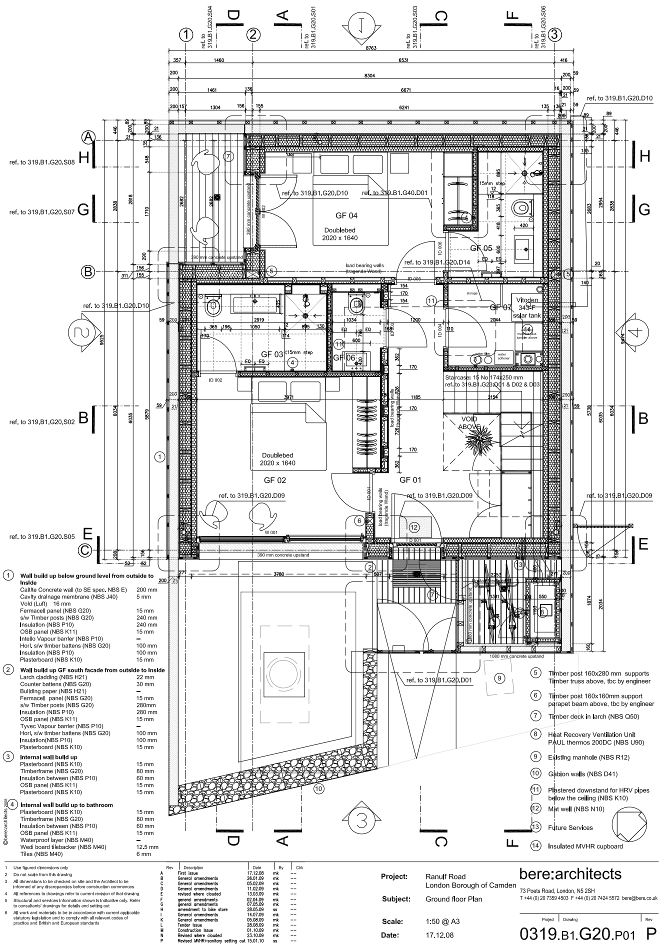
This section shows a gabion wall at the front of the garden. However this was not constructed, instead an Ivy wall was installed which will encourage local biodiversity.



