Project Documentation
Gebäude-Dokumentation

1 Abstract / Zusammenfassung

Detached house in Huddersfield, UK

1.1 Data of building / Gebäudedaten

Year of construction/ Baujahr	2015	**Space heating / Heizwärmebedarf**	**8.7 kWh/(m²a)**
U-value external wall/ U-Wert Außenwand	0.118 W/(m²K)		
U-value Floor slab/ U-Wert Kellerdecke	0.107 W/(m²K)	**Primary Energy Renewable (PER) / Erneuerbare Primärenergie (PER)**	41 kWh/(m²a)
U-value roof/ U-Wert Dach	0.104 W/(m²K)	**Generation of renewable energy / Erzeugung erneuerb. Energie**	10 kWh/(m²a)
U-value window/ U-Wert Fenster	0.79 W/(m²K)	**Non-renewable Primary Energy (PE) / Nicht erneuerbare Primärenergie (PE)**	52 kWh/(m²a)
Heat recovery/ Wärmerückgewinnung	91.5 %	Pressure test n_{50} / Drucktest n_{50}	0.3 h-1
Special features/ Besonderheiten	Solar thermal for hot water generation.		

1.2 Brief Description ...

Golcar Passivhaus is a detached 230 m^2 dwelling in Huddersfield, West Yorkshire. The building is of stone block cavity wall construction maintaining the local vernacular. The buildings orientation is nearly due south at 188°. It is a three-storey dwelling with living areas on the first floor, two bedrooms to the ground floor and a third bedroom in the warm roof space. Special features include: Solar thermal collectors for hot water.

1.2 Responsible project participants / Verantwortliche Projektbeteiligte

Architect/ Entwurfsverfasser	Green Building Store https://www.greenbuildingstore.co.uk
Implementation planning/ Ausführungsplanung	Bill Butcher, Chris Herring Green Building Store https://www.greenbuildingstore.co.uk
Building systems/ Haustechnik	Green Building Store https://www.greenbuildingstore.co.uk
Structural engineering/ Baustatik	SGM Structural design http://sgmstructuraldesign.com
Building physics/ Bauphysik	Paul Smith, Green Building Store https://www.greenbuildingstore.co.uk
Passive House project planning/ Passivhaus-Projektierung	Paul Smith, Green Building Store https://www.greenbuildingstore.co.uk
Construction management/ Bauleitung	Jude Wilson, Green Building Company https://www.greenbuildingstore.co.uk
Certifying body/ Zertifizierungsstelle	WARM low energy building practice https://www.peterwarm.co.uk/
Certification ID/ Zertifizierungs ID	13562_Warm_PH_20160517_PW Project-ID (5068)

Author of project documentation / Verfasser der Gebäude-Dokumentation	Mr Paul Smith https://www.greenbuildingstore.co.uk

Date, Signature/ 24 October 2019
Datum, Unterschrift

2. Views of the Passive House, Huddersfield.

The south-facing side is shown in the cover page.

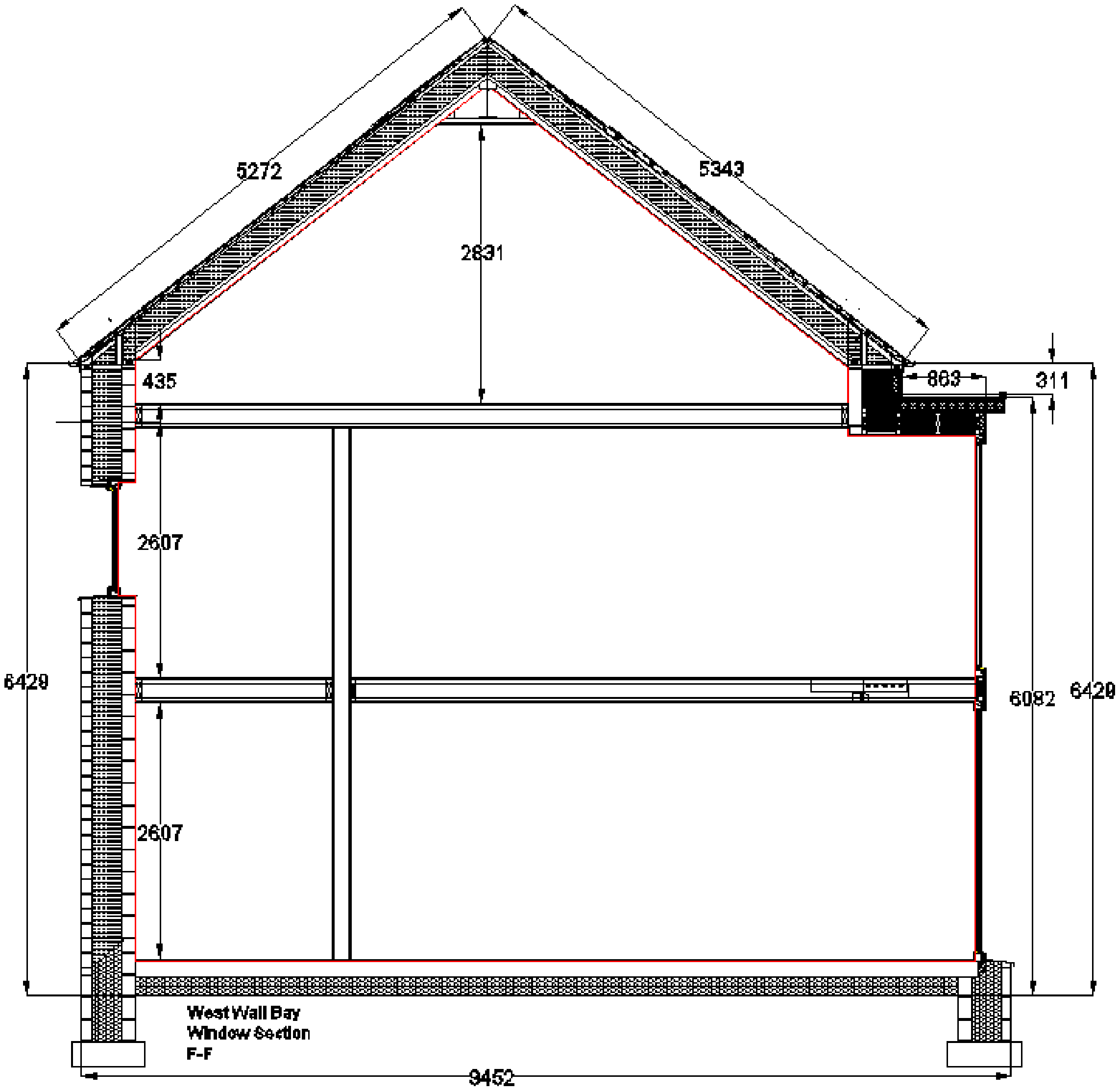
***West side* of the Passive House in Huddersfield, West Yorkshire;** The intake and exhaust air grilles for the MVHR system are clearly visible, this elevation faces a public road, the windows were sized for adequate daylighting.

