

Project Documentation

Private residence in St. Andreu de Llavaneres, Spain



Abstract



Building data

Year of construction	2025	Heating Demand	15 kWh/(m²a)
U-value external wall	0,138 W/(m ² K)	Cooling Demand	17 kWh/(m²a)
U-value basement	0,131W/(m ² K)	Primary Energy Renewable (PER)	40 kWh/(m ² a)
U-Value roof	0,108W/(m ² K)	Non-renewable Primary Energy (PE)	65 kWh/(m ² a)
U-value window	0,78W/(m ² K)	Pressurization test n50	0,5 h-1
Heat recovery	87 %		
Special features	Air-to-water heatpump for radiant heating/cooling, Greywater recycling for use in toilets.		

Brief Description

Passive House Llavaneres

This private dwelling is the first certified Passive House in St Andreu de Llavaneres, on the Spanish Maresme coast (just north of Barcelona). The house was commissioned by two hydraulic engineers to be built around the beautiful old oak tree on the plot, which resulted in an L-shaped floorplan with extreme transparency in one leg of the L, with a full basement for parking, hobbies and machine room. The clients commissioned the architect Co Govers and the firm ZEST architecture to create this house for their retirement.

The design of this house has pushed the envelope of Passivhaus considerably, with a first floor that does not coincide with the ground floor because of an overhang, and a partially non-storey wing. Further complexity was introduced by the need to create transparency in order to maximise views of the old tree from various parts of the garden. As a result, the dining room acts as an intermediary space between the North facing (tree-filled) and South facing garden (with swimming pool). This space has two façades that are nearly completely glazed, with folding-sliding doors. We understand that in Spring and Autumn, which in Spain are very very mild, this space will often be open to create an inside-outside experience which is not common in Passivhaus buildings. In Summer and Winter the folding-sliding doors will obviously remain closed.

The load bearing construction was prefabricated and is a hybrid system of timberframe and CLT. The façade is finished with two different systems. All day-spaces have a façade with External Thermal Insulation Composite System (ETICS) while all bedrooms (mostly first floor but also in the one-story wing on the ground floor, have a ventilated façade finished with Japanese burnt cedar wood. All insulation above ground is wood-fibre (including that of the ETICS façade). The plaster used is lime-based. This means that the building has a very low CO2 footprint as well as being a Passivhaus.

The underground parking, machine room and storage areas were built using an in situ reinforced concrete construction. In order to avoid having to have a door from the basement into the thermal envelope that had to comply with both Passivhaus airtightness and fire resistance (because of being a garage), the thermal envelope underground was reduced to include only the machine room, the staircase and a small hall. The rest of the underground spaces are in fact outside the thermal envelope. This means that access through the basement takes place through a fire resistant door in the garage, followed by a PH entrance door a little further.

Responsible project participants

Architect	ZEST architecture: Coraline Govers Ir. MA (project architect), Anna Vidal, Maria Matamala & Bianca Schaub) http://www.zestarchitecture.com
Implementation planning	Carlos Vazquez Yanez – Abhaus (Abos Construcción y Rehabilitación SL)
Building systems	Carlos Vazquez Yanez – Abhaus (Abos Construcción y Rehabilitación SL)
Structural engineering	Albert Ametller – Kmod Enginyeria en Fusta SL
Building physics	Coraline Govers, Ir. MA – ZEST architecture http://www.zestarchitecture.com
Passive House project planning	Coraline Govers, Ir. MA – ZEST architecture http://www.zestarchitecture.com
Construction Management	Alba Subirada Cervera – Gruart Arquitectura Técnica

Certifying body

Praxis resilient Buildings
www.praxis-rb.com

Certification ID

48228_PRB_PH_20250429_OS	Project-ID 8030 www.passivehouse-database.org
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Author of project documentation

Coraline Govers, Ir. MA, ZEST architecture www.zestarchitecture.com

Date	Signature
24 - 11 - 2025	

1. Exterior photos



NORTH EAST



SOUTH EAST

Photos: PICTUM



SOUTH WEST

Photo: PICTUM

2. Interior photos



LIVING ROOM WITH VIEW ON LEFT OF DINING ROOM (OPEN)



