Universities and the Built Estate Conference, May 2009

Passivhaus in practice: benefits and pitfalls

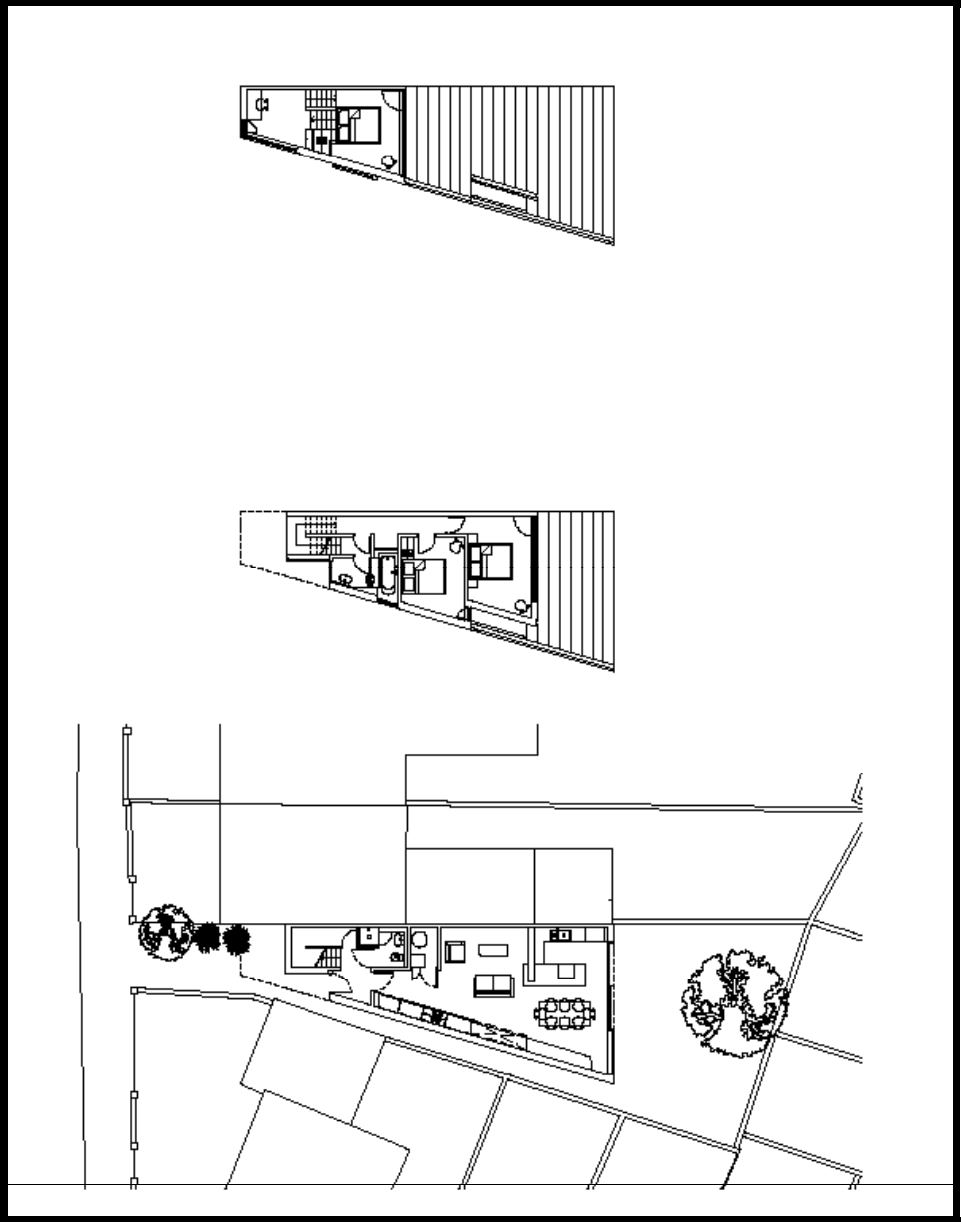
Dan Gibbons

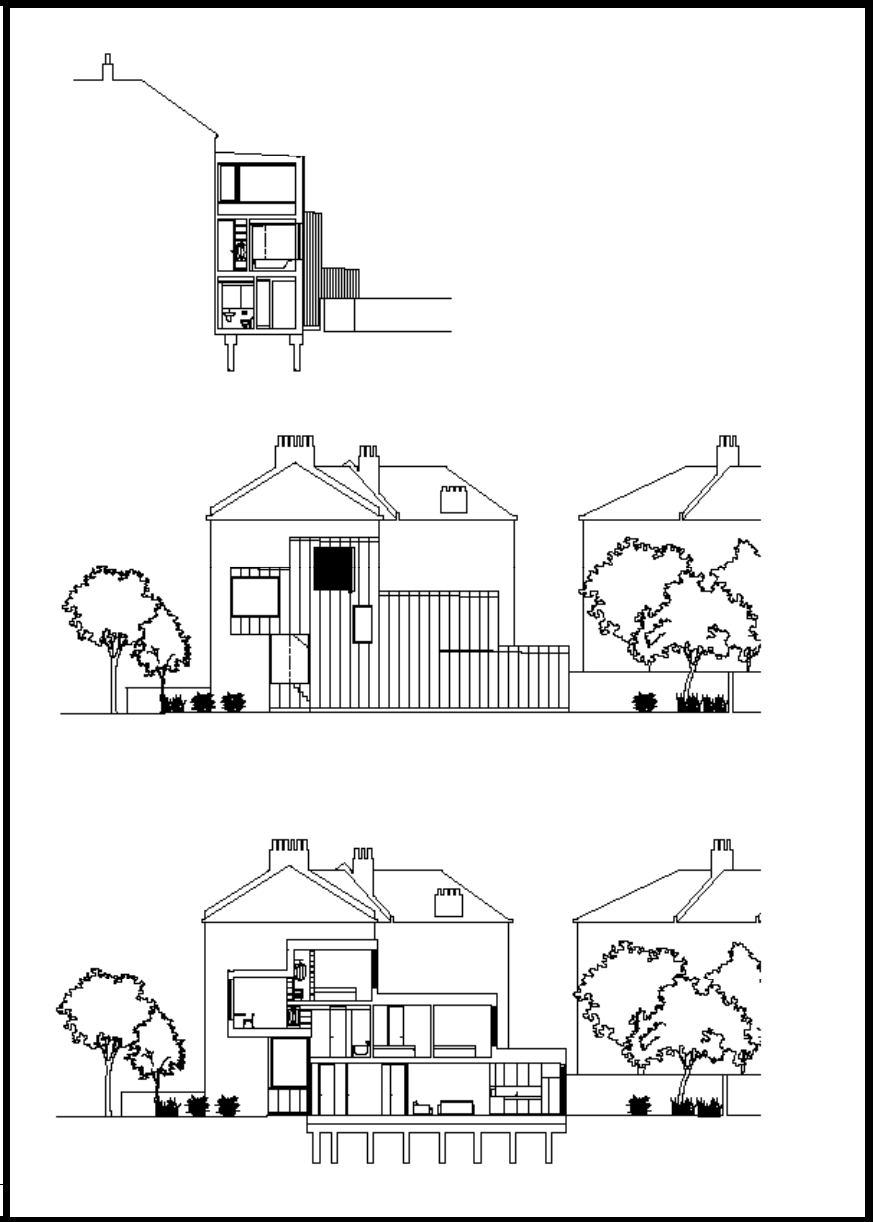
bere:architects

Focus House

Design commenced 2003

Construction February – September 2006





Focus House

Design commenced 2003

Construction Feb – September 2006

Solar thermal

Heat recovery ventilation

Focus House

Design commenced 2003

Construction Feb – September 2006

Pressurised air testing

High air loss through Swedish windows

Focus House

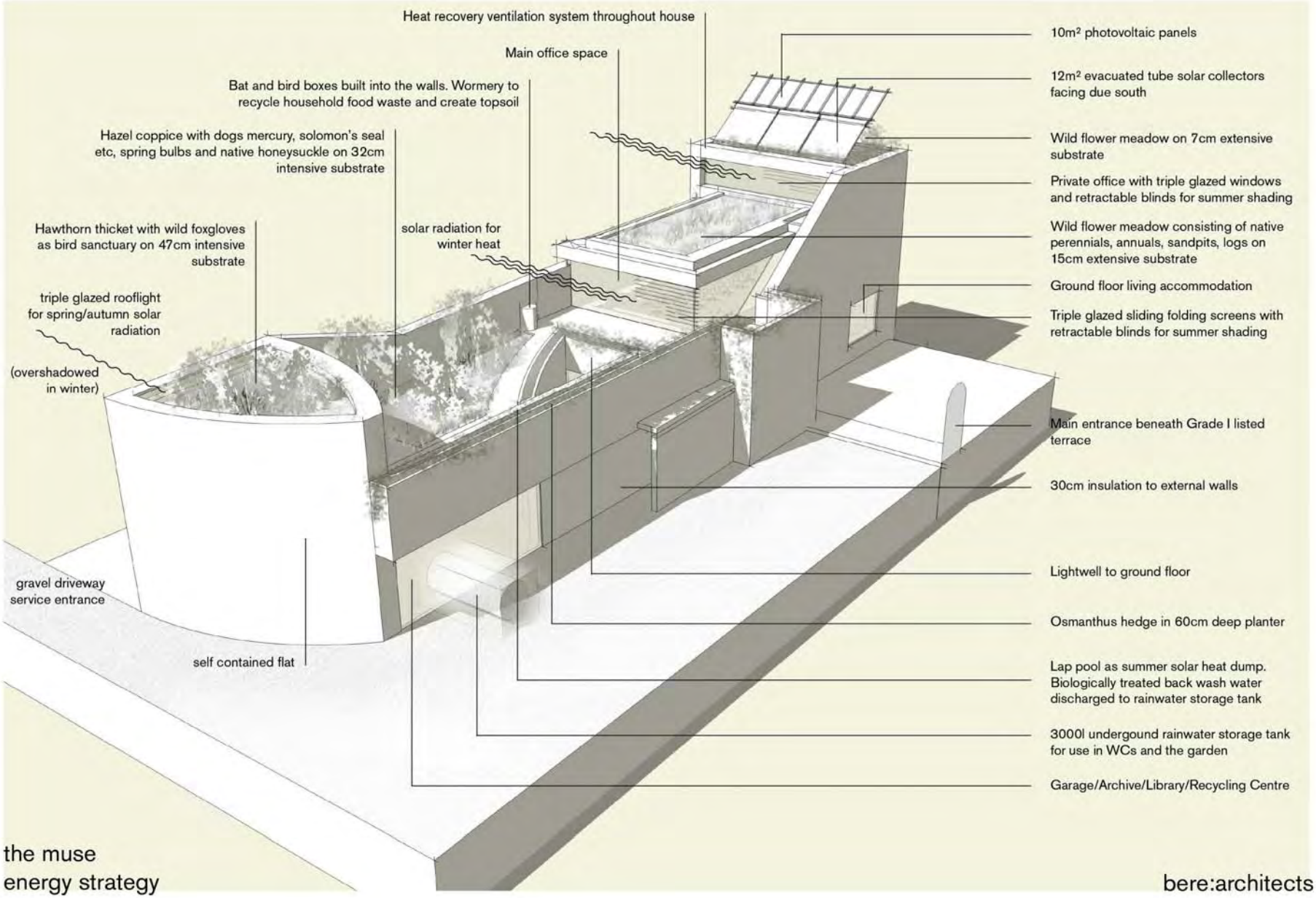
Design commenced 2003

Construction Feb – September 2006

The Muse

Design commenced 2001

Construction 2002 – 2009 (self build)



the muse
energy strategy

bere:architects

Passive House Planning
AREAS DETERMINATION

Passive House Planning
U-VALUES OF BUILDING ELEMENTS

Passive House Planning
HEAT LOSSES VIA THE GROUND

Passive House Planning
REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Passive House Planning
SPECIFIC ANNUAL HEAT DEMAND

Passive House Planning
SUMMER

Passive House Planning
HOT WATER PROVIDED BY SOLAR

Monthly Heat Load Covered by Solar
Monthly Solar Fraction
Radiation on Tilted Collector Surface
Total Monthly Heat Load DHW Production

Solar Radiation; Heat Load DHW Production; Heat Load Covered by Solar [kWh/m² month]
Solar Fraction [-]

Passive House Planning
AUXILIARY ELECTRICITY

Passive House Planning
PRIMARY ENERGY VALUE

Passive House Planning
INTERNAL HEAT GAINS Non-domestic Use

Passive House Planning
UTILISATION Non-domestic Use

Passive House Planning
U - LIST

Passive House Planning
FRAME TYPE ACCORDING TO CERTIFICATION

Passive House Planning
CALCULATING SHADING FACTORS

Passive House Planning
VENTILATION DATA

Building: Hildway Community Centre

Treated Floor Area A_{TFA} 748 m²
Room Height h 2.5 m
Room Ventilation Volume $(A_{TFA} \cdot h) = V_n$ 1871 m³

Ventilation System Design - Standard Operation

Occupancy	m²/P	35			
Number of Occupants	P	21.4			
Supply Air per Person	m³/(P·h)	30			
Supply Air Requirement	m³/h	641			
Extract Air Rooms		Kitchen	Bathroom	Shower	WC	Corridor
Quantity		1		1	16	14
Extract Air Requirement per Room	m³/h	60	40	20	20	20
Total Extract Air Requirement	m³/h	680				

Design Air Flow Rate (Maximum) m³/h 730

Average Air Change Rate Calculation

Type of Operation	Daily Operation Duration h/d	Factors Referenced to Maximum	Air Flow Rate m³/h	Air Change Rate 1/h
Maximum	12.0	1.00	730	0.39
Standard	12.0	0.77	561	0.30
Basic	0.54	0.52	383	0.21
Minimum	0.40	0.40	292	0.16
X Residential Building	Average value	0.89	Average Air Flow Rate (m³/h) 645	Average Air Change Rate (1/h) 0.35