Picture of the Passive House in Huddersfield West Yorkshire from the *north*; entrance lobby to the first floor living areas and optimised glazing areas can be seen.

Passive House in Huddersfield, UK, view from the *East*; The east elevation before landscaping was complete and scaffold removed. Heavily shaded by established trees on the boundary edge.

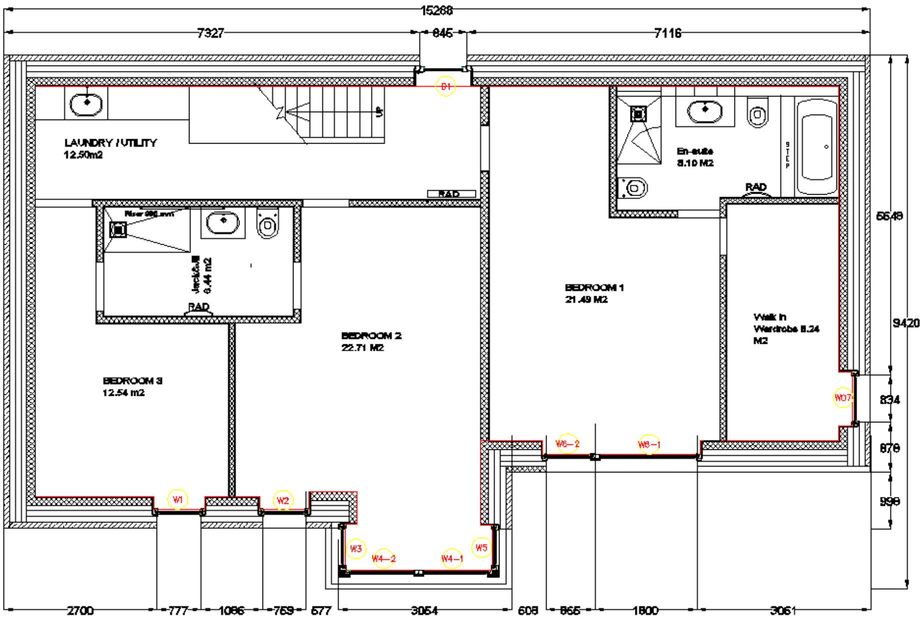
Interior view from the Kitchen towards the dining room and living room; shows the open layout and south-facing glazed bay window area utilised for sitting and taking in the views across the Colne Valley.

3. Sectional drawing of the Passive House, Huddersfield.

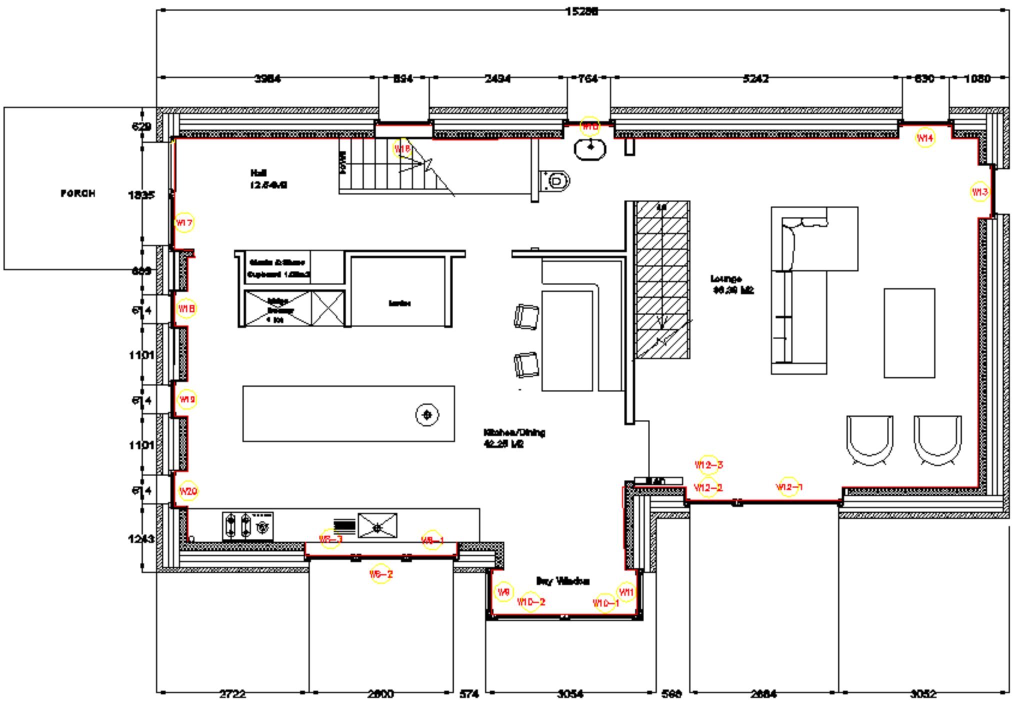


Typical cross-section through the Passive House in Huddersfield. The buildings thermal envelope with continuous insulation can be seen and the internal airtightness layer is visible as a red line.