UPSTAIRS LANDING

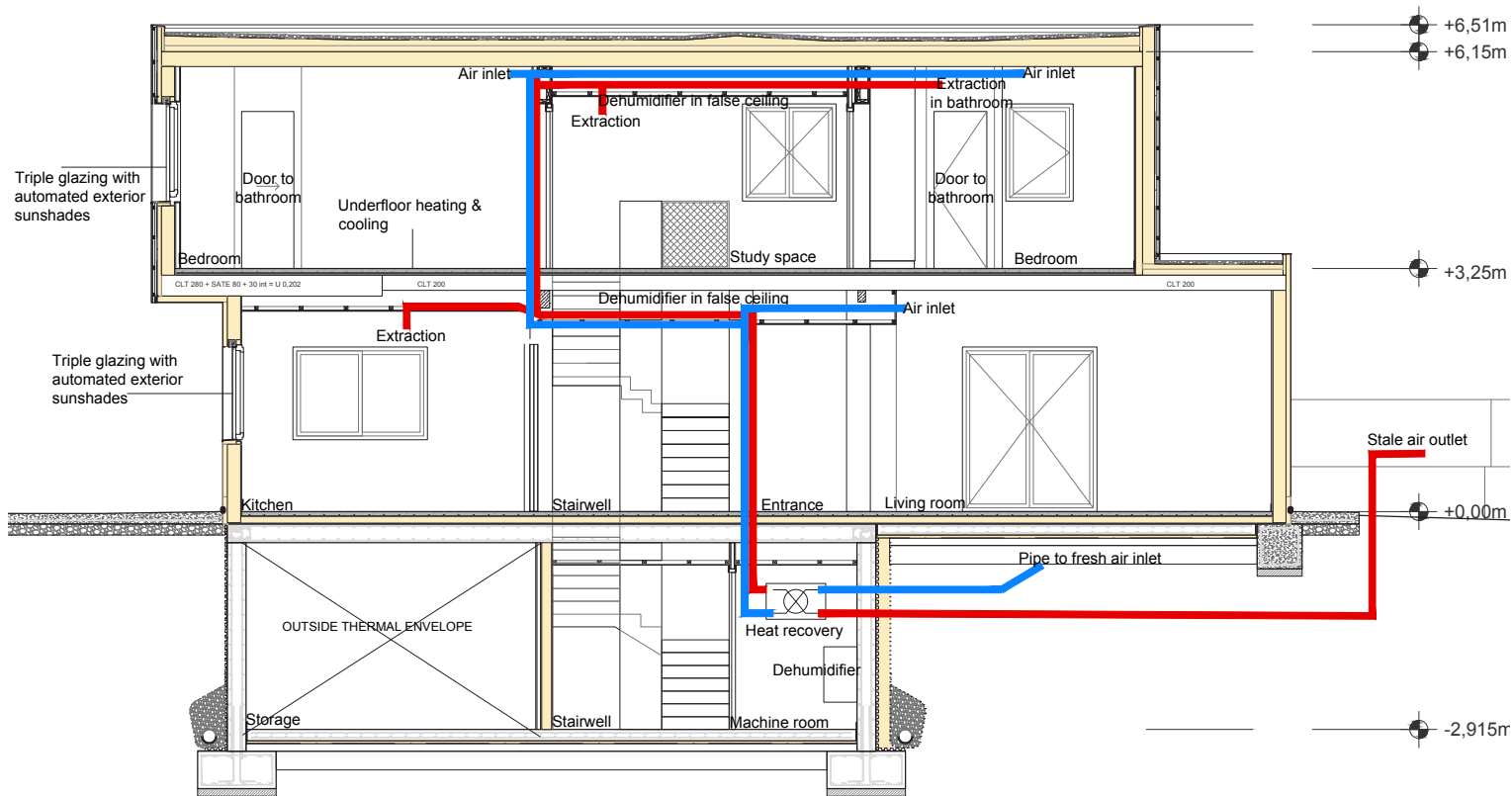
Photos: PICTUM



MASTER BEDROOM

Photo: PICTUM

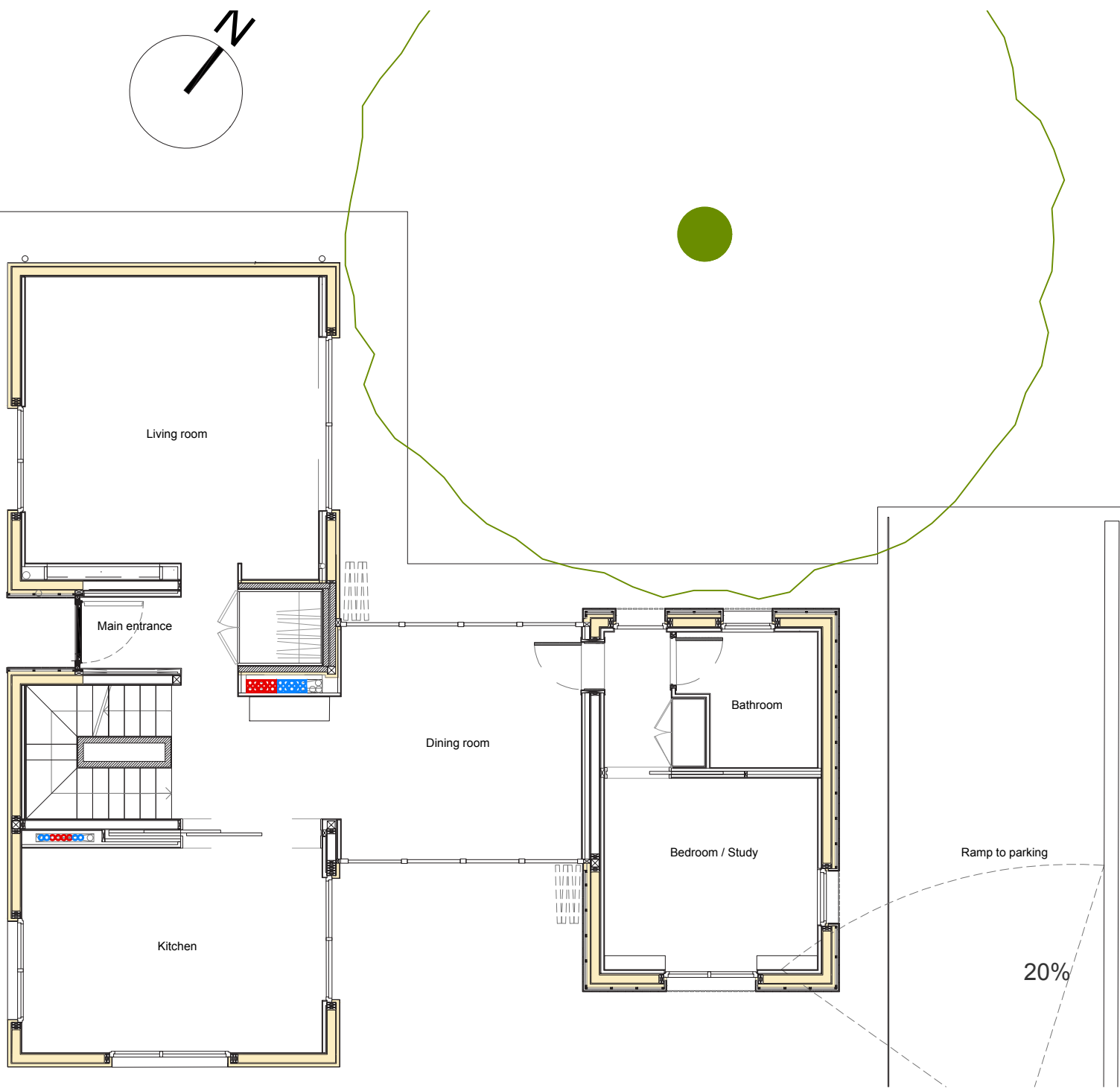
3. Cross section



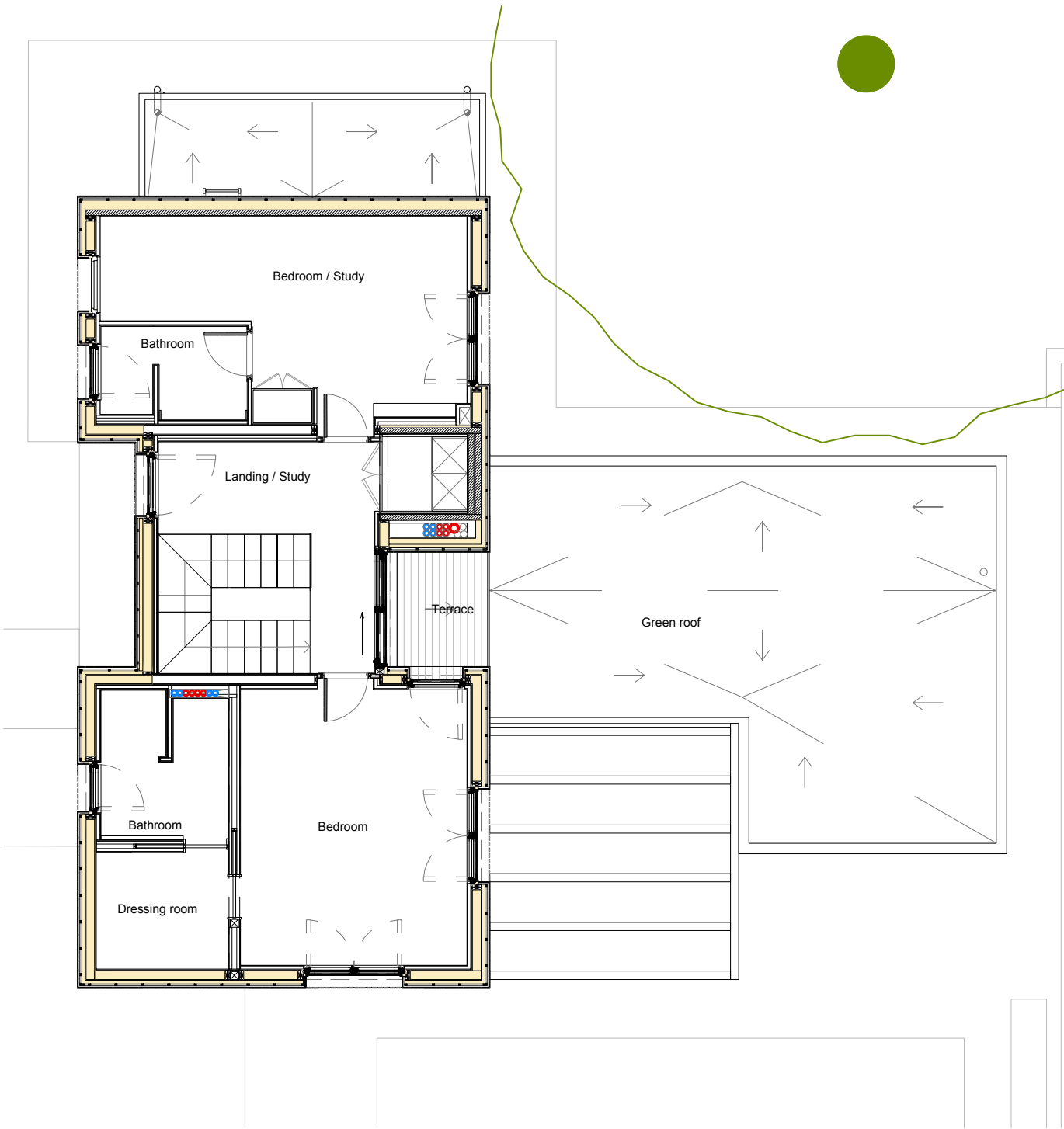
© ZEST architecture

In the cross section we can clearly see how the use of a timber load bearing construction has contributed to the prevention and reduction of thermal bridges. There is on the one hand an overhang of the first floor, where the insulation has to be wrapped around the outside. Here the CLT floor construction causes a reduction in the insulation needed on the outside. Similarly, where the living room volume sticks out in relation to the bedroom above, the CLT roof construction has led to a reduction in insulation necessary, when compared to a more traditional Spanish construction system, using concrete.