Infiltration Air Change Rate according to EN 13790

Wind Protection Coefficients According to EN 13790	General Sides Exposed	One Side Exposed
Coefficient e for Screening Class		
No Screening	0.10	0.05
Moderate Screening	0.07	0.03
High Screening	0.04	0.02
Coefficient f	15	20

		for Annual Demand	for Heat Load
Wind Protection Coefficient, e		0.04	0.10
Wind Protection Coefficient, f		15	15
Air Change Rate at Press. Test	n_{50} 1/h	0.60	2400 m³

Heat Air Volume for Press. Test V_{50} — Air Permeability q_{50} 0.75 m³/(h·m²)

Type of Ventilation System

X Balanced PH Ventilation — Passive Cooling — for Annual Demand — for Heat Load
Pure Exhaust Air
Excess Extract Air 1/h 0.00 0.00
Infiltration Air Change Rate n_{inf} 1/h 0.031 0.077

Effective Heat Recovery Efficiency of the Ventilation System with Heat Recovery

X Central unit within the thermal envelope
Central unit outside of the thermal envelope

Efficiency of Heat Recovery η_{hr} 0.83 Heat recovery specified by Alex Ziebke

Transmittance Ambient Air Duct	U W/mK	0.455	Calculation see Secondary Calculation
Length Ambient Air Duct	m	2	
Transmittance Exhaust Air Duct	U W/mK	0.455	Calculation see Secondary Calculation
Length Exhaust Air Duct	m	2	
Temperature of Mechanical Services Room	°C	20	Room Temperature (°C) 15
(Enter only if the central unit is outside of the thermal envelope)			Av. Ambient Temp. Heating P. (°C) 5.1
			Av. Ground Temp (°C) 10.0

Effective Heat Recovery Efficiency $\eta_{hr,eff}$ 84.2%

Effective Heat Recovery Efficiency Subsoil Heat Exchanger

SHX Efficiency η_{SHX}
Heat Recovery Efficiency SHX $\eta_{hr,SHX}$ 0.0

PHPP 2007, Ventilation — 320ms PHPP 5004280b New Large File

Passive House Verification

Photo or Drawing

Building:	Mildmay Community Centre
Location and Climate:	London GB - Manchester
Street:	Woodville Road
Postcode/City:	N16 8NA
Country:	England
Building Type:	Community Centre
Home Owner(s) / Client(s):	
Street:	
Postcode/City:	
Architect:	bere:architects
Street:	73 Poets Road
Postcode/City:	N5 2SH
Mechanical System:	
Street:	
Postcode/City:	
Year of Construction:	1800's
Number of Dwelling Units:	
Enclosed Volume V_e:	3124.0 m^3
Number of Occupants:	21.4
Interior Temperature:	20.0 °C
Internal Heat Gains:	3.5 W/m²

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 748.3 m^2

	Applied:	Annual Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	11	kWh/(m^2a)	15 kWh/(m^2a)	Yes
Pressurization Test Result:	0.6	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):	27	kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	25	kWh/(m^2a)		
Heating Load:	8	W/m^2		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:	5	W/m^2		

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

Issued on:

signed:

PHPP 2007, Verification

300mc PHPP 090428co New Large File

Verification data

Basic conditions for Passivhaus standard:

Specific Space Heat Demand max 15kWh/(m2a)

Pressure test (air tightness) max 0.6 h-1

Specific Primary Energy Demand max 120kWh/(m2a)

Passivhaus Planning Package –

Verification page

FOCUS HOUSE AS BUILT

- Roof insulation ave 235mm foamglas
- Wall insulation 140mm foamglas
- Swedish double glazed windows
- Air pressure test: 4.5 volumes/hr @ 50pa
- East and West aspect windows
- Heat recovery ventilation
- Solar thermal

Passive House Verification

Photo or Drawing

Building:	End of terrace new build to existing terrace
Location and Climate:	London — GB-London
Street:	23a Prah Road
Postcode/City:	N4 2RB London
Country:	U.K
Building Type:	Terraced house/dwelling
Home Owner(s) / Client(s):	Edward Gibbs
Street:	40 Fairholt Road
Postcode/City:	N16 5HW
Architect:	bere:architects
Street:	Rosebury Avenue
Postcode/City:	EC1R 4SX
Mechanical System:	
Street:	
Postcode/City:	
Year of Construction:	2004
Number of Dwelling Units:	1
Enclosed Volume V_e:	319.7 m^3
Number of Occupants:	3.0
Interior Temperature:	20.0 °C
Internal Heat Gains:	2.1 W/m^2

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 105.2 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	54	$kWh/(m^2a)$	15 $kWh/(m^2a)$	No
Pressurization Test Result:	4.5	h^{-1}	0.6 h^{-1}	No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		$kWh/(m^2a)$	120 $kWh/(m^2a)$	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		$kWh/(m^2a)$		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		$kWh/(m^2a)$		
Heating Load:		W/m^2		
Frequency of Overheating:	10	%	over 25 °C	
Specific Useful Cooling Energy Demand:		$kWh/(m^2a)$	15 $kWh/(m^2a)$	
Cooling Load:		W/m^2		

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Issued on:

signed:

MUSE HOUSE AS BUILT

- Roofs nos.1&2, 200mm foamglas + 320 - 450mm soil
- Roof no.3, 200mm Celotex + 150mm soil
- Wall insulation 260mm Rockwool + insulating blocks
- Triple glazed windows, later ones Passivhaus certified
- Air pressure test: 0.6 volumes/hr @ 50pa (assumed)

Passive House Verification

Photo or Drawing

Building:	114hr 73 Poets Road
Location and Climate:	London — GB - Manchester
Street:	73 Poets Road
Postcode/City:	N5 2SH
Country:	England
Building Type:	Detached Residential Dwelling & Office
Home Owner(s) / Client(s):	Justin Bere
Street:	73 Poets Road
Postcode/City:	N5 2SH
Architect:	bere:architects
Street:	73 Poets Road
Postcode/City:	N5 2SH
Mechanical System:	
Street:	
Postcode/City:	
Year of Construction:	2002-2008
Number of Dwelling Units:	1
Enclosed Volume V_e:	552.7 m^3
Number of Occupants:	5.5
Interior Temperature:	20.0 °C
Internal Heat Gains:	3.5 W/m^2

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	25	$kWh/(m^2a)$	15 $kWh/(m^2a)$	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		$kWh/(m^2a)$	120 $kWh/(m^2a)$	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		$kWh/(m^2a)$		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		$kWh/(m^2a)$		
Heating Load:	15	W/m^2		
Frequency of Overheating:	1	%	over 25 °C	
Specific Useful Cooling Energy Demand:		$kWh/(m^2a)$	15 $kWh/(m^2a)$	
Cooling Load:	10	W/m^2		

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

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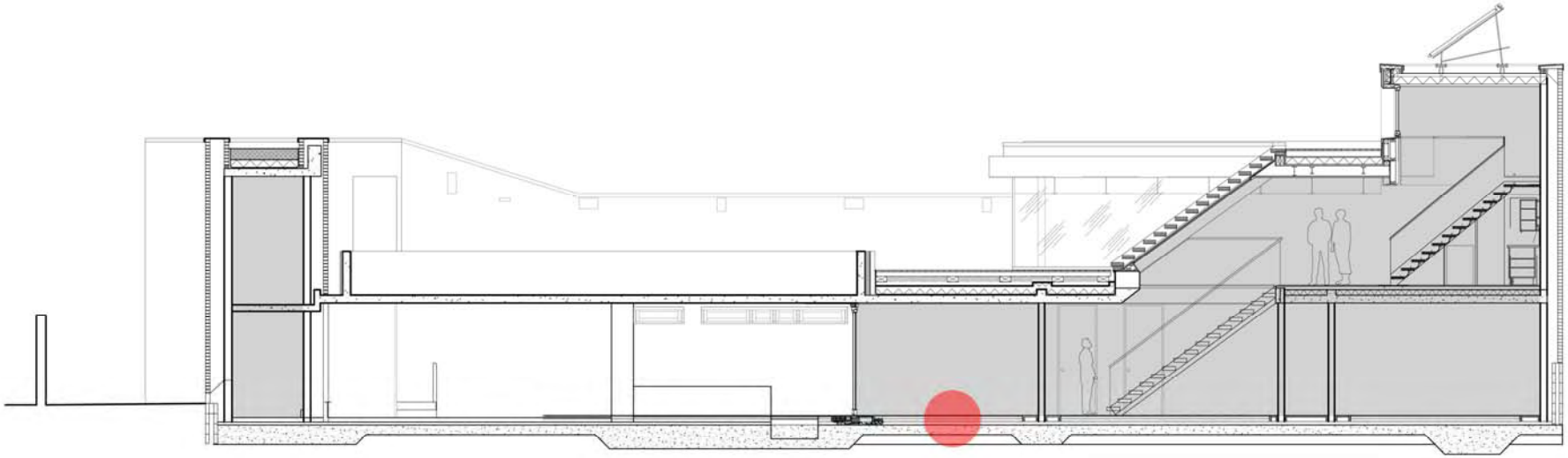


Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	23	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

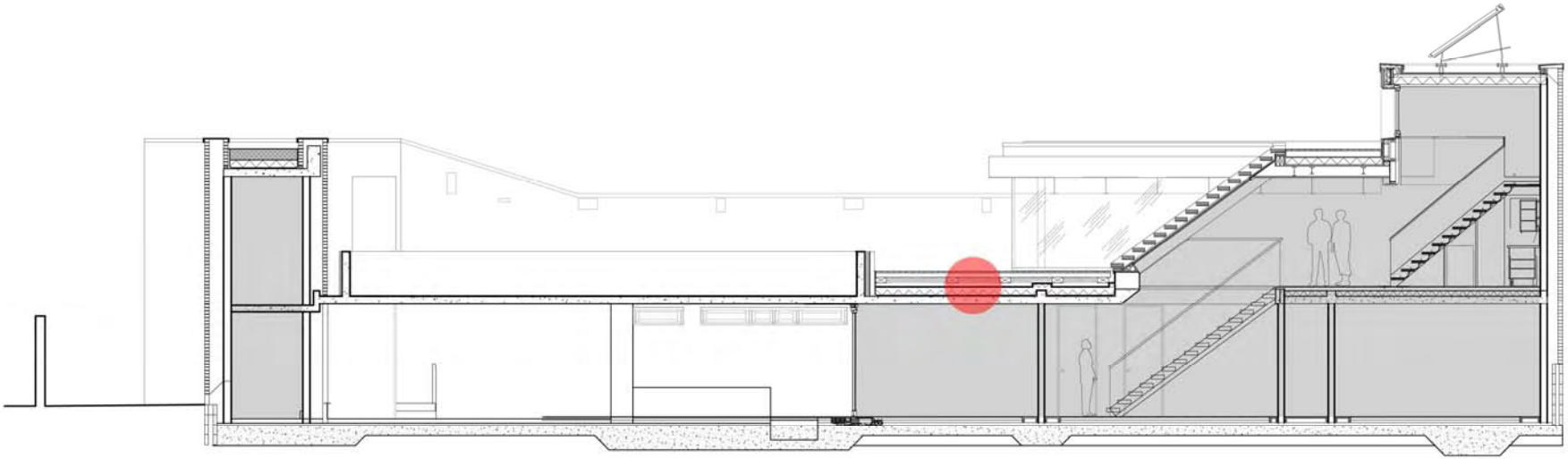
Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	18	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		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		

THE MUSE UPGRADED

+30 mm vacuum insulation, on top of existing insulation, above floor slab (equivalent to 240mm cellular foam insulation)



Specific Demands with Reference to the Treated Floor Area

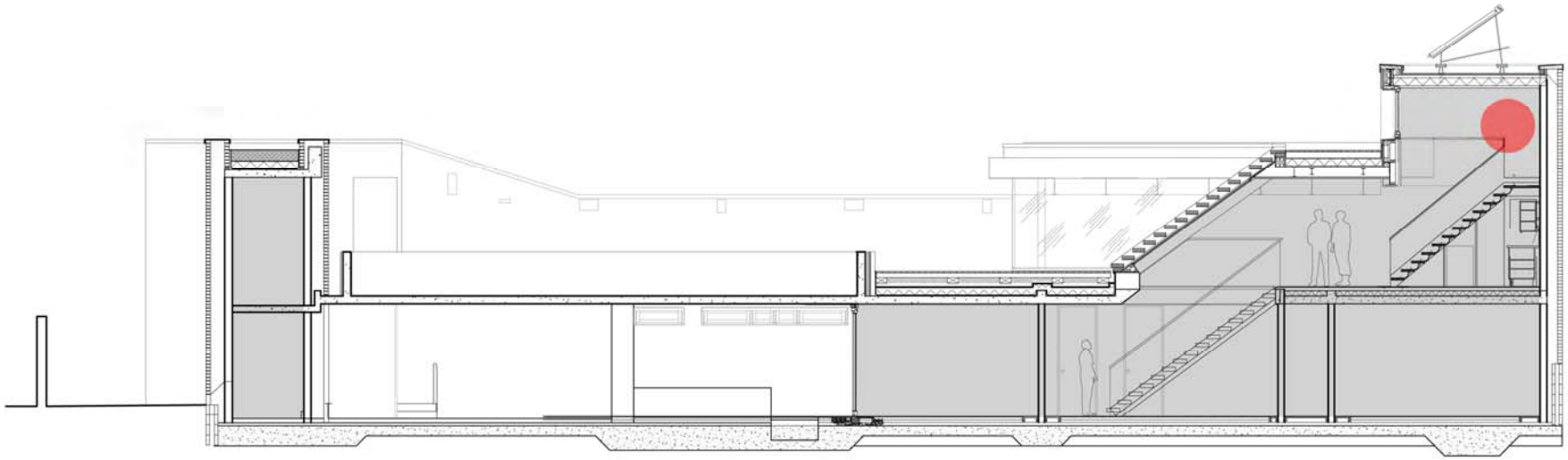
Treated Floor Area:	191.6	m^2		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	23	$kWh/(m^2a)$	15 $kWh/(m^2a)$	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity)Σ		$kWh/(m^2a)$	120 $kWh/(m^2a)$	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity)Σ		$kWh/(m^2a)$		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		$kWh/(m^2a)$		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		$kWh/(m^2a)$	15 $kWh/(m^2a)$	
Cooling Load:		W/m^2		

