REPORT
PUBLIC

OP 20: OFFICE BUILDING CASTELLANA, 19 MADRID (SPAIN)

RENOVATION APPROACH DOCUMENT

outPHit
Deep retrofits made faster, cheaper and more reliable

Call: H2020-LC-SC3-2018-2019-2020 / H2020-LC-SC3-EE-2020-1

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Last updated 7. October 2022 by Nuria Díaz Antón

CONTACT

VAND ARQUITECTURA
+34 661 95 21 18 | info@vandarquitectura.info

OUTPHIT – DEEP RETROFITS MADE FASTER, CHEAPER AND MORE RELIABLE
outPHit pairs such approaches with the rigour of Passive House principles to make deep retrofits cost-effective, faster and more reliable. On the basis of case studies across Europe and in collaboration with a wide variety of stakeholders, outPHit is addressing barriers to the uptake of high quality deep retrofits while facilitating the development of high performance renovation systems, tools for decision making and quality assurance safeguards.
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OP20_OFFICE BUILDING CASTELLANA, 19_MADRID

Renovation Approach Description

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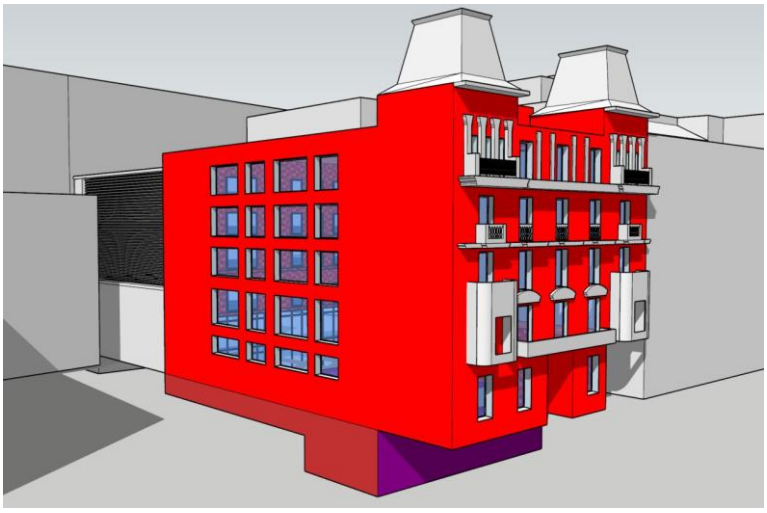
1. Executive Summary

The original building, located in the center of the city of Madrid, consists of two independent volumes separated by a central courtyard, and connected through the basement floor which is out of the thermal envelope.

The main building has five floors, and the second building has three floors. The main building has a protected historical façade, which makes difficult the implementation of the airtight layer.

The original building, built using a traditional construction system, is from 19th century, and it was retrofitted in 1903 and 1986.



Main building

Second building

Design PH model @ Velmar ingenieros

2. Description of the existing building

The building has a single access from Paseo de la Castellana, 19, one of the most emblematic arteries of Madrid.

The main building has five floors, and the second building has three floors. The main building has a protected historical façade, which makes difficult the implementation of the airtight layer. The initial use for this building was residential, and it was changed with the retrofitted in 1986. The initial use for the second building was for garages and storage rooms, which also was changed in 1986.

2.1. Building data

Year of construction:	dated in 1903, retrofitted in 1986
Treated Floor Area:	3231,52+342,71 m²
Number of floors:	5+basement in main building
	3+basement in second building
Number of apartments:	-
Building typology (residential / other):	Other (office)
Main construction type (e.g. massive)	Massive