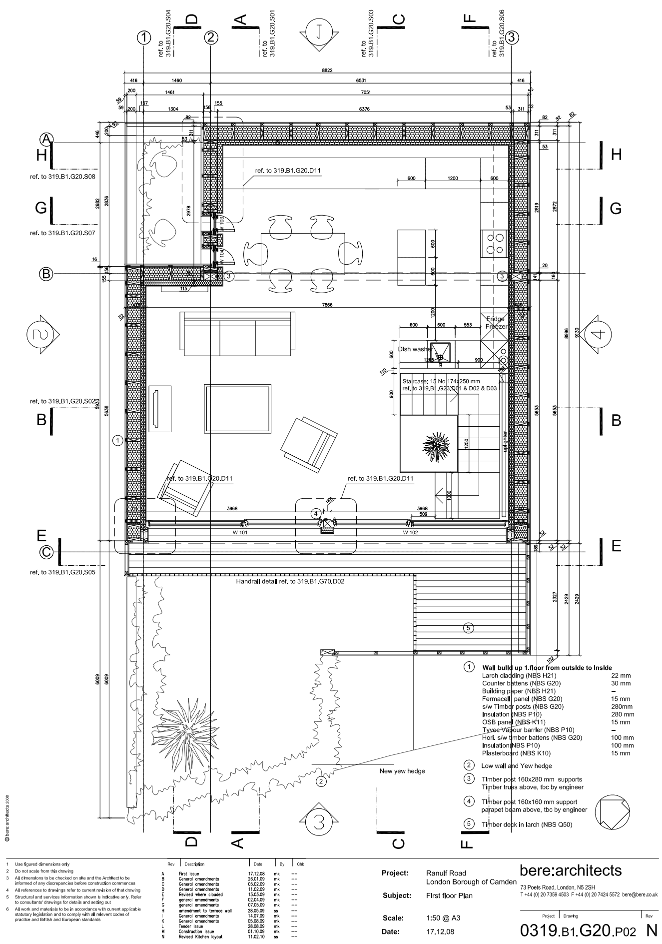
2.6 Plans in Detail



The main entrance to the house is at the ground floor level. To minimise the need for artificial lighting during the day all of the main living spaces are on the first floor. At first floor level there is also a generous external terrace. The bedrooms, bathrooms and utility are all on the ground floor as their requirements for natural daylight are lower. Both of the bedrooms have private outdoor areas.



Ground floor plan

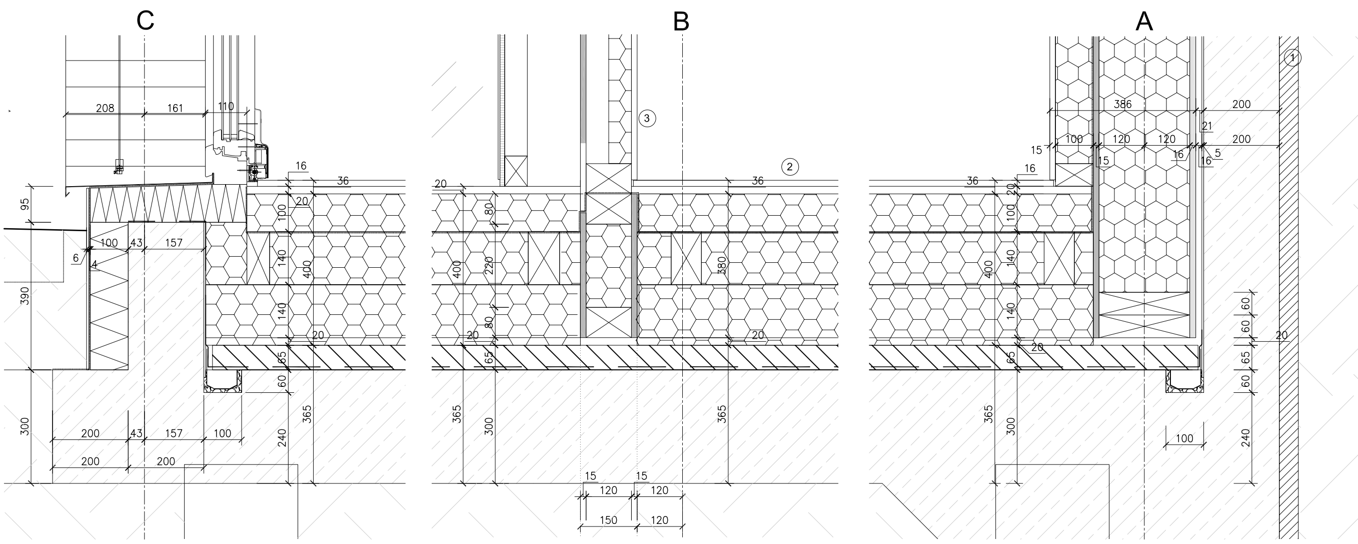


First floor plan

2.7 Construction Details

The following section looks at some of the key construction details throughout the house.

2.7.1 Ground floor and external/internal wall junction details



(1) **Wall build up below ground level from outside to inside**

Caltite Concrete wall (to SE spec. NBS E)	200 mm
Cavity drainage membrane (NBS J40)	5 mm
Void (Luft) 16 mm	
Fermacell panel (NBS G20)	15 mm
s/w Timber posts (NBS G20)	240 mm
Insulation (NBS P10)	240 mm
OSB panel (NBS K11)	15 mm
Intello Vapour barrier (NBS P10)	--
Hori. s/w timber battens (NBS G20)	100 mm
Insulation (NBS P10)	100 mm
Plasterboard (NBS K10)	15 mm