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area:	191.6	m^2		
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	21	$kWh/(m^2a)$	15 $kWh/(m^2a)$	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity)Σ		$kWh/(m^2a)$	120 $kWh/(m^2a)$	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity)Σ		$kWh/(m^2a)$		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		$kWh/(m^2a)$		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		$kWh/(m^2a)$	15 $kWh/(m^2a)$	
Cooling Load:		W/m^2		

THE MUSE UPGRADED

Additional 200mm Styrofoam Roofmate SL insulation overlaid on warm roof construction beneath decking



Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	23	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity)Σ		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity)Σ		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

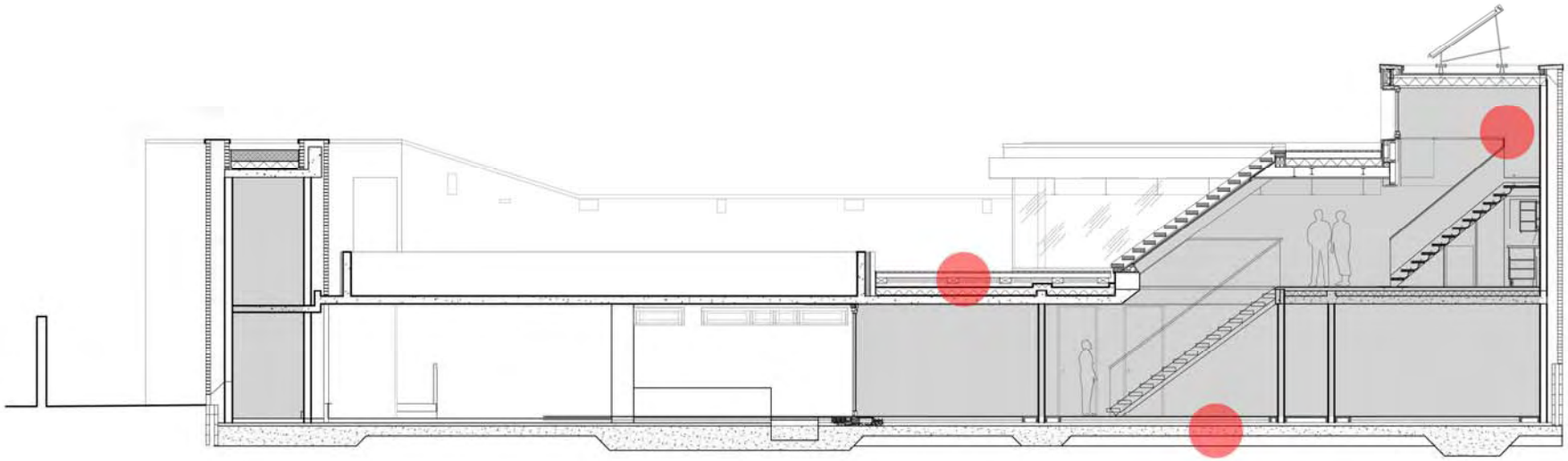
Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	22	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity)Σ		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity)Σ		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

THE MUSE UPGRADED

Replace existing heat recovery ventilation unit with a German 92% efficient unit certified by the Passivhaus Institute



Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	23	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	6	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

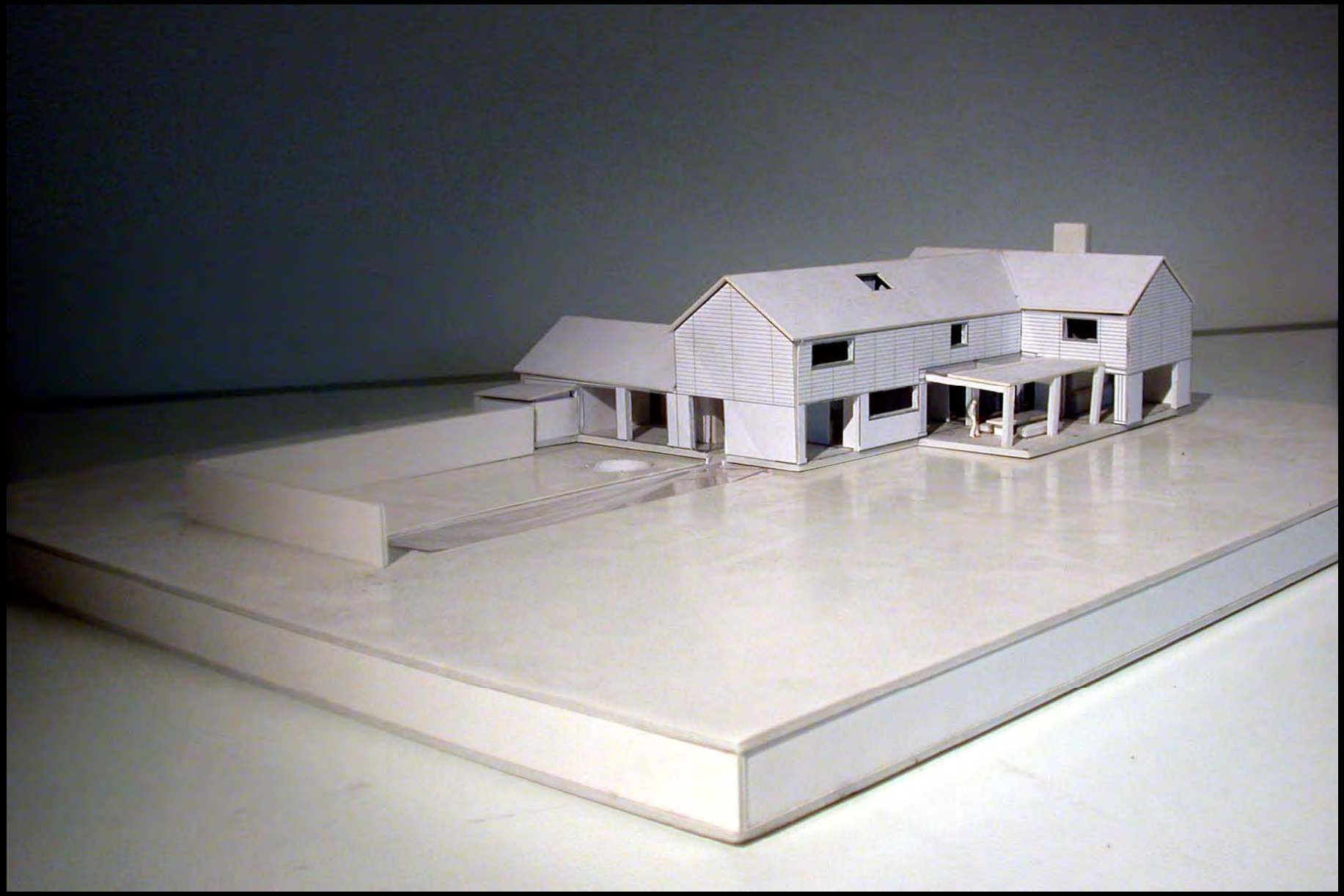
Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 191.6 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	15	kWh/(m^2a)	15 kWh/(m^2a)	Yes
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		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		

THE MUSE UPGRADED

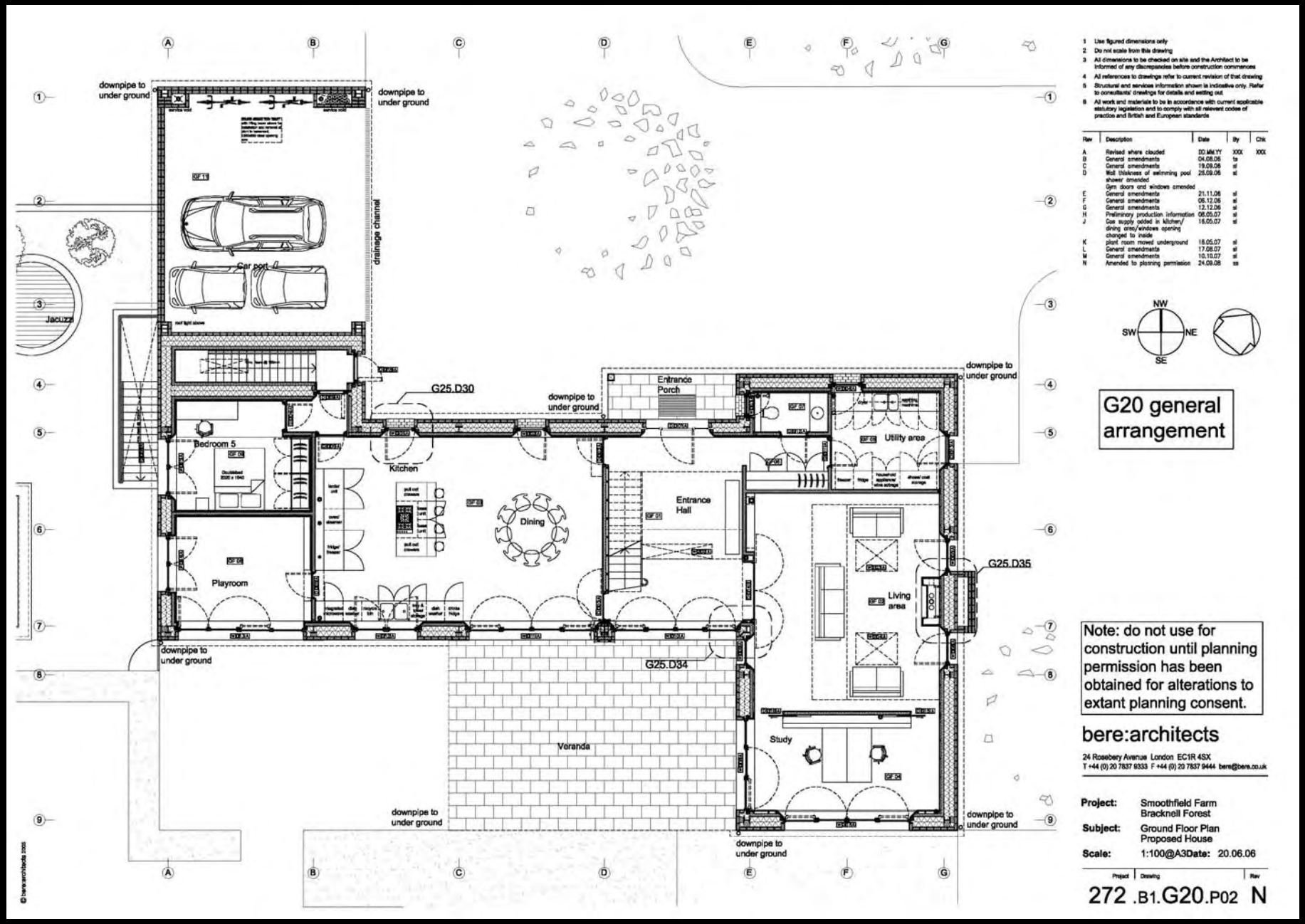
Combined results for increasing roof and floor insulation and replacing the heat recovery ventilation unit



Smoothfield Farm

Design commenced 2004

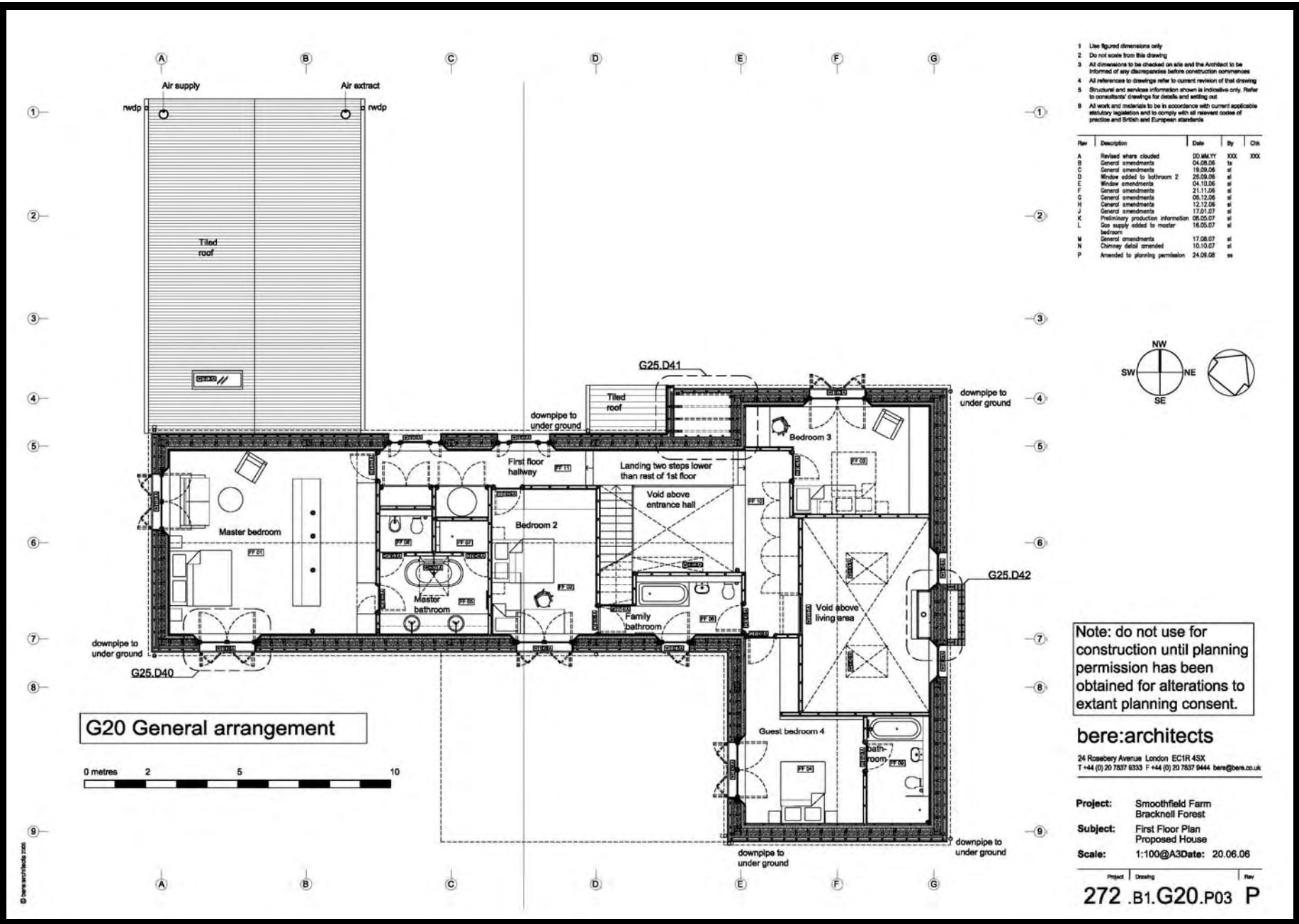
Construction 2008 – 2009



Smoothfield Farm

Design commenced 2004

Construction 2008 – 2009



Smoothfield Farm

Design commenced 2004

Construction 2008 – 2009

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 300.0 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	24	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	44	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

