Project Documentation
Gebäude-Dokumentation

Abstract | Zusammenfassung

Reihenhaus-Komplex mit vier Einheiten in Darmstadt-Kranichstein

Data of building | Gebäudedaten

Year of construction Baujahr	2024	**Space heating** **Heizwärmebedarf**	**15** **kWh/(m^2a)**
U-value external wall U-Wert Außenwand	0,137, 0.209, 0.234, 0.259 W/(m^2K)		
U-value basement U-Wert Kellerdecke	N/A W/(m^2K)	Primary Energy Renewable (PER) Erneuerbare Primärenergie (PER)	49 kWh/(m^2a)
U-value roof U-Wert Dach	0,078, 0,125 W/(m^2K)	Generation of renewable Energy Erzeugung erneuerb. Energie	0 kWh/(m^2a)
U-value window U-Wert Fenster	0,95 W/(m^2K)	Non-renewable Primary Energy (PE) Nicht erneuerbare Primärenergie (PE)	124 kWh/(m^2a)
Heat recovery Wärmerückgewinnung	77 %	Pressurization test n_{50} Drucktest n_{50}	0,52 h^{-1}
Special features Besonderheiten	Its predominate wall construction is clay poroton single skin block work which is acting also as the main insulating material.		

Brief Description

Passive House Darmstadt Kranichstein

Brook House is a four-storey social housing development located in Hamlin Gardens, Exeter. Designed by Gale & Snowden Architects for Exeter City Council, the scheme comprises 21 apartments (11 two-bedroom and 10 one-bedroom units) and reflects a strong commitment to sustainable design.

External wall U-values ranged from 0.222 to 0.259 W/m²K—slightly above typical Passivhaus benchmarks. However, the design team optimised performance by leveraging the region's milder climate and the building's compact form. Single-skin Poroton clay blocks were used as the primary insulated wall element, enhancing thermal efficiency.

The building is split into two wings, each serviced by a Nilan Compact P combi unit. This integrated system provides ventilation, space heating, and domestic hot water via a micro air-source heat pump, offering an efficient and compact solution for each apartment.

Responsible project participants
Verantwortliche Projektbeteiligte

Architect Entwurfsverfasser	Lawrence Millyard Gale & Snowden Architects www.ecodesign.co.uk
Implementation planning Ausführungsplanung	
Building systems Haustechnik	Jason Fitzsimmons Gale & Snowden Architects www.ecodesign.co.uk
Structural engineering Baustatik	-
Building physics / Passivhaus designer Bauphysik	Jason Fitzsimmons Gale & Snowden Architects www.ecodesign.co.uk
Passive House project planning Passivhaus-Projektierung	Jason Fitzsimmons Gale & Snowden Architects www.ecodesign.co.uk
Construction management Bauleitung	Nevada Construction

Certifying body
Zertifizierungsstelle

Passivhaus Institut Darmstadt www.passiv.de	WARM

Certification ID
Zertifizierungs ID

7792	Project-ID (www.passivehouse-database.org) Projekt-ID https://passivehouse-database.org/index.php?lang=en#d_7792

Author of project documentation

Passivhaus Institut Darmstadt www.passiv.de	
Date Datum	Signature Unterschrift
10/06/24	J Fitzsimmons

1. Ansichtsfotos

North East top floor

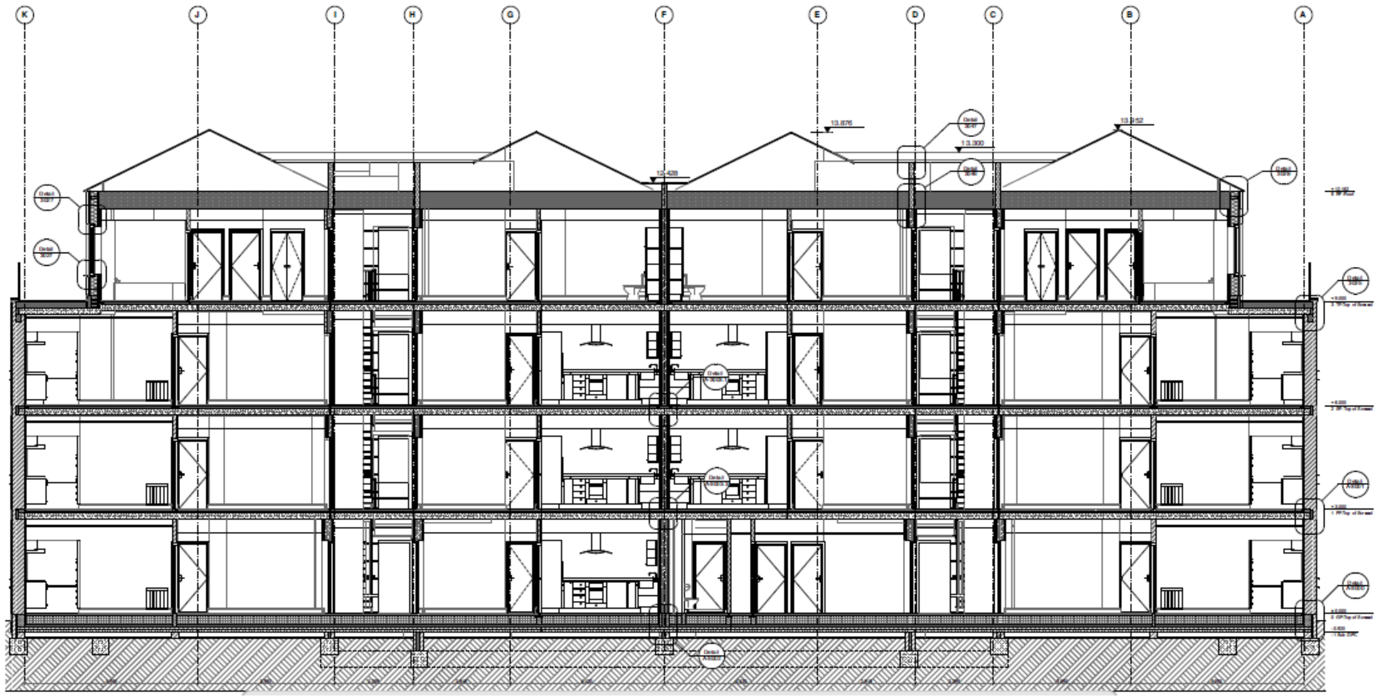
2. Innenfoto exemplarisch

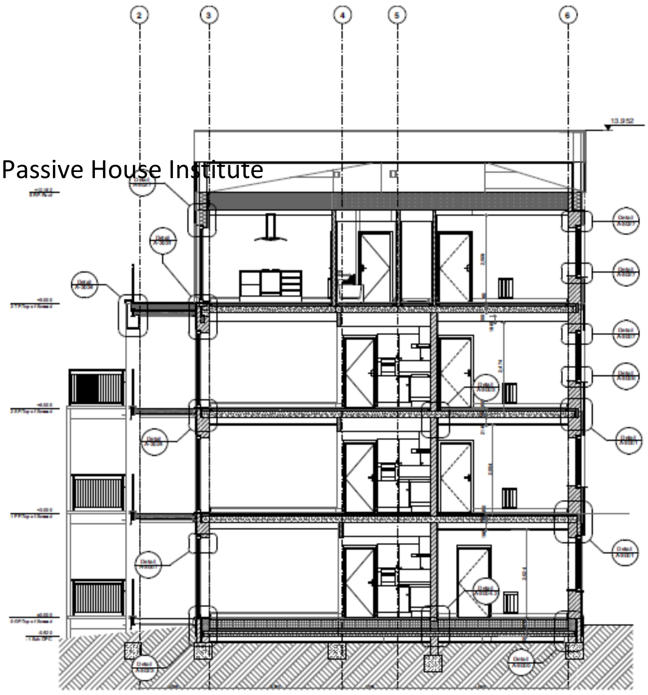
Landlords area



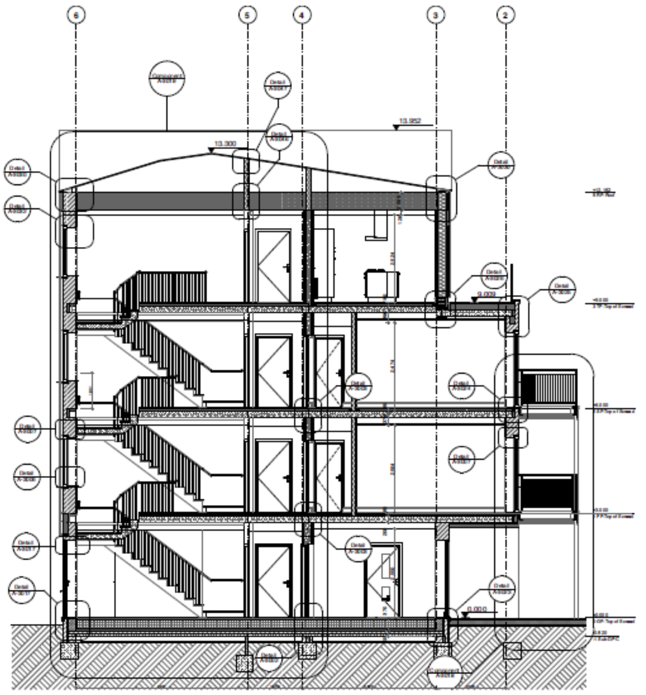

3. Schnittzeichnung

Note all architectural details / drawings provided herein were developed by Gale & Snowden Architects

