Flash Retrofit Seminar

22 September 2011

Scaling up Retrofit: Passivhaus Examples from Germany

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Passfield Drive

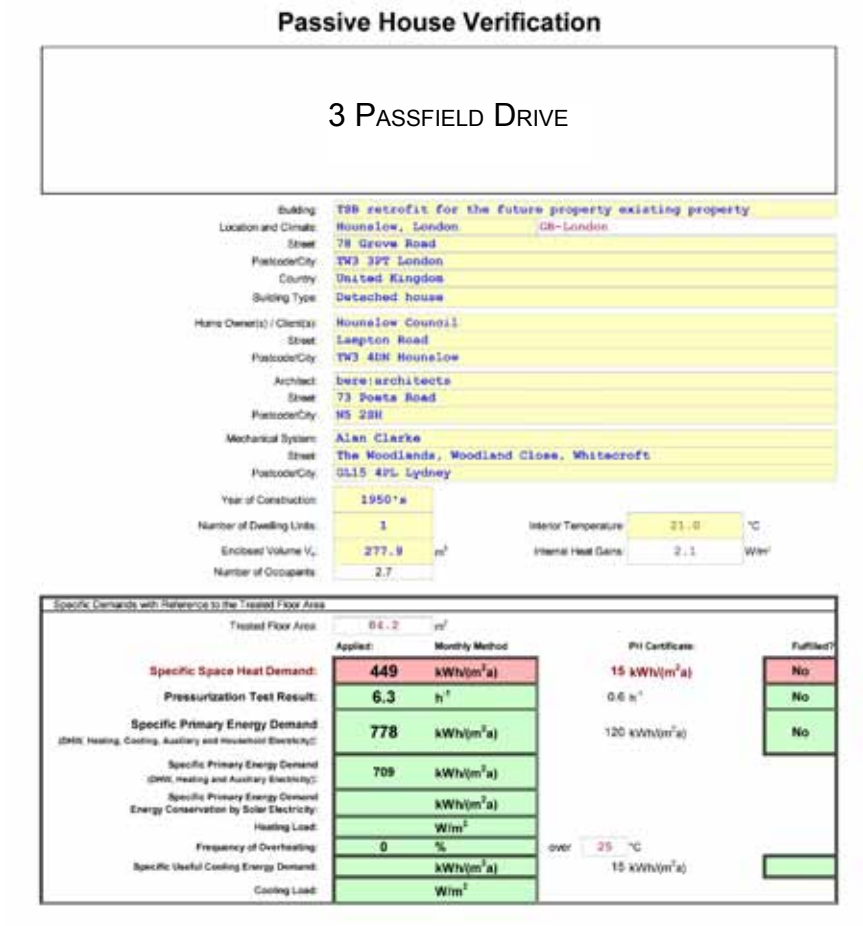
3 Passfield Drive before the Retrofit works

3 Passfield Drive following the Retrofit works

Grove Road

78 Grove Road before the Retrofit works

Awaiting scaffolding removal following completion of render
- final air testing to be completed



Passive House Verification

3 Passfield Drive

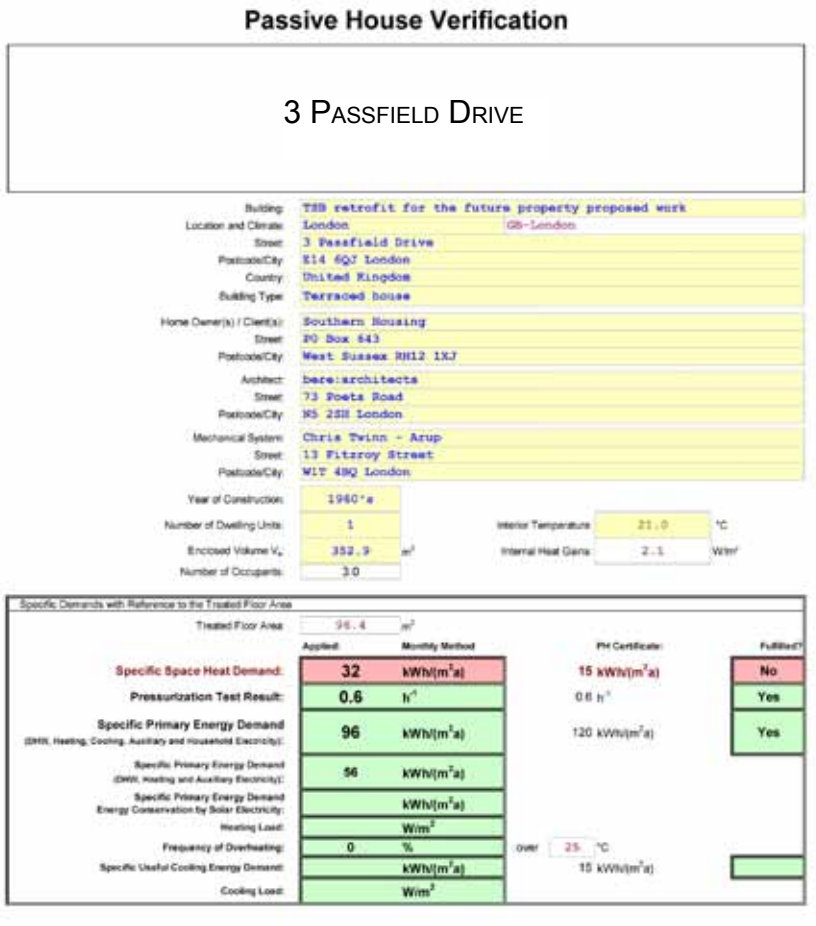
Building:	TSB retrofit for the future property existing property
Location and Climate:	Hounslow, London GB-London
Street:	78 Grove Road
Postcode/City:	TW3 3PT London
Country:	United Kingdom
Building Type:	Detached house
Home Owner(s) / Client(s):	Hounslow Council
Street:	Lampton Road
Postcode/City:	TW3 4DN Hounslow
Architect:	bere:architects
Street:	73 Poets Road
Postcode/City:	N5 2SH
Mechanical System:	Alan Clarke
Street:	The Woodlands, Woodland Close, Whitecroft
Postcode/City:	GL15 4PL Lydney
Year of Construction:	1950's
Number of Dwelling Units:	1
Interior Temperature:	21.0 °C
Enclosed Volume V_e:	277.9 m³
Internal Heat Gains:	2.1 W/m²
Number of Occupants:	2.7

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 64.2 m²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	449	kWh/(m²a)	15 kWh/(m²a)	No
Pressurization Test Result:	6.3	h⁻¹	0.6 h⁻¹	No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	778	kWh/(m²a)	120 kWh/(m²a)	No
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	709	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)		
Heating Load:		W/m²		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)	
Cooling Load:		W/m²		

A Passivhaus Planning Package (PHPP) assessment of the energy requirements of the existing house



Passive House Verification

3 Passfield Drive

Building:	TSB retrofit for the future property proposed work
Location and Climate:	London GB-London
Street:	3 Passfield Drive
Postcode/City:	E14 6QJ London
Country:	United Kingdom
Building Type:	Terraced house
Home Owner(s) / Client(s):	Southern Housing
Street:	PO Box 643
Postcode/City:	West Sussex RH12 1XJ
Architect:	bere:architects
Street:	73 Poets Road
Postcode/City:	N5 2SH London
Mechanical System:	Chris Twinn - Arup
Street:	13 Fitzroy Street
Postcode/City:	W1T 4BQ London
Year of Construction:	1960's
Number of Dwelling Units:	1
Interior Temperature:	21.0 °C
Enclosed Volume V_e:	352.9 m³
Internal Heat Gains:	2.1 W/m²
Number of Occupants:	3.0

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 96.4 m²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	32	kWh/(m²a)	15 kWh/(m²a)	No
Pressurization Test Result:	0.6	h⁻¹	0.6 h⁻¹	Yes
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	96	kWh/(m²a)	120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	56	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)		
Heating Load:		W/m²		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)	
Cooling Load:		W/m²		

A PHPP assessment of the proposed Retrofit works as shown on the original competition entry

Passive House Verification

78 Grove Road

Building:	TSB retrofit for the future property existing property
Location and Climate:	London GB-London
Street:	3 Peasfield Drive
Postcode/City:	E14 6QJ London
Country:	United Kingdom
Building Type:	Terraced house
Home Owner(s) / Client(s):	Southern Housing
Street:	PO Box 643
Postcode/City:	West Sussex RH12 1XJ
Architect:	bere:architects
Street:	73 Poets Road
Postcode/City:	N5 2SH London
Mechanical System:	Chris Twinn - Arup
Street:	13 Fitzroy Street
Postcode/City:	W1T 4BQ London
Year of Construction:	1960's
Number of Dwelling Units:	1
Interior Temperature:	21.0 °C
Enclosed Volume V_e:	336.5 m³
Internal Heat Gains:	2.1 W/m²
Number of Occupants:	3.1

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 100.6 m²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	285	kWh/(m²a)	15 kWh/(m²a)	No
Pressurization Test Result:	5,6	h⁻¹	0.6 h⁻¹	No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	532	kWh/(m²a)	120 kWh/(m²a)	No
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	466	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)		
Heating Load:		W/m²		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)	
Cooling Load:		W/m²		

A Passivhaus Planning Package (PHPP) assessment of the energy requirements of the existing house

Passive House Verification

78 Grove Road

Building:	TSB retrofit for the future property proposed work
Location and Climate:	Hounslow, London GB-London
Street:	78 Grove Road
Postcode/City:	TW3 3PT London
Country:	United Kingdom
Building Type:	Detached house
Home Owner(s) / Client(s):	Hounslow Council
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Street:	73 Poets Road
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Mechanical System:	Alan Clarke
Street:	The Woodlands, Woodland Close, Whitecroft
Postcode/City:	GL15 4PL Lydney
Year of Construction:	1950's
Number of Dwelling Units:	1
Interior Temperature:	21.0 °C
Enclosed Volume V_e:	353.1 m³
Internal Heat Gains:	2.1 W/m²
Number of Occupants:	2.7

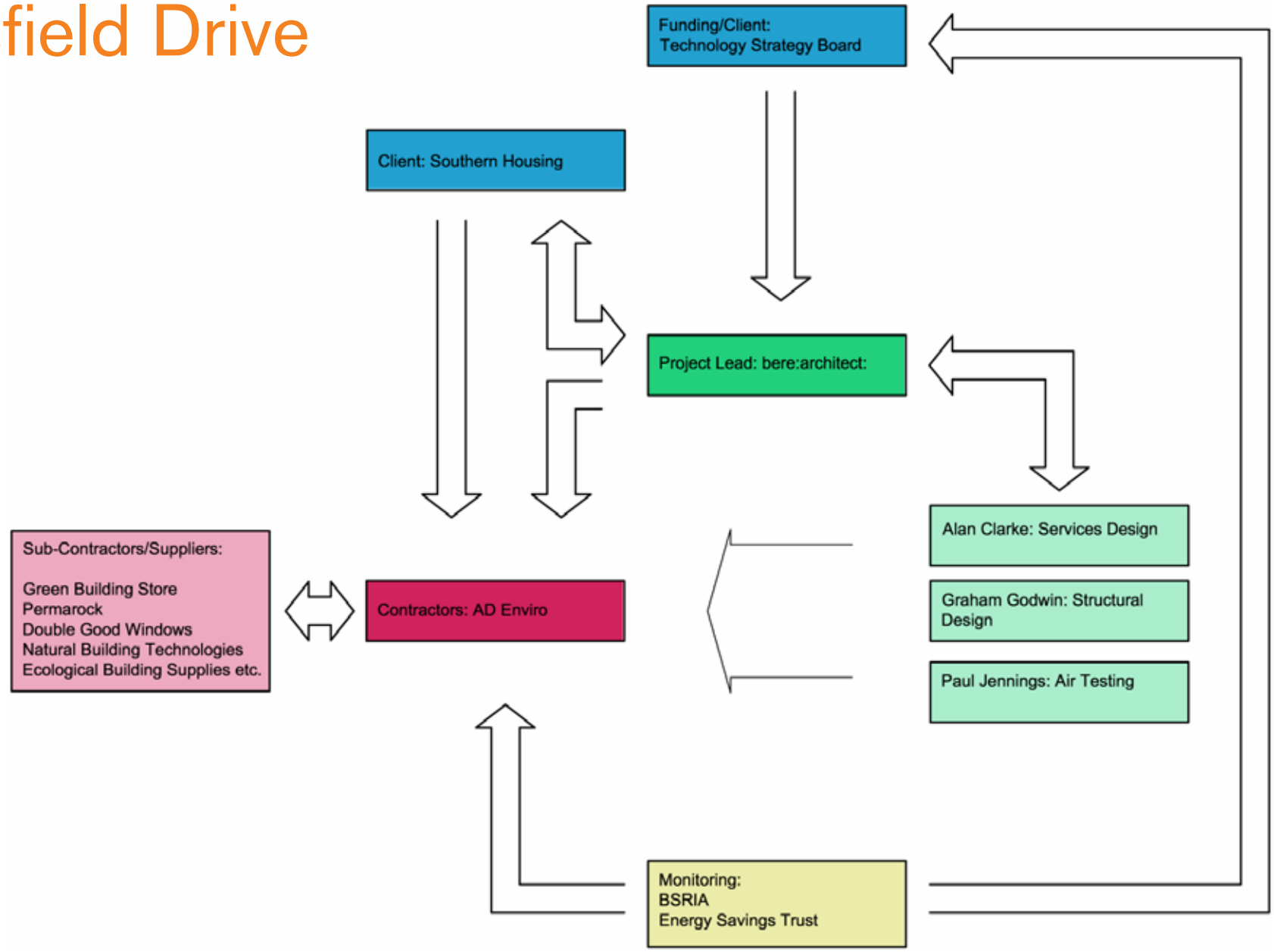
Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 84.2 m²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?	Verification:
Specific Space Heat Demand:	26	kWh/(m²a)	15 kWh/(m²a)	No	
Pressurization Test Result:	0.6	h⁻¹	0.6 h⁻¹	Yes	
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	94	kWh/(m²a)	120 kWh/(m²a)	Yes	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	53	kWh/(m²a)			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)			
Heating Load:		W/m²			
Frequency of Overheating:	8	%	over 25 °C		
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)		
Cooling Load:		W/m²			