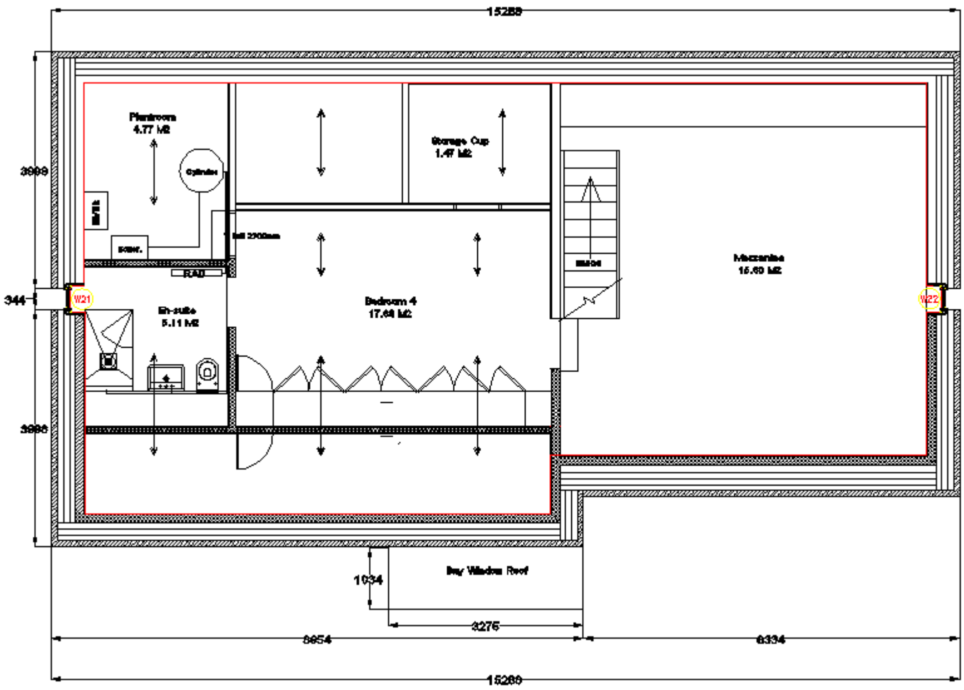
4 Floor plans of the Passive House in Huddersfield



Ground Floor plan of the Passive House in Huddersfield.



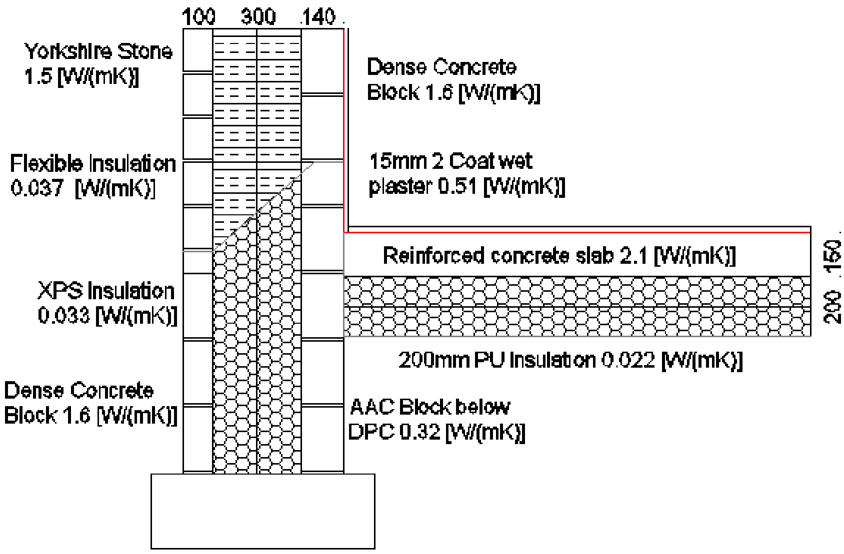
First Floor plan of the Passive House in Huddersfield.



Second Floor plan of the Passive House in Huddersfield.

5 Construction details of the envelope and Passive House technology of the Passive House, Huddersfield.

5.1 Construction Ground floor slab



The ground floor is constructed from a 150mm reinforced concrete slab floating on 200mm of Pu insulation. To reduce the thermal bridge at the perimeter junction the internal block skin below the FFL is constructed from AAC concrete blocks 0.32 λW/(mK) (fig 1). Thermal bridging at fenestration thresholds was reduced by casting blocks of Compactfoam Insulation 0.47 λW/(mK) into the slab perimeter (fig 2).

Floor slab build-up:

Ground Floor Slab	150mm Reinforced Concrete slab 2.1 λW/(mK), 200mm Pu insulation 0.022 λW/(mK),	U-value 0.107 W/(m²K)

Fig 1. Slab and permieter insulation, installation.

Fig 2. Compacfoam positioned to be cast into slab to reduce thermal bridge at thresholds.

5.2 Construction including insulation of cavity walls

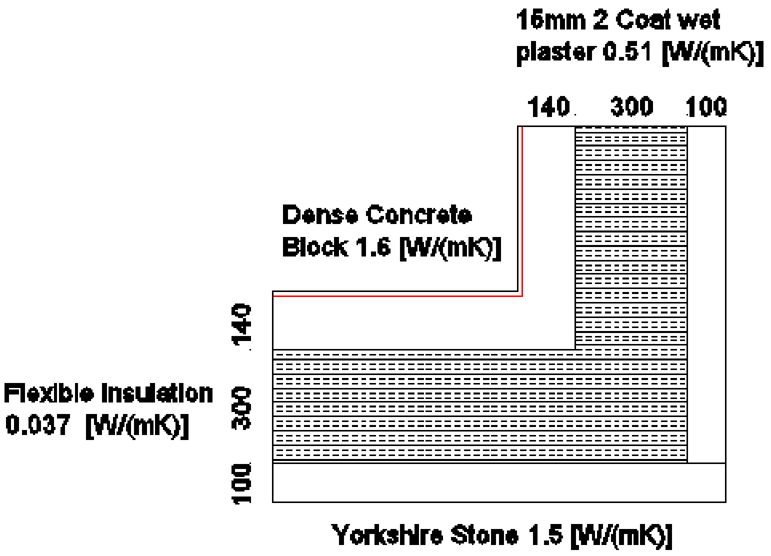
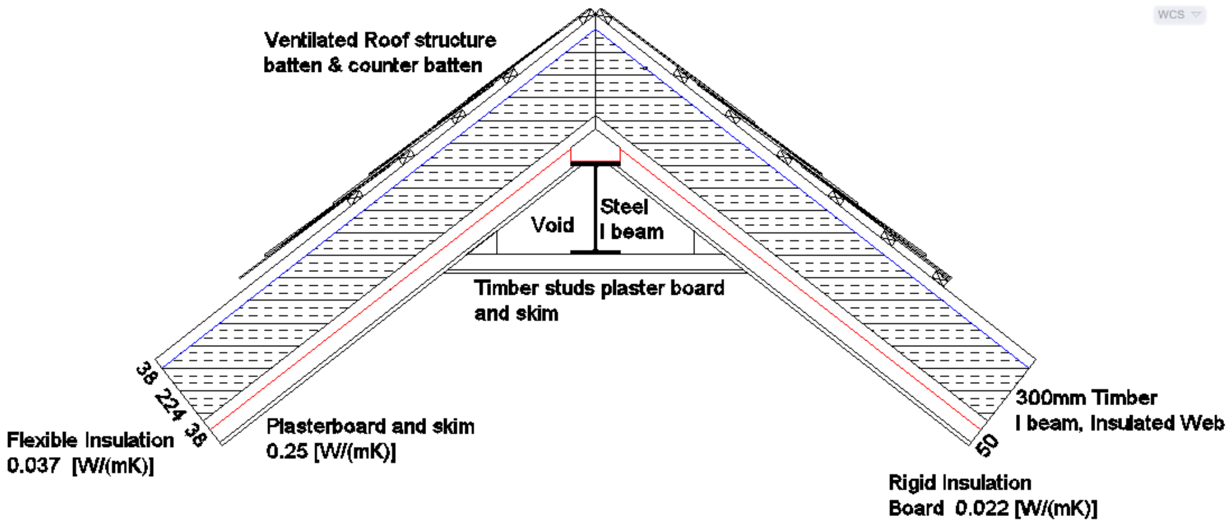


Fig 3. Full fill cavity insulation and basalt wall ties.