PHPP results for original design with basement, ground floor and small mezzanine

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 387.0 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	17	kWh/(m^2a)	15 kWh/(m^2a)	No
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	44	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

PHPP results for amended scheme which was granted planning approval on appeal with basement, ground floor and full first floor

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 346.9 m^2

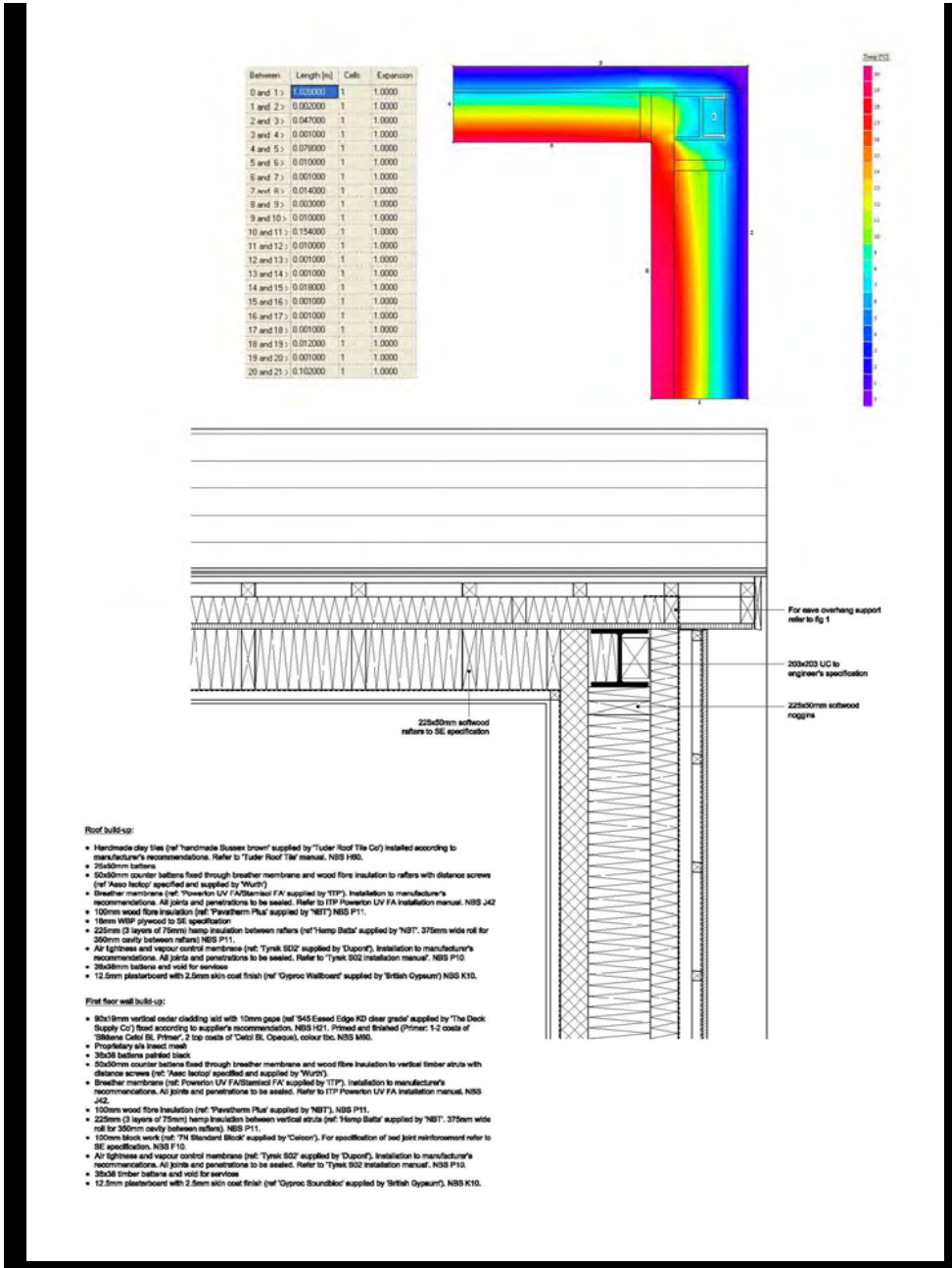
	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	15	kWh/(m^2a)	15 kWh/(m^2a)	Yes
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		kWh/(m^2a)	120 kWh/(m^2a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m^2a)		
Heating Load:		W/m^2		
Frequency of Overheating:	55	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:		W/m^2		

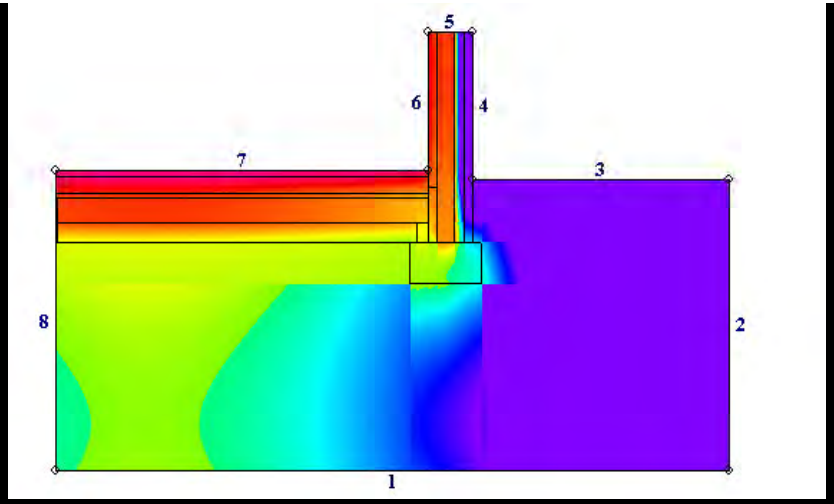
PHPP results for planning approved scheme with basement omitted

Smoothfield Farm

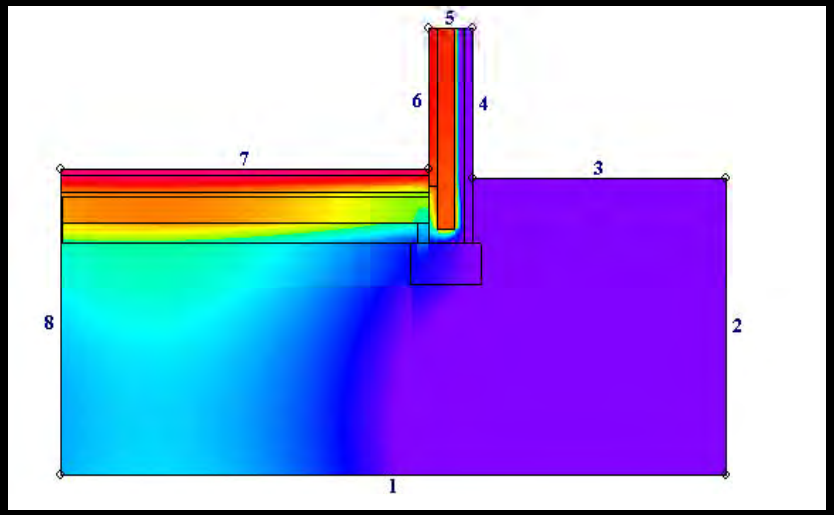
Design commenced 2004

Construction 2008 – 2009





Without a Schock Isokorb



With a Schock Isokorb

PHPP allows for complete consideration of all two dimensional thermal bridges.. The design principles of “Thermal Bridge-Free Construction” are highly recommended for Passive Houses. For linear thermal bridge heat loss coefficients greater than 0.01W/(mK), the losses from the supplementary heat flows must be considered. A two dimensional heat flow calculation program, recommended by PHPP was used.

Smoothfield Farm

Design commenced 2004

Construction 2008 – 2009

Avoiding thermal bridging in the steel frame

Smoothfield Farm

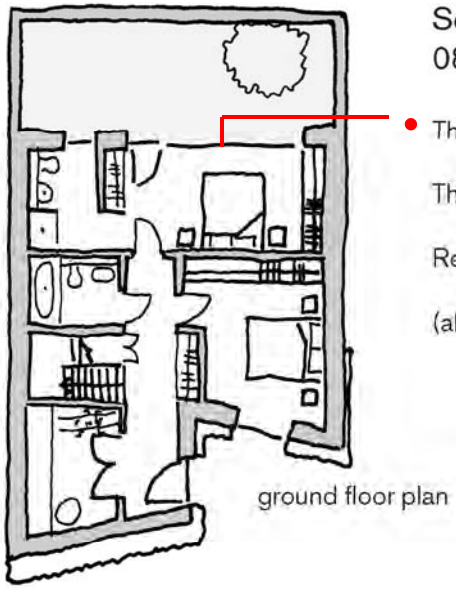
Design commenced 2004

Construction 2008 – 2009

Camden Passivhaus

Design commenced 2007

Construction 2009



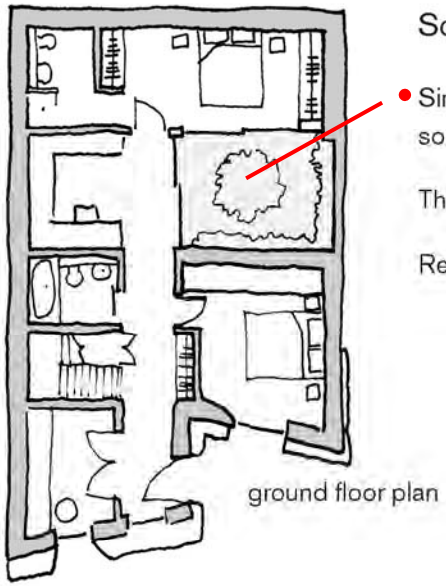
Scheme A - As brought to our pre-planning meeting of 08/05/08

- This scheme has a high percentage of north glazing.

The envelope to treated floor area[1] (TFA) is also fairly high.

Result = 21.2 kWh/(m²a)

(all results shown are the specific primary energy demands[2])



Scheme B - Open Courtyard within plan

- Similar issues to scheme A, with a high percentage of glazing either not south facing or heavily shaded.

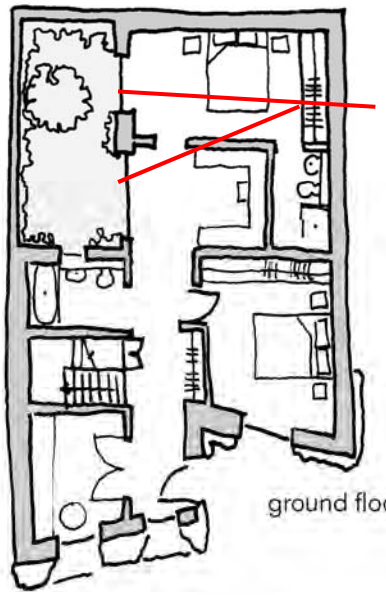
The envelope to treated floor area (TFA) in this case is also too high.

Result = 21.9 kWh/(m²a)

Camden Passivhaus

Design commenced 2007

Construction 2009



ground floor plan

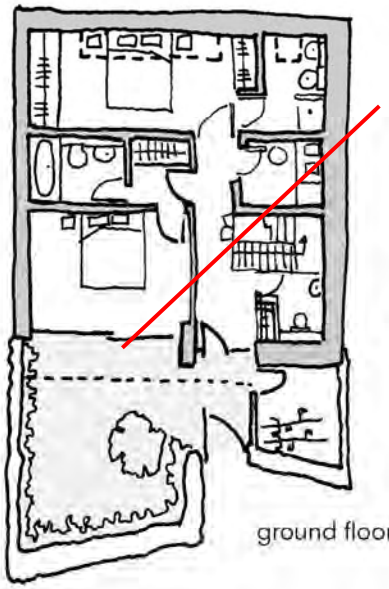
Scheme D - Open courtyard in NW corner

- The NW courtyard results in a high percentage of glazing not south orientated.

Again with this option the envelope to treated floor area (TFA) is too high.

The specific heat demand is lower than with the existing scheme, however it is not yet to passive standards.

Result = 16.7 kWh/(m²a)



ground floor plan

Scheme E - South garden

- This plan allows for a high percentage of glazing to be south orientated.

It also provides a good ratio of envelope to treated floor area (TFA).

Another benefit is the large south facing outdoor area.