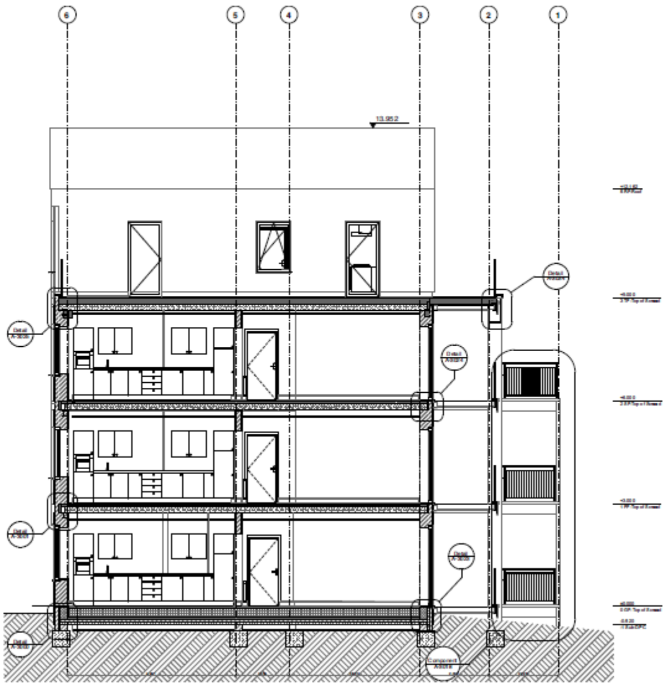




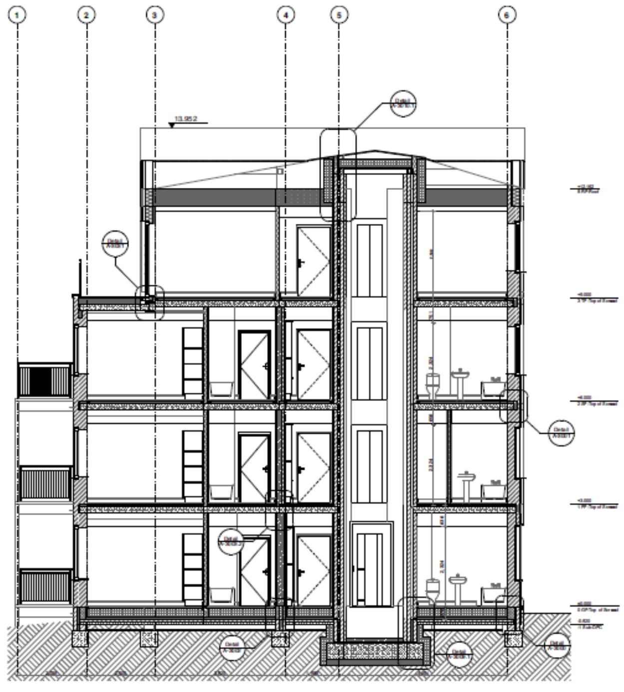
1 Building Section BB 1:50



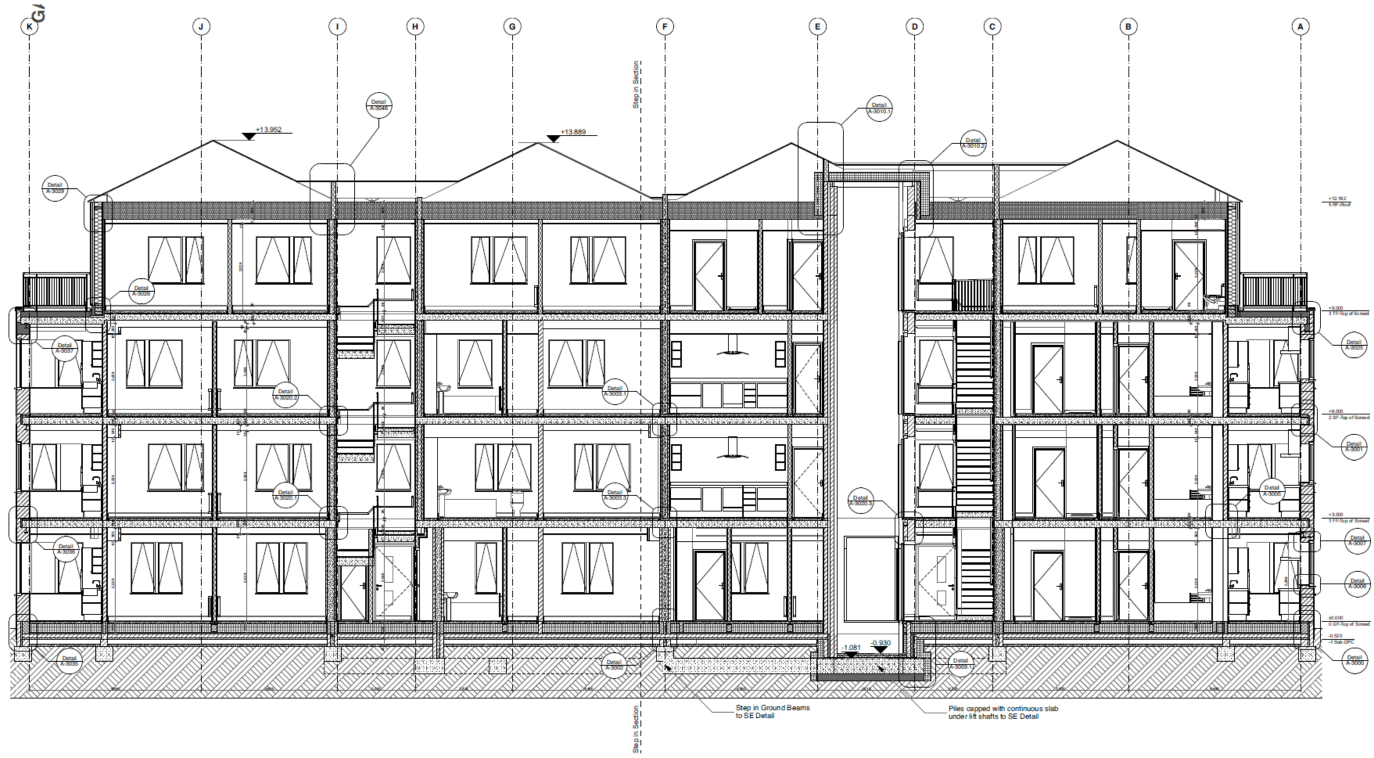
2 Building Section CC 1:50



1 Building Section DD 1:50



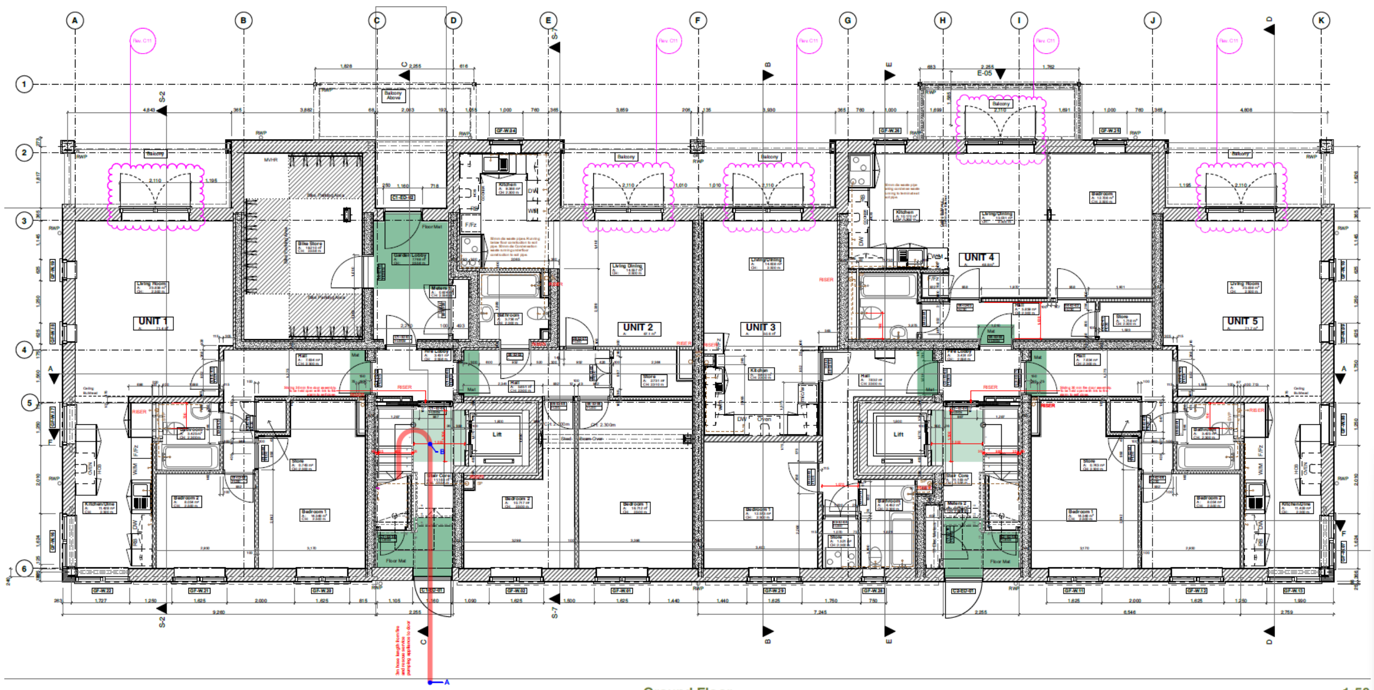
2 Building Section EE 1:50



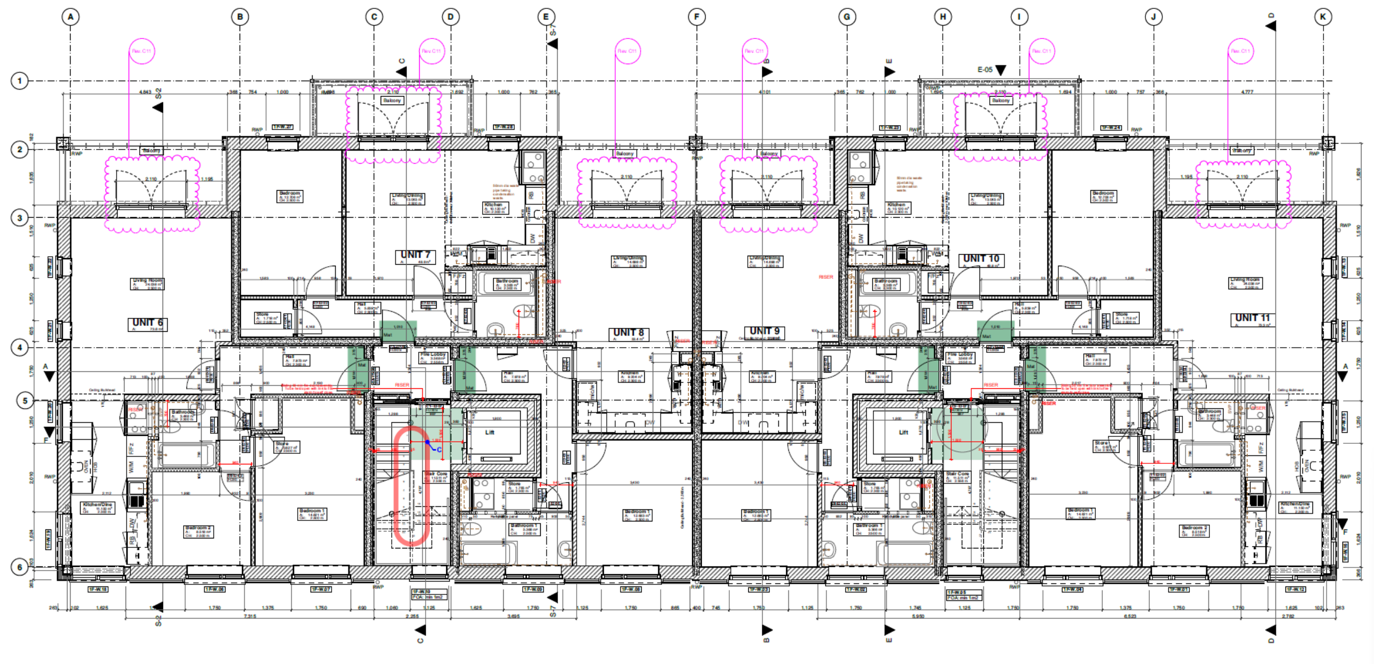