Exterior wall assembly. 15mm Gypsum Wet plaster is applied as the airtightness layer to 140mm dense concrete block inner leaf. 300mm full fill cavity with flexible batt insulation and basalt wall ties (fig 3). 100mm Yorkshire stone external leaf.

Exterior wall	15mm Gypsum plaster 0.51λW/(mK), 140mm concrete block 1.6 λW/(mK), 300mm flexible batt insulation 0.037λW/(mK), 100mm Yorkshire stone 1.5λW/(mK).	U-value 0.118 W/(m²K)

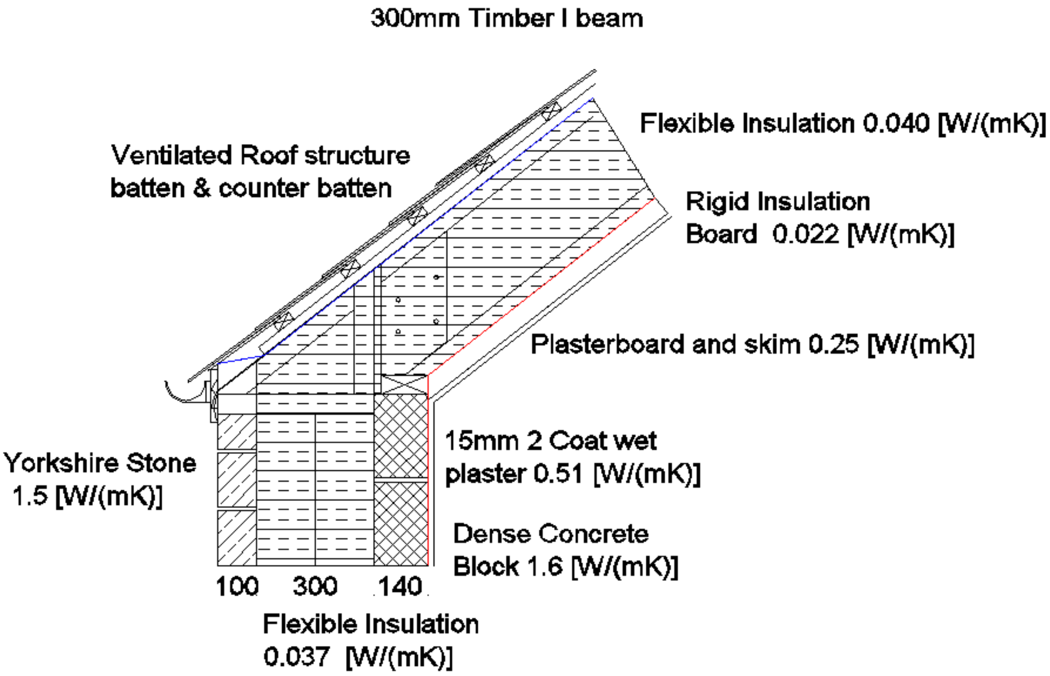
5.3 Construction including insulation of the roof



Roof build-up of the Passive House in Huddersfield. The roof was constructed with timber I beams spanning from the eaves to a steel ridge beam and fully filled with flexible insulation batts. An airtight membrane was installed, joints taped, insulated backed plaster board was fixed to the underside of the timber I beams to take a skim coat of plaster to finish and reduce thermal bridging

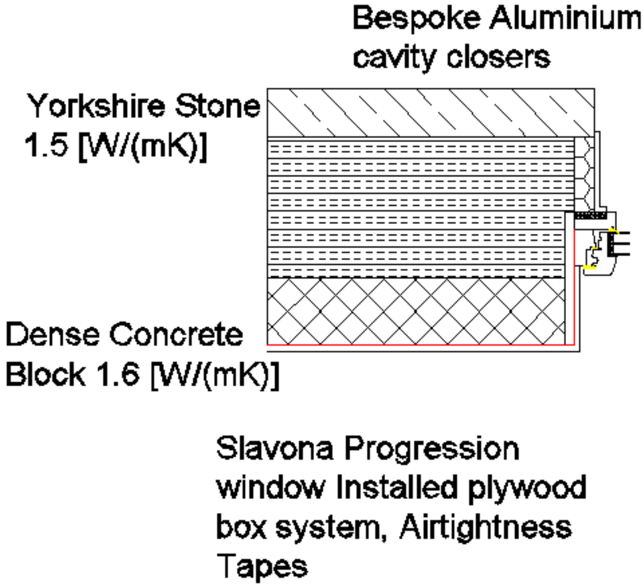
Roof	15mm plasterboard and skim 0.25λW/(mK), 50mm rigid board insulation 0.022 λW/(mK), 300mm flexible batt insulation 0.040 λW/(mK), Roofing membrane, battens and counter battens, slate.	0.104 W/(m²K)

5.4 Construction including insulation of the eaves



Eaves build-up for the Passive House in Huddersfield. To maintain continuity of the insulation layer and keep thermal bridging to a minimum the eaves were constructed using timber formers fixed to the underside of the beams and spanning the depth of the wall. This allowed the insulation to be installed neatly and continue in line with the roof insulation.

5.5 Window sections including installation drawing



The windows used on the Golcar project are from the Green Building Store Progression window range with an average U_f of 0.83 W/(m^{2}K). The frame is designed to be wrapped within the insulation layer of the building fabric reducing the installation thermal bridge and maximising the available glazing area (glazing is bonded to the sash removing the need for an external frame to support the glazing). The Green Building Store Ultra range with an average U_f of 0.99 W/(m^{2}K) were used for the entrance doors. Triple glazed units with warm edge spacers were specified throughout. The U_g values ranged from 0.53 – 0.58 W/(m^{2}K) and the g values 48 – 49 %. The average overall U value for the fenestration was 0.79 W/(m^{2}K).