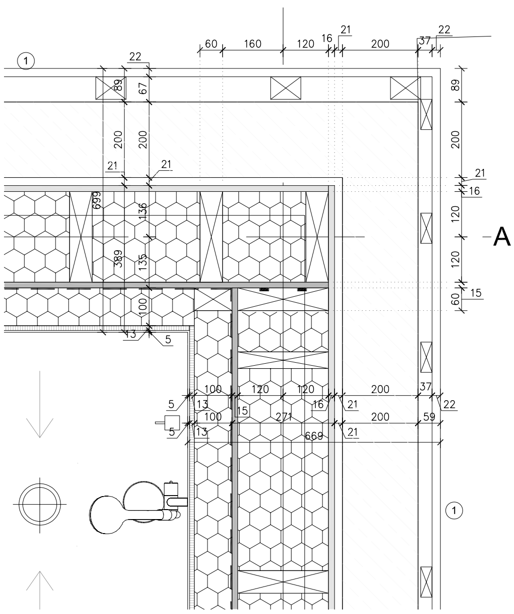
(2) **Floor build up from outside to inside:**

Caltite Concrete slab (to SE spec. NBS E)	300mm
RIW sheetseal 226 (NBS J40)	--
Screed (to SE spec. NBS)	65 mm
Void (Luft)	20 mm
s/w Timber beams (NBS G20)	2x140 mm
Insulation (NBS P10)	2x140 mm
Intello Vapour barrier (NBS P10)	--
Timber beams (NBS G20)	100 mm
Insulation (NBS P10)	100 mm
s/w Floor boards (NBS K20)	20 mm
Oak flooring + fleece (NBS K20)	16 mm

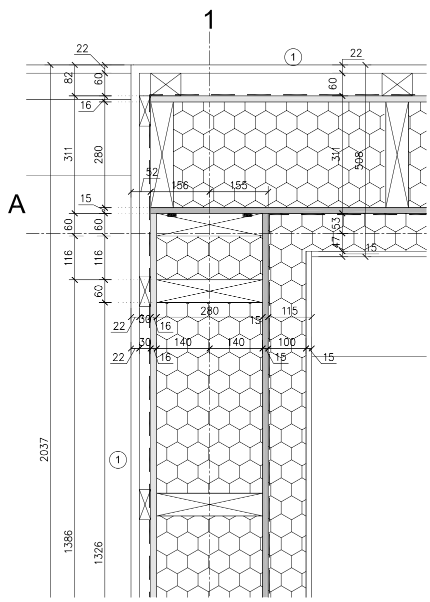
(3) **Masterbed Ensuite wall build up**

Plasterboard (NBS K10)	15 mm
Timber frame (NBS G20)	120 mm
Insulation between (NBS P10)	60 mm
OSB panel (NBS K11)	15 mm
Timber frame	60 mm
Wedi board tilebracker (NBS M40)	12.5 mm
BAL-WPI tanking (NBS M40)	1 mm

2.7.2 Plan exterior wall details



Ground floor external wall corner detail



First floor external wall corner detail

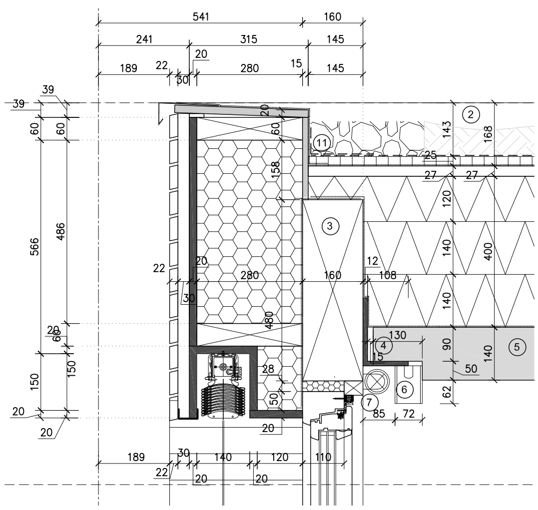
(1) **Wall build up 1.floor from outside to inside**