1 Building Section FF 1:50

4. Grundrisse

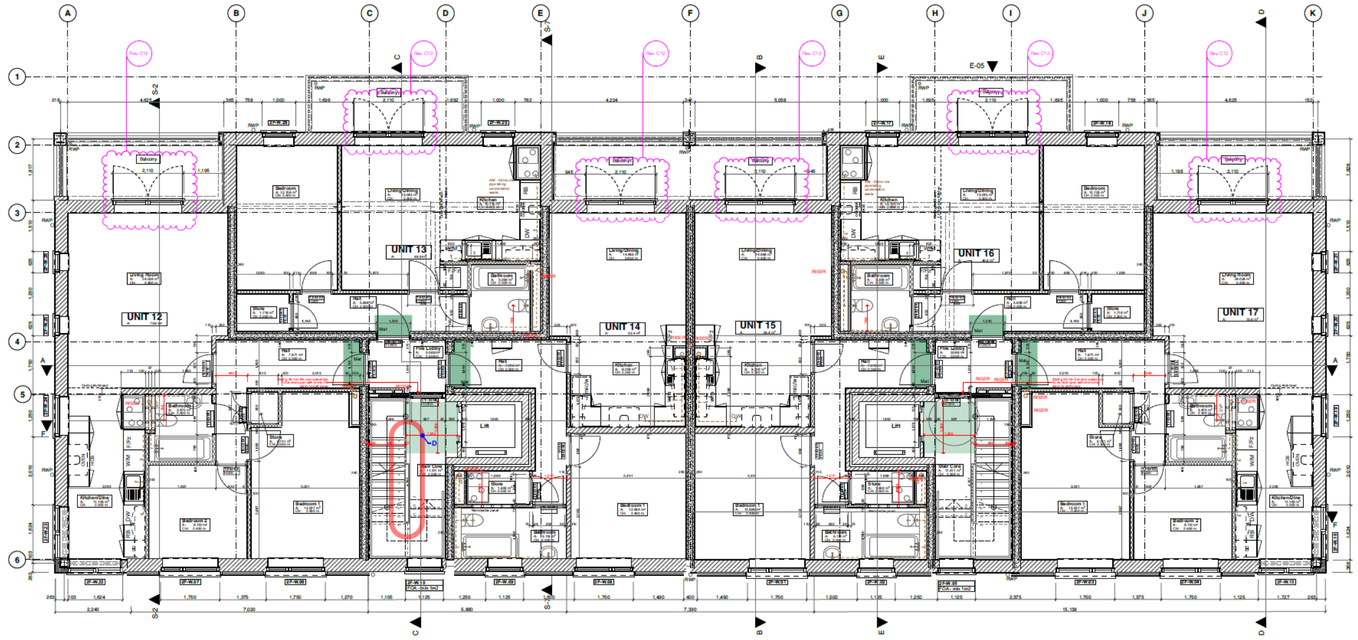
The following general arranagments show the architectural layouts, for the scheme consisting of 21 flats which span from north to south.   The building is split into 2 zones. The green areas highlight common stairwells and lifts zone.