Window data

Window	Triple low-e glazing filled with Argon gas and SWISSP.V warm edge spacer. Timber window frames with Thermowood, cork insulation and GRP bottom bead.	0.68 W/(m^{2}K)

6 Description of the airtight envelope; documentation of the pressure test result

An internal two coat wet plaster system was used to provide the airtightness layer on the external walls, airtightness tapes and membranes were used at the various different junctions (fig 4) to maintain the airtightness barrier and prevent future air leakage form cracking due to differential movement and drying out of different materials. The Golcar house achieved an airtightness result of 0.25 ACH/hr @ 50 Pa.

The resulting air pressure test was carried out by Leeds Beckett University, the air leakage at depressurisation was 0.25 h-1@50 Pa, and 0.26 h-1@50 Pa at pressurisation.

LEEDS BECKETT UNIVERSITY

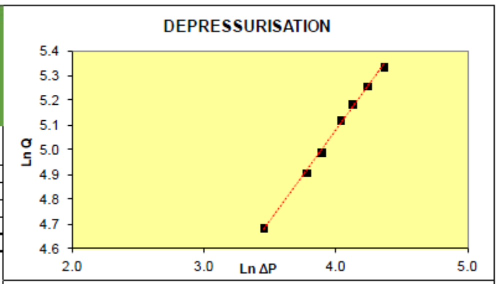
Leeds Sustainability Institute

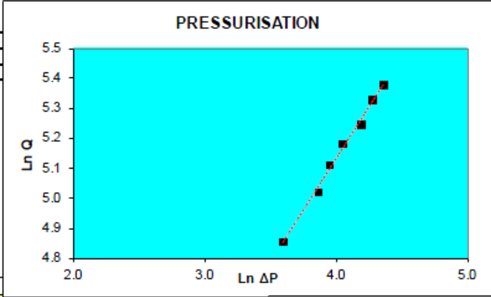
MINNEAPOLIS BLOWER DOOR DATA INPUT AND CALCULATION

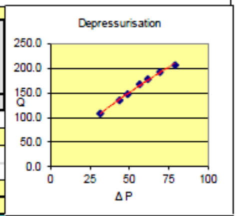
date:	15/01/2015		Version 16c 04 November 2014
test house address:	Glocar Passivhaus		
company:	Green Building Company		
house type:	Passivhaus		
tester:	DMS, DF,MP, DJ		
test reference number:	Glolcar2		Blower Door & Gauge Used: Model 3 with DG700
outdoor temp (°C)	5.4	°C	Note: ENSURE THAT FLOW SETTINGS ARE IN m3/h - When using the DG700 gauge run baseline pressure adjustment for minimum 30s with fan switched on but not rotating
indoor temp (°C)	15.2	°C	
outdoor humidity (%rh)	68.6	%RH	
indoor humidity (%rh)	54.2	%RH	
outdoor barometric pressure	960.5	mbar or hPa	Calculated Outdoor Air Density: 1.20 kg/m^3
indoor barometric pressure	960.6	mbar or hPa	Calculated Indoor Air Density: 1.16 kg/m^3
temperature corr. fact. depress.	0.966		description of main construction details:
temperature corr. fact. press.	1.035		Masonry cavity fully-filled
wind speed (m/s):	1.5		
baseline pressure diff (Pa) (+/-)		Pa	
house width:		m	
house depth:		m	
house height:		m	
floor area:		m^2	
volume:	612	m^3	
envelope area including floor:		m^2	
Pressure Difference for ELA	10	Pa	
RESULTS:			
Q50 Mean Flow at 50Pa =	154.09	m^3/h	
Mean Air Leakage at 50Pa =	0.25	h^{-1}	
Mean Air Permeability at 50 Pa =		m/h or m^3h/m^2	
Equivalent Leakage Area =	0.005	m^2 at	10 Pa

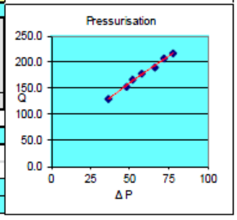
DEPRESSURISATION	RING - O,A,B,C,D,E for BD3 0,1,2,3 for DuctBB	MEASURED FAN PRESSURE (Pa)	MEASURED FLOW (m^3/h)	ADJUSTED FLOW (m^3/h)	FLOW RANGE OK FOR SELECTED RING?	Adjusted Pressure (Pa)	Ln delta P	Ln Q	Q50 Calculated Flow at 50Pa (m^3/h)	Permeability Depressurisation Only ($m^3/(h.m^2)$)	Air Leakage Depressurisation Only (h^{-1})
Approx 65 Pa	3	79	215	207.5	OK	79	4.369	5.335	150.54		0.25
Approx 57 Pa	3	69.4	199	192.0	OK	69.4	4.240	5.258	r^2	0.998	
Approx 49 Pa	3	62	185	178.5	OK	62	4.127	5.185	C_{env}	8.703	$m^3/h.Pa^n$
Approx 41 Pa	3	56.6	173	166.9	OK	56.6	4.036	5.118	n	0.729	
Approx 33 Pa	3	48.9	152	146.7	OK	48.9	3.890	4.988			
Approx 25 Pa	3	43.6	140	135.1	OK	43.6	3.775	4.906	C_L (corrected)	8.699	$m^3/h.Pa^n$
Approx 20 Pa	3	31.6	112	108.1	OK	31.6	3.453	4.683			

PRESSURISATION	RING - O,A,B,C,D,E for BD3 0,1,2,3 for DuctBB	MEASURED FAN PRESSURE (Pa)	MEASURED FLOW (m^3/h)	ADJUSTED FLOW (m^3/h)	FLOW RANGE OK FOR SELECTED RING?	Adjusted Pressure (Pa)	Ln delta P	Ln Q	Q50 Calculated Flow at 50Pa (m^3/h)	Permeability Pressurisation Only ($m^3/(h.m^2)$)	Air Leakage Pressurisation Only (h^{-1})
Approx 65 Pa	3	77.9	209	216.6	OK	77.9	4.355	5.378	157.63		0.26
Approx 57 Pa	3	71.9	199	206.2	OK	71.9	4.275	5.329	r^2	0.993	
Approx 49 Pa	3	66.1	183	189.7	OK	66.1	4.191	5.245	C_{env}	10.742	$m^3/h.Pa^n$
Approx 41 Pa	3	57.5	172	178.3	OK	57.5	4.052	5.183	n	0.690	
Approx 33 Pa	3	51.8	160	165.8	OK	51.8	3.947	5.111			
Approx 25 Pa	3	47.8	146	151.3	OK	47.8	3.867	5.019	C_L (corrected)	10.619	$m^3/h.Pa^n$
Approx 20 Pa	3	36.4	124	128.5	OK	36.4	3.595	4.856			