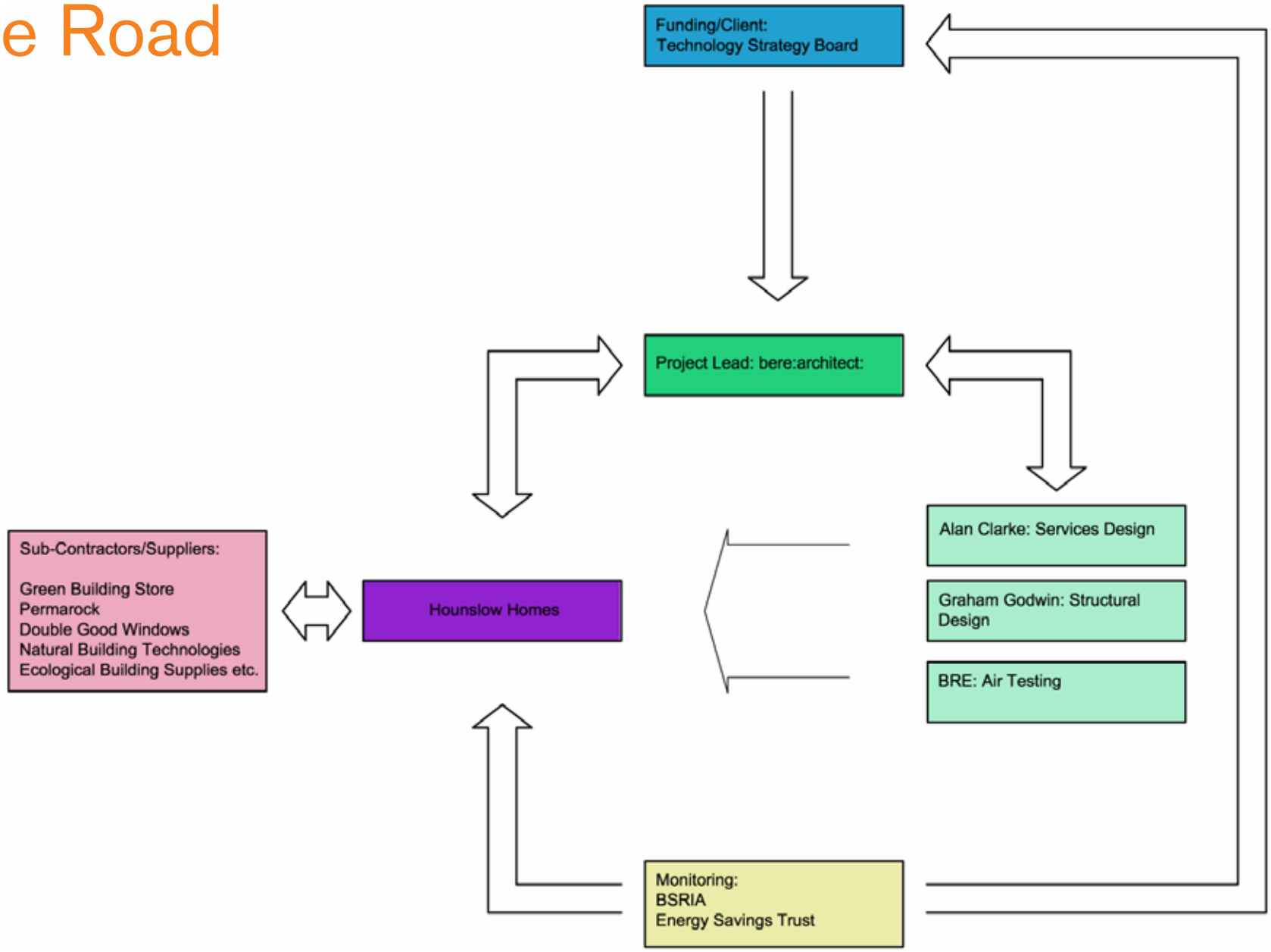
A PHPP assessment of the proposed Retrofit works as shown on the original competition entry

Passfield Drive



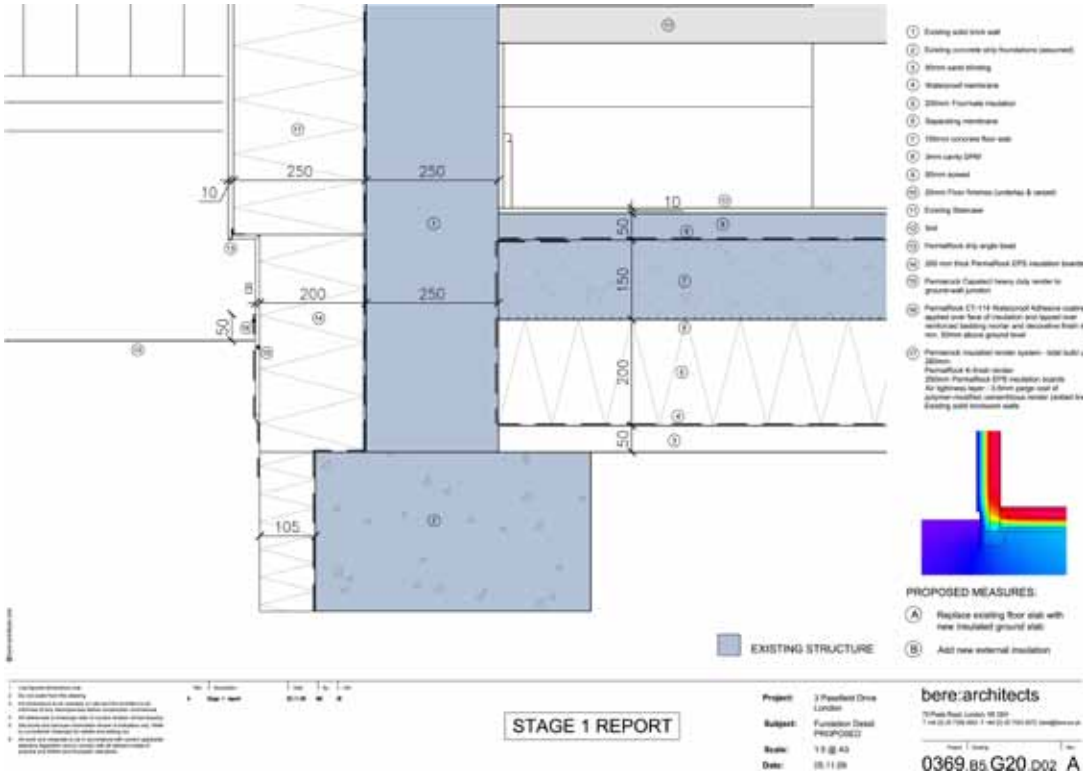
team organisation

Grove Road



team organisation

Passfield Drive

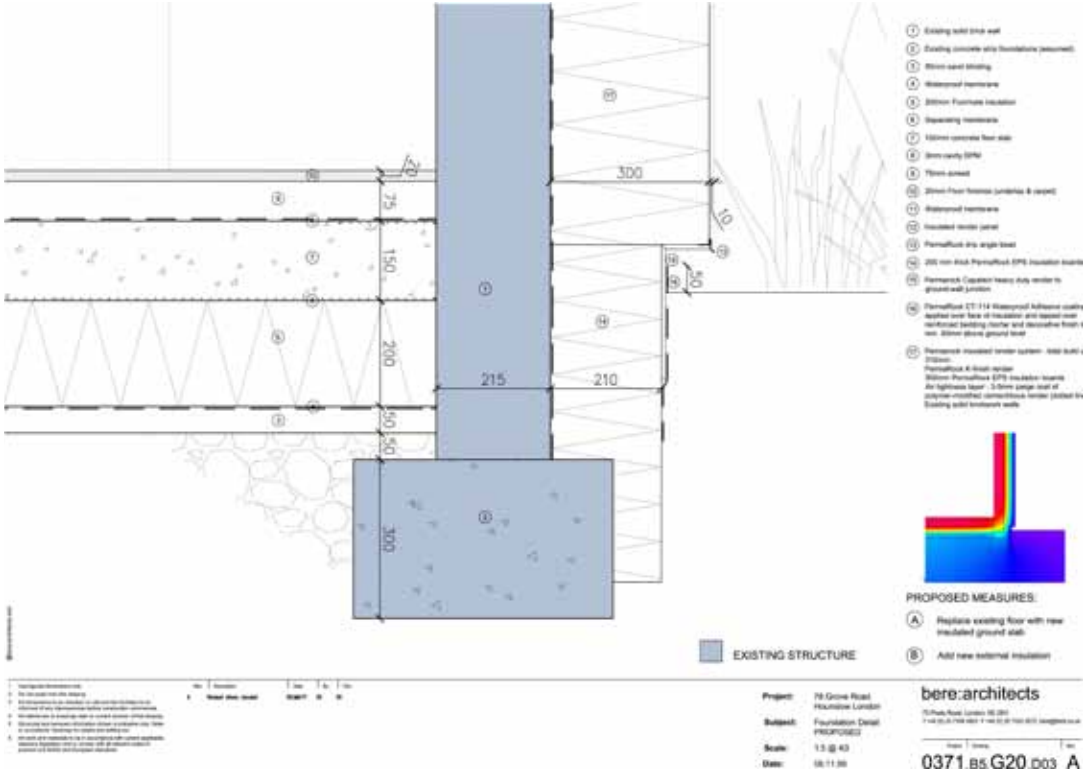


Original proposals assumed that the ground floor slab could be replaced with a new insulated slab requiring a decant of the tenants

Prefabricated vacuum insulation panels were fitted above the existing concrete ground floor slab; protected with foam sheets. The insulation could be installed one room at a time

client - design team

Grove Road

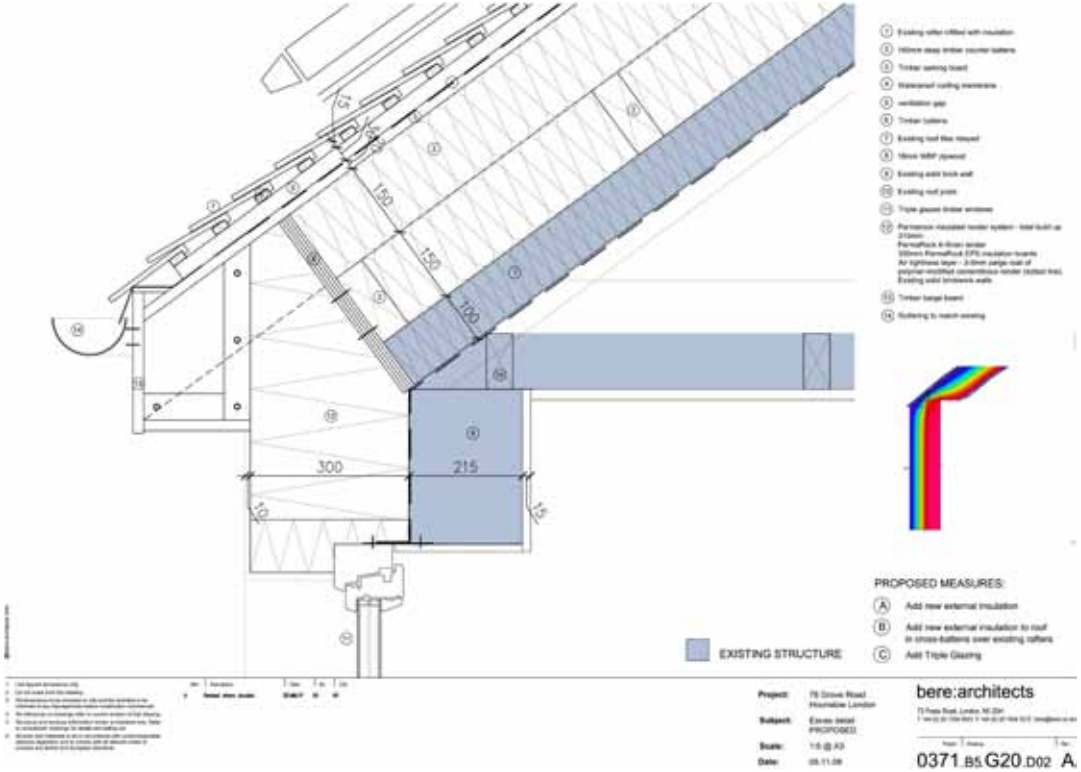


Original proposals assumed that the suspended timber floor could be replaced with a similar insulated slab requiring a decant of the tenants

Geotextile membranes were laid across the floor joists to support mineral wool insulation. OSB boards are laid over the floor and taped to the walls to provide an airtightness barrier. This work was also carried out on a room by room basis

client - design team

Grove Road



Original proposals assumed that the existing roof tiles could be replaced allowing insulation to be installed between and above the rafters. Hounslow Homes wanted to avoid the requirement for a temporary roof and requested an alternative solution.