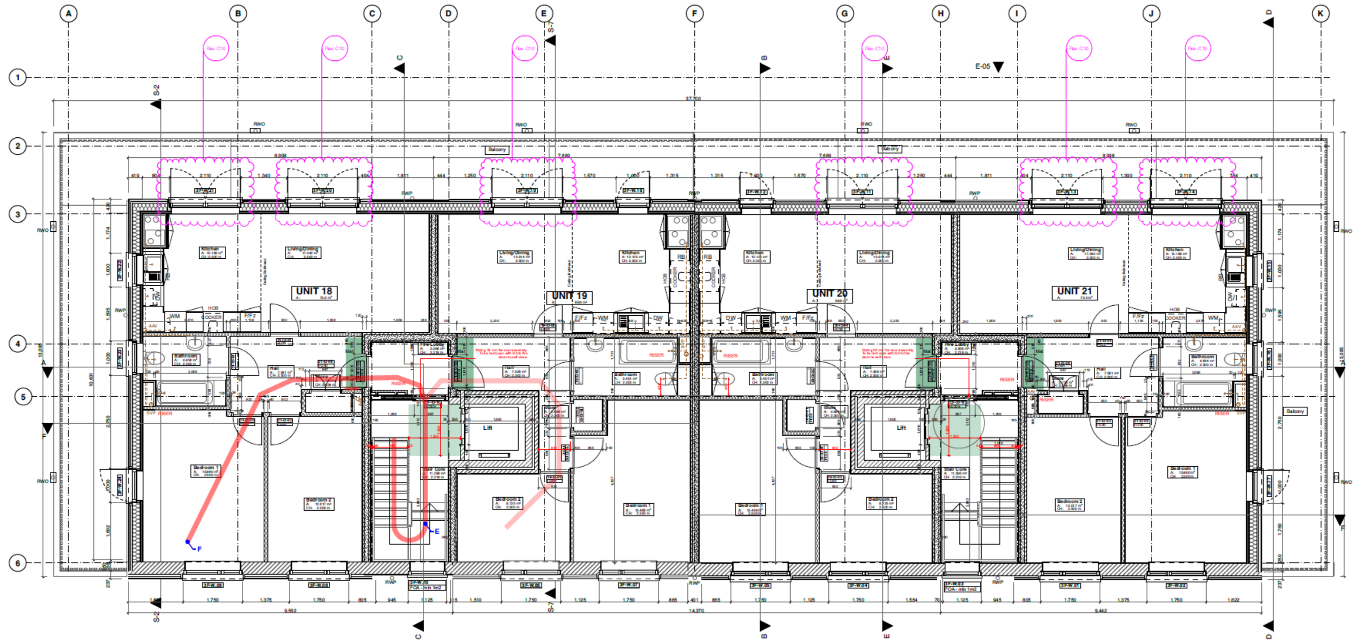
Ground Floor 1:50



First Floor 1:50



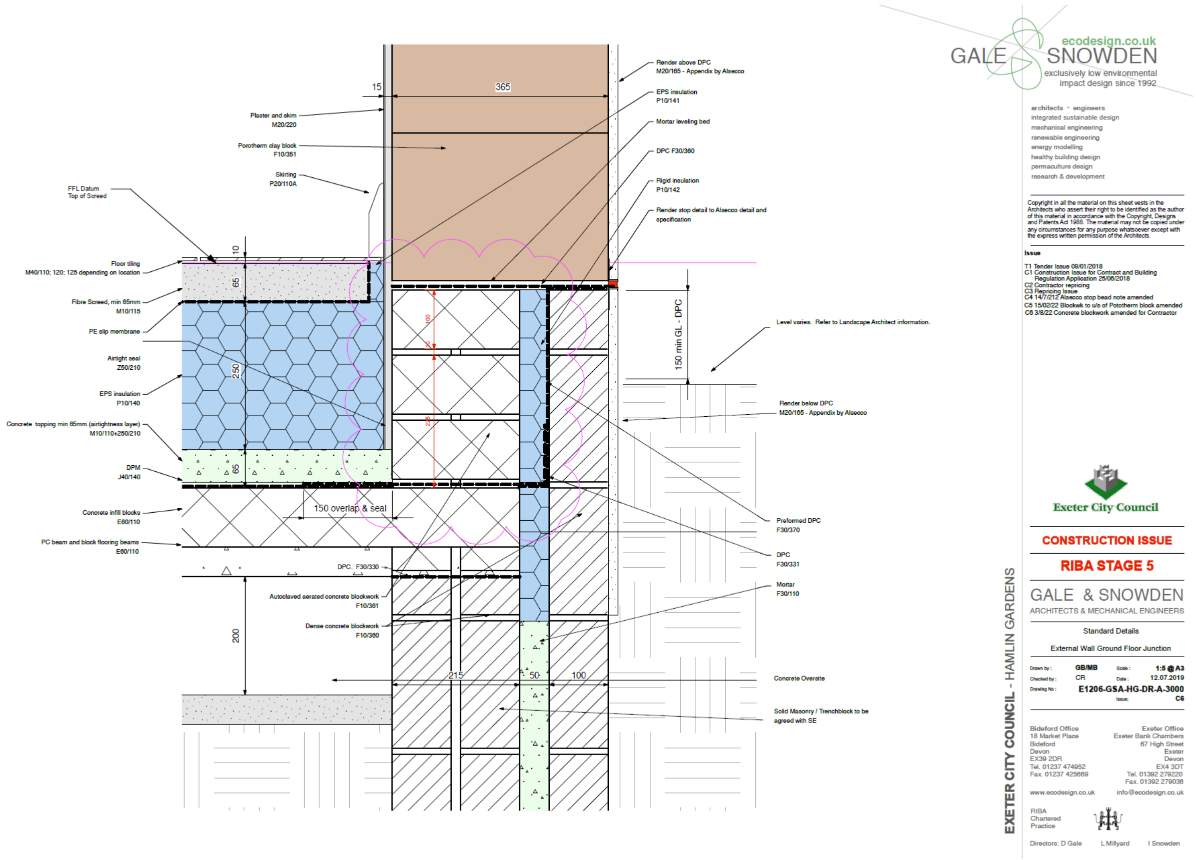
Second Floor 1:50

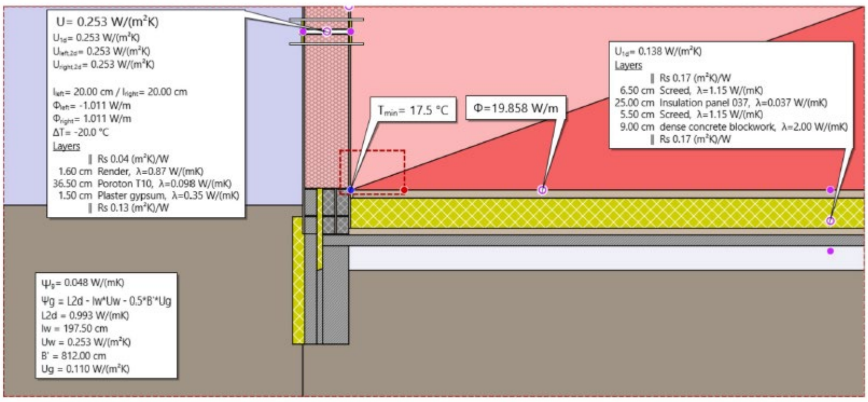


TF-Top of Screed 1:50

5. Konstruktion der Bodenplatte

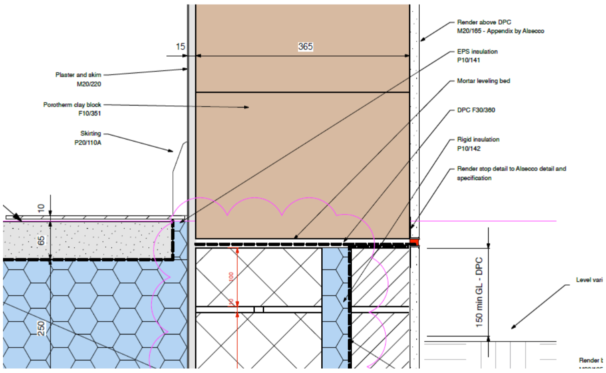
The floor construction consisted of beam and block floor with concrete topping which formed the air tight layer at ground level. Ground insulation consisted of 250mm sitting on top of the concrete topping layer.

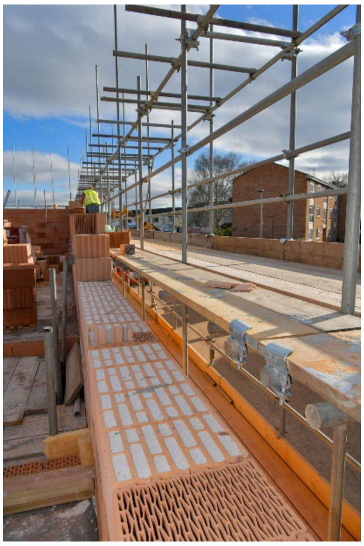




6. Konstruktion der Außenwände

The walls consisted of poroton cay blocks on the ground, first and second floors and timber frame on the 3rd top floor.   For structural reasons 3 different poroton block types were used.   Typical clay block detail is shown to the right with site images below. The poroton blocks providied a number of advantages – speed of construction, single skin construction with render and plaster on in the inside forming the air tight layer. The resulted in reduced materials and trades and a very simple to execute thermal and robust air tight line. Plus the product is very low in embodied carbon.