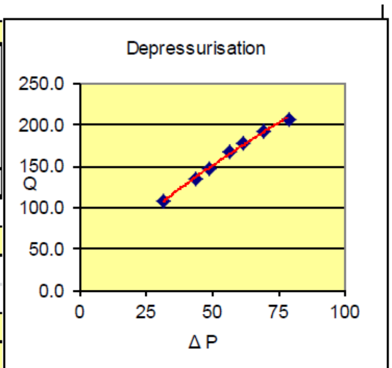




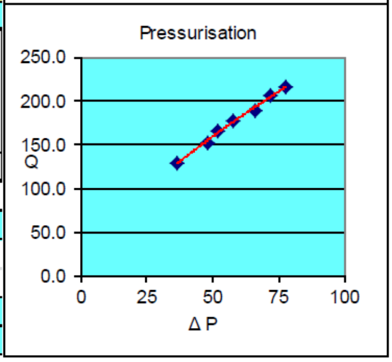




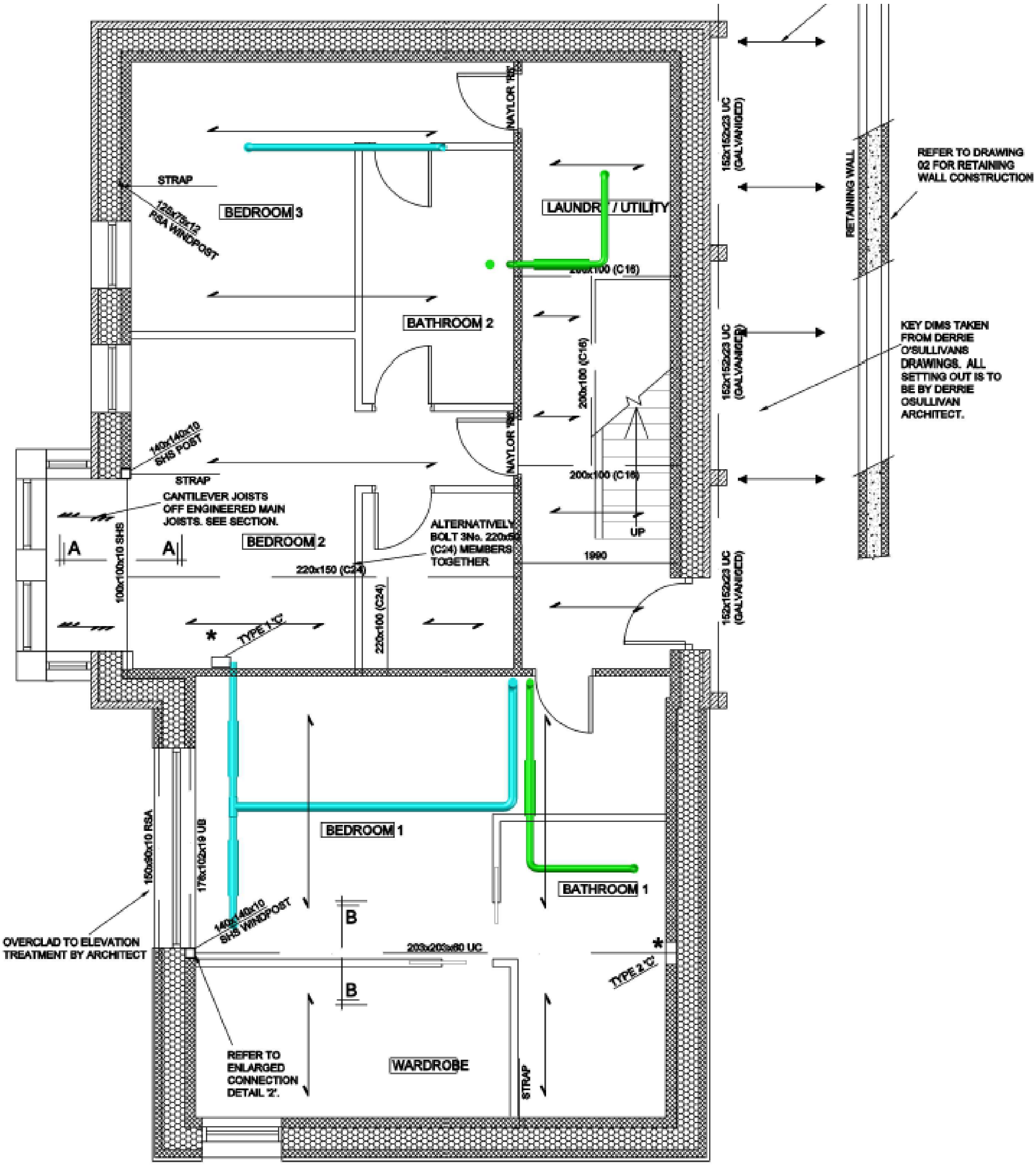
Q50 Calculated Flow at 50Pa (m^3/h)	Permeability Depressurisation Only ($m^3/(h.m^2)$)	Air Leakage Depressurisation Only (h^{-1})
150.54		0.25
r^2	0.998	
C_{env}	8.703	$m^3/h.Pa^n$
n	0.729	
C_L (corrected)	8.699	$m^3/h.Pa^n$