4. Floor plans

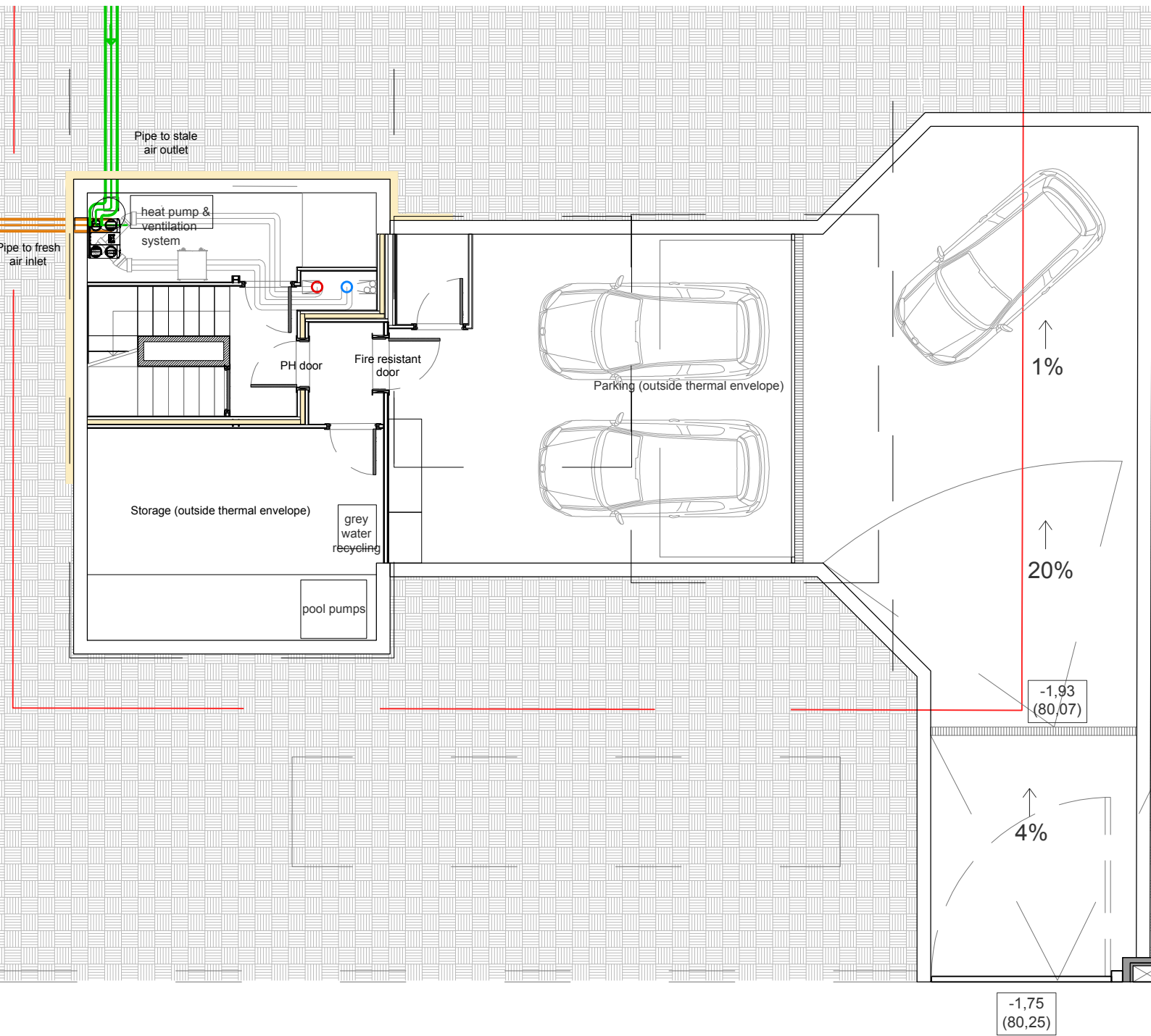


GROUND FLOOR



FIRST FLOOR

© ZEST architecture

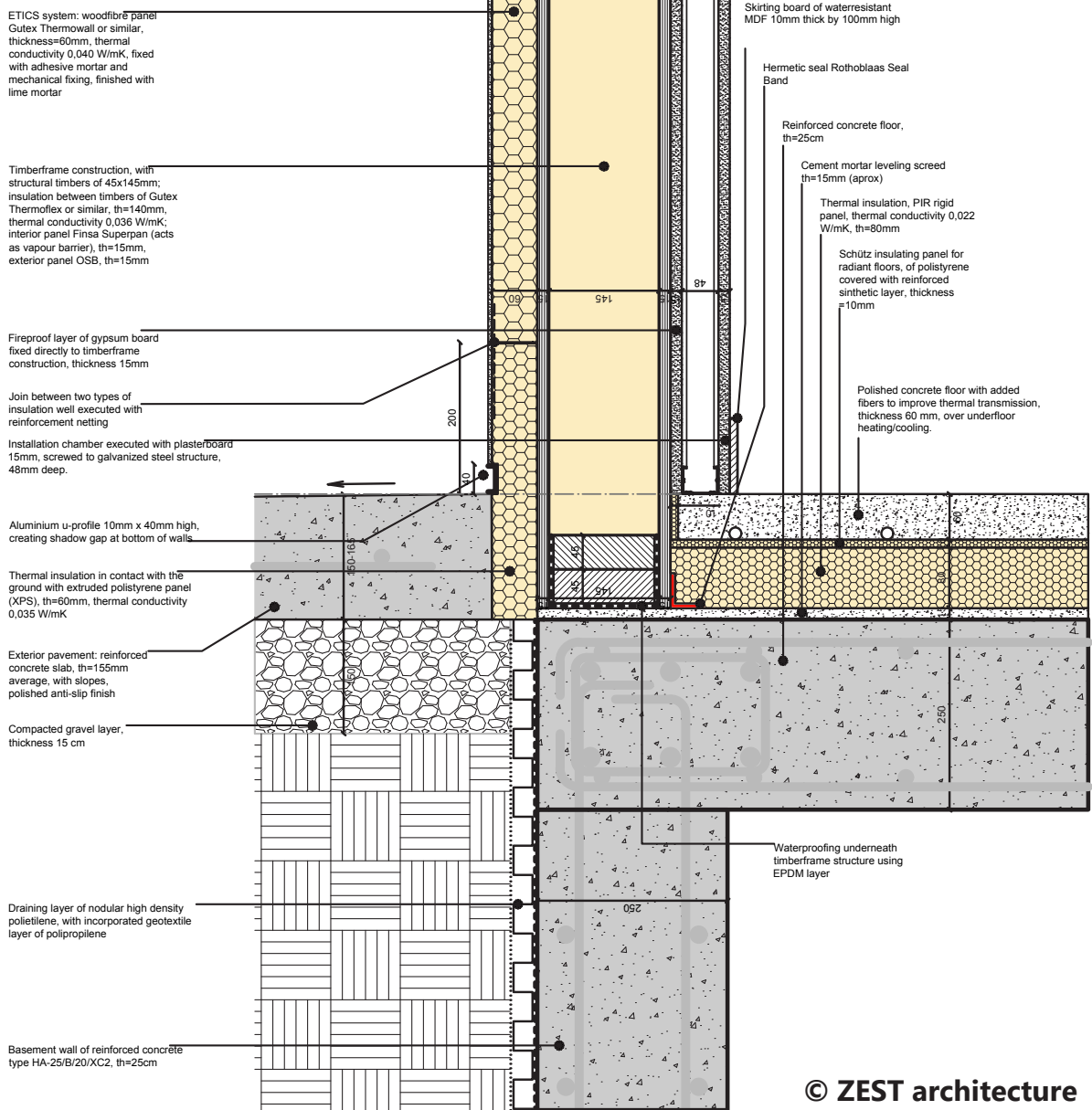


BASEMENT FLOOR

© ZEST architecture

The basement was a must-have for the clients, even though its construction was relatively expensive and complicated the Passivhaus volume. We opted for a reduced area within the thermal envelope on the basement level, which includes just the stairwell and the machine room. The entrance to the parking area is through a second, separate door, with a high fireproof rating. Separating the function of entrance to the thermal envelope from the fireproofing, led to a saving.