Assembly no. 16ud — T8 Porotherm

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plaster	0.570					15
Poroton T8 365 / T8P	0.085					365
Render	0.918					16

Percentage of sec. 1: 100% — Percentage of sec. 2: — Percentage of sec. 3: — Total: 39.6 cm

U-value supplement: W/(m²K) — U-value: 0.222 W/(m²K)

Assembly no. 17ud — T9 Porotherm

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plaster	0.570					15
Render	0.918					16
Poroton T9	0.095					365

Percentage of sec. 1: 100% — Percentage of sec. 2: — Percentage of sec. 3: — Total: 39.6 cm

U-value supplement: W/(m²K) — U-value: 0.247 W/(m²K)

Assembly no. 18ud — T10 Porotherm

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

Adjacent to: 1-Outdoor air — exterior R_{se}: 0.04

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plaster	0.570					15
Render	0.918					16
Poroton T10	0.100					365

Percentage of sec. 1: 100% — Percentage of sec. 2: — Percentage of sec. 3: — Total: 39.6 cm

U-value supplement: W/(m²K) — U-value: 0.259 W/(m²K)

Assembly no. 06ud — Timber Frame 3rd floor

Interior insulation?

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall — interior R_{si}: 0.13

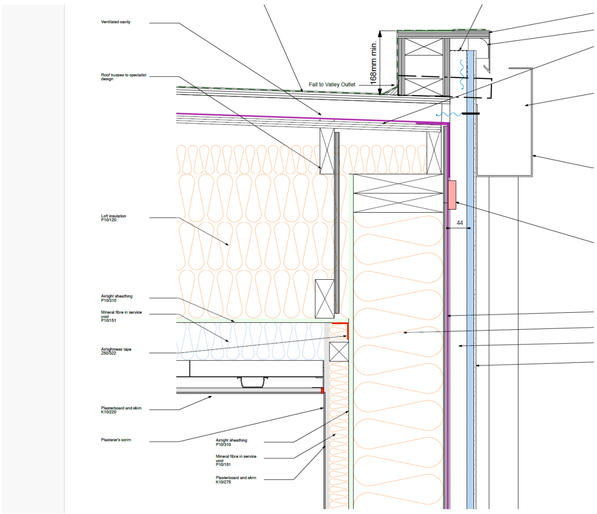
Adjacent to: 3-Ventilated — exterior R_{se}: 0.13

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plasterboard	0.250					15
Mineral Wool + Joists	0.035	Battens	0.130			45
Smart Ply	0.130					12
Mineral Wool	0.035	Studs	0.130			235
Ply	0.130					12

Percentage of sec. 1: 80% — Percentage of sec. 2: 20.0% — Percentage of sec. 3: — Total: 31.9 cm

U-value supplement: W/(m²K) — U-value: 0.172 W/(m²K)

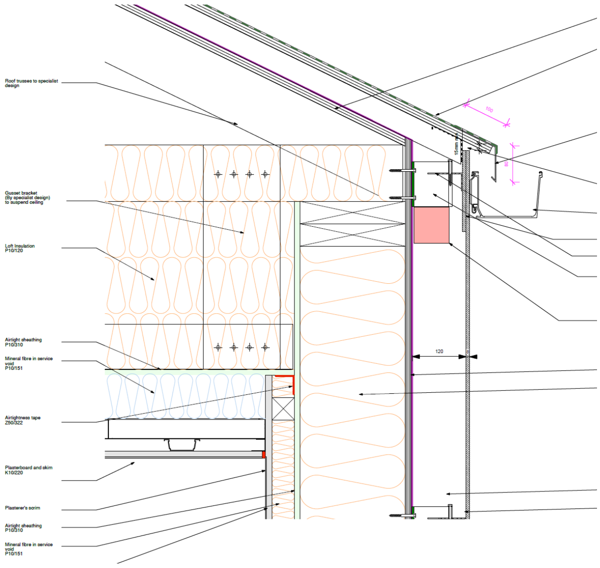
Timber frame wall detail at roof level



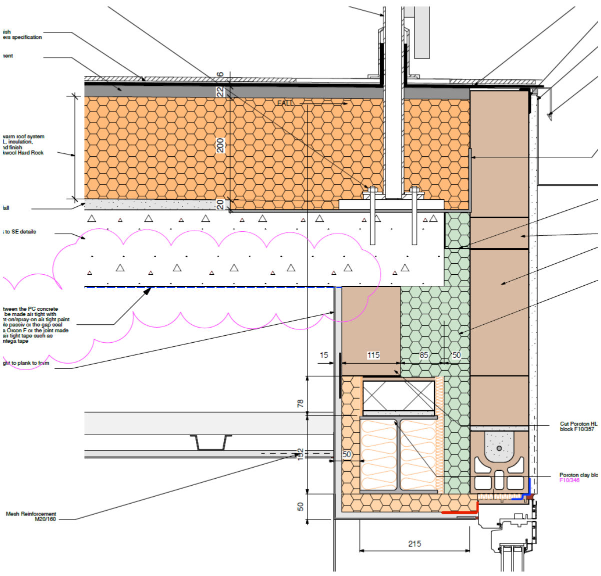
7. Konstruktion des Daches

Roof construction and detail. There were 3 roof types. The predimoninant roof type was pitched roof at a Uvalue of 0.78. There were 2 additional smaller area roof types - flat roof (same U-value as pitched roof), and terrace roof. Both the picthed and flat roof contained 500mm of mineral wool insulation and the terrace roof ocntained 170mm PUR insulation – U-values detailed below.

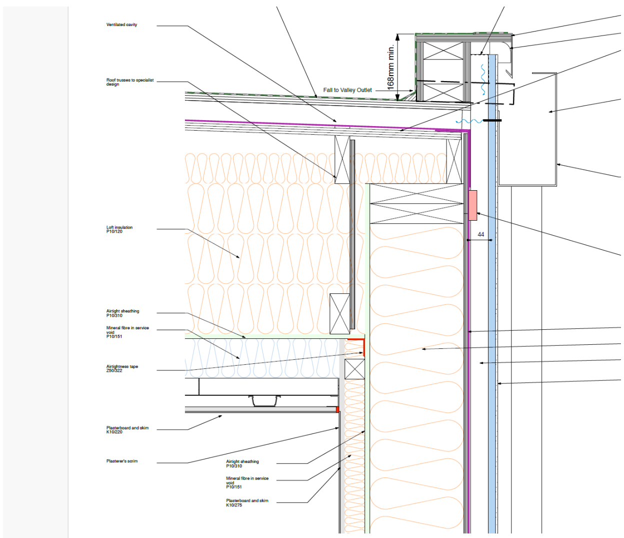
Pitched roof



Terrace roof:



Flat roof:



Assembly no.		Interior insulation?
03ud	Pitched Roof Ceilings	

		Heat transmission resistance [m²K/W]	
Orientation of building element	1-Roof	interior R_{si}:	0.10
Adjacent to	3-Ventilated	exterior R_{se}:	0.10

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Plasterboard	0.250					15
Knauf Rafter Roll	0.032	Truss Roof	0.130			450
Percentage of sec. 1	90%	Percentage of sec. 2	10.0%	Percentage of sec. 3		Total 46.5 cm

U-value supplement W/(m²K) — **U-value: 0.090** W/(m²K)

Assembly no.		Interior insulation?
04ud	Roof Terrace	

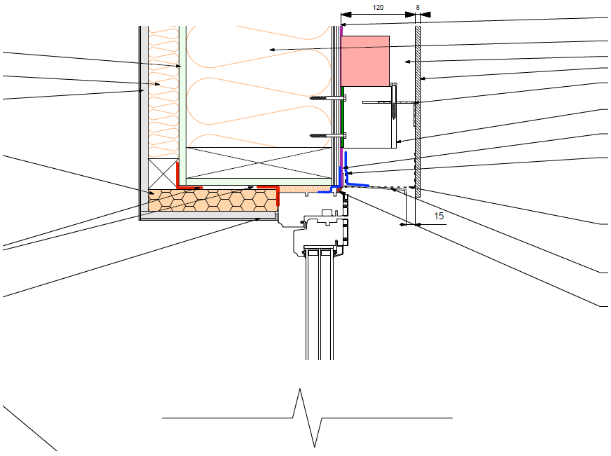
		Heat transmission resistance [m²K/W]	
Orientation of building element	0	interior R_{si}:	0.00
Adjacent to	0	exterior R_{se}:	0.00

Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Tapped roof	0.126					1000
Percentage of sec. 1	100%	Percentage of sec. 2		Percentage of sec. 3		Total 100.0 cm

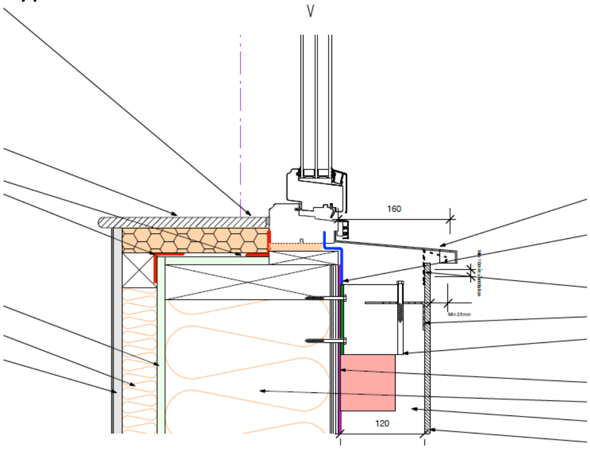
U-value supplement W/(m²K) — **U-value: 0.126** W/(m²K)

8. Fenster und Fenster-Einbau

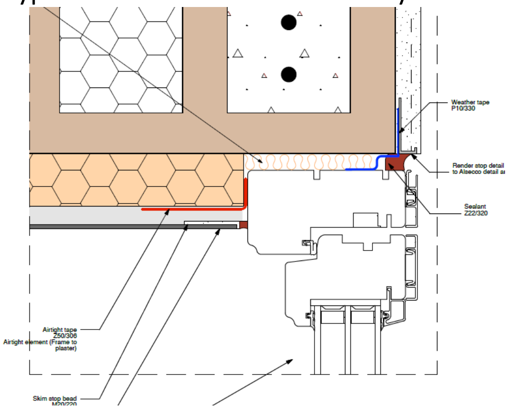
Typical window head detail in timber frame



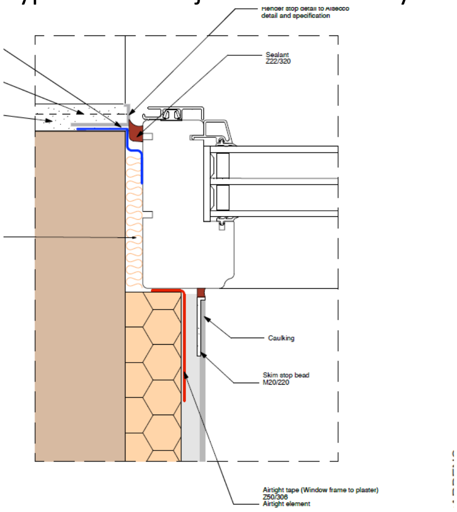
Typical window cill detail in timber frame



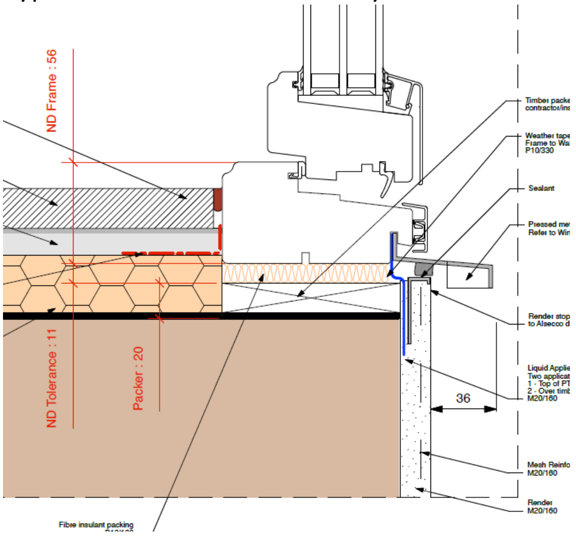
Typical window head detail in clay block



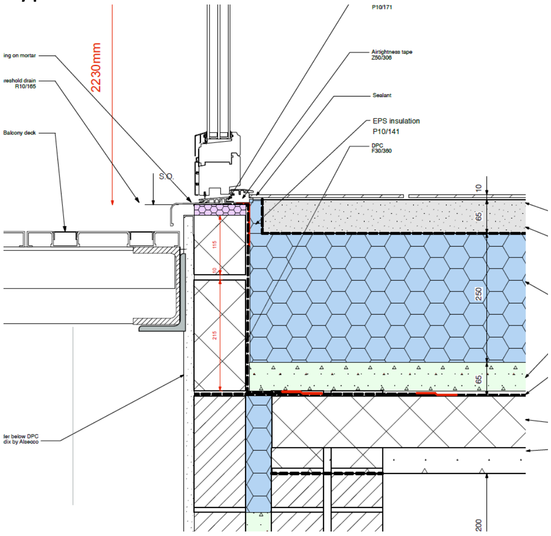
Typical window jamb detail in clay block



Typcial window cill detail in clay block



Typical door threshold



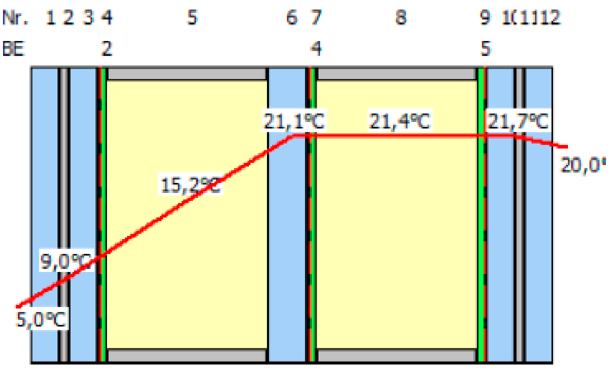
Calculation SommerGlobal

Project: 2024_09_30

Position: 01

Layer composition (outside to inside)

Number	BE	Description	mm
1		Float ExtraClear	3,00
2		Saflex® Clear	0,76
3		Float ExtraClear	3,00
4	2	ClimaGuard Premium2 (εn=3%)	
5		90% Argon	16,00
6		EUROFLOAT	4,00
7	4	Matelux (εn=89%)	
8		90% Argon	16,00
9	5	ClimaGuard Premium2 (εn=3%)	
10		Float ExtraClear	3,00
11		Saflex® Clear	0,38
12		Float ExtraClear	3,00
			49,14



Transmission, reflexion, absorption

ρ_V = 0,1439 (external light reflectance) | T_{UV} =**0,0000** (ultraviolet transmittance)

ρ'_V = 0,1535 (internal light reflectance) | T_V =**0,7210** (light transmittance)

ρ_e = 0,2565 (solar direct reflectance outside) | T_e =**0,4183** (solar direct transmittance)

ρ'_e = 0,2726 (solar direct reflectance inside) | R_a = 96,36 (general color rendering index (CRI))

α_e 1 = 0,2252; 3 = 0,0496; 5 = 0,0504 (solar direct absorptance)

EN 410

SC = 0,5674 (Shading Coefficient, g/0,87) | q_i =**0,0753** (secondary heat inside)

b-Faktor = 0,6170 (VDI 2078, g/0,80) | **g** =**0,4936** (solar heat gain coefficient)

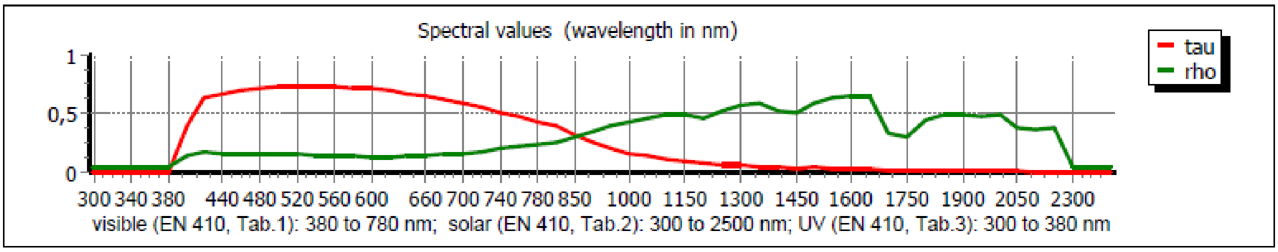
EN 673 Installation angle = 90° vertical | U_g =**0,5713 W/m²K** (Heat transfer coefficient)
Corrected emissivity according to EN 12898:2019