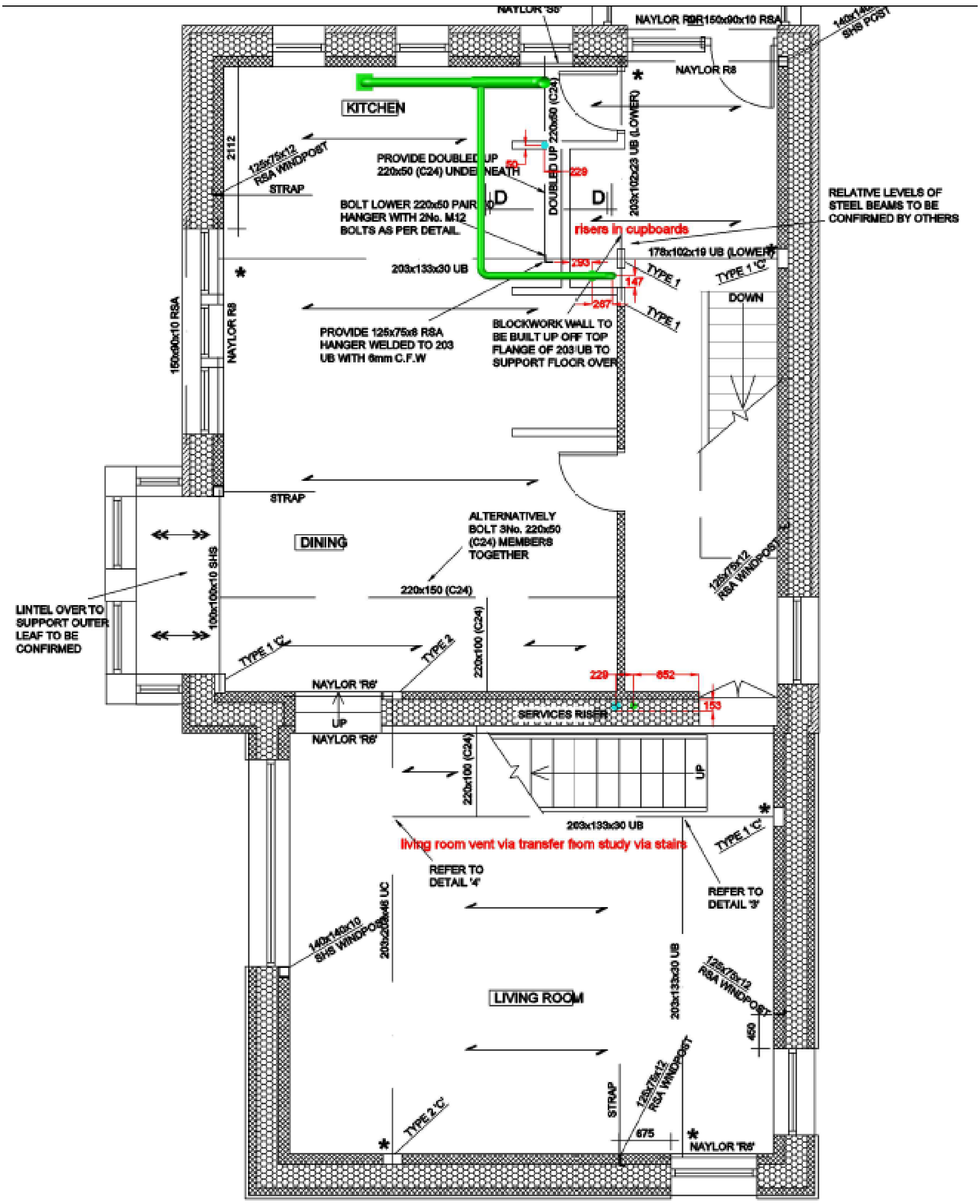
Q50 Calculated Flow at 50Pa (m^3/h)	Permeability Pressurisation Only ($m^3/(h.m^2)$)	Air Leakage Pressurisation Only (h^{-1})
157.63		0.26
r^2	0.993	
C_{env}	10.742	$m^3/h.Pa^n$
n	0.690	
C_L (corrected)	10.619	$m^3/h.Pa^n$