And the second bedroom no longer opens to the street

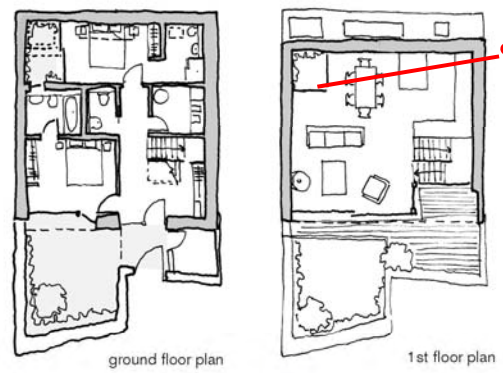
However the master bedroom only has roof lights

Result = 13.5 kWh/(m²a)

Camden Passivhaus

Design commenced 2007

Construction 2009

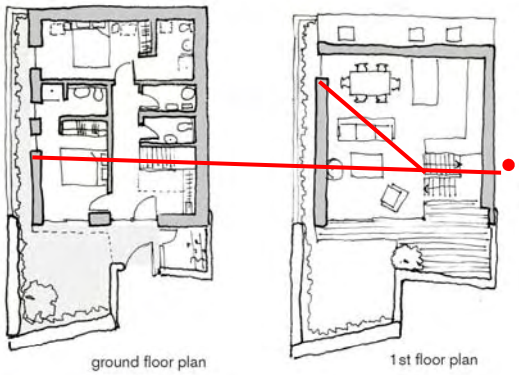


Scheme F(vi) - with covered NW courtyard and a reduced light scoop

Ratio of envelope to TFA improved.

Result = 16.3 kWh/(m²a)

If the insulation was increased in the roof and floor and the specification of the insulation in the walls increased the specific heat demand would reduce to 15.3kWh/(m²a).

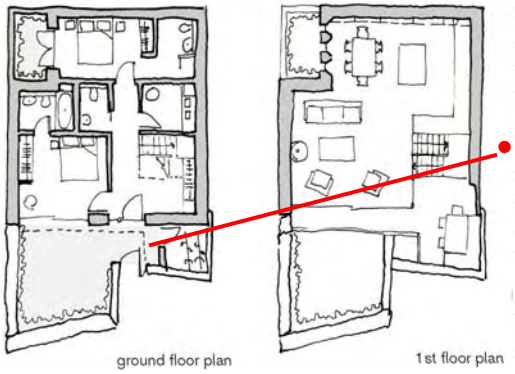


Scheme F(vii) - with 1m gap to west side of the building

Provides the opportunity to have windows from all of the rooms towards the back of the plan.

However the ratio of south glazing is reduced, as 1m of south glazing is lost from both the ground and first floors.

Result = 20.1 kWh/(m²a)



Scheme F(viii) - with no roof lights above bedroom 2 and a straight wall to bedroom 1.

Ratio of envelope to TFA improved.

Shading of windows on ground floor reduced

The second bedroom benefits from its light source being in the wall and from a private courtyard.

Result = 15.4 kWh/(m²a)

If the insulation was increased as described in F(vi) the specific heat demand would reduce to 14.5kWh/(m²a), which achieves passive house standard.

Summary

All energy demands calculated using a very efficient Passive House Certified heat recovery ventilation unit (92% efficiency)

Scheme	Description	Specific Energy Demand
Scheme A	Scheme brought to meeting of 08/05/08	21.2
Scheme B	Open courtyard within plan	21.9
Scheme C	Closed courtyard within plan with glass roof	11.7
Scheme D	Open courtyard in NW corner	16.7
Scheme E	South Garden	13.5
Scheme E (i)	with internal bike store	14.2
Scheme F	South garden with north court	17.6
Scheme F (i)	with straight wall in bed 1	17
Scheme F (ii)	with straight south wall on 1st floor	16.3
Scheme F (iii)	with reduced court from 1.5m to 1m wide	16.1
Scheme F (iv)	with reduced wall thickness to 300mm	15.4
Scheme F (v)	with covered north court and light scoop	17.2
Scheme F (vi)	with covered n court and light scoop reduced	16.2
Scheme F (vii)	with 1m gap to west side	20.1
Scheme F (viii)	with no roof lights above bedroom 2	15.4
Scheme F (viii)	as above with additional insulation	14.5
Scheme F (viii)	as above once all shading from balustrades considered	15

Heat Supply

The heat demand is so low that a conventional heating system can be omitted. The small amount of heat which may be required in the winter will be supplied through the HRVU.

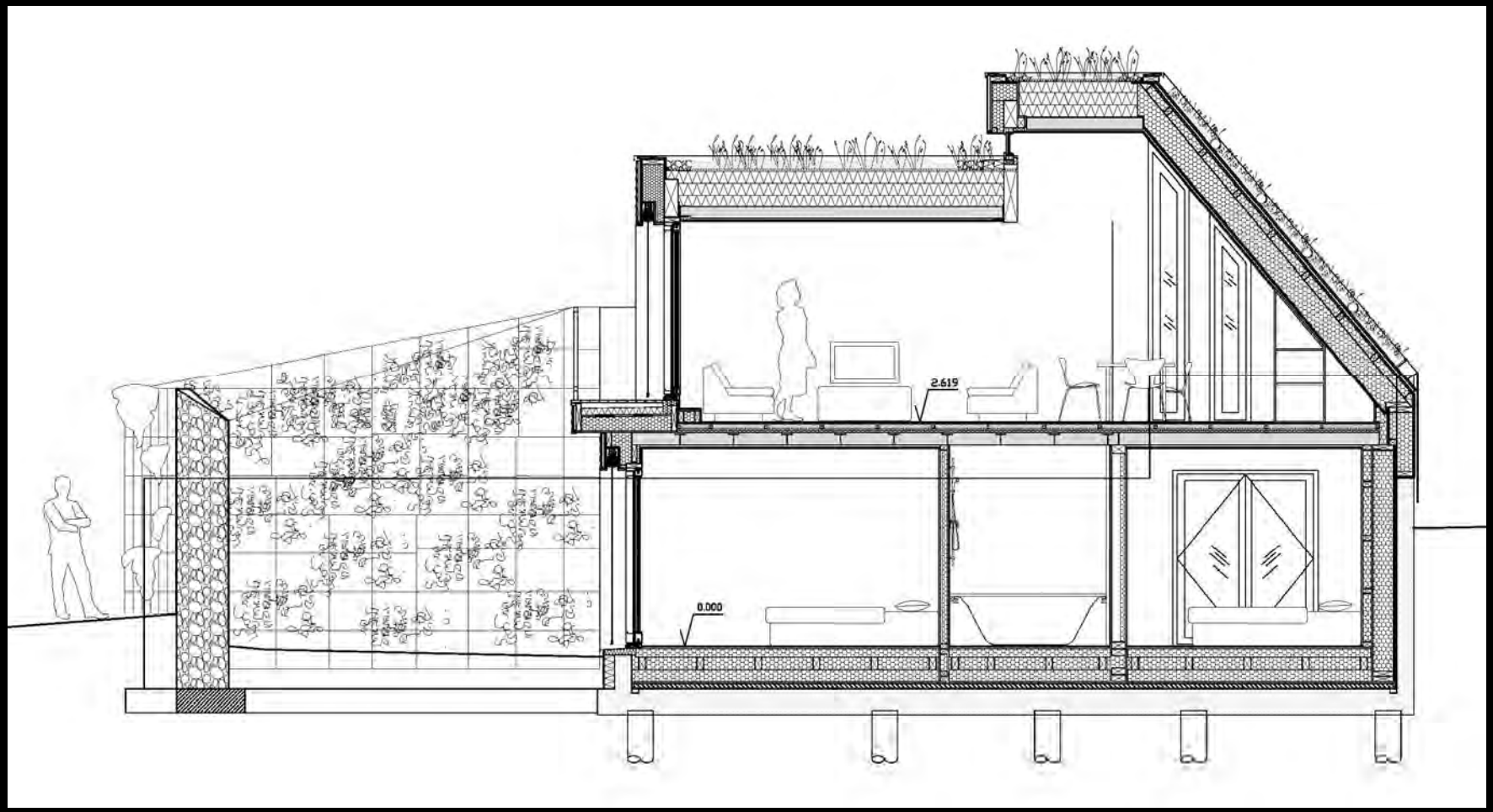
Cost of HRVU + electrical resistance heater = £3125+VAT

Indicative cost of conventional system for project = £8,300+VAT (cost at Prah Road – similar m² floor area)

Camden Passivhaus

Design commenced 2007

Construction 2009



Camden Passivhaus

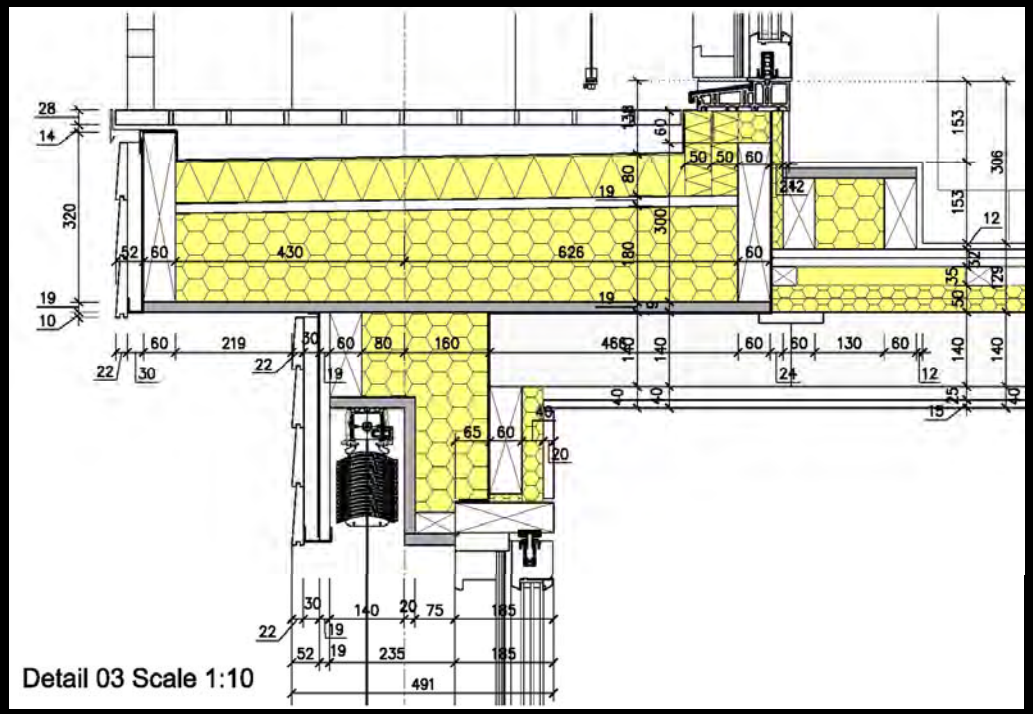
Design commenced 2007

Construction 2009

Camden Passivhaus

Design commenced 2007

Construction 2009



Balcony Detail

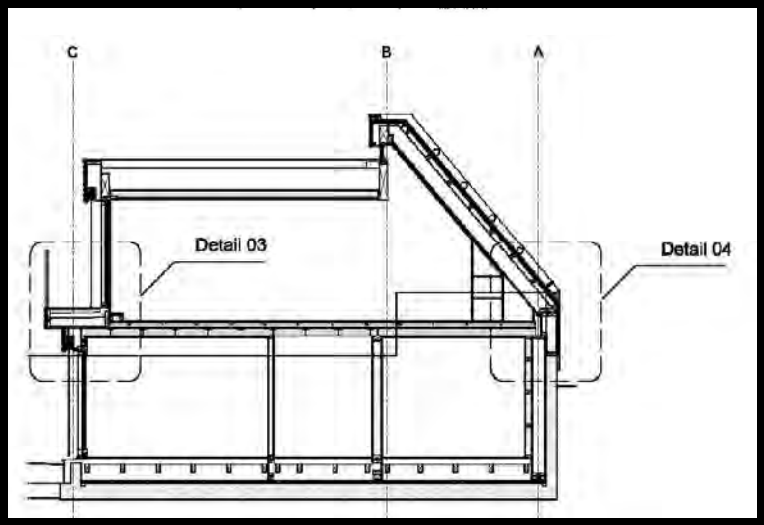
The first floor steps back to reduce the shading to the ground floor

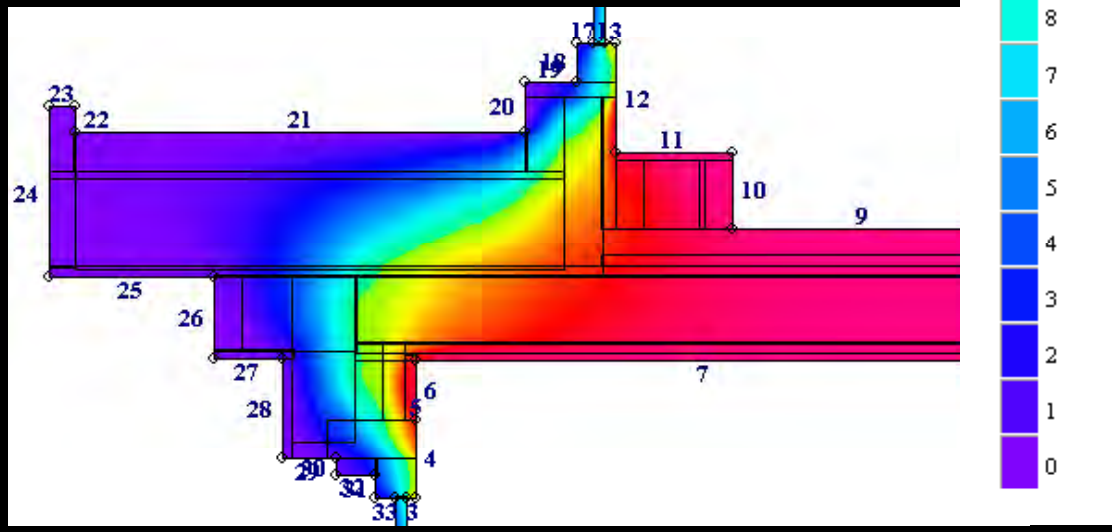
This created a complex detail which had to be resolved

The solution is to wrap the projection in insulation preventing a potential major thermal bridge

This was modelled in heat2 and the results fed into the PHPP

Heat 2 showed that the detail preformed significantly better than the triple glazed windows above and below