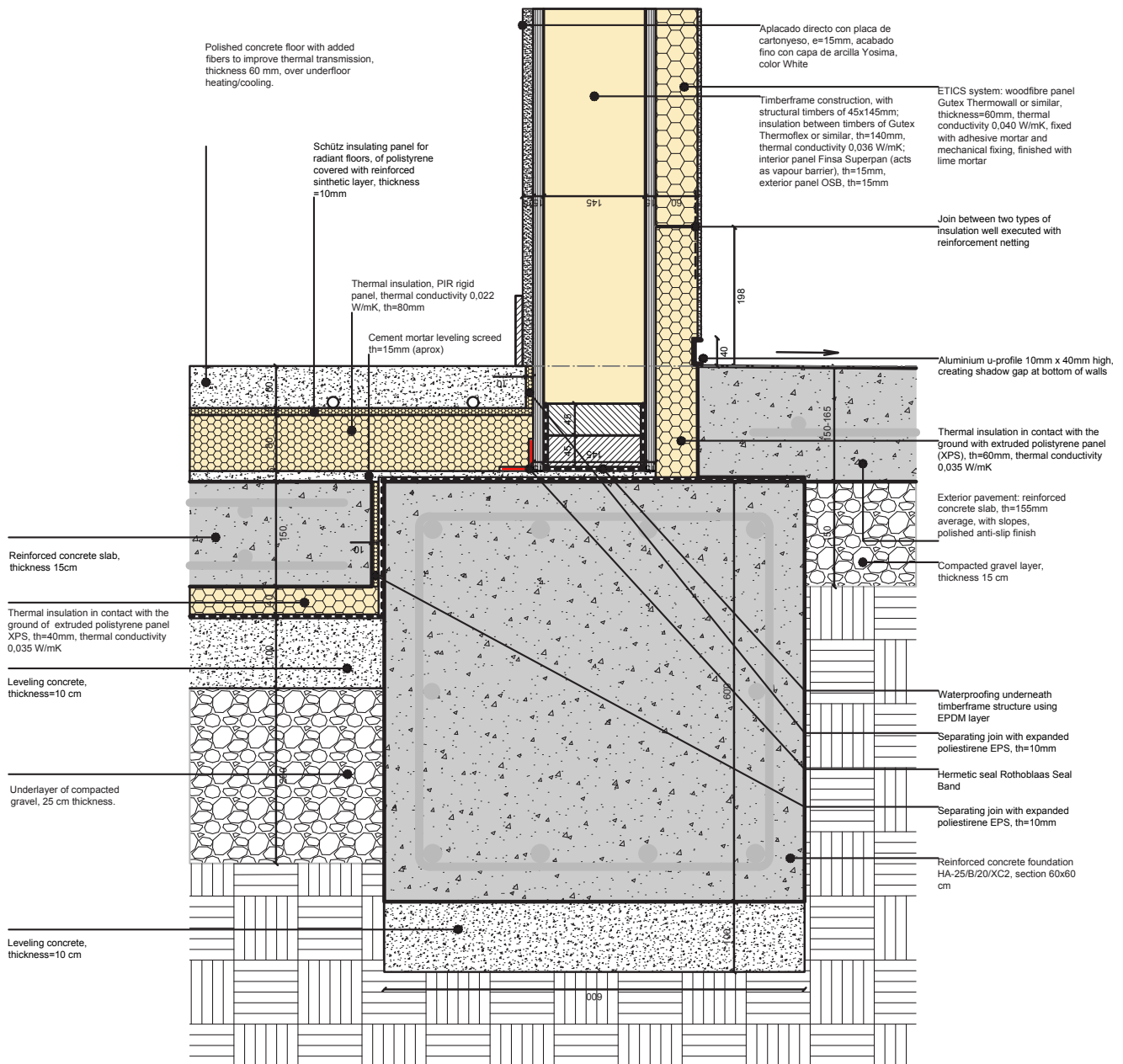
5a. Ground floor above unheated basement



© ZEST architecture

Description of building assembly		Assembly no.					
Ground floor above unheated basement		09ud					
Orientation of building assembly (or R _{si})		3-Floor	Interior insulation?				
Adjacent to (or R _{se})		3-Ventilated	U-value supplement [W/(m²K)]				
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]	
Polished concrete with fibers	2.000					43	
Schutz underfloor heating panels with polished concrete with fibers	0.039	Concrete floor	2.000			17	
Schutz underfloor heating panels	0.034					28	
PIR Rigid insulation panel	0.028					80	
Leveling screed (cement mortar)	1.800					10	
Reinforced concrete slab	2.500					250	
Percentage of sec. 1:	40%	Percentage of sec. 2:	60.0%	Percentage of sec. 3:			
Heat transmission resistance coefficients						Total thickness [cm]:	42.8
Interior R _{si} :						0.17	m²KW
Exterior R _{se} :						0.17	m²KW
U-value [W/(m²K)]:						0.233	

5b. Ground floor in contact with the terrain



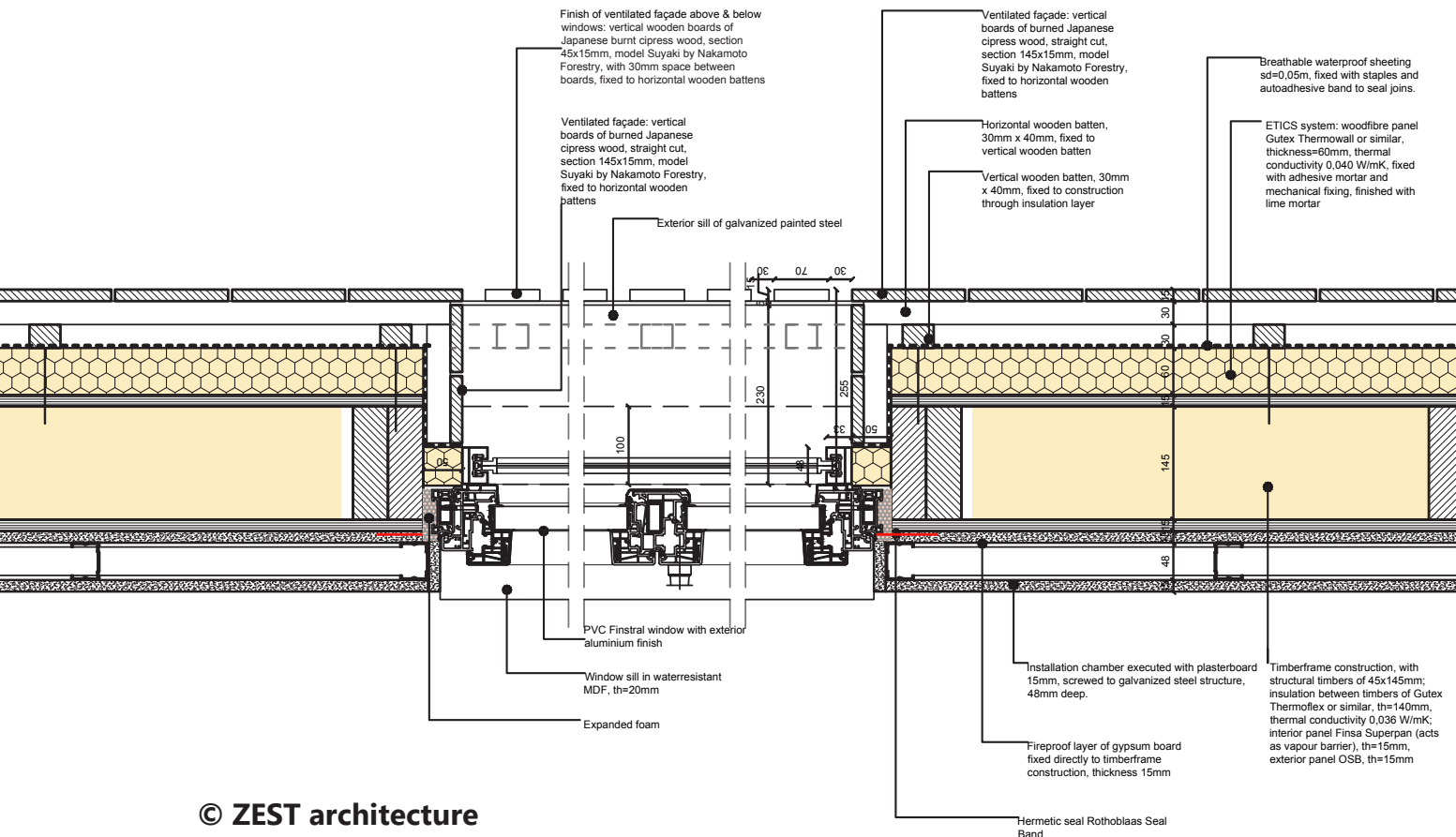
Description of building assembly						Assembly no.	
Ground floor against terrain						10ud	
Orientation of building assembly (or R_{si})				3-Floor		Interior insulation?	
Adjacent to (or R_{se})				2-Ground		U-value supplement [W/(m ² K)]	
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]	
Polished concrete with fibers	2.000					43	
Schutz underfloor heating panels with polished concrete with fibers	0.039	Concrete floor	2.000			17	
Schutz underfloor heating panels	0.034					28	
PIR Rigid insulation panel	0.028					80	
Reinforced concrete slab	2.500					165	
Insulation XPS	0.034					40	
Leveling concrete	2.000					100	
Compacted gravel	2.000					150	
Percentage of sec. 1:		Percentage of sec. 2:		Percentage of sec. 3:			
40%		60.0%					
Heat transmission resistance coefficients						Total thickness [cm]: 62.3	
Interior R_{si} :		0.17		m ² KW		U-value [W/(m ² K)]: 0.186	
Exterior R_{se} :		0.00		m ² KW			

Below a photograph of the build, with in the second plane the ground floor above the basement, and in the foreground the separate construction of the floor of the living room, where there is no basement underneath.