Eaves were extended to allow continuity of insulation from the loft to the walls without removing the entire roof

client - design team

Passfield Drive

A continuous membrane installed in the loft at Passfield Drive to create the airtightness barrier, sealed to the external walls.

The membrane proved difficult to install; requiring many taped joints and difficult sealing details around service penetrations

Grove Road

18mm OSB provides the airtight barrier. Membranes are used to seal around roof timbers and connect to the external walls

The boards allowed access to be maintained in the roof space and simple seals to be used around services

Window installation training at 3 Passfield Drive

Window installation training at 78 Grove Road

design team - contractor

Airtight membranes provide continuity between the window sealing tapes and the parge coat of the external walls

The window sealing tapes are continuous with ‘rabbit ears’ at the corners to facilitate sealing and allow for differential movement

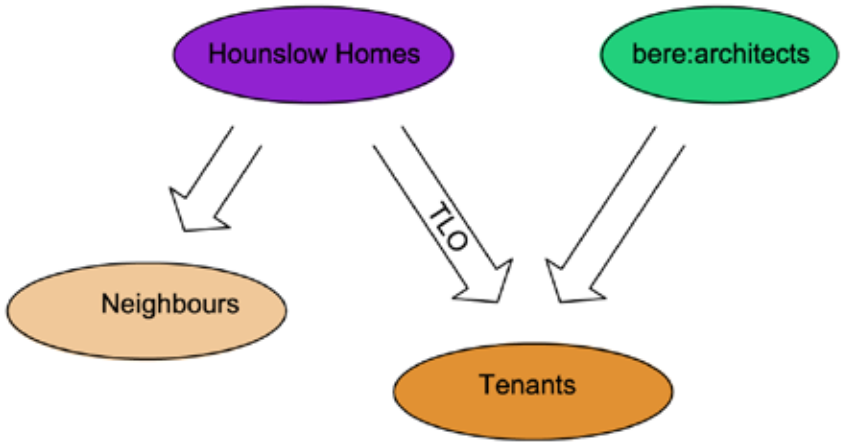
The ‘rabbit ears’ are folded back so that they can be sealed to the membranes

design team - contractor

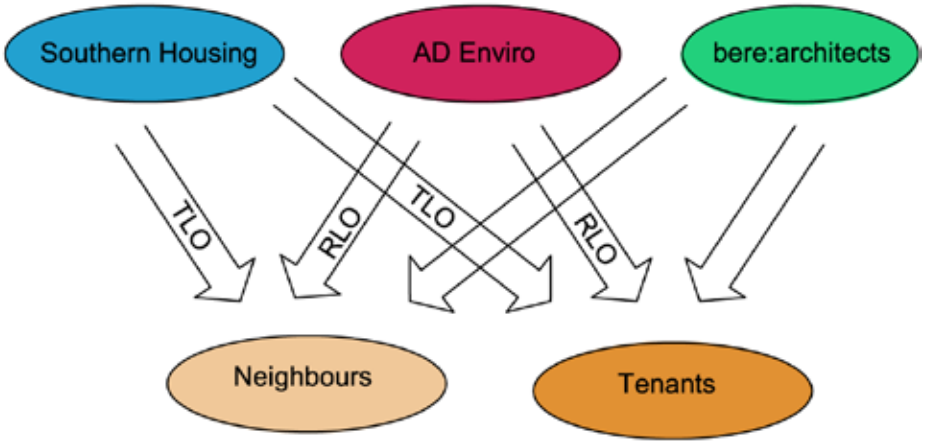
These tapes were fitted without ears and were cut by the installers when trying to tape them back to the membrane

contractor - sub-contractor

Grove Road



Passfield Drive

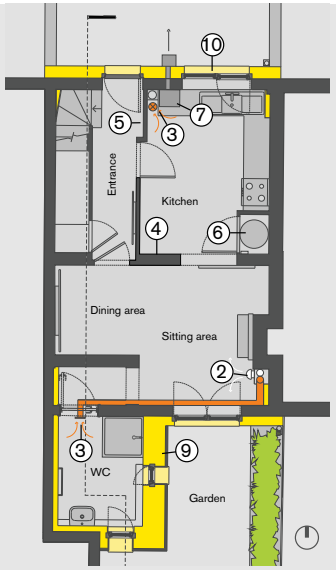


team - tenants

Passfield Drive User Guide

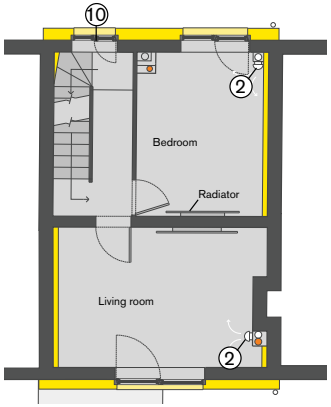
This house is built towards a building standard called Passivhaus.

Passfield drive north elevation

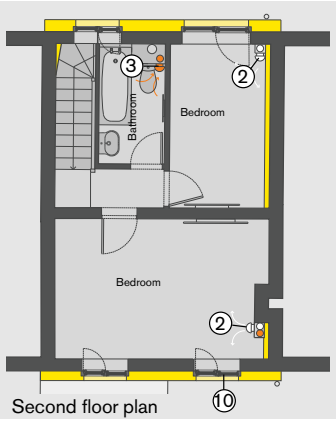


Ground floor plan

The term passivhaus refers to an advanced low energy construction standard for buildings, which have excellent comfort conditions in both winter and summer. They typically achieve a heating saving of 90% compared to existing housing. Passivhaus buildings are easy to live in and require little maintenance, but they do have some important features, which are explained in this guide. The features are simple to operate, but a full understanding will help you get the lowest energy consumption and best comfort. This guide has been design by Alan Clarke and bere:architects for you (the user) to understand how a passivhaus works and how to operate the controls in this house.
Each feature is labelled on the drawings below, highlighting their locations and briefly explaining how to operate them in the corresponding text. Please take the time to read this guide and familiarise yourself with the controls.

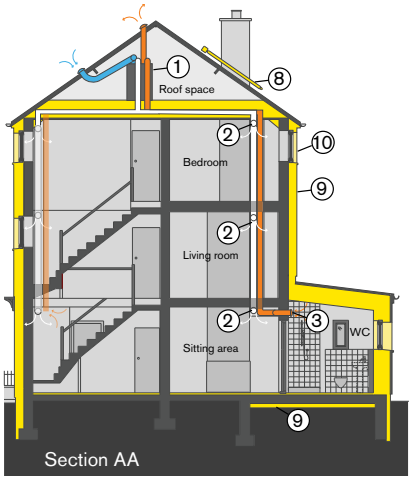


First floor plan



Second floor plan

Wall construction
Outside air intake
Supply ducts
Extract ducts
Insulation



Section AA

1 Heat recovery ventilation unit

This unit saves heat from the internal air produced by solar gains, people and electric items to pre-heat a supply of fresh air. If air heating is not required only fresh filtered air is supplied. These filters need to be replaced every 6months in London. The system saves about 10 times more energy than it uses! It is located in the store in an insulated cupboard.

2 Fresh air vents

The fresh air (pre-warmed in winter) is supplied by the heat recovery unit and delivered to the bedrooms and living room using these fresh air vents. The heating system (6,7) is automatic but you can adjust the fan speed (4) manually with the wall mounted panel in the kitchen. This will keep the air fresh during a family gathering or intensive cooking (in addition to the extractor fan.

3 Extract air vents

These vents remove possible stale and damp air from the kitchen, bathroom and WC. The heat recovery unit saves heat, which saves money. The ventilation runs continuously all year round but special motors have tiny energy consumption. The extract air vent filter in the kitchen needs to be cleaned about every 3 months depending on use.

4 Heat recovery ventilation control panel

The fresh air system can be left on "auto" but the fan speed can also be manually changed using this panel during cooking or if the bathrooms are steamy. If you go away for a period of time don't turn it off but leave it on the lowest speed.

5 Thermostat

The thermostat in the entrance way sets the temperature for your house. 20-21°C is the normal temperature, but you could turn it down if you are away for a few days or just for a few hours to save energy. To adjust the room temperature, locate the room temperature display and simple rotate the right knob up or down.

6 Solar tank and control panel

This unit stores hot water produced by the panel (8) on your roof and for the heating and added water heated by the gas boiler (7). The tank is well insulated meaning there is hot water day and night. The temperate of the tank is set with the control panel below. The space heating is controlled with the Thermostat in the entrance way (5) and not via this panel.

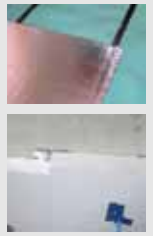
7 Boiler and control panel

This boiler serves as back up for the solar tank (6). If there has not been enough sun the water in the solar tank may not be hot enough for heating or showering. In this instance the gas boiler will top up the solar tank. There is no need to amended the setting on the boiler. To turn the heating up use the thermostat (5).

8 Hot water from the sun

In summer almost all the water in the solar tank is heated by the sun shining on the solar panel on the roof. In winter the panel can heat the bottom half of the tank and the boiler is used to top up the temperature. This means there is always hot water available in the tank even on a cloudy day.

9 Insulation and draft free construction



This house has been wrapped in insulation, floor walls and roof. The front wall has 200mm, rear 250mm, the roof 490mm and vacuum insulation on the floors. Every penetrations of this insulation has been sealed to produce a draft free building suitable for using a heat recovery unit. These improvement will make your energy cost much lower.