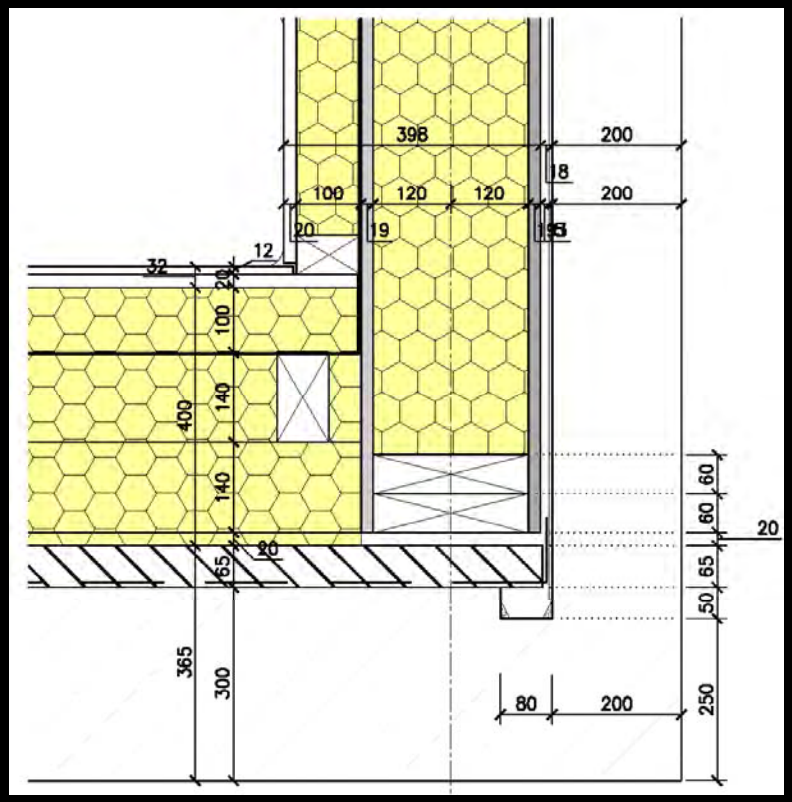


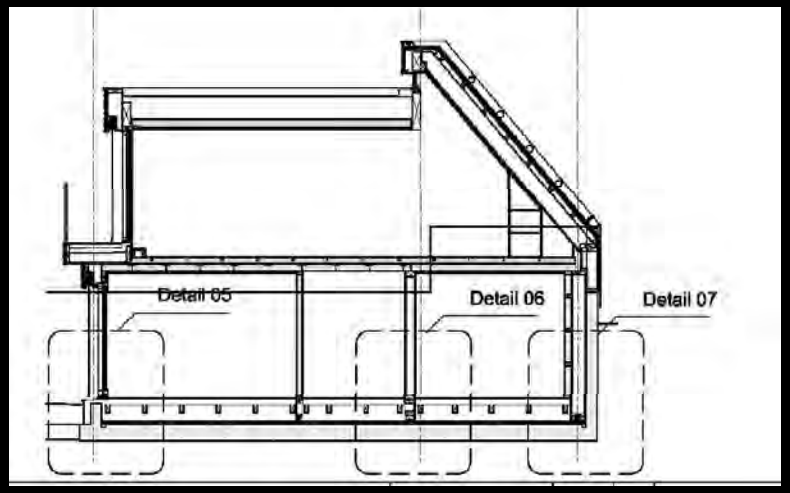


Camden Passivhaus

Design commenced 2007

Construction 2009



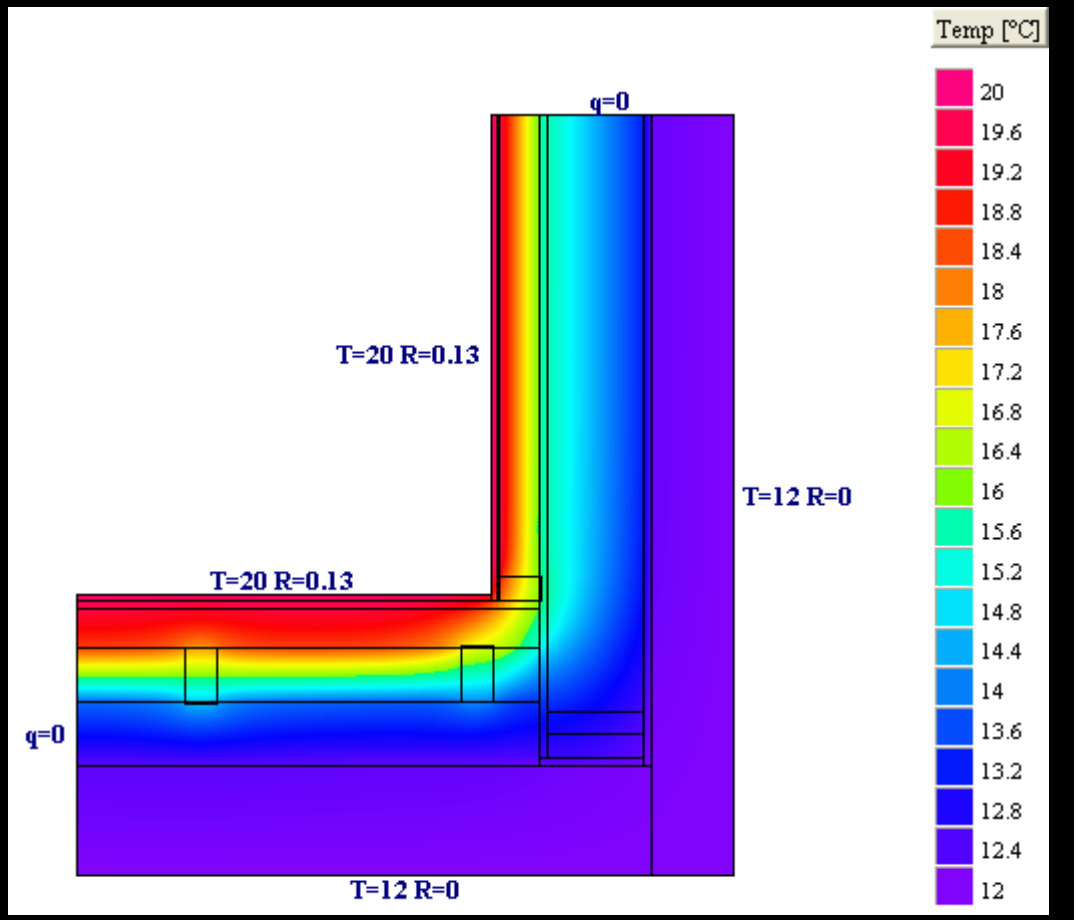


Retaining wall to floor slab

Due to site boundary issues the floor slab is under the insulation.

This reduces the potential benefits that the thermal mass of the slab could provide.

Although not ideal the highly insulated timber structure should perform extremely well. We will monitor how the building performs when complete.



Camden Passivhaus – 4th of 7 case studies

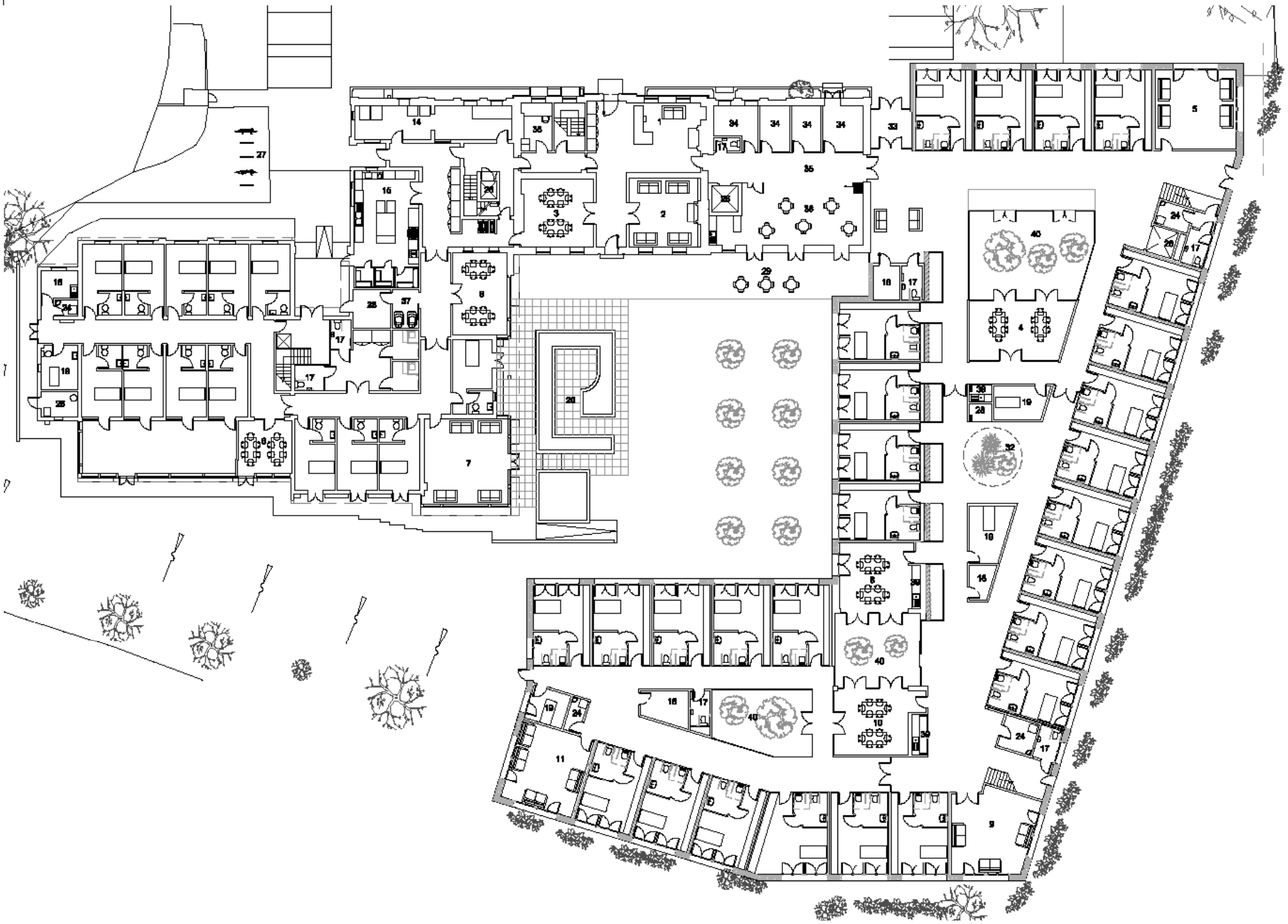
Design commenced 2007 Construction 2009

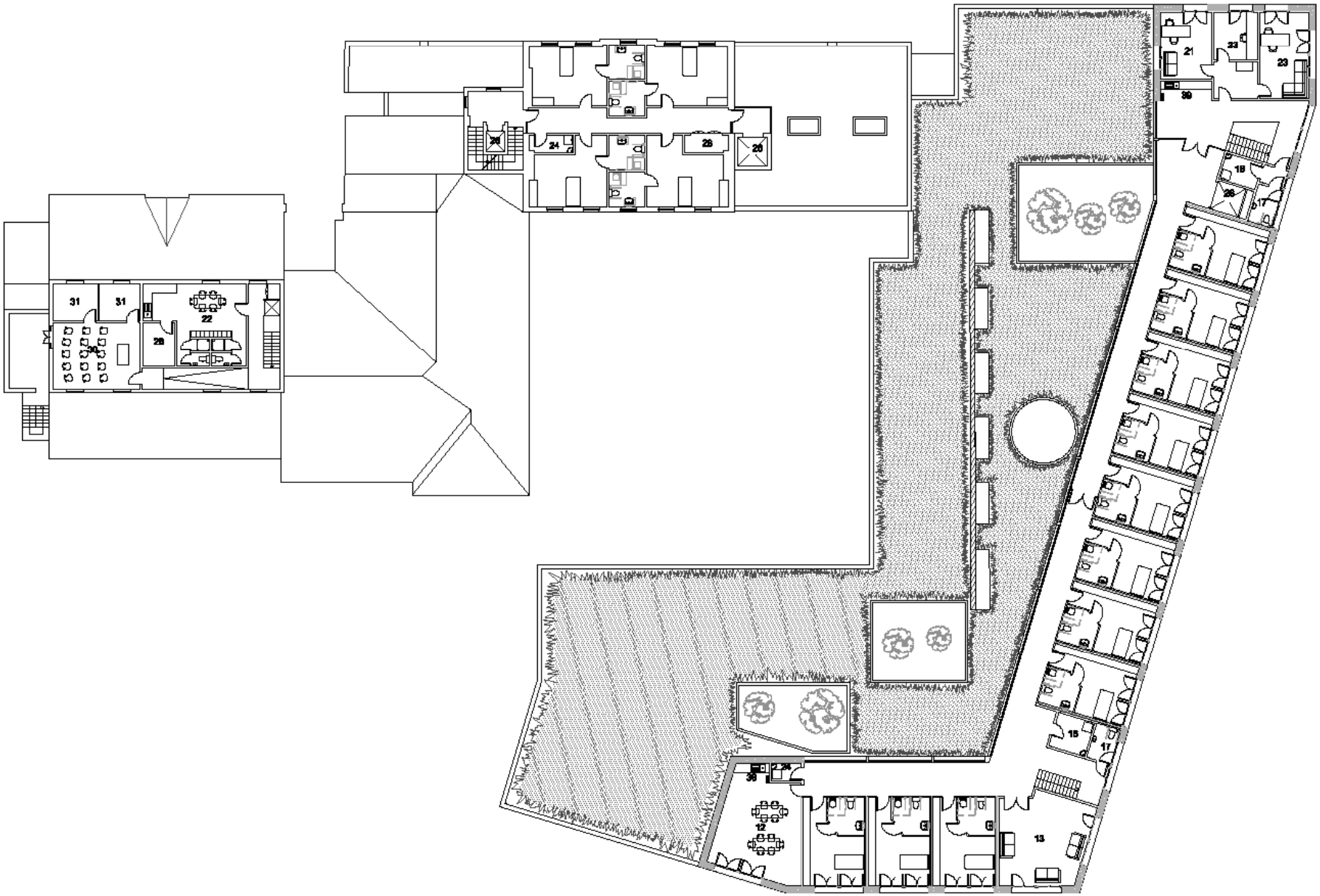
By moving from an ordinary house into a room at the Passivhaus extension of the nursing home, each person would make a heat energy saving of over 29,000 Kwh per annum. This equates to over 10,000 five-mile return trips per resident in an electric car.