Photo ZEST architecture

6. Façade construction



© ZEST architecture

The façade has two different types of finish; the day-spaces are finished with lime mortar, the bedrooms are finished with a ventilated façade of vertical boards of charred Japanese cypress wood. However, in terms of thermal behavior these façades are the same, except for the additional thermal bridges introduced by the fixings of the ventilated façade. For this reason we only show the detail for the ventilated façade here.

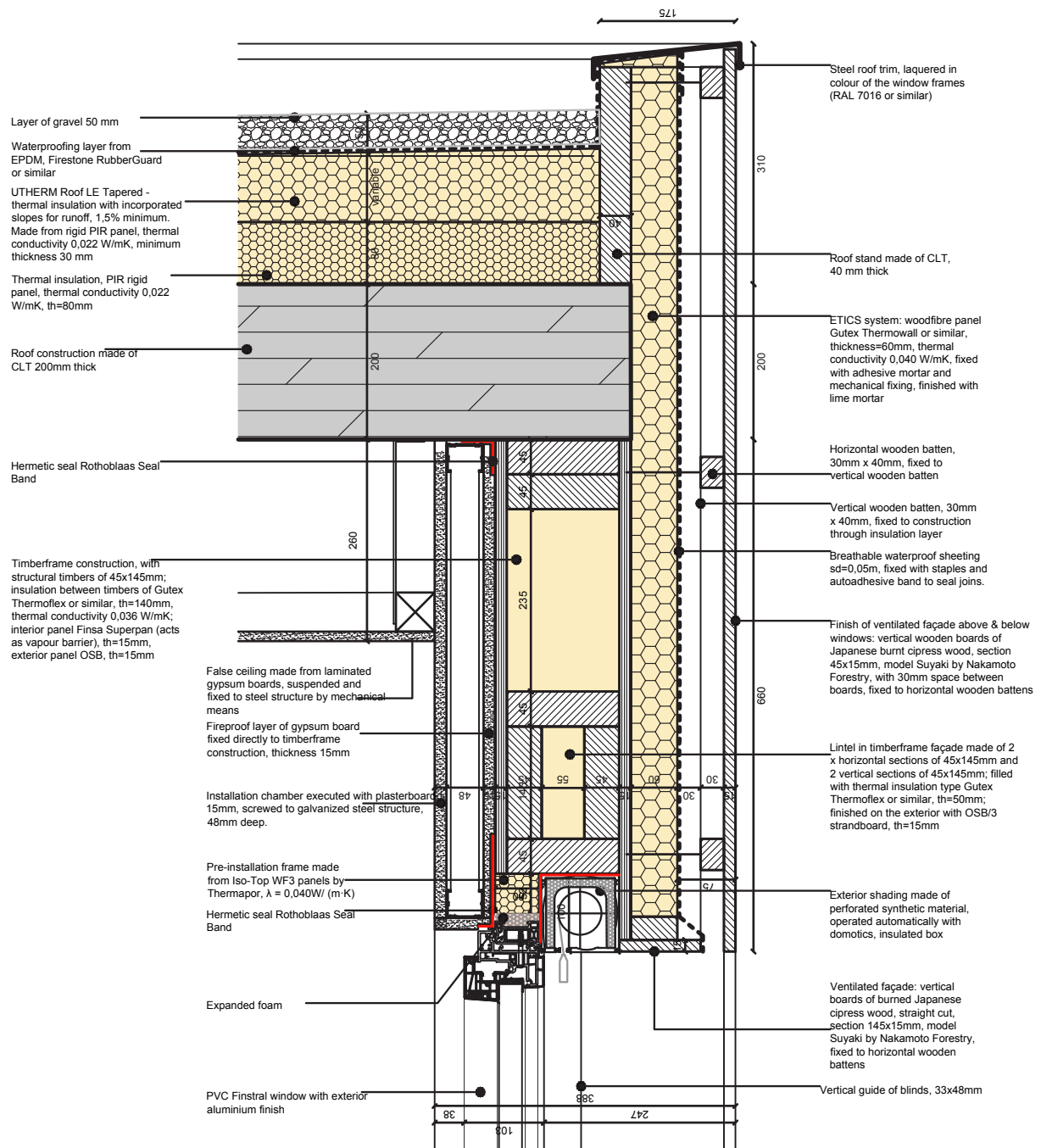
Description of building assembly						Assembly no.	
Wall with ETICS system						02ud	
Orientation of building assembly (or R_{si})			2-Wall		Interior insulation?		
Adjacent to (or R_{se})			1-Outdoor air		U-value supplement [W/(m ² K)]		
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]	
ETICS mortar finish	1.800					3	
Gutex Thermowall Insulation	0.040					60	
OSB 3	0.130					15	
Gutex Thermoflex insulation	0.036	Structural timbers	0.130			140	
Superpan Fintech	0.140					15	
Plasterboard	0.250	Screws to structure				15	
Air chamber	0.260			Galvanized steel structure	17.000	48	
Plasterboard	0.250					15	
Percentage of sec. 1:	92%	Percentage of sec. 2:	7.5%	Percentage of sec. 3:	0.2%		
Heat transmission resistance coefficients						Total thickness [cm]:	
Interior R_{si} :	0.13	m ² K/W					31.1
Exterior R_{se} :	0.04	m ² K/W					U-value [W/(m ² K)]:
						0.179	

Below a picture after the timberframe construction of the ground floor and first floor were finished. On the ground floor the façade has already been covered with additional exterior insulation, in the porch the material for covering the rest of the façade.



Photo ZEST architecture

7. Roof construction



© ZEST architecture

The roof consists of a CLT panel, topped with a layer of flat PIR insulation panel, with on top of that a prefabricated Utherm tapered roof panel, also PIR. This means the fall of the roof is calculated in factory and can be made using the insulation itself, thereby saving a layer of mortar or other material. Waterproofing is an EPDM membrane, with gravel on top.

Description of building assembly						Assembly no.	
Main roof						01ud	
Orientation of building assembly (or R _s)				1-Roof		Interior insulation?	
Adjacent to (or R _s)				1-Outdoor air		U-value supplement [W/(m ² K)]	
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]	
Layer of gravel	2.000					50	
EPDM-Firestone Rubberguard							
Insulation PIR Utharm Roof LE	0.028					80	
Insulation PIR Utharm Roof LE	0.028					80	
CLT panel 200	0.150					200	
Percentage of sec. 1:		Percentage of sec. 2:		Percentage of sec. 3:			
Percentage of sec. 1:		100%		Percentage of sec. 2:			
Heat transmission resistance coefficients						Total thickness [cm]:	
Interior R _s :		0.10		m ² K/W		41.0	
Exterior R _s :		0.04		m ² K/W		U-value [W/(m ² K)]:	
						0.137	