10 Windows (for summer cooling)

To keep the internal temperature cool in the summer utilise the cooler night temperatures by leaving the windows open in the secure "tilt" position overnight. If it's hotter outside in the day you can shut the windows then turn the heat recovery ventilation to summer by pass using the user settings on the control panel (4) to keep cool inside. Please refer to the heat recovery ventilation unit manual surplied by AD enviro.

bere:architects

For further information regarding these features:

AD enviro (passfield drive building contractor)
Consult the specific manufactures guides supplied

Alan Clarke (Building Services Engineer)
Tel: 01594 563356
E-mail: alan@arclarke.co.uk

bere:architects (passivhaus specialists)
Tel: 020 7359 4503
E-mail: bere@bere.co.uk

Passive House Verification

78 Grove Road

Building:	TSB retrofit for the future property proposed work	
Location and Climate:	Hounslow, London	GB-London
Street:	78 Grove Road	
Postcode/City:	TW3 3PT London	
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Postcode/City:	N5 2SH	
Mechanical System:	Alan Clarke	
Street:	The Woodlands, Woodland Close, Whitecroft	
Postcode/City:	GL15 4PL Lydney	
Year of Construction:	1950's	
Number of Dwelling Units:	1	Interior Temperature: 20.0 °C
Enclosed Volume V_e:	353.1 m³	Internal Heat Gains: 2.1 W/m²
Number of Occupants:	2.4	

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 76.0 m²

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	25	kWh/(m²a)	15 kWh/(m²a)	No
Pressurization Test Result:	1.0	h⁻¹	0.6 h⁻¹	No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	94	kWh/(m²a)	120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	52	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)		
Heating Load:		W/m²		
Frequency of Overheating:	15	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)	
Cooling Load:		W/m²		

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:

Predicted specific heat demand reduction of 91%

Passive House Verification

3 Passfield Drive

Building:	TSB retrofit for the future property proposed work	
Location and Climate:	London	GB-London
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Home Owner(s) / Client(s):	Southern Housing	
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Architect:	bere:architects	
Street:	73 Poets Road	
Postcode/City:	N5 2SH London	
Mechanical System:		
Street:		
Postcode/City:		
Year of Construction:	1960's	
Number of Dwelling Units:	1	Interior Temperature: 20.0 °C
Enclosed Volume V_e:	352.9 m³	Internal Heat Gains: 2.1 W/m²
Number of Occupants:	4.0	

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 82.2 m²

	Applied:	Annual Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	25	kWh/(m²a)	15 kWh/(m²a)	No
Pressurization Test Result:	1.9	h⁻¹	0.6 h⁻¹	No
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):	119	kWh/(m²a)	120 kWh/(m²a)	Yes
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):	58	kWh/(m²a)		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		kWh/(m²a)		
Heating Load:		W/m²		
Frequency of Overheating:	0	%	over 25 °C	
Specific Useful Cooling Energy Demand:		kWh/(m²a)	15 kWh/(m²a)	
Cooling Load:		W/m²		

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:

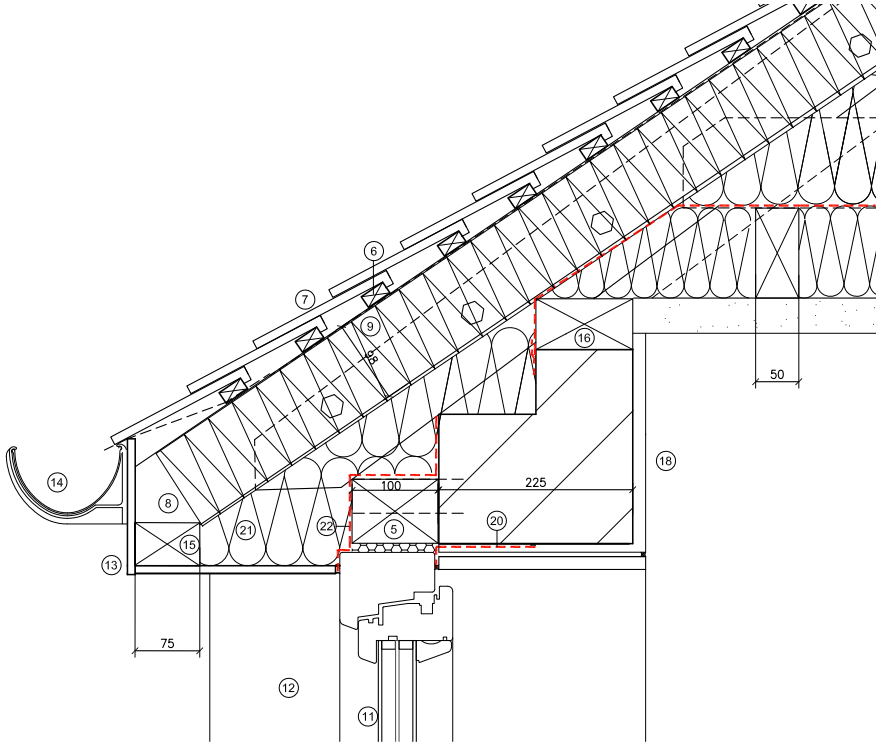
Predicted specific heat demand reduction of 94%

Passfield Drive

Although the insulation had been installed by a recommended contractor the finishing of details was poor; assumptions were made by the sub-contractor instead of following the drawings and specification.

Window reveals were re-rendered to provide the correct sealant joins and weathering details.

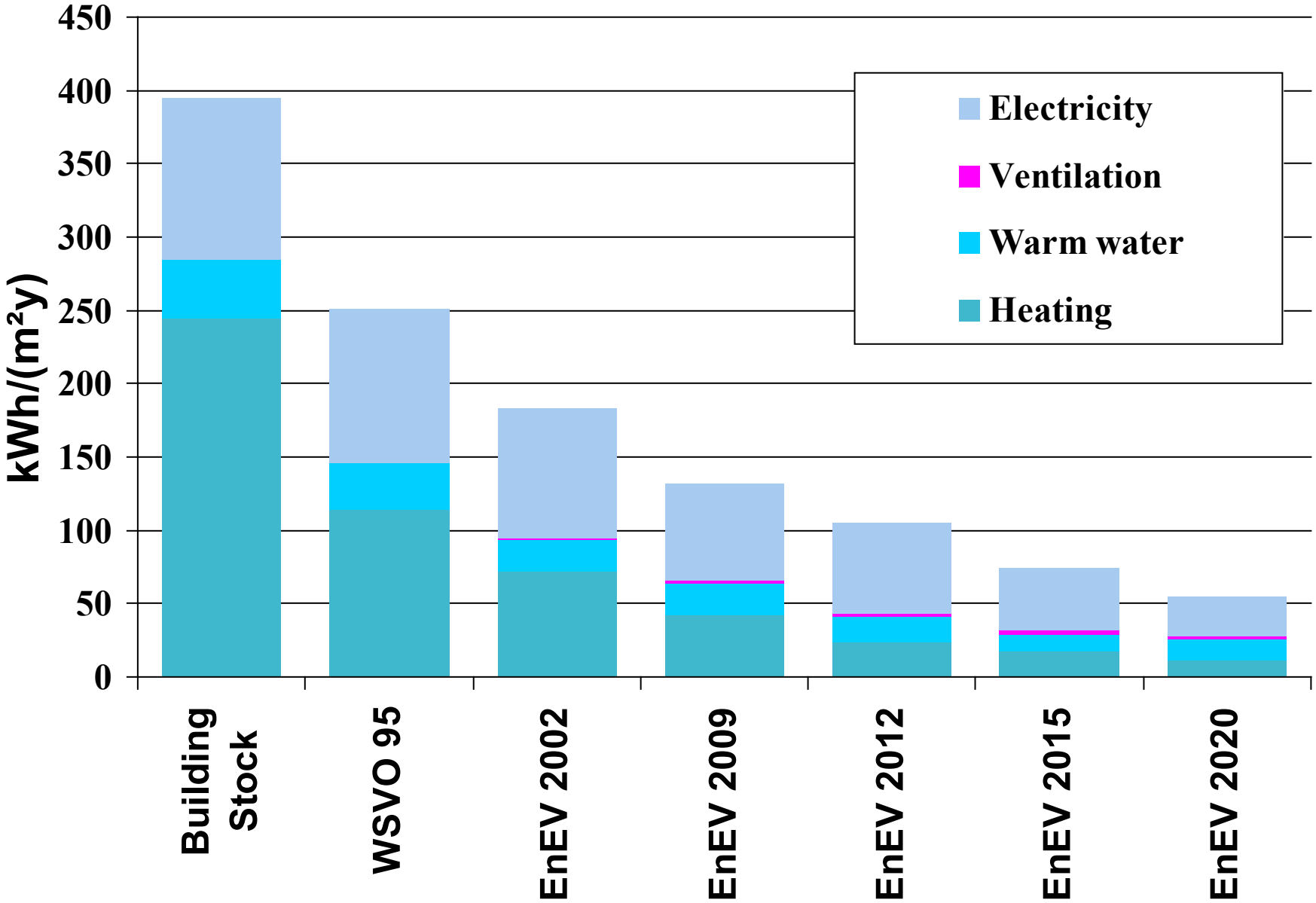
Grove Road



Revised proposals required the continuity of airtightness membrane from the external walls to the OSB boards in the roof space

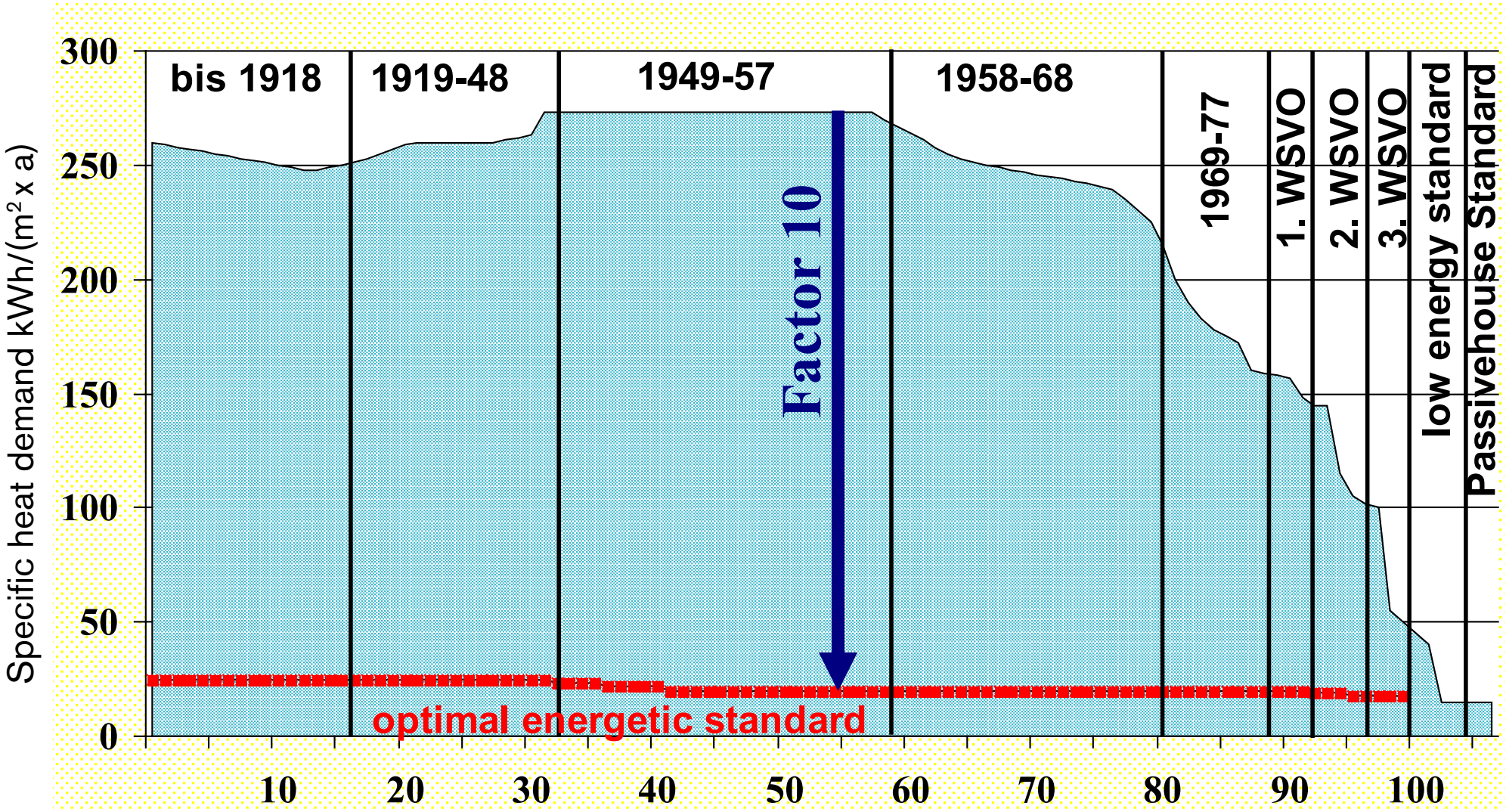
Taping around the roof timbers was considerably harder than envisaged. Hounslow Homes suggested that on future projects it would be easier to locally lift the roof timbers in order to insert a continuous membrane