EN ISO 52022-3 T_e = 5,00 °C T_i = 20,00 °C | E_S = 300,00 W/m² System height = 1,50 m

g_{th} = 0,0440 (Thermal radiation factor) | $h_{c,e}$ = 18,00 W/m²K $h_{c,i}$ = 3,60 W/m²K

g_c = 0,0333 (Convection factor) | q_i =**0,0773** (secondary heat inside)

g_v = 0,0000 (Ventilation factor) | g_{tot}=**0,4956** (solar heat gain coefficient)



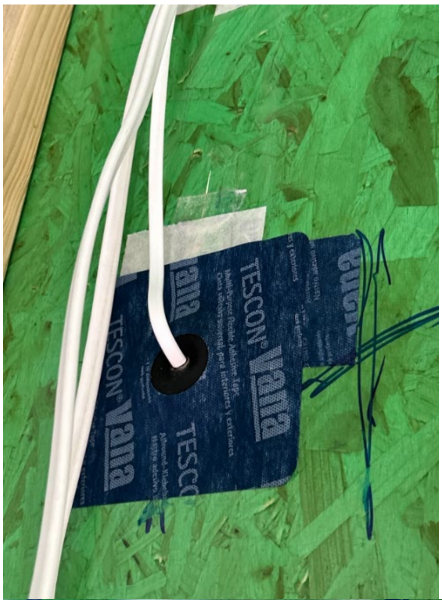

PILKINGTON IGP 02 13-06-23 CE EN 1279-5 Order

9. Beschreibung der luftdichten Hülle

Building on experience from previous Passivhaus social housing projects with Exeter City Council, Gale & Snowden adopted a straightforward airtightness strategy for Hamlin Gardens: a direct plaster skim applied to the internal face of the Poroton clay blocks.

This plaster layer connected seamlessly to the concrete ground floor slab and to smart ply at roof level. Airtightness tapes were used to seal window junctions and service penetrations. The approach offered multiple benefits: it aligned well with the single-skin Poroton block construction, eliminated the need for additional insulation or airtightness membranes, reduced the number of trades and construction complexity, and lowered material use. Combined with the inherently low embodied carbon of the clay blocks, this strategy significantly reduced the project’s overall embodied carbon footprint.

At roof level, smart ply was used as the airtightness barrier—a decision informed by lessons from previous projects where membrane-based solutions proved unreliable. Membranes often posed challenges in securing airtightness tapes due to their flexibility and tendency to shift. In contrast, the rigid smart ply provided a stable surface, allowing tapes to be applied securely and remain fixed, even under pressure testing. This approach ensured a more robust and durable airtight seal.



Block 1 air test result

Results		
Direction:	Pressurise +	Depressurise −
UCRN:	11542923	11542922
Air Flow Coefficient (C_{env}):	36.364	100.012
Air Leakage at 50 Pa (Q_{50}):	798.847	866.197
Air Flow Exponent (n):	0.79	0.55
Coefficient of Determination (r^2):	0.991	0.983

Air Permeability				Pass
Target:	<= 10.00	$m^3.h^{-1}.m^{-2}$@50Pa	0.82 $m^3.h^{-1}.m^{-2}$@50Pa	✓
Pressurisation Test: +	0.79	$m^3.h^{-1}.m^{-2}$@50Pa		
Depressurisation Test: −	0.85	$m^3.h^{-1}.m^{-2}$@50Pa		

Air Changes Per Hour				Pass
Target:	<= 0.6	$m^3.h^{-1}.m^{-3}$@50Pa	0.51 $m^3.h^{-1}.m^{-3}$@50Pa	✓
Pressurisation Test: +	0.49	$m^3.h^{-1}.m^{-3}$@50Pa		
Depressurisation Test: −	0.53	$m^3.h^{-1}.m^{-3}$@50Pa		

Block 2 air test result

Results		
Direction:	Pressurise +	Depressurise −
UCRN:	11542921	11542920
Air Flow Coefficient (C_{env}):	41.002	51.974
Air Leakage at 50 Pa (Q_{50}):	855.596	881.386
Air Flow Exponent (n):	0.78	0.72
Coefficient of Determination (r^2):	0.995	0.991

Air Permeability				Pass
Target:	<= 10.00	$m^3.h^{-1}.m^{-2}$@50Pa	0.88 $m^3.h^{-1}.m^{-2}$@50Pa	✓
Pressurisation Test: +	0.86	$m^3.h^{-1}.m^{-2}$@50Pa		
Depressurisation Test: −	0.89	$m^3.h^{-1}.m^{-2}$@50Pa		

Air Changes Per Hour				Pass
Target:	<= 0.6	$m^3.h^{-1}.m^{-3}$@50Pa	0.53 $m^3.h^{-1}.m^{-3}$@50Pa	✓
Pressurisation Test: +	0.52	$m^3.h^{-1}.m^{-3}$@50Pa		
Depressurisation Test: −	0.54	$m^3.h^{-1}.m^{-3}$@50Pa		

10. Lüftungsgerät

Ventilation, heating, and hot water at Hamlin Gardens are provided by a Nilan Compact P combi unit in each apartment. This system integrates mechanical ventilation with heat recovery (MVHR) and a micro air-source heat pump, delivering both heated air and domestic hot water efficiently.

The Nilan unit was selected as a simple, cost-effective solution that avoided the drawbacks of alternative approaches. A centralised system was considered but ruled out due to long pipe runs from the roof, associated heat losses, and the need for tenants to commit to a shared energy contract—something the council wished to avoid. Individual external air-source heat pumps were also discounted due to challenges with installation on a multi-storey building, as well as concerns over aesthetics, noise, and future maintenance.

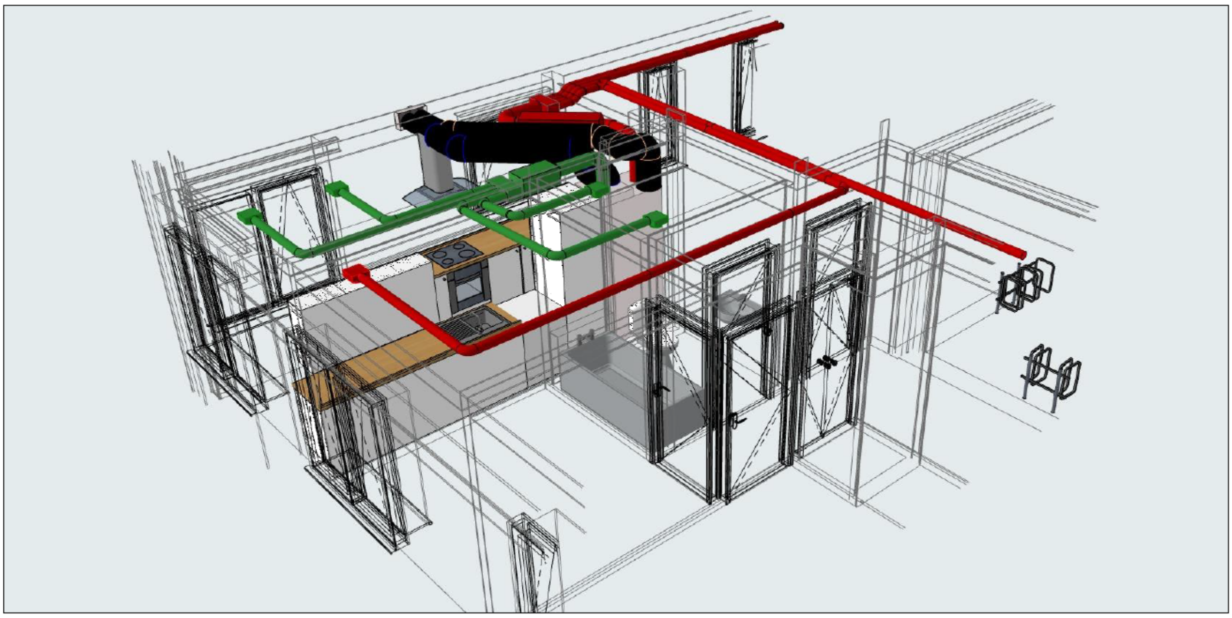
The Nilan Compact P offered an all-in-one, low-impact solution ideally suited to the project's design and operational goals.