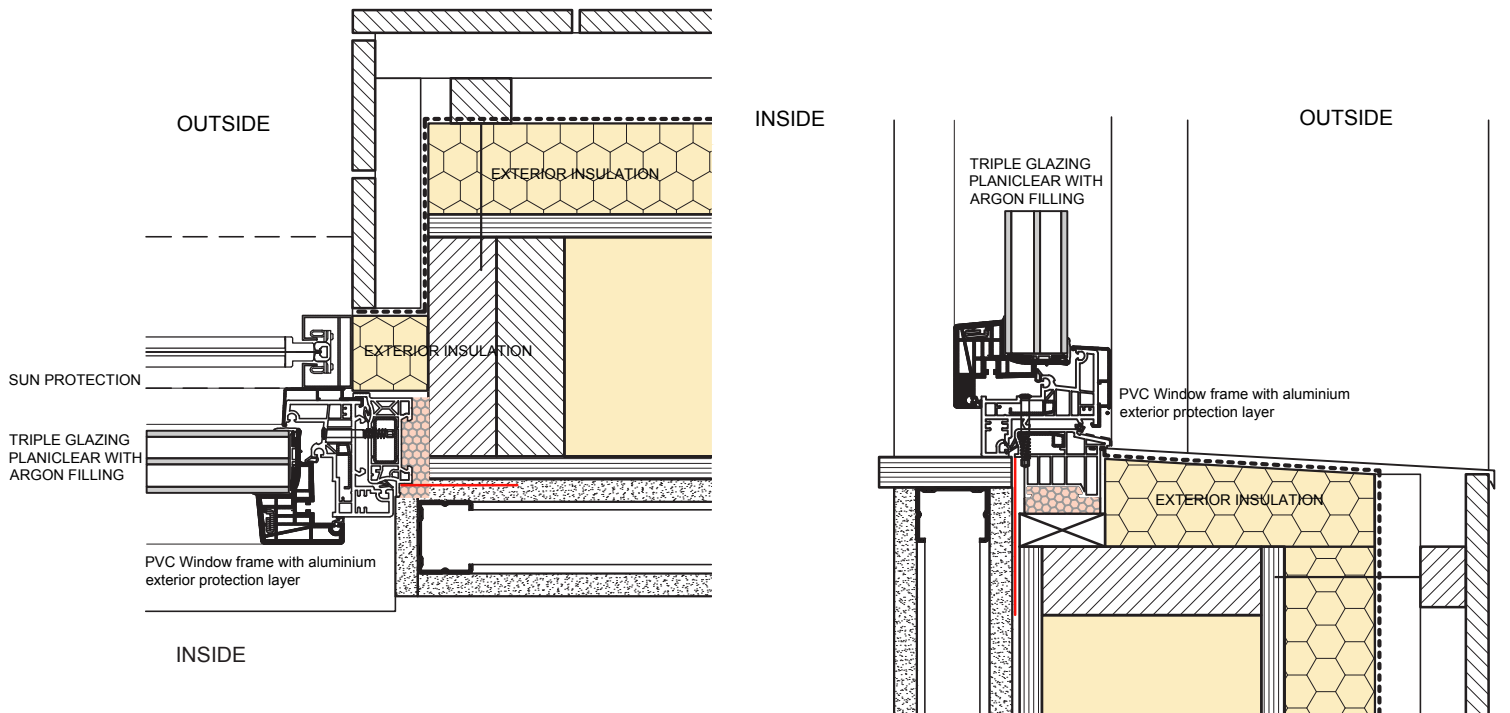
Photo ZEST architecture

Above a picture of the roof during the process of insulation. In the rear of the photo the roof has received the first layer of 8cm PIR insulation. In the foreground the material stand-ing ready.

8. Window and window installation

The house has PVC window frames with triple glazing. Except in the dining room, where there are sliding folding windows of aluminium from a different brand. On this page we show the detailed installation of the PVC windows, on the next page the installation of the aluminium folding sliding doors.

PVC window frames:



© ZEST architecture

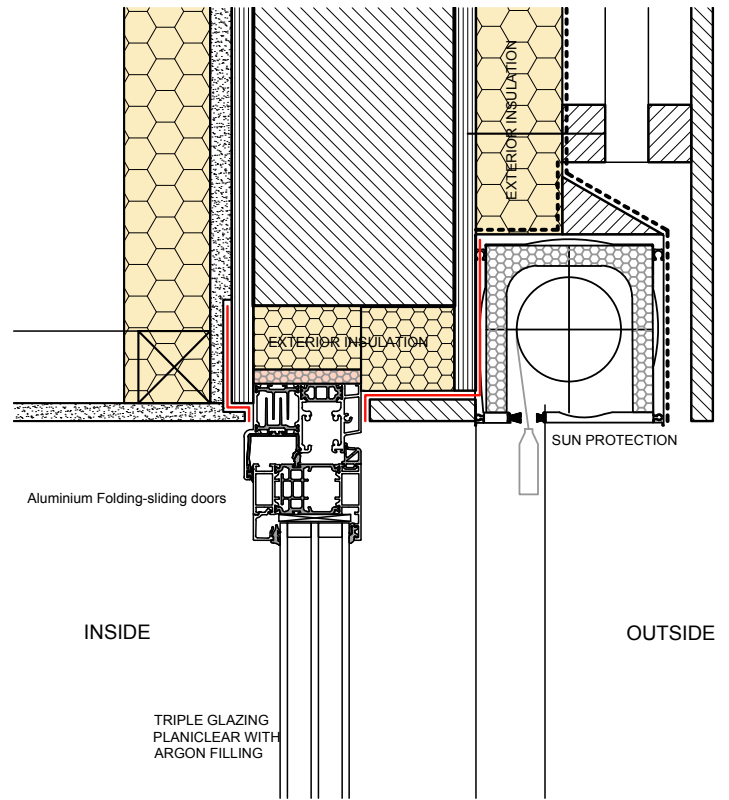
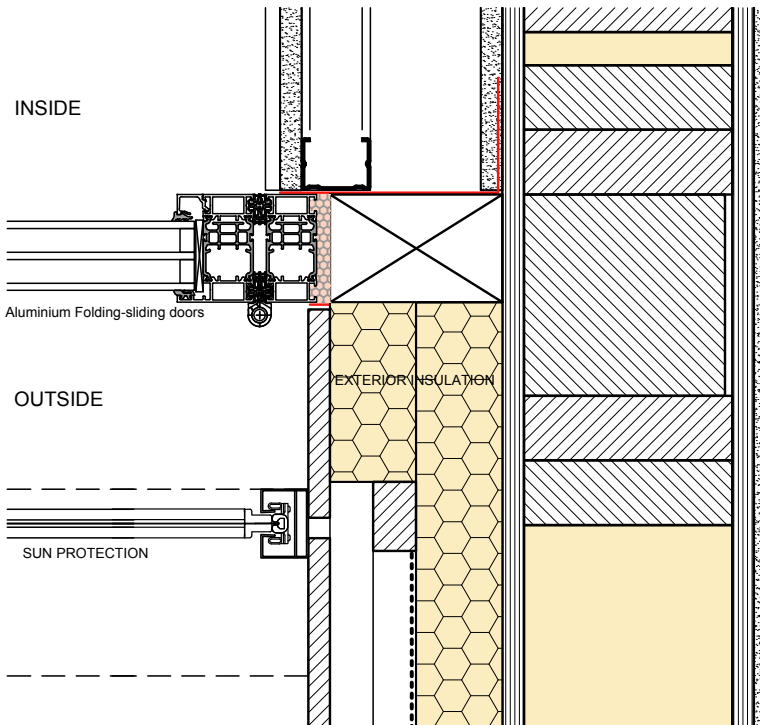
Window manufacturer	Finstral
Window frame materials	PVC window frames, aluminium exterior protection layer
Window-U-Value U_f	1,04 W/(m ² K)
Glass composition	3+3 12ar 4 13ar 4
Glass U-Value U_g	0,85 W/(m ² K)
Glass g-Value	0,44

Below the PVC windows installed, and underneath the folding sliding doors of the dining room.



Photos ZEST architecture

Aluminium folding sliding frames:



© ZEST architecture

Window manufacturer	Sunflex
Window frame materials	Aluminium window frames
Window-U-Value Uf	1,74 W/(m ² K)
Glass composition	4+4 12ar 6 13ar 6
Glass U-Value Ug	1,04 W/(m ² K)
Glass g-Value	0,43

9. Description of Air Tightness layer

A first blowerdoor test was done on 17.9.2024 after the airtight envelope was finished, which was not sufficient. After locating a number of issues, a second test was done on 19.9.2024, which was more than compliant.