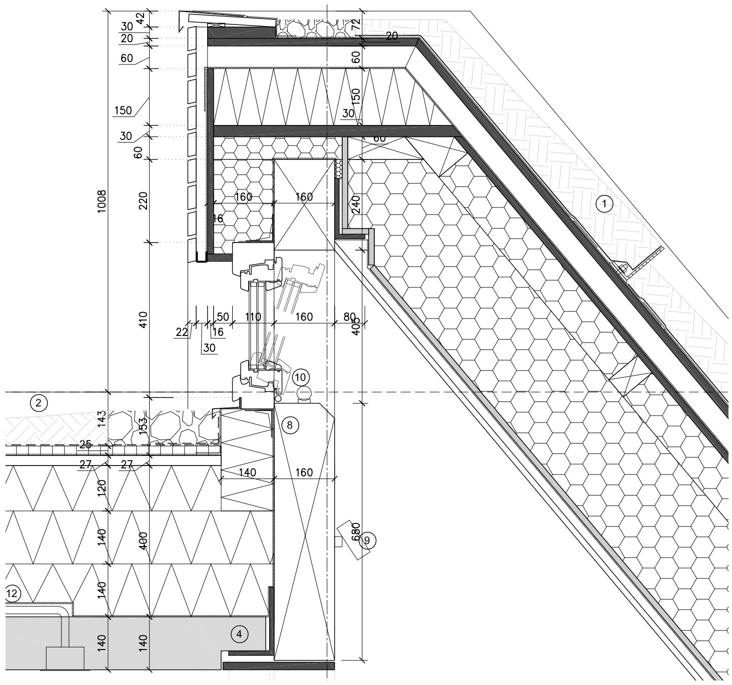
Larch cladding (NBS H21)	22 mm
Counter battens (NBS G20)	30 mm
Building paper (NBS H21)	--
Fermacell panel (NBS G20)	15 mm
s/w Timber posts (NBS G20)	280mm
Insulation (NBS P10)	280 mm
OSB panel (NBS K11)	15 mm
Tyvec Vapour barrier (NBS P10)	--
Hori. s/w timber battens (NBS G20)	100 mm
Insulation(NBS P10)	100 mm
Plasterboard (NBS K10)	15 mm

(2) Timber post 160x160 mm, tbc by engineer

The prefabricated wall units arrived on site pre-insulated, once craned into place the airtighness membranes were bonded and the battens installed to create a 100mm service void which was filled with wood fibre insulation after the completion of the first fix mechanical and electrical installation.

2.7.3 Roof to external wall detail / flat to sloping roof detail





(1) **Sloped roof build up from outside to inside**

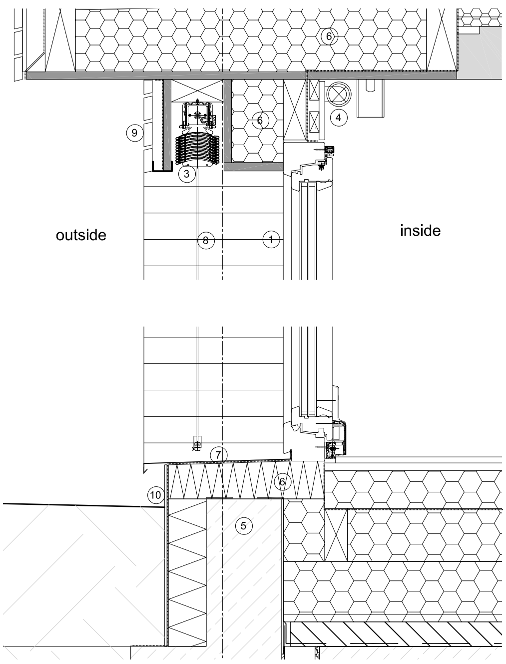
Soil (NBS Q37)	80-140 mm
Fleece (NBS Q37)	--
Sarnafil waterproofing (NBS J42)	--
s/w Timber deck (NBS Q50)	20 mm
s/w Battens (NBS G20)	60 mm
Stamisol waterproofing (NBS J42)	--
Fermacell panel (NBS G20)	15 mm
s/w Timber joists (NBS G20)	100 mm
Insulation (NBS P10)	100 mm
s/w Timber joists (NBS G20)	280 mm
Insulation (NBS P10)	280 mm
OSB panel (NBS K11)	15 mm
Tyvec Vapour barrier (NBS P10)	--
s/w Counter battens (NBS G20)	25 mm
Plasterboard (NBS K10)	15 mm