lessons learned



German Energy Standards - Primary Energy

source: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

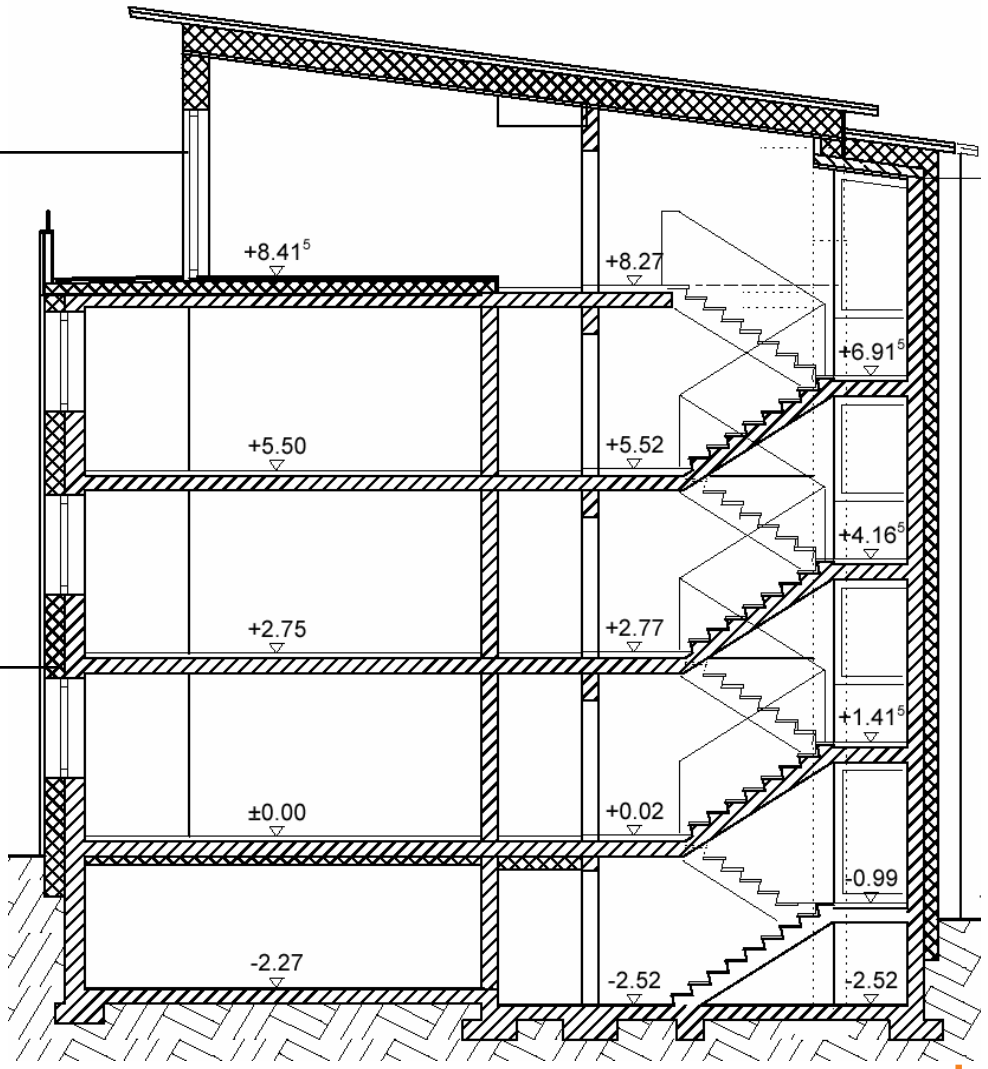


Reduction of heat demand by rehabilitation using Passivhaus components

source: ARENHA 1993, IWU 1994, Bundesarchitektenkammer 1995, Schulze Darup 1998/2000

Passivhaus
Windows
Uw < 0.80
W/m²K

Wall
U ≤ 0.16
W/(m²K)



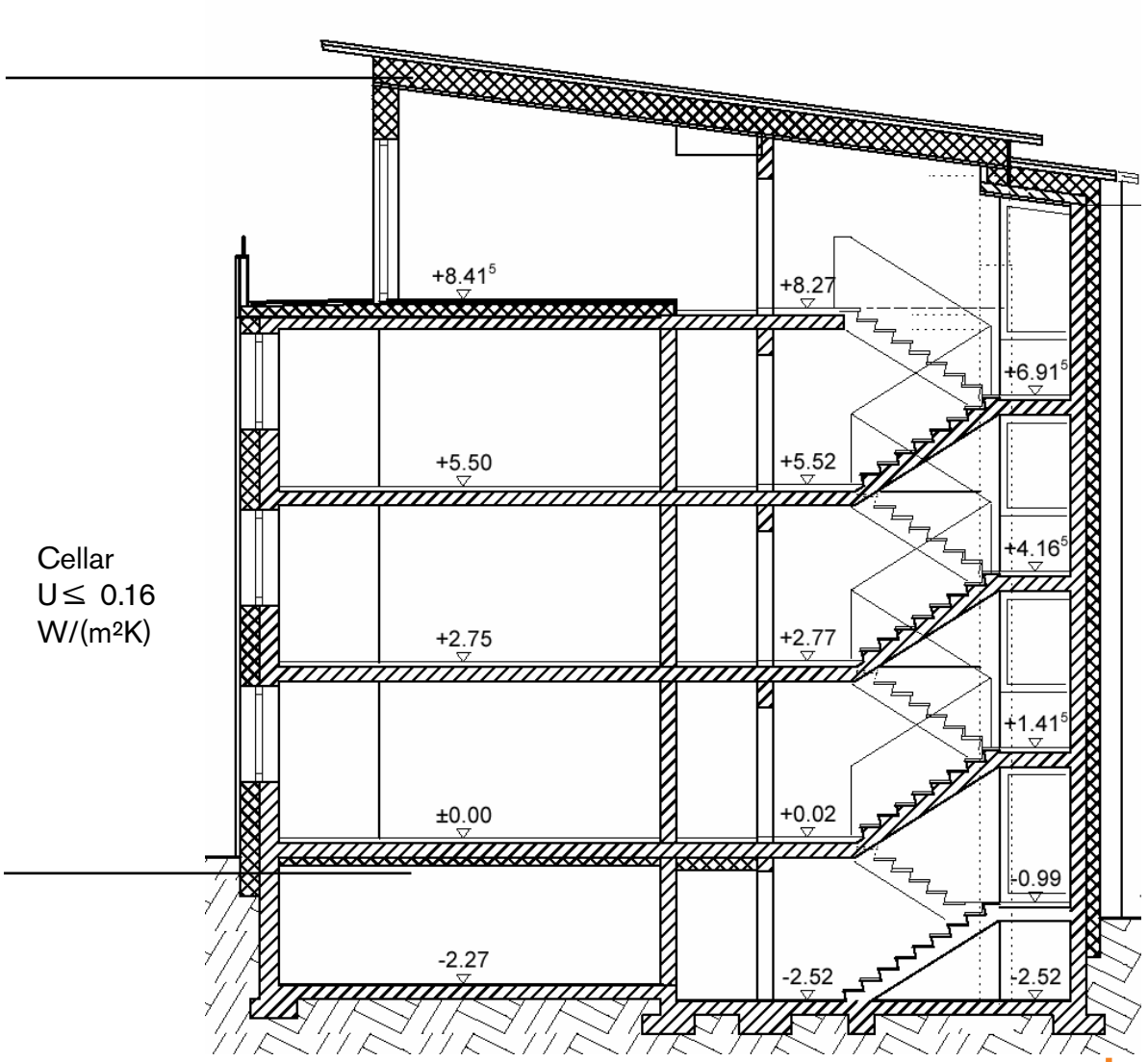
approach

bere:architects

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Roof
U ≤ 0.16
W/(m²K)

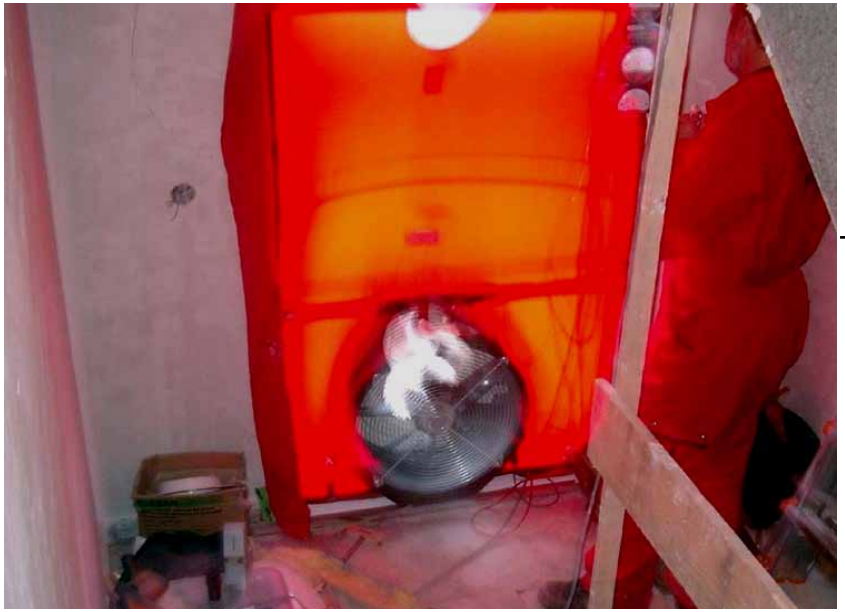
Cellar
U ≤ 0.16
W/(m²K)



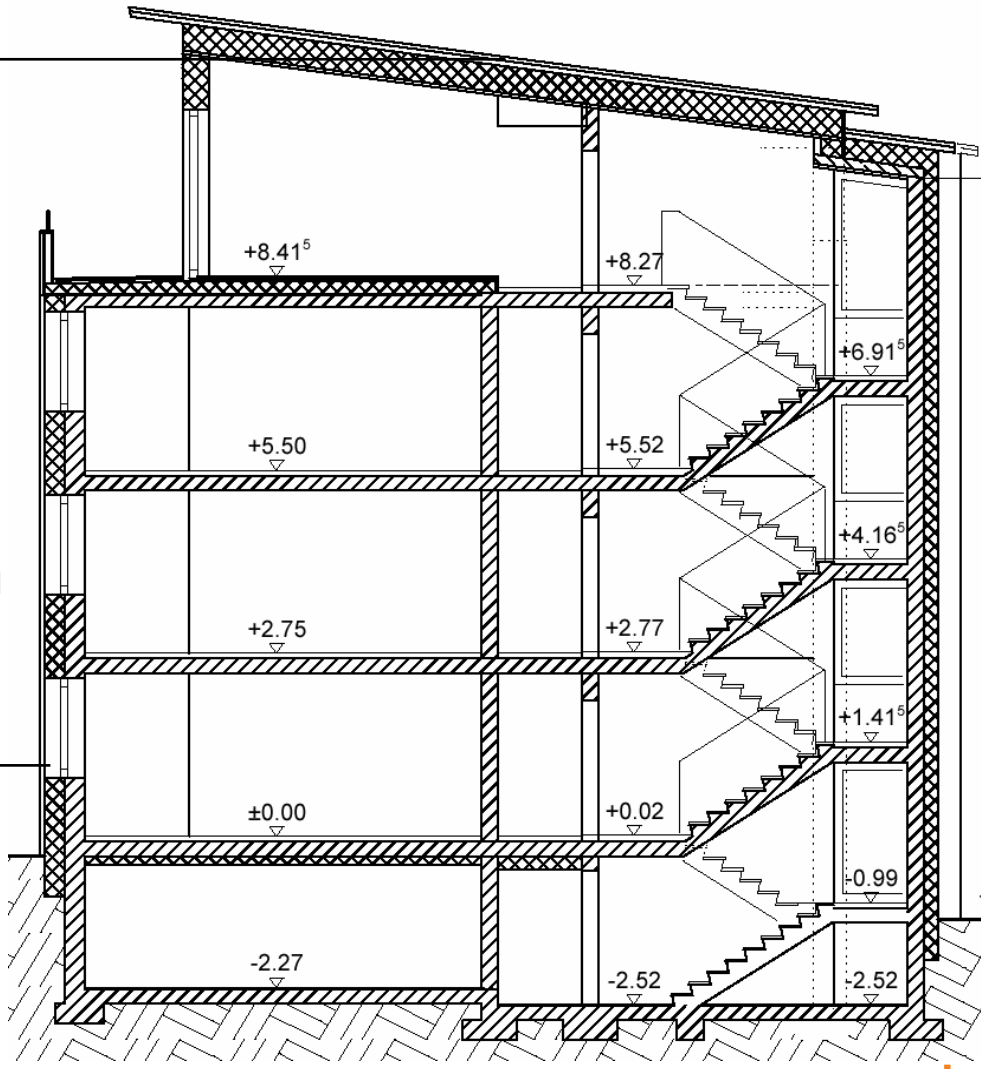
approach

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Renewable HVACR-systems, Plus energy techniques