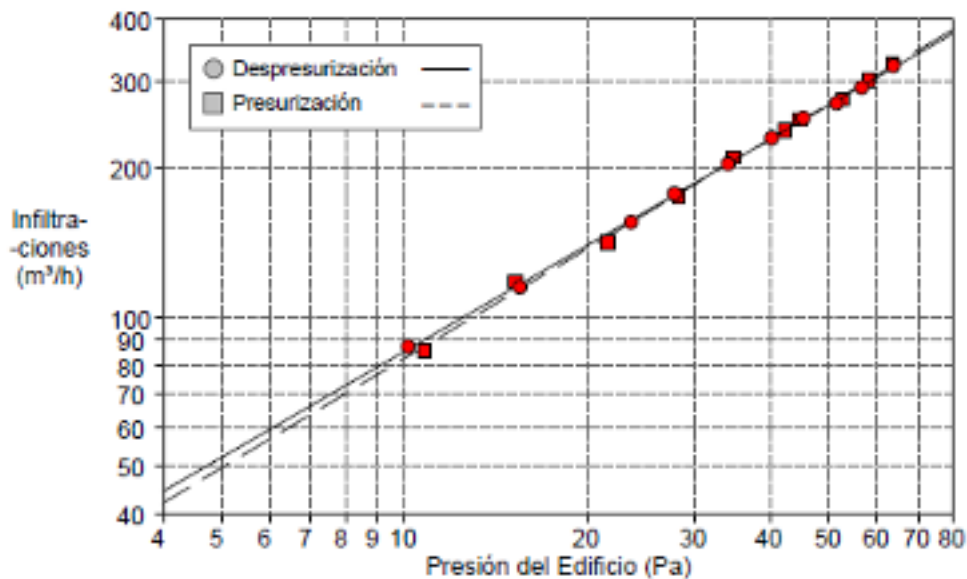
Fecha del Test: 11/03/2025	Archivo de Test: 20250311 ANA GABINO Blower Door 03		
Técnico: Oliver Style			
Número de proyecto:			
Cliente: Hans Helmut Linkmeyer - Ana Gabino	Dirección del Edificio:	Vivienda unifamiliar	
Av. Turró d'en Lluï 26		C/Mare de Deu del Pilar 63	
- Sant Andreu de Llavaneres		Barcelona - 08392 Sant Andreu de Llavaneres	
Teléfono:			
Fax:			

Resultados del test a 50 Pa:	Despresurización	Presurización	Media
q ₅₀ : m³/h (Caudal de Aire)	268 (+/- 0.9 %)	269 (+/- 2.2 %)	268
n ₅₀ : 1/h (Tasa de Renovación de Aire)	0.54	0.54	0.54
qF50 : m³/(h·m² Área del Suelo)	1.56	1.56	1.56
qE50 : m³/(h·m² Área de la Envolvente)	0.36	0.37	0.37

Áreas de Infiltraciones:	Despresurización	Presurización	Media
ELA ₅₀ : m²	0.0082 (+/- 2.2 %)	0.0082 (+/- 2.2 %)	0.0082
ELA _{F50} : m²/m²	0.0000474	0.0000477	0.0000475
ELA _{E50} : m²/m²	0.0000111	0.0000112	0.0000112

Curva de Infiltraciones del Edificio:	Despresurización	Presurización
Coefficiente de Caudal de Aire (C _{env}) m³/(h·Pa ⁿ)	16.5 (+/- 4.6 %)	15.2 (+/- 10.9 %)
Coefficiente de Infiltraciones (C _L) m³/(h·Pa ⁿ)	16.6 (+/- 4.6 %)	15.2 (+/- 10.9 %)
Exponente (n)	0.710 (+/- 0.013)	0.734 (+/- 0.031)
Coefficiente de Determinación (r²)	0.99949	0.99733

Norma del Test:	ISO 9972
Modo del Test:	Despresurización y Presurización
Método del Test:	Método 1 - Test para el edificio en uso
Objetivo del test:	Passivhaus n50 ≤ 0.64 1/h



Airtightness Concept

Façade: Fintech Superpan board (functions both as airtightness layer and vapor barrier, with the joints between panels taped with Siga Sikrall seal band)

Floorslab: The joint between the floor slab and façade is sealed with Siga Rissan seal band

Windows: The joint between window frame and façade is sealed with Siga Corvum seal band

Roof: The joint between façade and roof is sealed with Siga Corvum seal band.

Meets with	Floor slab	Casement frame	Mounting frame	Façade	Roof
Roof				Sikrall Siga Seal band	Siga Corvum Seal band
Façade	Siga Rissan Seal band		Siga Corvum Seal band	Siga Sikrall Seal band	
Mounting frame	Siga Corvum Seal band	Hermetic seal band		Siga Corvum Seal band	



Joint between Fintech panels and with window mounting frame

Photo ZEST architecture



Demonstration of fit Casement frame with Mounting frame



View of 3 types of Siga seal band installed

Photos ZEST architecture

10. Ventilation

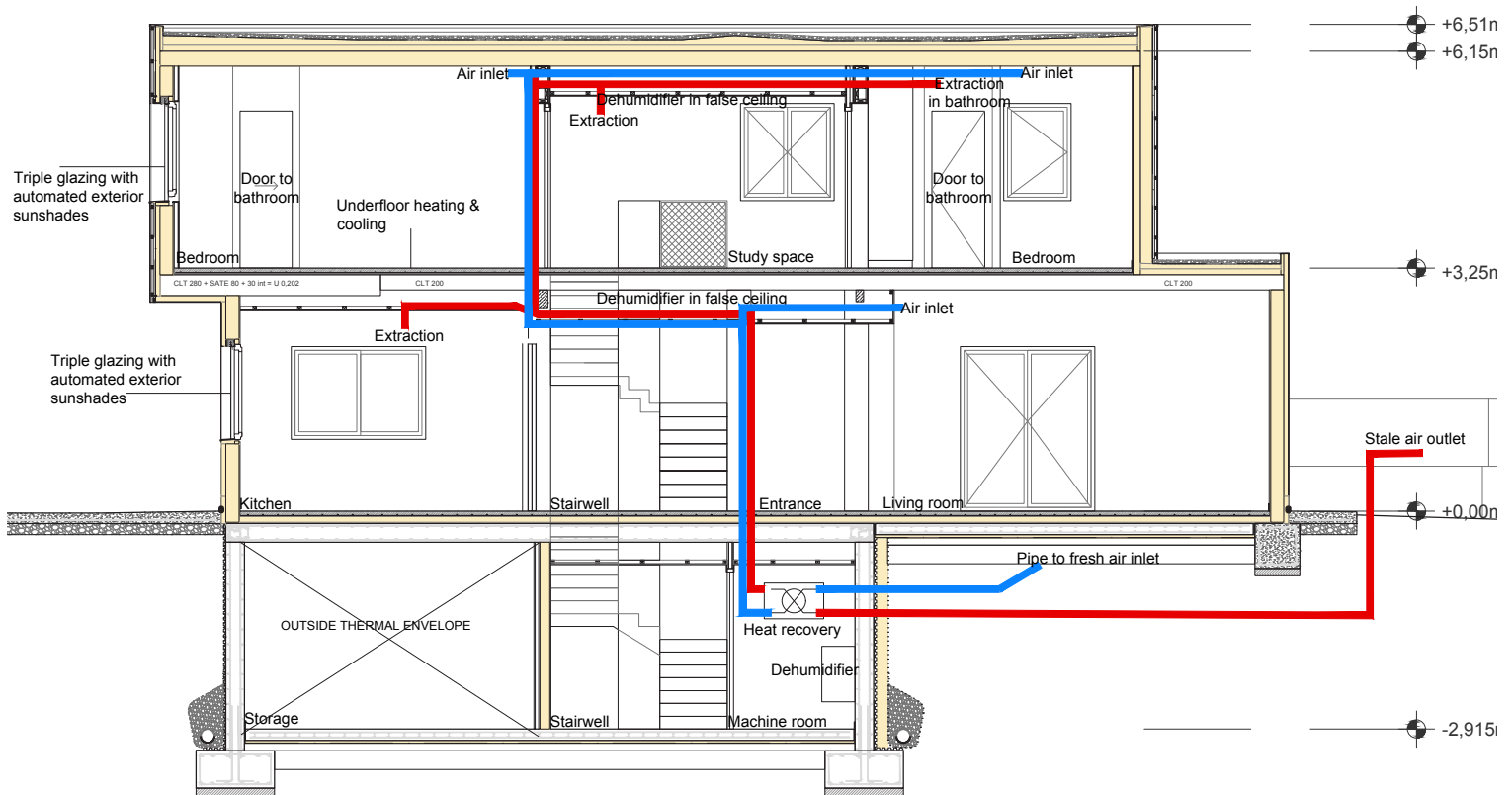
The house has a Zehnder ComfoAir Q600 HRV ES ST ventilation system with heat recuperation.



Zehnder ComfoAir Q600
Photo ZEST architecture

Manufacturer	Zehnder
Heat recovery efficiency	87%
Power input	0,24 Wh/m ³

11. Ventilation pipe network



© ZEST architecture

Fresh Air Admission happens in the dining room, living room and all the bedrooms. These are the blue pipes.

Stale air is extracted from the kitchen, bathrooms and stairwell. These are the red pipes.