Nursing Home

planning approval received Feb 2009

currently being assessed in PHPP

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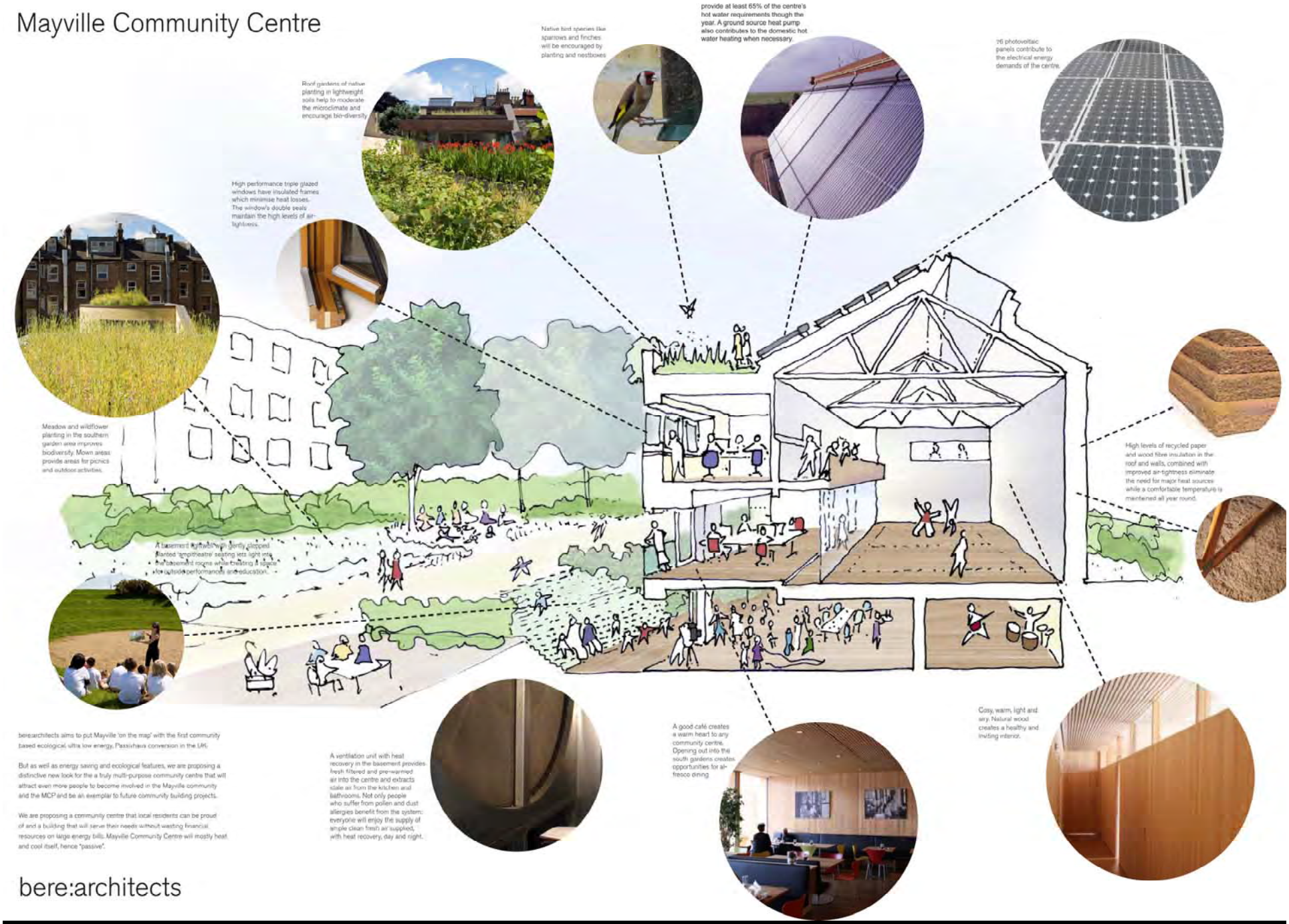
Mayville Community Centre



bere:architects aims to put Mayville 'on the map' with the first community based ecological, ultra low energy, Passivhaus conversion in the UK.

But as well as energy saving and ecological features, we are proposing a distinctive new look for the a truly multi-purpose community centre that will attract even more people to become involved in the Mayville community and the MCP and be an exemplar to future community building projects.

We are proposing a community centre that local residents can be proud of and a building that will serve their needs without wasting financial resources on large energy bills. Mayville Community Centre will mostly heat and cool itself, hence "passive".

bere:architects

Mayville Community Centre

Design commenced August 2007

Mayville Community Centre

Design commenced August 2007

Mayville Community Centre

Design commenced August 2007

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 758.8 m^2

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	13	kWh/(m^2a)	15 kWh/(m^2a)	Yes
Pressurization Test Result:	0.6	h^{-1}	0.6 h^{-1}	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	86	kWh/(m^2a)	120 kWh/(m^2a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	25	kWh/(m^2a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	22	kWh/(m^2a)		
Heating Load:	9	W/m^2		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m^2a)	15 kWh/(m^2a)	
Cooling Load:	6	W/m^2		

Passive House Planning

PRIMARY ENERGY VALUE

Building: Mildmay Community Centre
Location: London

Building Type/Use: Community Centre
Treated Floor Area A_{TFA}: 759 m^2
Space Heat Demand incl. Distribution: 13 kWh/(m^2a)
Useful Cooling Demand: 0 kWh/(m^2a)

			Final Energy kWh/(m^2a)	Primary Energy kWh/(m^2a)	Emissions CO_2-Equivalent kg/(m^2a)
Electricity Demand (without Heat Pump)				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		(Project)		2.7	680
Direct Electric Heating	$Q_{h,de}$		0.0	0.0	0.0
DHW Production, Direct Electric (without Wash&Dish)	$Q_{DHW,de}$	(DHWDistribution, SolarDHW)	0.0	0.0	0.0
Electric Postheating DHW Wash&Dish		(Electricity, SolarDHW)	0.0	0.0	0.0
Electricity Demand Lighting/Equipment/Kitchen	Q_{EHW}	(Electricity worksheet)	22.7	61.2	15.4
Electricity Demand - Auxiliary Electricity			2.2	6.0	1.5
Total Electricity Demand (without Heat Pump)			**24.9**	**67.2**	**16.9**
Heat Pump				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		(Project)		2.7	680
Energy Carrier - Supplementary Heating			Electricity	2.7	680
Annual Coefficient of Performance - Heat Pump		Separate Calculation			
Total System Performance Ratio of Heat Generator		Separate Calculation			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{hp}		0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish		(Electricity worksheet)	0.0	0.0	0.0
Total Electricity Demand Heat Pump			**0.0**	**0.0**	**0.0**
Compact Heat Pump Unit				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)		kWh/kWh	g/kWh
Covered Fraction of DHW Demand		(Project)		2.7	680
Energy Carrier - Supplementary Heating			Electricity	2.7	680
COP Heat Pump Heating		(Compactworksheet)	0.0		
COP Heat Pump DHW		(Compactworksheet)	0.0		
Performance Ratio of Heat Generator (Verification)		(Compactworksheet)			
Performance Ratio of Heat Generator (Planning)		(Compactworksheet)			
Electricity Demand Heat Pump (without DHW Wash&Dish)	Q_{hp}	(Compactworksheet)	0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish			0.0	0.0	0.0
Total Compact Unit		(Compactworksheet)	**0.0**	**0.0**	**0.0**
Boiler				PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand		(Project)	100%	kWh/kWh	g/kWh
Covered Fraction of DHW Demand		(Project)	100%	1.1	250
Boiler Type		(Boiler worksheet)	Condensing Boiler Gas		
Utilisation Factor Heat Generator		(Boiler worksheet)	94%		
Annual Energy Demand (without DHW Wash&Dish)		(Boiler worksheet)	17.4	19.1	4.3
Non-Electric Demand, DHW Wash&Dish		(Electricity worksheet)	0.0	0.0	0.0
Total Heating Oil/Gas/Wood			**17.4**	**19.1**	**4.3**

Energy use

The PHPP results (using Manchester climate data) show a provisional carbon emission rate of 16.6kgCO2/m²/annum. In the ESD energy study, the building BERb (building emission rate {before}) was 127kgCO2/m²/annum, making an 87% reduction in carbon emissions. We still have outstanding information to be added to the calculation, but we have made conservative estimates on most provisional items, and remain confident that a greater reduction than 85% can be achieved.

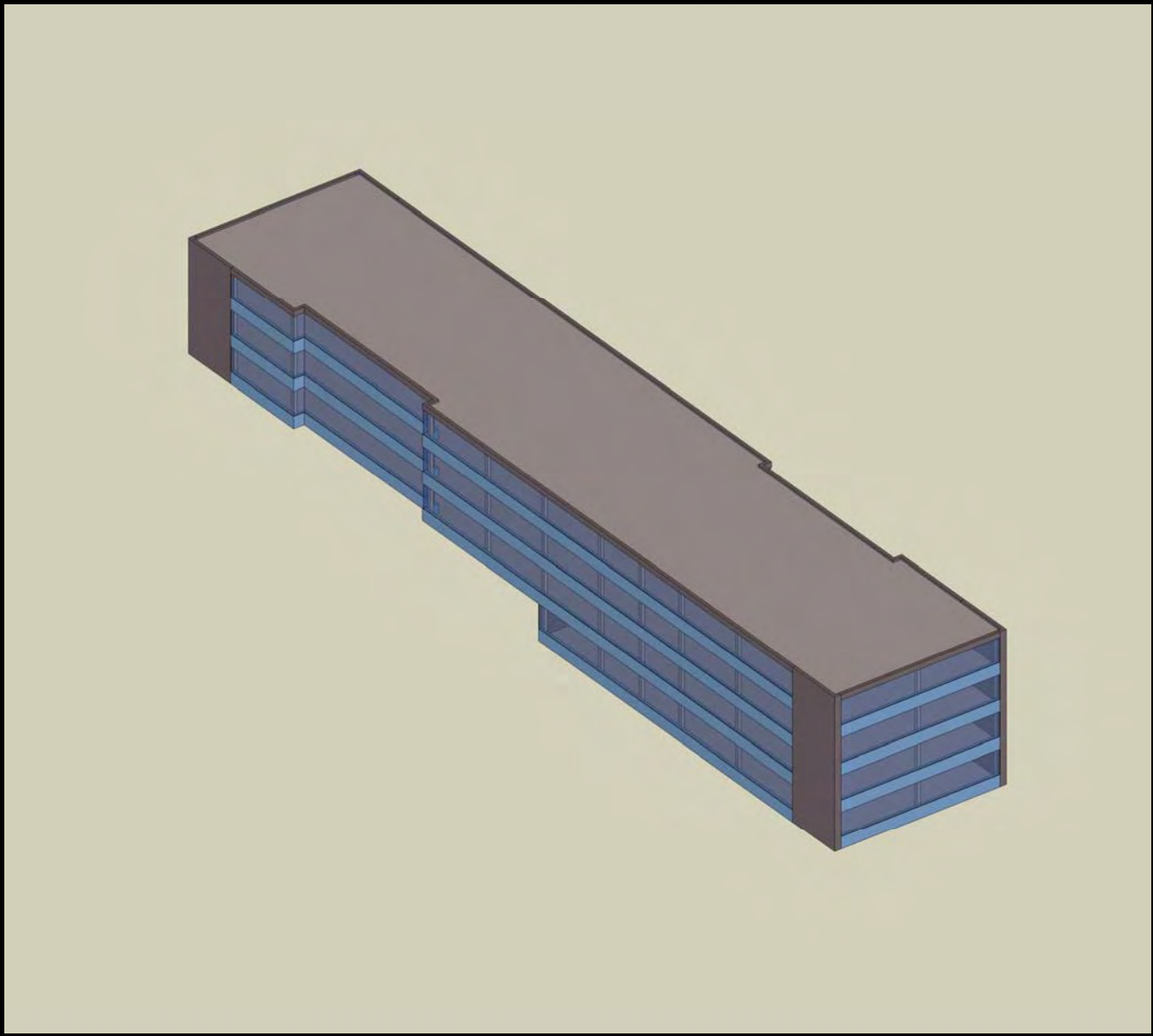
			PE Value	CO_2-Emission Factor (CO_2-Equivalent)
District Heat			kWh/kWh	g/kWh
Covered Fraction of Space Heat Demand	(Project)		0.7	-70
Covered Fraction of DHW Demand	(Project)			
Heat Source	(District Heat worksheet)			
Utilisation Factor Heat Generator	(District Heat worksheet)	0%		
Heat Demand District Heat (without DHW Wash&Dish)	(District Heat worksheet)	0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish	(Electricity worksheet)	0.0	0.0	0.0
Total District Heat		**0.0**	**0.0**	**0.0**
Other			PE Value	CO_2-Emission Factor (CO_2-Equivalent)
Covered Fraction of Space Heat Demand	(Project)		kWh/kWh	g/kWh
Covered Fraction of DHW Demand	(Project)		0.2	55
Heat Source	(Project)	Wood		
Utilisation Factor Heat Generator	(Project)			
Annual Energy Demand, Space Heating		0.0	0.0	0.0
Annual Energy Demand, DHW (without DHW Wash&Dish)		0.0	0.0	0.0
Non-Electric Demand, DHW Wash&Dish	(Electricity worksheet)	0.0	0.0	0.0
Non-Electric Demand Cooking/Drying (Gas)	(Gas Sheet)	0.0	0.0	0.0
Total - Other		**0.0**	**0.0**	**0.0**
Cooling with Electric Heat Pump			PE Value	CO_2-Emission Factor (CO_2-Equivalent)
			kWh/kWh	g/kWh
Covered Fraction of Cooling Demand	(Project)	100%	2.7	680
Heat Source		Electricity		
Annual Cooling COP				
Energy Demand Space Cooling		**0.0**	**0.0**	**0.0**
Heating, Cooling, DHW, Auxiliary and Household Electricity			42.3	86.3	21.3
Total PE Value		86.3	kWh/(m^2a)		
Total Emissions CO_2-Equivalent		21.3	kg/(m^2a)		
Primary Energy Requirement		120	kWh/(m^2a)		Yes (Yes/No)
Heating, DHW, Auxiliary Electricity (No Household Applications)			19.6	25.1	5.8
Specific PE Demand - Mechanical System		25.1	kWh/(m^2a)		
Total Emissions CO_2-Equivalent		5.8	kg/(m^2a)		
Solar Electricity		kWh/a	PE Value (Savings)	CO_2-Emission Factor	
Planned Annual Electricity Generation	Separate Calculation	8360	kWh/kWh	g/kWh	
			0.7	250	
Specific Demand		11.0	7.7	2.8	
PE Value: Conservation by Solar Electricity		22.0	kWh/(m^2a)		
CO_2-Emissions Avoided Due to Solar Electricity		4.7	kg/(m^2a)		