(2) **Flat roof build up from outside to inside**

Soil (NBS Q37)	80-140 mm
Moisture retention fleece (NBS Q37)	--
Sarnafil Aquadrain draingage	
filter Layer (NBS J42)	25 mm
Sarnafil Waterproofing (NBS J42)	--
s/w Timber deck (NBS K20)	27 mm
Insulation (NBS P10)	400 mm
Tyvec Vapour barrier (NBS P10)	--
Glue-laminated timber	
panel (NBS G20)	140 mm

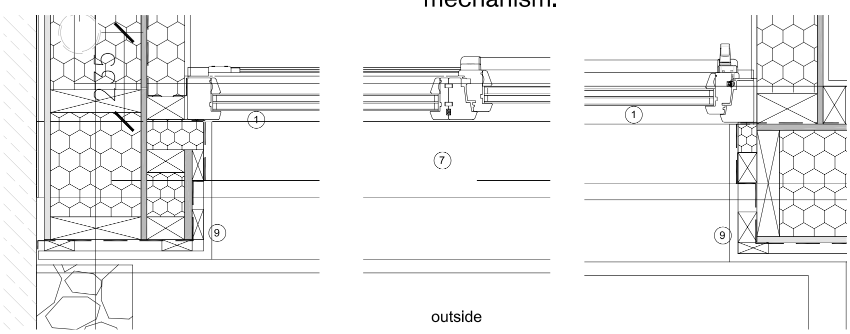
(3) Timber beam 160x480 mm, tbc by engineer
(4) Steel angle 120x180x12 mm, tbc by engineer
(5) Kaufmann Profi timber panel 140mm, tbc by engineer
(6) Zumtobel light fitting
(7) Blinds (NBS N10)
(8) Timber truss, beams 160x680 mm & 160x240 mm, tbc by engineer
(9) Directional lighting only above sink
(10) Lighting
(11) Sarnafil Type T fleece
(12) Insulation to be cut for sprinkler, electrical conduits, conduits to be installed before Tyvec membrane is laid

2.7.4 Window details in plan and section



(1) Triple glazed timber PSK window passivhaus certified, exterior painted dark grey U value glass = 0,6, supplied by Bayer Dimensions refer to layout **319.B1.G32.E01**
(2) Terrace
(3) External metal louvre for solar shading supplied by Hella
(4) Internal blind
(5) Concrete upstand
(6) Timber battens with insulation between
(7) Aluminium window sills supplier by Bayer
(8) External blind guide
(9) Larch cladding
(10) Eternit panel
(11) Gabion wall

There are two types of windows in the house, tilt and turn and sliding. The tilt and turn windows are PHI certified with a Ug 0.6W/(m²K) and an overall Uf 0.72W/(m²K). The sliding windows are PSK windows with the same build-up as the tilt and turn but with a different opening mechanism.