The fresh air inlet can be found in the garden by the front door, on the South side of the house. A pipe leads from there underground to the machine room in the basement.

The stale air outlet can be found in the garden behind the living room, on the East side of the house. A pipe leads from there underground to the machine room in the basement.

There are shafts both in the wall between stairwell and kitchen/master bedroom, and in the wall by the provisional space for the elevator to lead pipes comfortably to

12. Heating / Cooling



Radiant floor installed



Panasonic heat pump

Although heating/cooling would have been sufficient using air based systems, the sensitivity to air movements of the owner of the house led us to opt for a radiant system. A polished concrete screed covers a radiant floor which can be run both in heating and cooling setting. This floor is fed by a Panasonic air-to-water heat pump. The system includes dehumidifiers which control the dew point when the underfloor system is in cooling mode, ensuring sufficient cooling power is achieved at all times.



Zehnder dehumidifier



Exterior unit of the Panasonic heat pump

Photos ZEST architecture

13. Building costs

This Passivhaus dwelling in Llavaneres was built in 2025, when building costs in Spain had risen sharply in comparison with pre-Covid prices. The insistence of the clients on having underground parking drove buildings costs up further.

Total building costs were € 917.697,28.


Of this total, the baseline buildingcosts add up to 2359 €/m². The extra investments made to achieve Passivhaus certification added up to 320 €/m² which works out to 12% of the total construction costs.

14. PHPP Results

Passive House-Verification

10.6 EN



	Building: Casa Linkmeyer-Gabino	
	Street: Carrer Mare de Déu del Pilar 63	
	Postcode/City: 08392 Sant Andreu de Llavaneres	
	Province/Country: Barcelona ES-Spain	
Building type: 1-Freestanding single family house		
Climate data set: ES0002c-Barcelona, Altitude corrected		
Climate zone: 5: Warm	Altitude of location: 81 m	
Home owner / Client: Hans Helmut Linkmeyer - Ana Gabino		
Street: Carrer Mare de Déu del Pilar 63		
Postcode/City: 08392 Sant Andreu de Llavaneres		
Province/Country: Barcelona ES-Spain		
Mechanical engineer: ABHaus		
Street: Avda. Pere Planas 236		
Postcode/City: 08198 Sant Cugat del Vallès		
Province/Country: Barcelona ES-Spain		
Certification: Oliver Style - Praxis Resilient Buildings		
Street: C/ Torres i Amat 21, 1er Piso		
Postcode/City: 08001		
Province/Country: Barcelona ES-Spain		
Year of construction: 2024	Interior temperature winter [°C]: 20,0	Interior temp. summer [°C]: 25,0
No. of dwelling units: 1	Internal heat gains (IHG) winter [W/m²]: 2,4	IHG summer [W/m²]: 2,6
No. of occupants: 3,0	Specific heat capacity [Wh/K per m² TFA]: 60	Mechanical cooling: x


Specific building characteristics with reference to the treated floor area		Criteria	Alternative criteria	Fullfilled? ²
Space heating	Treated floor area m²	168,5		
	Heating demand kWh/(m²a)	15,1	15	Yes
	Heating load W/m²	19	- / 10	Yes
Space cooling	Cooling & dehum. demand kWh/(m²a)	17,1	17	Yes
	Frequency of overheating (> 25 °C) %	-	-	-
	Frequency of excessively high humidity (> 12 g/kg) %	0	10	Yes
Airtightness	Pressurisation test result n ₅₀ 1/h	0,54	0,6	Yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	65	-	-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	40	60 / 60	Yes
	Renew. energy generation (in rel. to projected building footprint area) kWh/(m²a)	0	- / -	

² Empty field: data missing; '-': No requirement

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

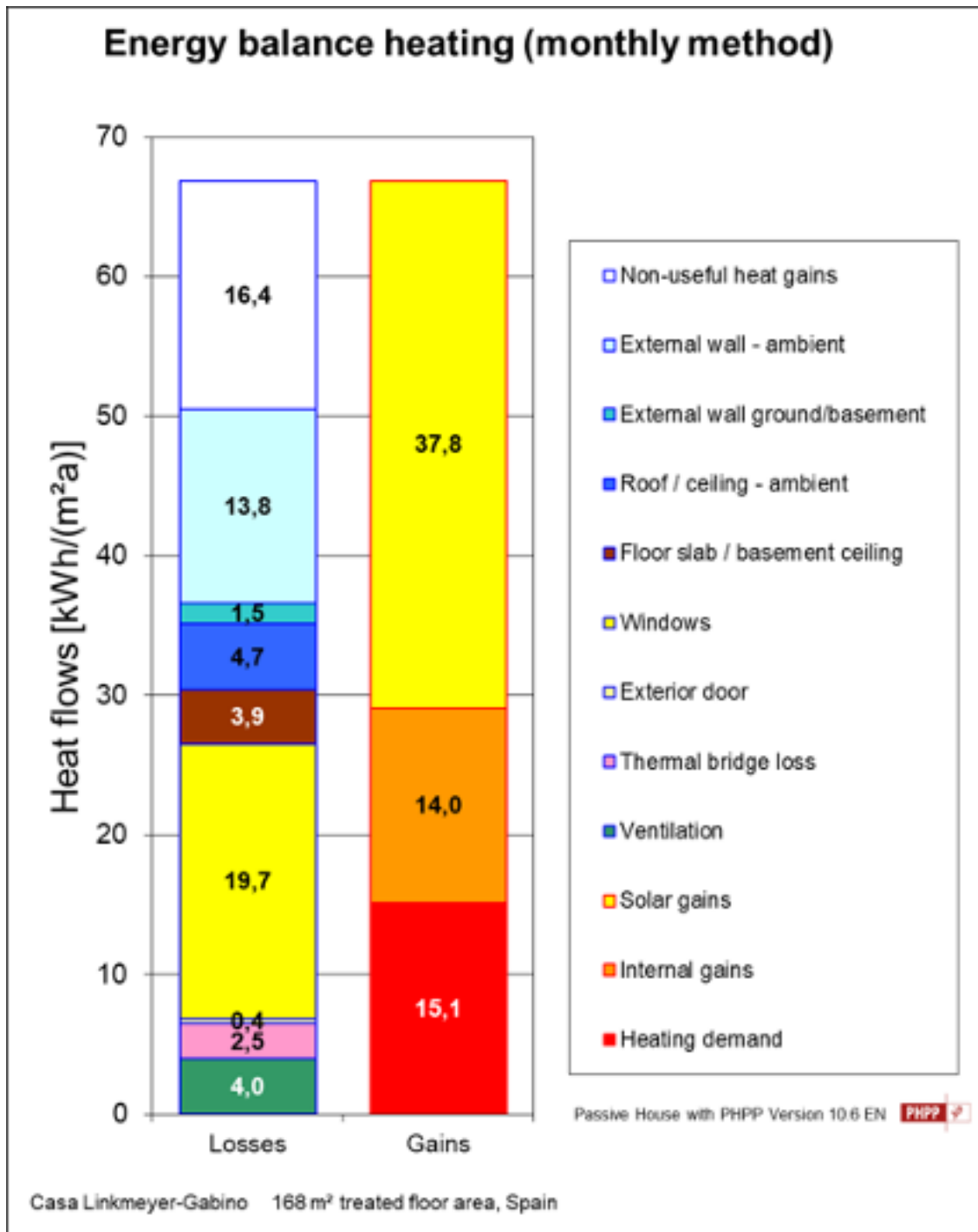
Task: 2-Certification First name: Oliver Surname: Style

Certificate-ID: 48228_PRB_PH_20250429_OS Issued on: 29/04/25 City: Barcelona

Passive House Classic? **Yes** Signature: 

This Passivhaus dwelling has been an exercise in making small adjustments.

First factor complicating matters was the orientation, which was far from ideal. As a result, we could not follow the rule of few openings that face North, and most openings facing South. As visible in the energy balance on the next page, although the windows facing South-East, South and South-West give us a lot of solar gains, these are offset with the heat losses of North-East, North and North-West facing windows, of which there are quite a few, including large glazed elements in the dining room.



Another important factor is the low compactness of the building. With its overhang, a first floor that is substantially smaller than the ground floor and with the basement, the resulting building has a complex volume with a relatively large roof area, exterior walls and basement walls, all contributing to heat losses. We worked very hard to avoid making matters worse with our thermal bridges, so these actually contribute relatively little to the heat losses in the end. And thankfully we used a timberframe construction for the house (except the basement) which made this easier.