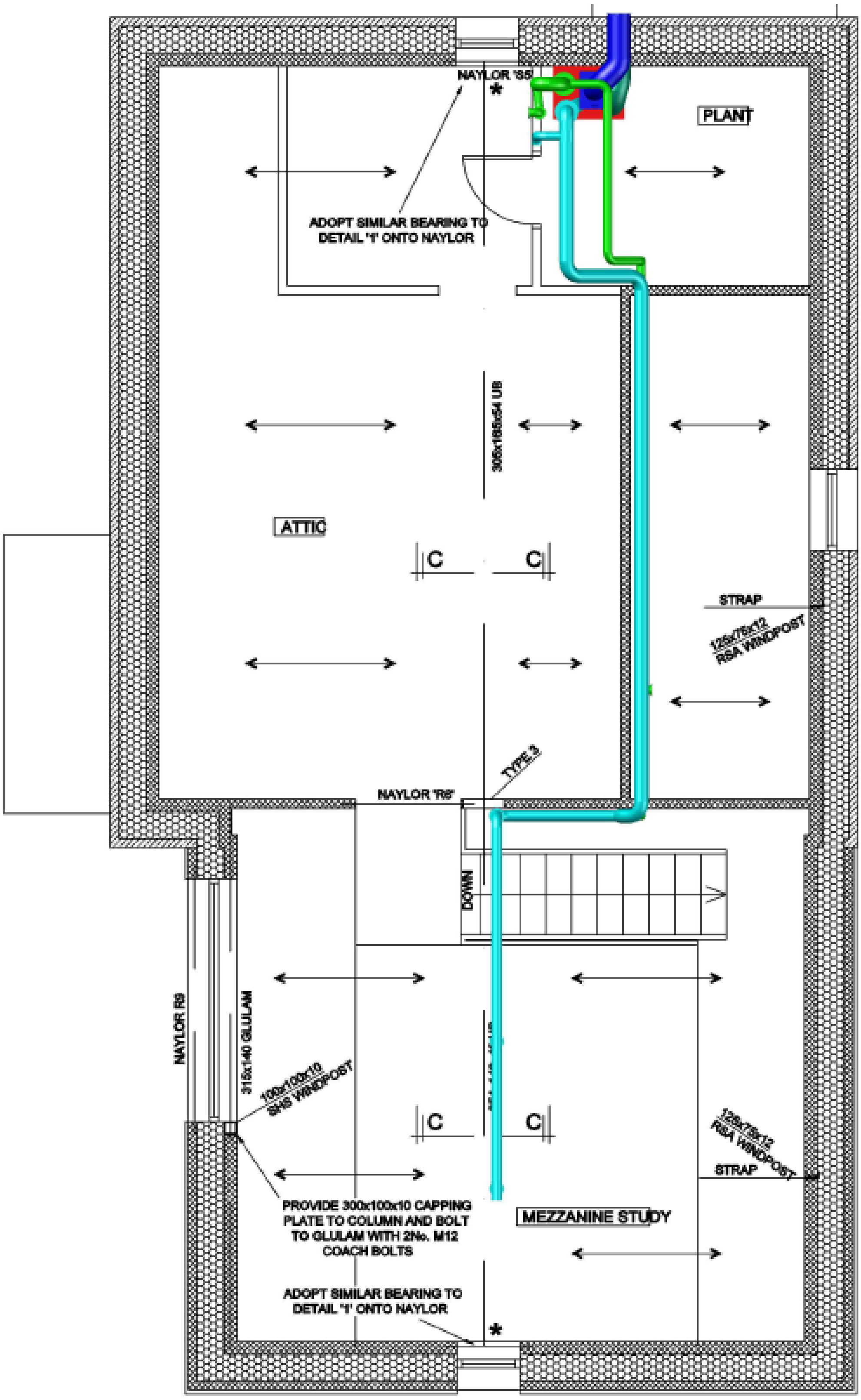
7 Planning of ventilation ductwork



Ground Floor Plan



First Floor Plan



Second Floor Plan

The unit was installed inside the thermal envelope in the plant room on the second floor, against an external wall. This allows the intake and exhaust duct lengths to be kept to a minimum. Lindab rigid steel spiral wound ducting was used throughout with sound attenuators where necessary. The cooker hood in the kitchen is a re-circulating model with a carbon filter. At the time the Novus unit wasn't supplied with a built in frost protection unit so we provided an external frost protection box. The supply air ducts (blue) were installed in the bedrooms, living room and mezzanine. The extract ducts (green) were installed in the kitchen, bathrooms and the utility. The air transfer paths are formed by undercutting the doors to all rooms with a supply or exhaust air valve. The size of the undercut is attributed to reducing the velocity of the air under the door to 1 m/s to prevent drafts and sound issues this is typically around 10mm on a standard domestic project.

7.1 Ventilation Unit

Heat recovery ventilation: Passivhaus certified MVHR Paul Novus 300. This model had a separate frost protection unit which can be clearly seen in the photograph. 50mm of Armaflex closed cell insulation was used to insulate the intake and exhaust ducts from the unit to outside. Sound attenuators are installed straight off of the unit to prevent mechanical noise from the unit into the ducting system. The installed heat recovery was 91.5 % Specific power input 0.24 Wh/m^3. The system was installed and commissioned by Green Building Store.

8 Heat supply

The central heating boiler and MVHR unit are both located in the upstairs plant room but work completely independently. A Vaillant EcoTec gas boiler was installed at the Golcar project. A thermal store or ‘buffer tank’ (also located in the plant room) has been added to the heating system to add volume to the system (which would otherwise be too small as there are only two small radiators and three towel radiators in the whole building). This is to prevent the boiler ‘cycling’ and switching itself on and off repeatedly and causing overheating. In addition the thermal store will be heated by the house’s solar thermal panels and will also supply the hot water. The boiler will heat the thermal store to a certain temperature which will only lose its heat slowly. If the room temperature thermostats drop the radiators and towel rails in the system will take water from the thermal store. The boiler is only asked to go on when the thermal store itself has dropped to a pre-set temperature.

9 PHPP calculations

The verification sheet from PHPP.

Passive House Verification

Building:	Golcar Passivhaus		
Street:	Chapel Lane		
Postcode/City:	HD7 4HZ	Huddersfield	
Province/Country:	West Yorkshire	GB-United Kingdom/ Britain	
Building type:	Detached Dwelling		
Climate data set:	GB0012a-Waddington		
Climate zone:	3: Cool-temperate	Altitude of location:	165 m
Home owner / Client:	Mr & Mrs Dallas		
Street:	Chapel Lane		
Postcode/City:	HD7 4HZ	Huddersfield	
Province/Country:	West Yorkshire	GB-United Kingdom/ Britain	

Architecture:	Green Building Store		**Mechanical system:**	Green Building Store	
Street:	Heath House Lane		Street:	Heath House Lane	
Postcode/City:	HD7 4JW	Huddersfield	Postcode/City:	HD7 4JW	Huddersfield
Province/Country:	West Yorkshire	GB-United Kingdom/ Britain	Province/Country:	West Yorkshire	GB-United Kingdom/ Britain
Energy consultancy:	Green Building Store		**Certification:**	WARM: Low Energy Building Practice	
Street:	Heath House Lane		Street:	3 Admirals Hard	
Postcode/City:	HD7 4JW	Huddersfield	Postcode/City:	PL1 3RJ	PLYMOUTH
Province/Country:	West Yorkshire	GB-United Kingdom/ Britain	Province/Country:	DEVON	GB-United Kingdom/ Britain

Year of construction:	2015	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) heating case [W/m²]:	2.3	IHG cooling case [W/m²]:	2.3
No. of occupants:	3.1	Specific capacity [Wh/K per m² TFA]:	84	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area m²	229.7				
Space heating	Heating demand kWh/(m²a)	8.7	≤	15	-	yes
	Heating load W/m²	8	≤	-	10	
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤	-	-	-
	Cooling load W/m²	-	≤	-	-	
	Frequency of overheating (> 25 °C) %	7	≤	10		yes
	Frequency excessively high humidity (> 12 g/kg) %	0	≤	20		yes
Airtightness	Pressurization test result n_{50} 1/h	0.3	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	52	≤	120		yes
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	41	≤	-	-	-
	Generation of renewable energy kWh/(m²a)	10	≥	-	-	

[2] Empty field: Data missing; '-': No requirement

I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Passive House Classic? yes

Task:	First name:	Surname:	Signature:
2-Certifier	Mike	Roe	
Certificate ID	Issued on:	City:	
	13th May 2016	Plymouth	

10 Construction costs

The costs was approximately £1730/m² of living/useful floor area

11 Measured results of the inhabited Passive House in Huddersfield.

11.1 Measured energy consumption values

Gas consumption data was recorded from February 2015 – February 2016: 654 m3 gas = 7316 kWh 7316 kWh divided by the Treated Floor Area: 230m2 = 32 kWh/m2 / annum this included cooking, water heating costs and energy consumption used for 'drying out' the house. The House was fully occupied from May 2015 however gathering the utility bill information was somewhat problematic. Prior to May 2015, the house was being heating to dry out the house, while decoration and other internal works were going on.

11.2 Year of construction

2014-2015

11.3 User satisfaction, user behaviour

Angela Dallas, owner, Golcar Passivhaus
We are really enjoying the pleasure of living in a house with a consistent and even temperature. It never drops below 19 degrees and varies by about 3 degrees above that. The house is not at all fusty-smelling. There is always a fresh and comfortable warmth in the atmosphere with no wet or moist patches anywhere in the house. Clothes dry quickly and almost straight away. There's no need for extras - like underfloor heating, a glut of radiators, real fires - it just offers constant, economical comfortable living. • The house is also very peaceful and quiet, thanks to the insulation and triple glazing. The MVHR system has been hassle free and it just gets on with ventilating the house and we are not able to hear it (unless it is in boost mode). • We've not had any problems with overheating, we have a good shading strategy with the mature trees outside our south facing glazing. It is easy to regulate the temperature in the house by opening the appropriate windows if needed.