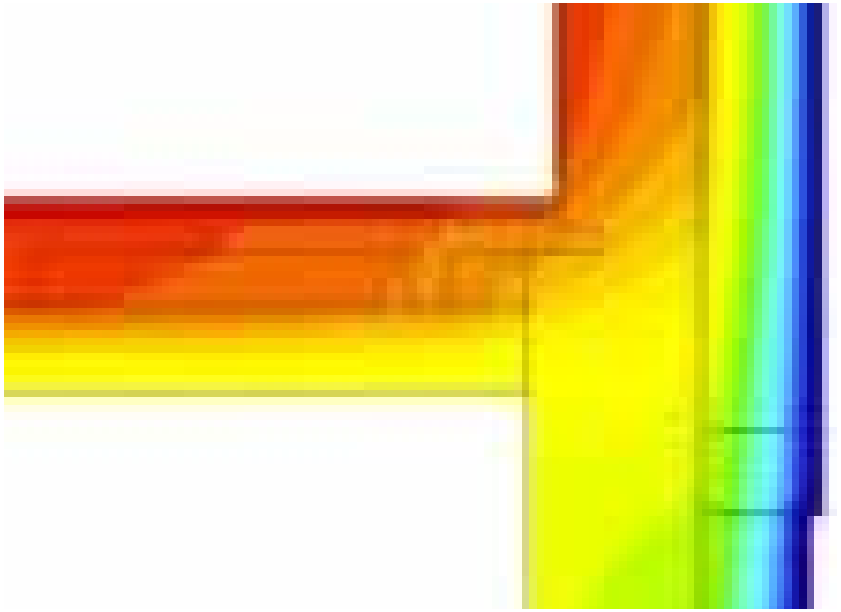
Air-tightness n50 ≤ 0.6h-1



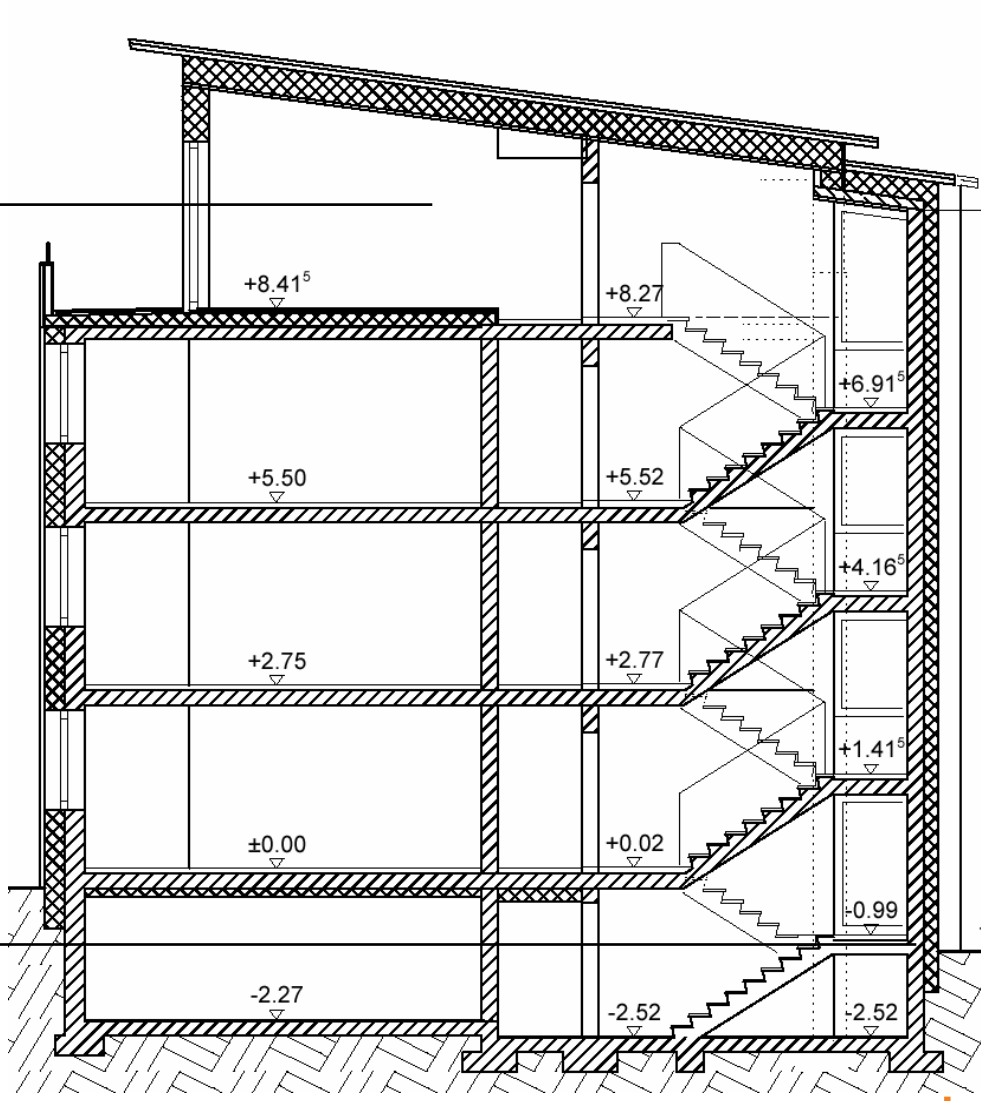
approach

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Ventilation – heat recovery



Cold bridging



approach

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Location: Karlsbader Straße, Nürnberg

Year of first construction: 1930

Year of retrofit: 2002

family house

Architect. Schulze Darup & Partner

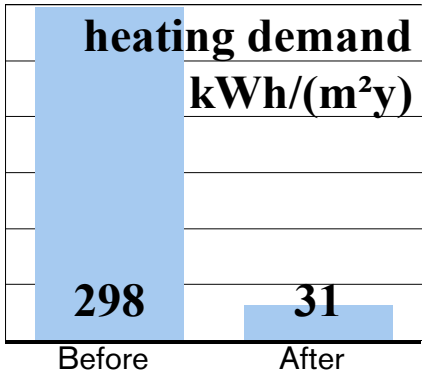
images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Location: Karlsbader Straße, Nürnberg

Year of first construction: 1930

Year of retrofit: 2002



family house

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Location: Jean-Paul-Platz, Nürnberg

Year of first construction: 1930

Year of retrofit: 2002

Heated floor area: 895m^2

apartment building

Architect. Schulze Darup & Partner

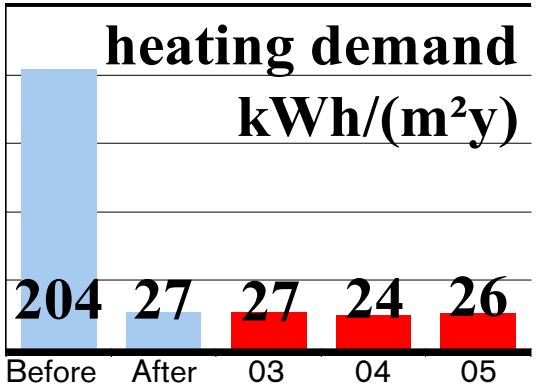
images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Location: Jean-Paul-Platz, Nürnberg

Year of first construction: 1930

Year of retrofit: 2002



energy reductions

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Location: Ingolstädter Straße 139/141