Ventilation, heating and hot water was via Nilan compact P combi MVHR unit with micro air source heat pump delivering heated air and hot water

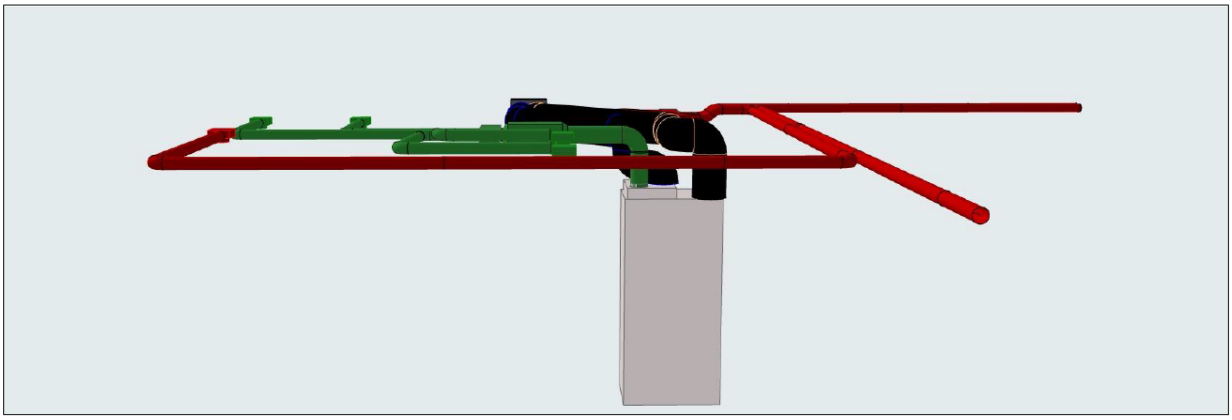
Thermal Comfort:	$\theta_{supply\ air} \geq 16{,}5°C$
Heat Recovery of ventilation system:	$\eta_{WRG,eff} \geq 75\%$
Electric efficiency ventilation system:	$P_{el} \leq 0{,}45\ Wh/m^3$
Air tightness (internal/external):	$V_{Leakage} \leq 3\%$
Total Primary Energy Demand (**):	$PE_{total} \leq 55\ kWh/(m^2a)$

The duct distribution was via plenums and radial ductwork to each room.

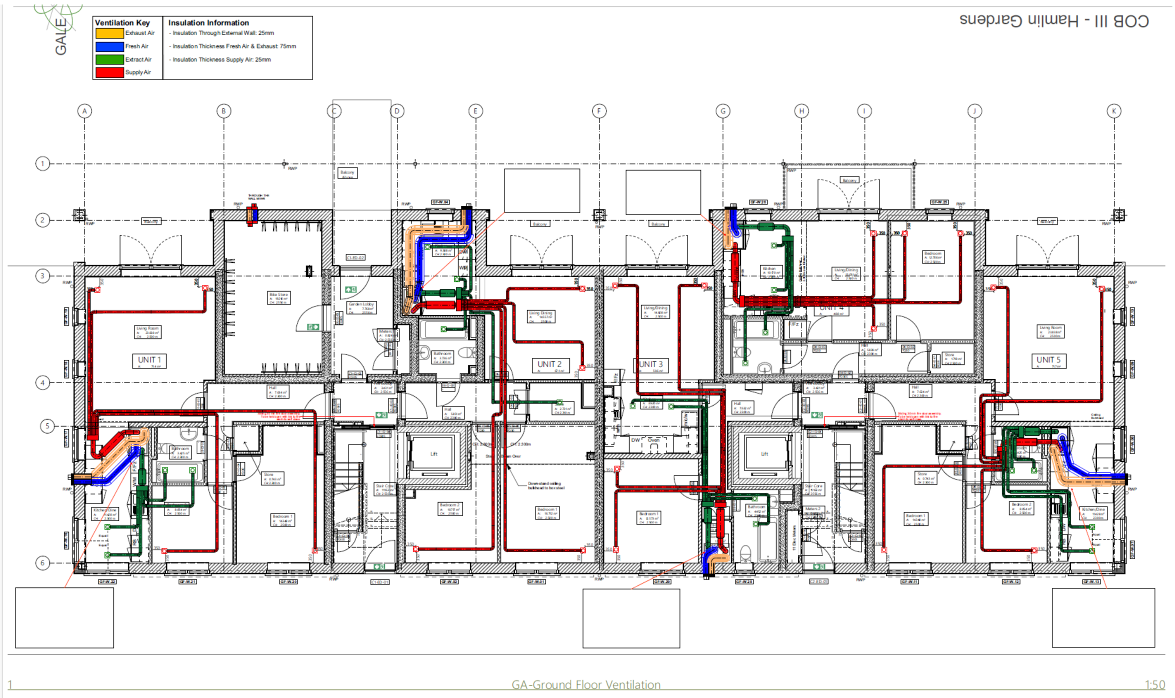
11. Lüftungsplanung Kanalnetz



1 MVHR Detail 1:100



2 MVHR Detail 2 1:100



12. Wärmeversorgung

See section 11 – via air supply of Nilan unit with micro air source heat pump

13. Baukosten

14. Literatur

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- [Ebel/Feist 1997] Witta Ebel und Wolfgang Feist: "Ergebnisse zum Stromverbrauch im Passivhaus Darmstadt Kranichstein" in "Stromsparen im Passivhaus"; Protokollband Nr. 7 zum Arbeitskreis Kostengünstige Passivhäuser; PHI; Darmstadt, 1997.
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- [Feist/Werner 1994] Wolfgang Feist und Johannes Werner: "Gesamtenergiekennwert < 32 kWh/(m²a)"; Bundesbaublatt 2/1994
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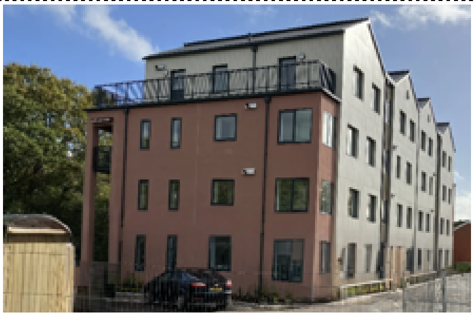
- [Rohrmann 1994] Bernd Rohrmann: "Sozialwissenschaftliche Evaluation des Passivhauses in Darmstadt"; Passivhaus-Bericht Nr. 11; Institut Wohnen und Umwelt; Darmstadt, September 1994.

15. PHPP-Ergebnisse

Passive House Verification



Building:	Brook House
Street:	Hamlin Gardens
Postcode/City:	EX1 3BE Exeter
Province/Country:	Devon GB-United Kingdom/ Bri
Building type:	Residential Flats
Climate data set:	GB0005a-Exeter
Climate zone:	4: Warm-temperate Altitude of location: 33 m
Home owner / Client:	Exeter City Council
Street:	Paris Street
Postcode/City:	EX1 1JN Exeter
Province/Country:	Devon GB-United Kingdom/ Bri

Architecture:	Gale and Snowden	**Mechanical engineer:**	Gale and Snowden
Street:	Exeter Bank Chambers, 67 High Street	Street:	Exeter Bank Chambers, 67 High Street
Postcode/City:	EX4 3DT Exeter	Postcode/City:	EX4 3DT Exeter
Province/Country:	Devon GB-United Kingdom/ Bri	Province/Country:	Devon GB-United Kingdom/ Bri
Energy consultancy:	Gale and Snowden	**Certification:**	WARM: Low Energy Building Practice
Street:	Exeter Bank Chambers, 67 High Street	Street:	3 Admirals Hard
Postcode/City:	EX4 3DT Exeter	Postcode/City:	PL1 3RJ Plymouth
Province/Country:	Devon GB-United Kingdom/ Bri	Province/Country:	Devon GB-United Kingdom/ Bri

Year of construction:	2024	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	21	Internal heat gains (IHG) heating case [W/m²]:	2.9	IHG cooling case [W/m²]:	2.9
No. of occupants:	35.2	Specific capacity [Wh/K per m² TFA]:	122	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

			Value		Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	1295.7				
Space heating	Heating demand	kWh/(m²a)	15	≤	15	-	yes
	Heating load	W/m²	11	≤	-	10	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	1	≤	15	15	yes
	Cooling load	W/m²	1	≤	-	11	
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	10		yes
Airtightness	Pressurization test result n_{50}	1/h	0.5	≤	0.6		yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	124	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	49	≤	60	60	yes
	Generation of renewable energy (in relation to projected building footprint area)	kWh/(m²a)	0	≥	-	-	

[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	Michael	Roe	

Certificate ID	Issued on:	City:
46333-46353_WARM_PH_20241219_MR	23rd Dec 2024	Plymouth