Window section

Window plan

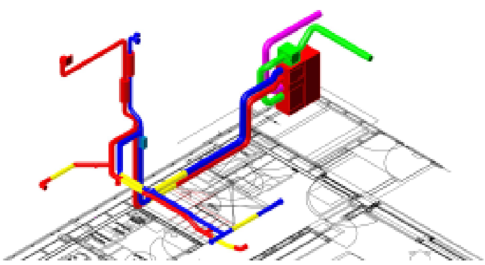
2.7.5 Description of air tightness strategy and air test result

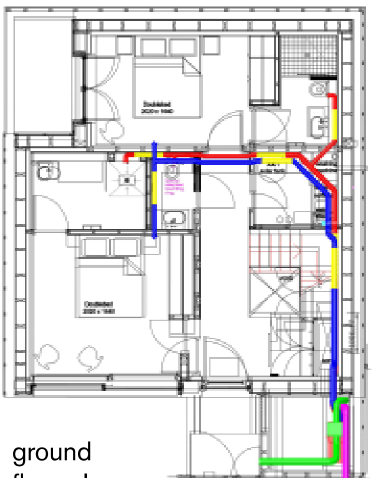
The air tightness strategy was to have easy to install construction details with a clear line of airtightness around the whole house created with Pro Clima Intello membranes. All the membranes were installed with overlaps bonded with single-sided Intello Uni tape. The Intello membrane was carefully installed around all of the windows and doors and overlaps achieved with the tapes pre-fixed to the windows. An air leakage point was identified around the large PSK windows at the top of the frame above the handle where a bracket holds the top of the door where an inner seal was missing. This was rectified by installing a new inner seal. The final air tightness result was **0.44h^{-1}**.

2.7.6 Ventilation layout

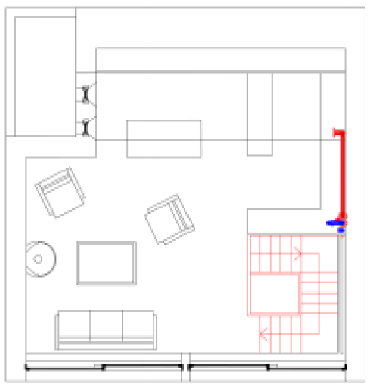
The heat recovery ventilation unit is located within the bike store at the front of the house, this is outside the thermal envelope. The air intake is from the garden side of the gate where it is hoped that the air quality will be better than adjacent to the road. The extract is straight through the bike store to the front of the house (adjacent to the road). The duct runs are kept as short as possible to maximise the efficiency.

3D layout for ductwork
(red=extract and blue=supply)





ground
floor plan



first
floor plan

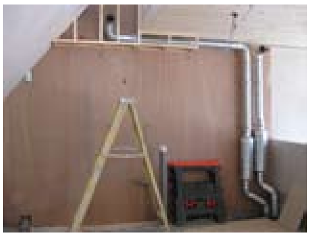
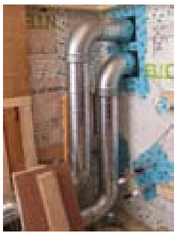
2.7.7 Type of ventilation, insulation for ducts, commissioning report

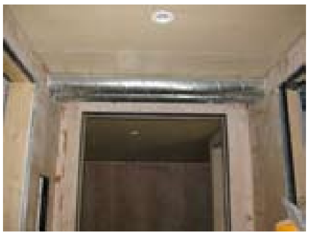
The heat recovery ventilation unit used is a PAUL thermos 200 DC, this is a PHI certified unit with an efficiency of 92%. The heat recovery unit is located outside the thermal envelope in the bike store. It is contained within an insulated cupboard. This cupboard is insulated with 60mm of closed cell insulation.

The ducts are 160mm dia from the unit to the external wall, this length of duct work is kept as short as possible and insulated with a 3 x 32mm thick sheet closed cell insulation. The ducts reduce to 150mm dia where they enter the house. The house is air heated with a post heater which is connected to the solar water tank/ gas boiler. As such the supply duct work is insulated with 50mm of foil backed mineral wool insulation. The main duct runs are 125mm dia ducts reducing to 100mm dia ducts when supplying only one room. Sound attenuating flexible duct work was specified as required to prevent noise transfer between rooms.

The unit controls provide for direct control of the air heating, as well as frost protection heating. There is also an automatic summer bypass function. This effectively turns off the heat recovery when it would be beneficial to bring cooler air into the house. So when the room temperature is above a set temperature, eg 24C, and the outside air is cooler, the outside air is brought direct without heat recovery.