Year of first construction: 1954

Year of retrofit: 2004

Heated floor area: 918m^2

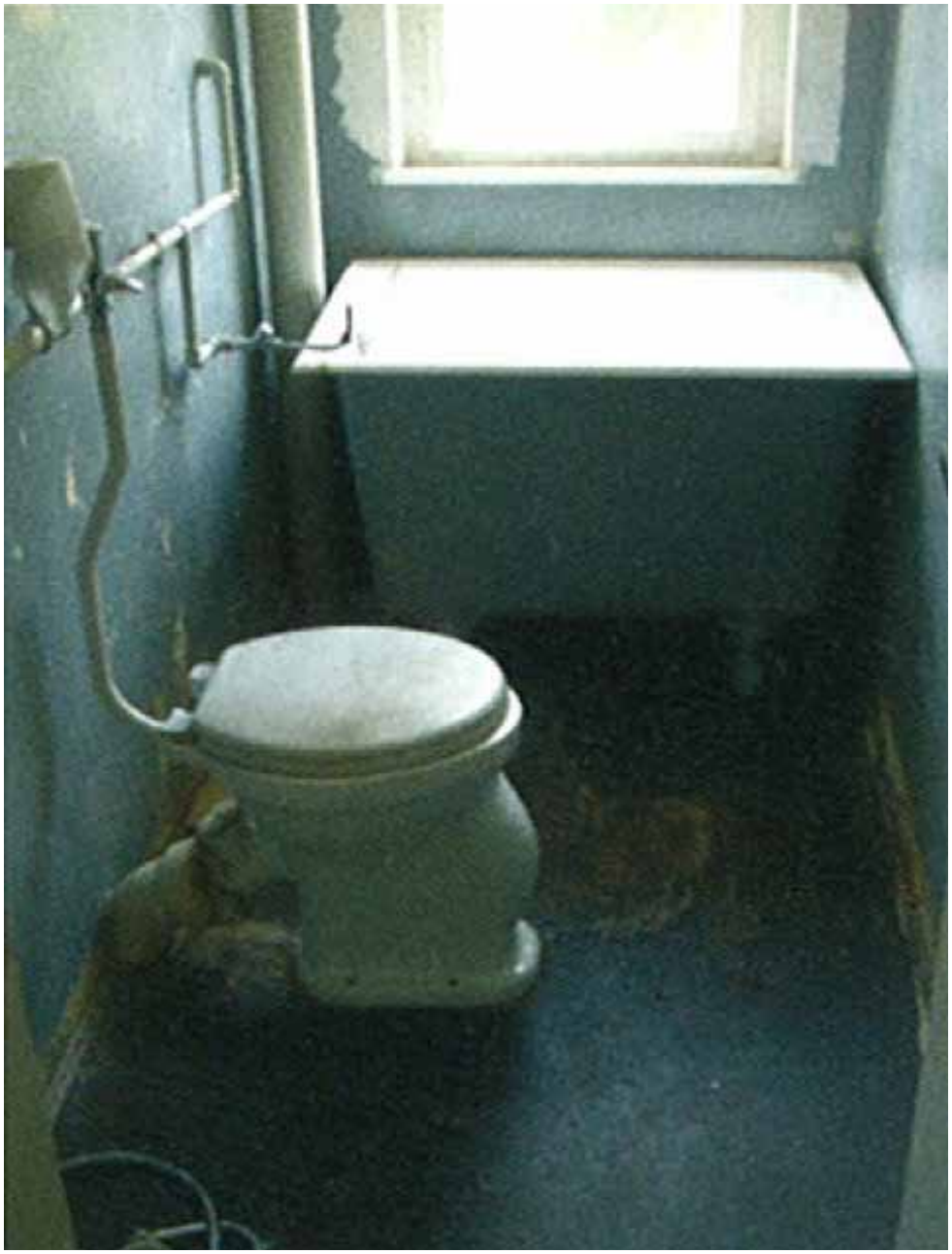
Number of residences: 24 > 12

apartment building

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

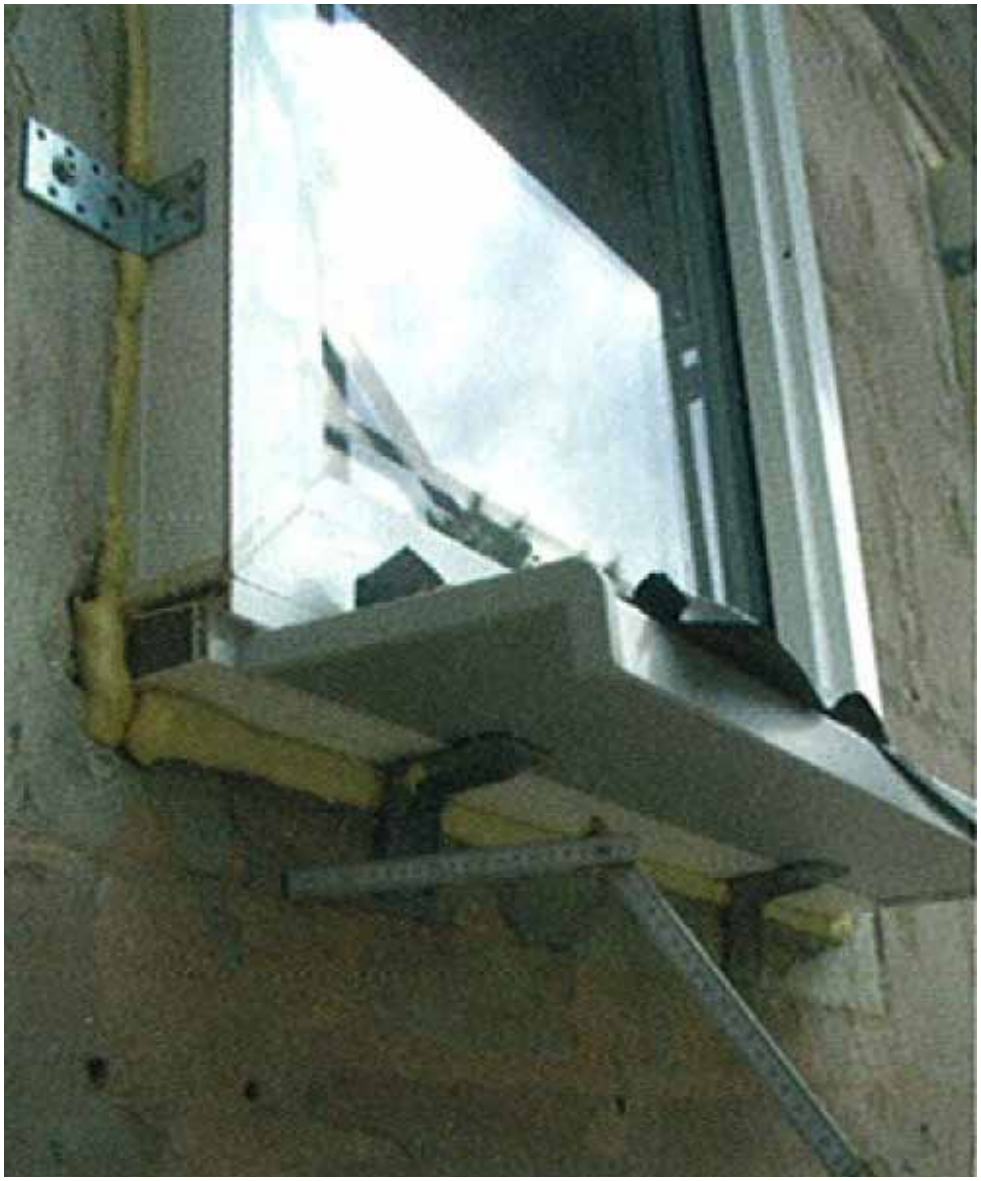
bere:architects



existing building

Ingolstädter Straße 139/141

images: HousingInnovativ



windows & external insulation

Ingolstädter Straße 139/141

images: bere:architects & HousingInnovativ

bere:architects

heat recovery ventilation

Ingolstädter Straße 139/141

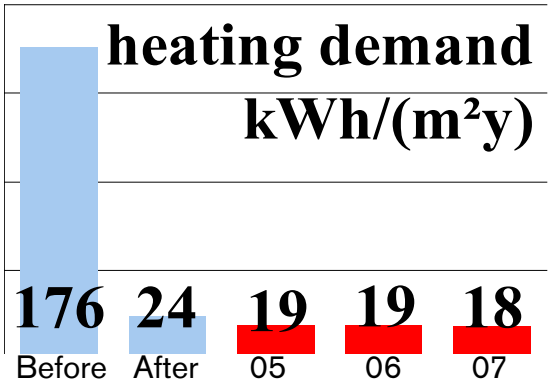
images: bere:architects & HousingInnovativ

bere:architects

Location: Ingolstädter Straße 139/141

Year of first construction: 1954

Year of retrofit: 2004



energy reductions

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Total Costs: Approx. 1.6million Euro

Cost per square metre: Approx 1069 Euro/m^2

Equivalent retrofit to EnEV standard 2004:

Approx. 945 Euro/m^2

total costs

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Funding secured under $C0^2$-

Gebäudesanierungsprogramm

Subsidy: Approx. 540,000 Euro

Capital Loan: Approx. 440,000 Euro

Client Contribution: Approx. 640,000 Euro

financing

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Basic rent (excluding bills): 6.60 Euro/m^2

Rent increase to fund Retrofit: 1.00 Euro/m^2

Reduction in heating and

warm water bills: 0.70 Euro/m^2

rent costs

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Location: Bernadottestraße, Nürnberg

Year of first construction: 1964

Year of retrofit: 2006

Heated floor area: 918m^2

Number of residences: 24 > 31

apartment building

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Retrofit:

Walls: 200-240mm external insulation = 0.16-0.14 W/(m²K)

Roof Terrace: 200mm external insulation = 0.18 W/(m²K)

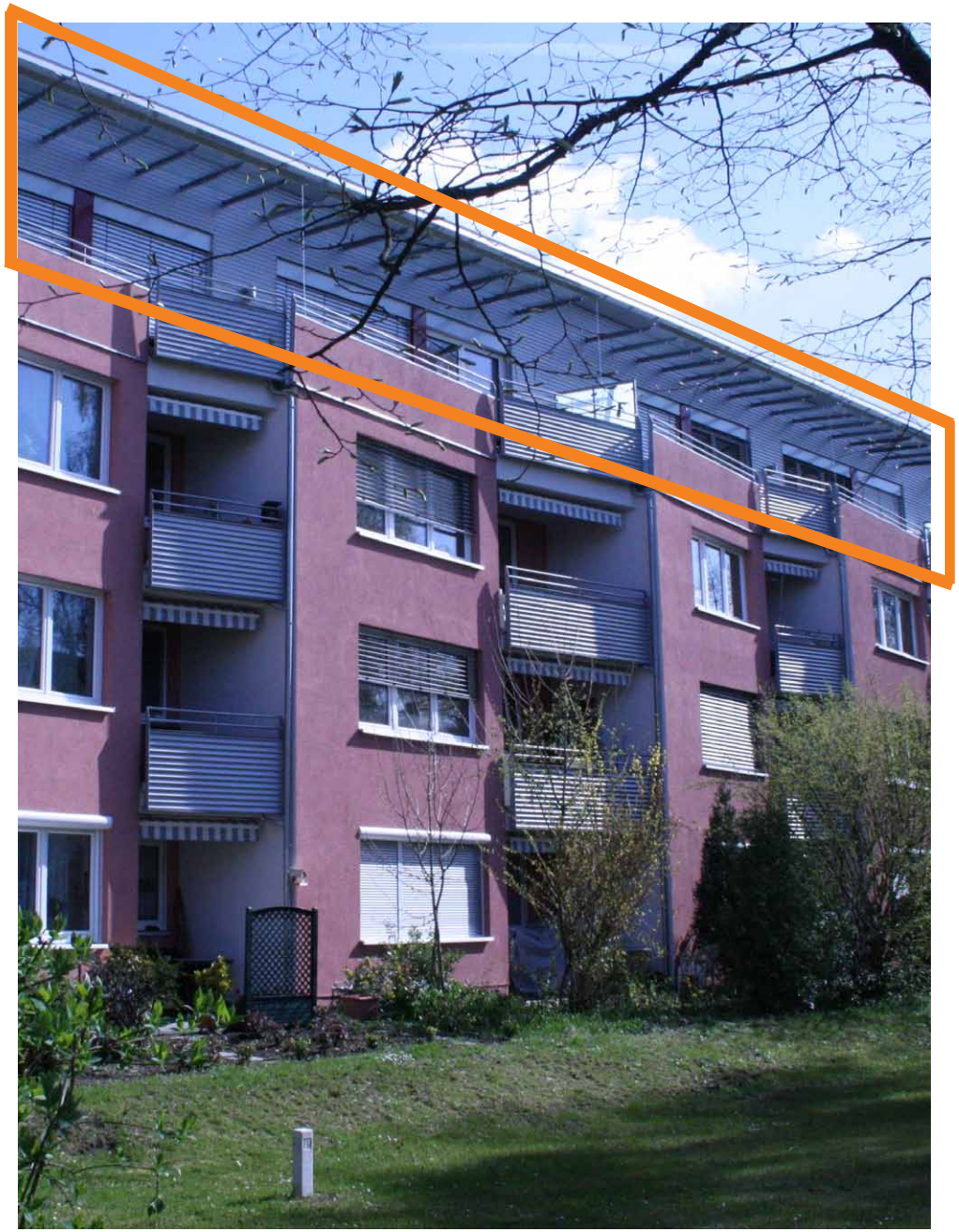
Ceilings: 120-240mm = 0.16-0.22 0.18 W/(m²K)

Windows: triple glazing = 0.92 W/(m²K)

fabric improvements

Bernadottestraße, Nürnberg

images: bere:architects



Retrofit:

Walls: 200-240mm external insulation = 0.16-0.14 W/(m²K)

Roof Terrace: 200mm external insulation = 0.18 W/(m²K)

Roof*: 120-240mm insulation = 0.16-0.22 0.18 W/(m²K)

Windows: triple glazing = 0.92 W/(m²K)

New Build Loft Apartments:

6 new Passivhaus certified apartments 70-110m²

fabric improvements

Bernadottestraße, Nürnberg

images: bere:architects

bere:architects

Heat source: District heating scheme

Ventilation: heat recovery ventilation (85% efficiency - centralised system)

heating and ventilation

Bernadottestraße, Nürnberg

images: bere:architects

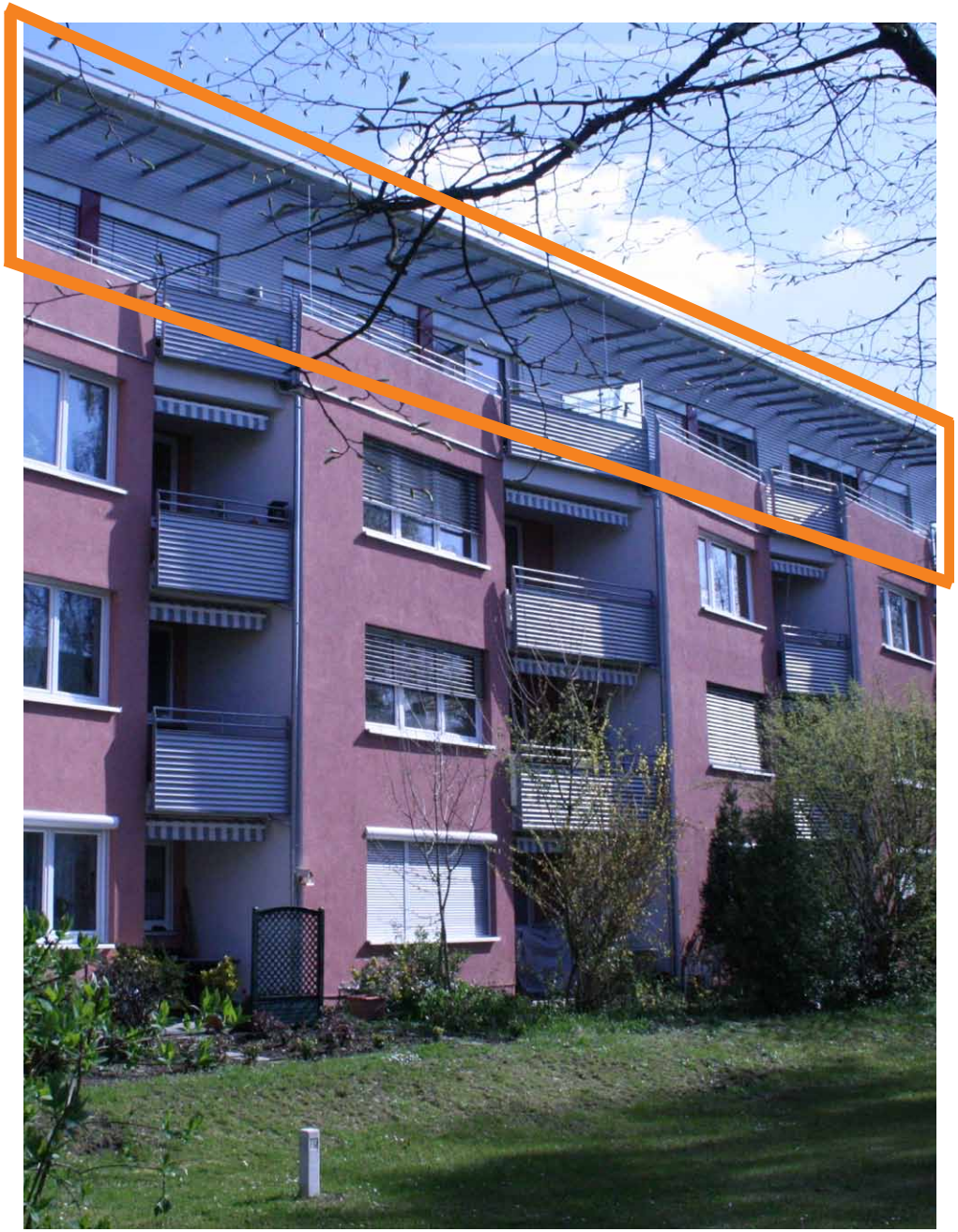
Retrofit:

Improvement works (Basement - 2nd Floor): 570 Euro/m²

costs

Bernadottestraße, Nürnberg

images: bere:architects



Retrofit:

Improvement works (Basement - 2nd Floor): 570 Euro/m^2

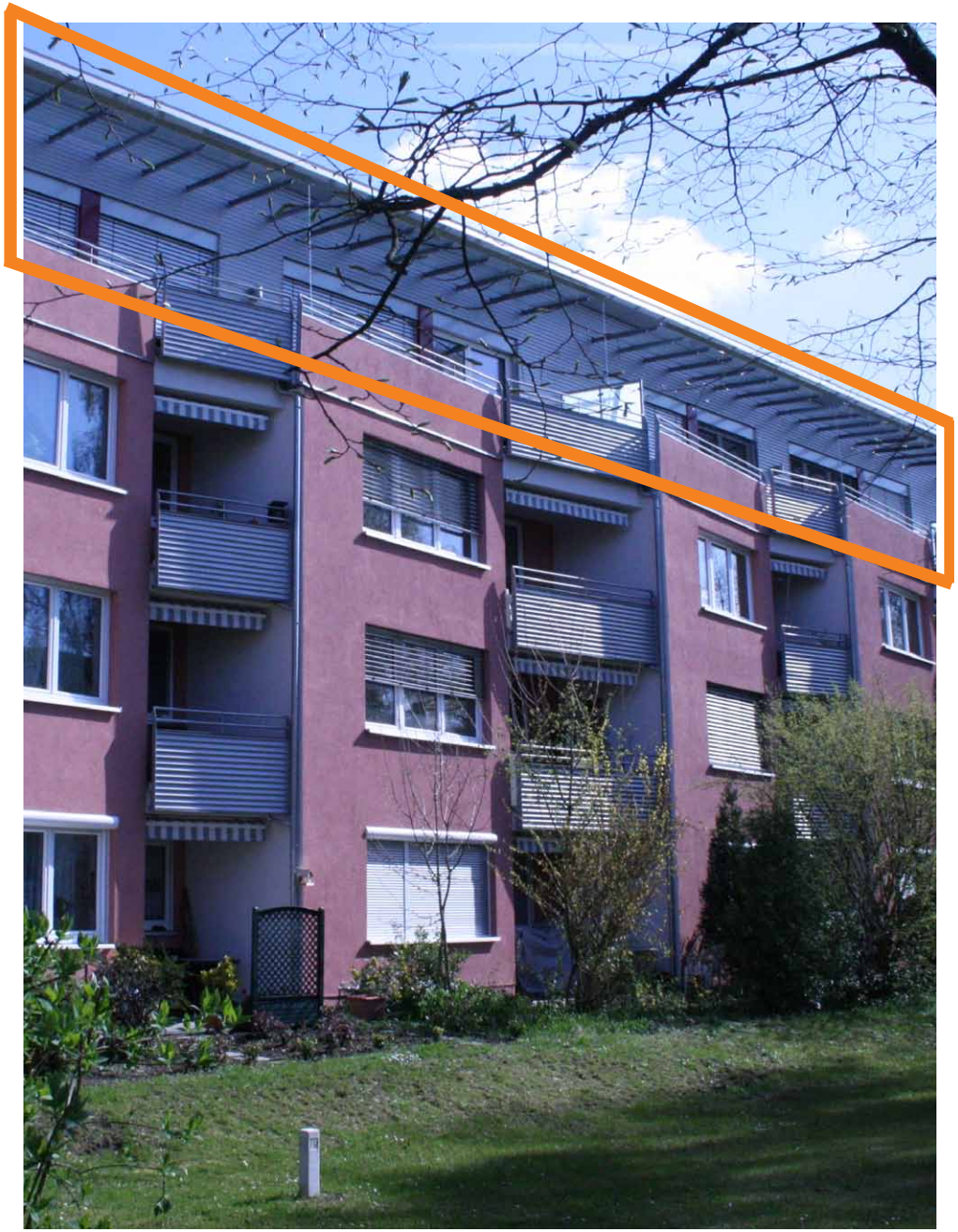
New Build:

Passivhaus construction: 850 Euro/m^2

costs

Bernadottestraße, Nürnberg

images: bere:architects



Retrofit:

Improvement works (Basement - 2nd Floor): 570 Euro/m^2

New Build:

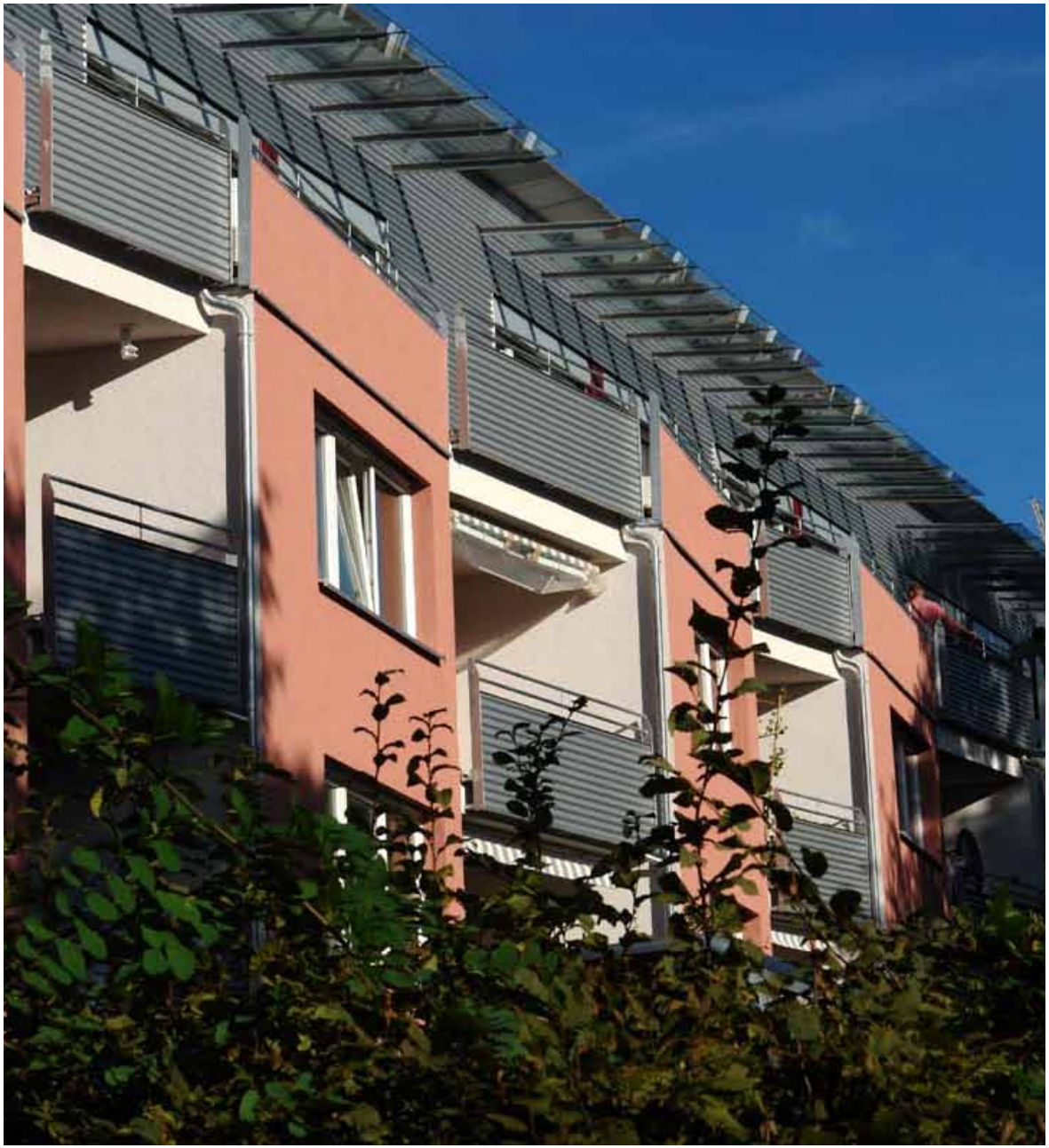
Passivhaus construction: 850 Euro/m^2

Additional costs compared to an equivalent new build construction to building regulations standards: 95 Euro/m^2

costs

Bernadottestraße, Nürnberg

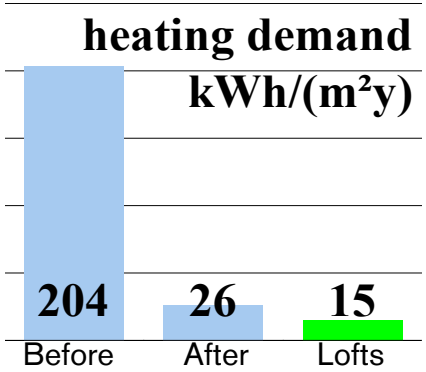
images: bere:architects



Location: Bernadottestraße, Nürnberg

Year of first construction: 1964

Year of retrofit: 2006



energy reductions

Architect. Schulze Darup & Partner

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Location: Kollwitzstraße, Nürnberg

Year of first construction: 1958

Year of retrofit: 2009

Heated floor area: 2754m^2

Number of residences: 54 > 61

apartment building

Architect. Schulze Darup & Partner Aicher & Hautmann

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

bere:architects

Retrofit:

Improvement works: 1150 Euro/m^2

New Build:

Passivhaus construction: 1200 Euro/m^2

Additional costs compared to an equivalent new build construction to building regulations standards: 110 Euro/m^2

costs

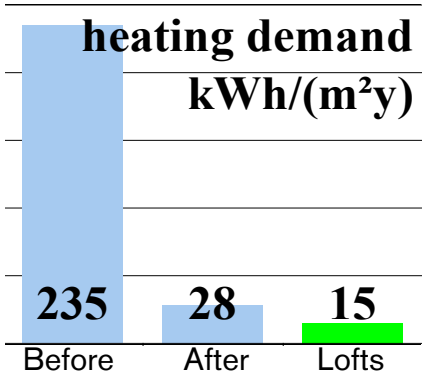
Architect. Schulze Darup & Partner Aicher & Hautmann

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Location: Kollwitzstraße, Nürnberg

Year of first construction: 1958

Year of retrofit: 2009



energy reductions

Architect. Schulze Darup & Partner Aicher & Hautmann

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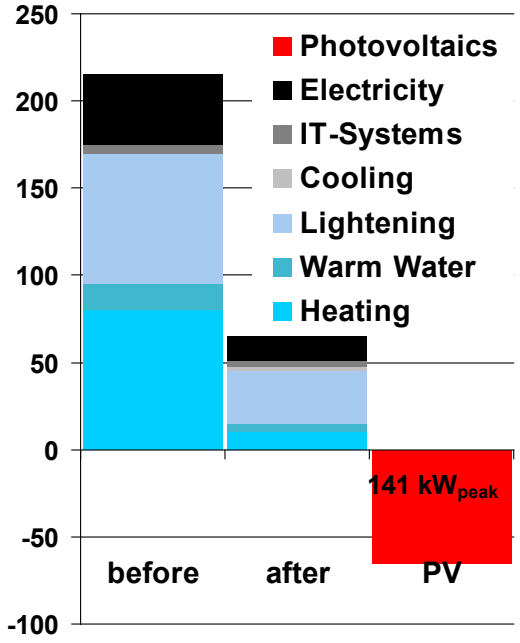
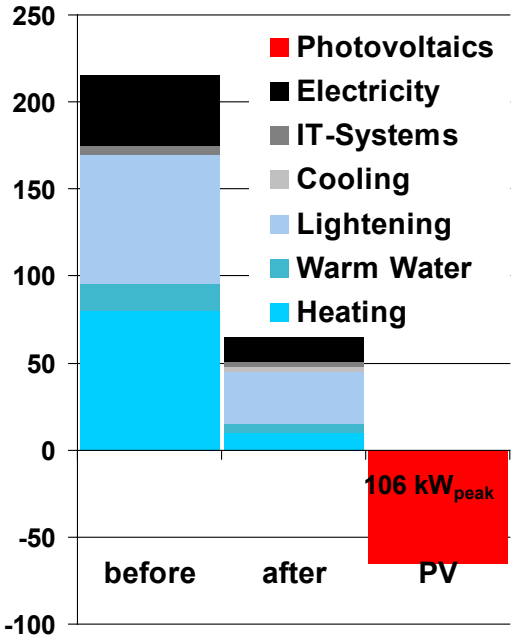
bere:architects



School (5280 m²)

Balancing of primary energy $C0_2$ - neutral by PV

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg



Cityhall (5980 m²)

Balancing of primary energy $C0_2$ - neutral by PV

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Park condominium west – 1030 flats, wbg Nuremberg

bere:architects

images: Dr. Burkhard Schulze Darup schulze darup & partner architekten nürnberg

Thank you

bere:architects

dan.gibbons@bere.co.uk