Total CO^2

CO^2 saved by PV

Mayville Community Centre

Design commenced August 2007

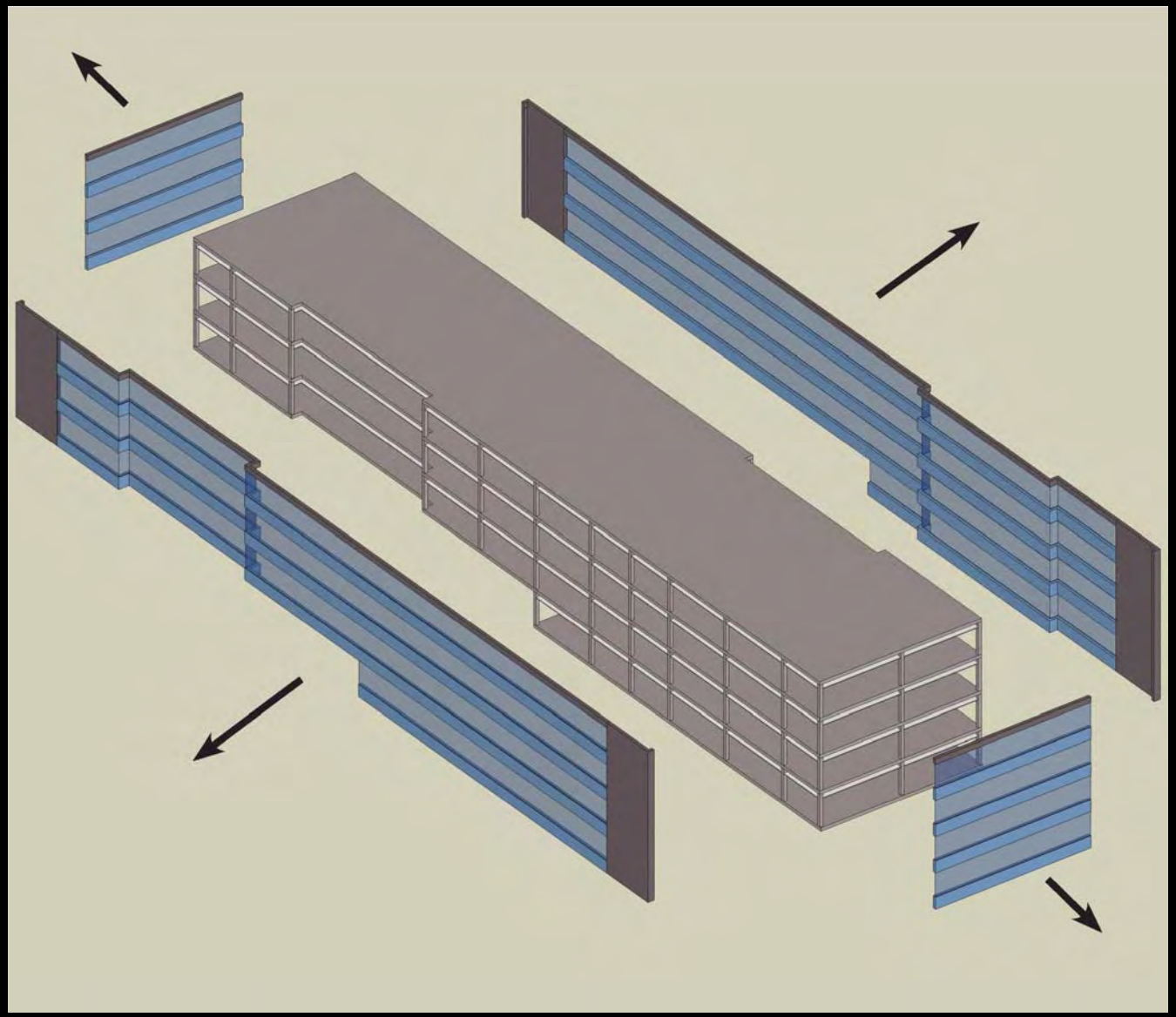


1. The building as existing

There are currently significant problems with overheating in summer and it has a high heating demand in winter.

Camden School

design commenced January 2009

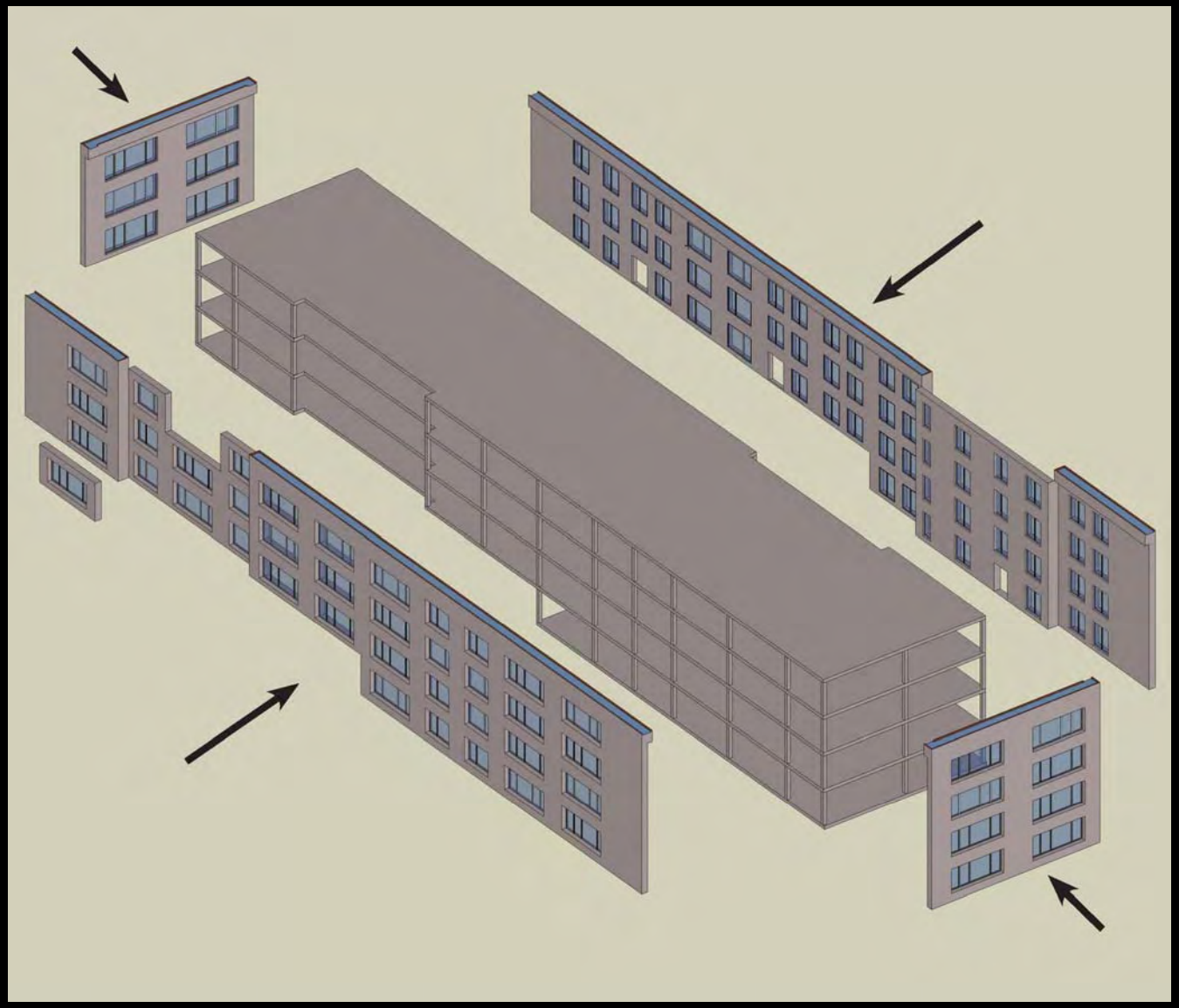


2. Removing the redundant facades and fittings

The existing facades and suspended ceilings are stripped out, leaving behind the structurally sound concrete frame, with much more generous head height than currently enjoyed.

Camden School

design commenced January 2009

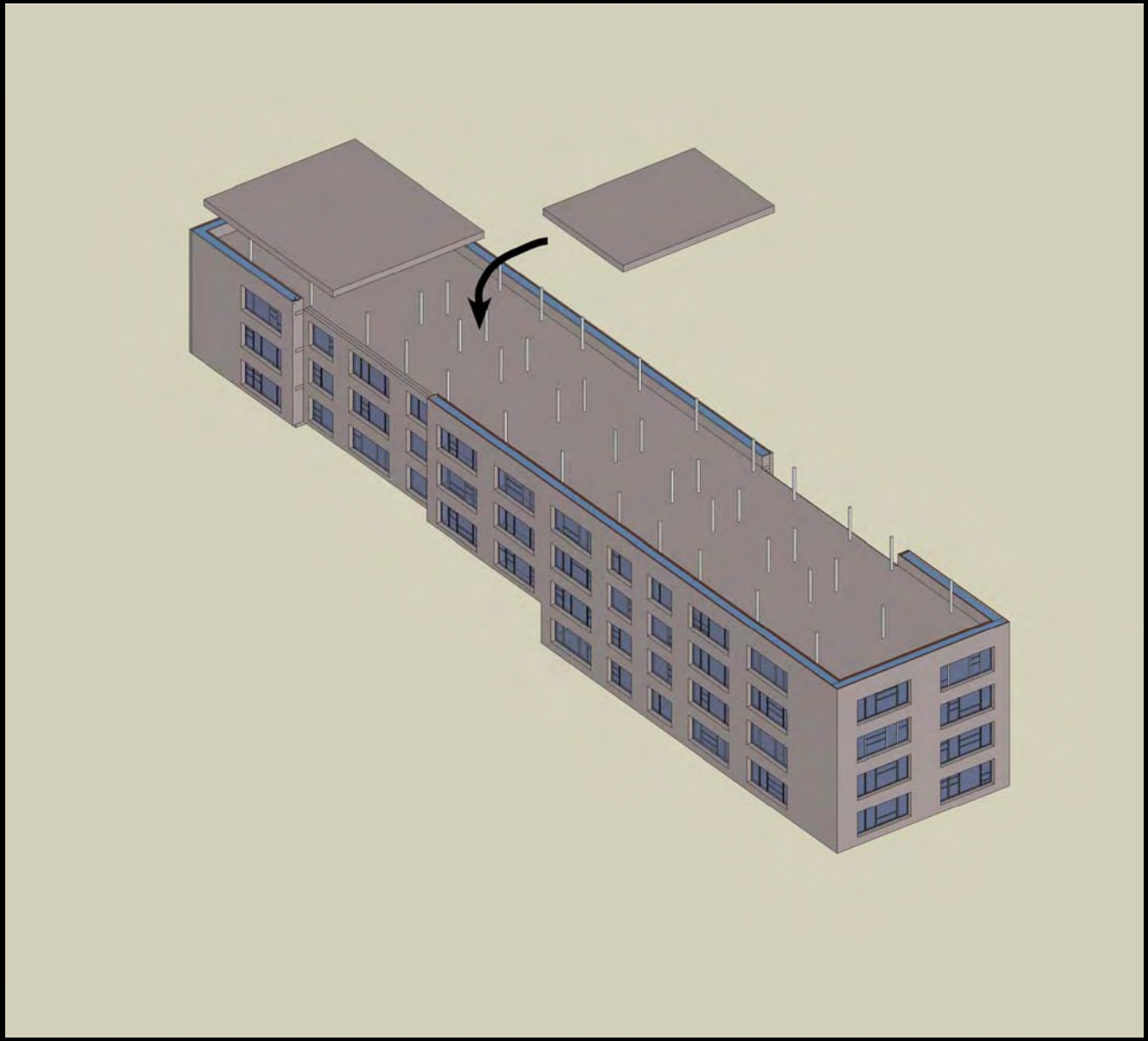


3. New passivhaus facades

The frame is retained, but with new classrooms created internally. New highly insulated and airtight Passivhaus facades manufactured in Austria will be craned onto the existing concrete frame; this prefabricated construction minimises noise, mess and time once on site, and will provide an internal environment that is warm in winter and cool in summer.

Camden School

design commenced January 2009



4. Building an additional floor of classrooms

The existing frame is likely to be able to support an additional floor, providing extra classrooms without sacrificing play areas. The columns will be extended upwards, to support new prefabricated roof panels. The result will be an additional ‘penthouse suite’ of classrooms.

Camden School

design commenced January 2009

5. The new school building

The scheme will result in a school that;

- has a winter heating demand 1/30th of that of the current building
- remains a comfortable temperature over the summer months
- has extremely good air quality - carbon dioxide levels in the air are lower than the rigorous German standard
- has a greater number of more spacious classrooms than the existing
- Saves £1.5 million by re-using the existing concrete frame

Camden School

design commenced January 2009