Provision was made for air to transfer from the supply rooms to the extract air rooms by designing a 10mm gap under all of the internal doors.

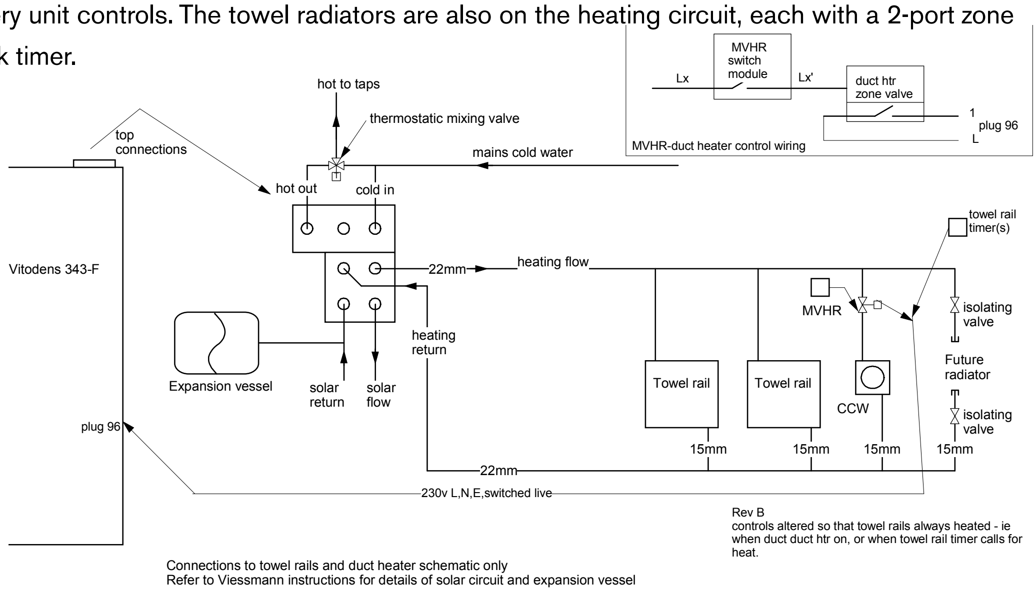





2.7.8 Heating strategy

Heating is by air and by 2no. towel radiators. The towel radiators were not required to maintain an internal temperature of 20C but installed for user comfort. The duct heater is connected to the boiler via a 2-port zone valve which is controlled by the heat recovery unit controls. The towel radiators are also on the heating circuit, each with a 2-port zone valve controlled by a run-back timer.

When the temperature drops below 20C the post heater and the towel radiators turn on automatically. It is also possible for the client to activate the boost function which turns the air heating and towel radiators on for 30mins even if the temperature has not dropped below 20C.



2.8 PHPP results (verification page)

Building:	no. 4 Ranulf Road	
Location and Climate:	London	GB-London
Street:	Ranulf Road	
Postcode/City:	NW2 2BU	
Country:	UK	
Building Type:	Detached house	
Home Owner(s) / Client(s):	Victoria Terry	
Street:	23 Ranulf Road	
Postcode/City:	NW2 2BU, London	
Architect:	bere:architects	
Street:	73 Poets Road	
Postcode/City:	N5 2SH, London	
Mechanical System:	The Green Building Store (PAUL Thermos 200DC)	
Street:	Heath House Mills	
Postcode/City:	HD7 4JW, Huddersfield	

Year of Construction:	2008				
Number of Dwelling Units:	1		Interior Temperature:	20.0	°C
Enclosed Volume V_e:	269.0	m^3	Internal Heat Gains:	2.1	W/m^2
Number of Occupants:	2.8				

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 99.0 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	13	$kWh/(m^2a)$	15 $kWh/(m^2a)$	Yes
Pressurization Test Result:	0.4	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	97	$kWh/(m^2a)$	120 $kWh/(m^2a)$	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	48	$kWh/(m^2a)$		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		$kWh/(m^2a)$		
Heating Load:		W/m^2		
Frequency of Overheating:	7	%	over 25 °C	
Specific Useful Cooling Energy Demand:		$kWh/(m^2a)$	15 $kWh/(m^2a)$	
Cooling Load:		W/m^2		

2.9-2.10 Costs £ /m^2 (treated floor area) - the client has asked that these are not published.

2.11 Year of Construction - 2009 - 2010

2.12 Design Overview

The house was designed from the outset with PHPP. Before the planning stage bere:architects ran up to 20 PHPP files to look at alternative orientations and envelope configurations. The result of these studies was a building orientated to the south with a large proportion of southern glazing. Glazing to the north was limited to 3 modest apertures in the north west facade.

As part of the overall biodiversity strategy flat and sloping green roofs were incorporated into the design. These provide an oasis for local insects and birds, as well as a beautiful outlook for the local residents.

The final design was comprehensibly studied with PHPP and heat2 to finalise the exact construction build-ups and details, glazing percentages, shading requirements and heating strategy.

2.13 Technical Design Overview

bere:architects were lead consultant and contract administrators for the project from inception to completion. bere:architects lead the full technical design and specification. bere:architects worked with the Energy Consultant and Building Services Engineer Alan Clarke on the design of the heating system and with the Green Building Store for the design of the heat recovery ventilation system. Lighting consultants GIA Equation were consulted on the low energy LED and fluorescent lighting design.

2.13 Technical Design Overview cont.

The technical design was designed to be able to be simple to use for the young family moving into the house. bere:architects have advised the client how to operate the systems in the house including all of the shading mechanisms, operation of the heat recovery ventilation and how and when to change the filters. How to use the windows and keep the house cool in the summer without air conditioning and how to avoid dry air in the winter. The clients understand that the ventilation system, solar collectors and water harvester should have an annual check in the same way as the boiler. The general strategy is outlined below:

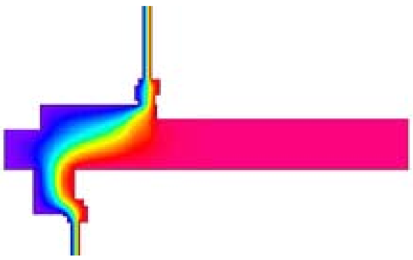
Rainwater harvesting - rain water is harvested from the green roofs and terrace areas and held in a 1600L under ground tank for irrigation use. The tank also has a mains back-up supply for use in times of low rainfall.

Solar collection - 3m^2 of evacuated solar collector tubes have been installed on the flat roof. This collector feeds the solar water tank located in the utility room which in turn is used for the hot water supply in the house and as the heating source for the post heater. A small gas boiler was specified as an integral part of the solar tank and tops up the tank when there has been insufficient sunshine.

Air heating - The house has been designed to have a heat load of less than 10W/m^2 so air heating is being used as the main source of heat. 2no. towel radiators are also used to provide an additional level of comfort for the young family.

2.14 In house PHPP and heat2

bere:architects completed the full PHPP assessment in house including all the static thermal modelling with Heat2. This was then re-assessed independently by a PHI approved certifier.



2.15 Experience so far

The client has not moved into the house yet however feed back from the builders has been very positive. London has experienced a very cold winter and the builders noted when on site that the house remained warm even when the air heating was not in use.

2.16 Engineering

The engineering for the substructure was completed in the UK by a firm called Rodrigues Associates. The timber superstructure engineering was completed by the Austrian timber companies sub-contractor. The complete structural design was approved by UK Building Control before the project started on site.

2.17 Monitoring

bere:architects have also been monitoring the internal temperatures with data loggers, these record the internal and external temperatures at 10min intervals. We will be publishing this information on our blog. The house will also be used as a study project for a masters student in London and a masters student at the Centre for Alternative Technologies in Wales.