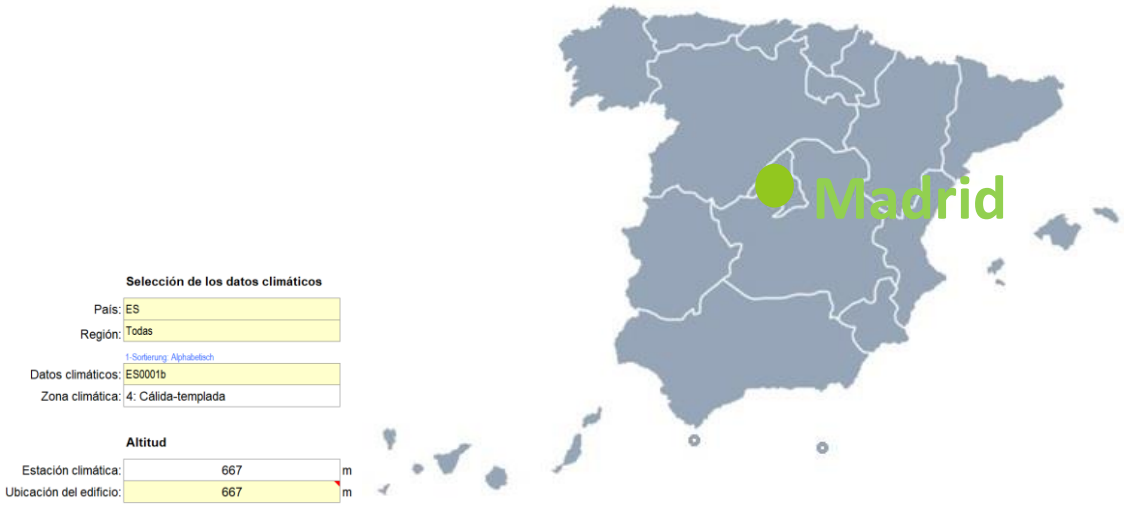
2.2. Owner data

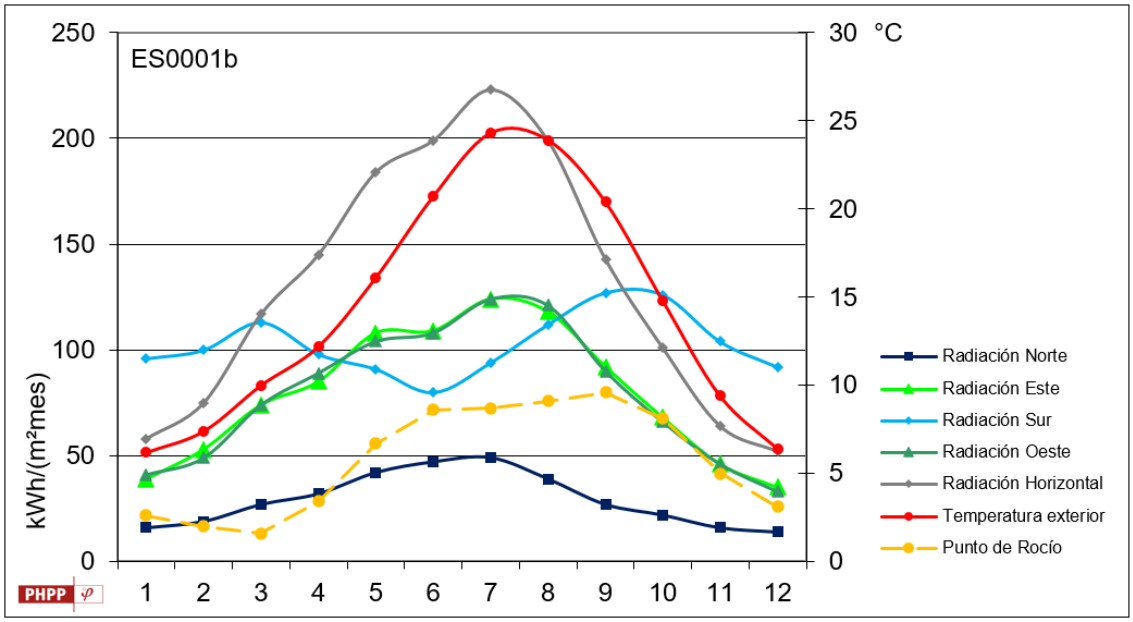
Name:	CCS Consorcio de Compensación de Seguros
City:	Madrid
Type (private / housing association):	Public entity

2.3. Location description

The building is located in the city of Madrid, in a warm-temperate climate, at 667 meters above sea level.

Madrid's climate is continental, with cold winters and very hot summers. As it is a big city, the urban heat effect must be taken into account for summer comfort testing.





PHPP clima Madrid @ Velmar ingenieros

2.4. Original situation

The building from 1903 was retrofitted in 1986, and it was built using a traditional construction system.

2.5. Plans and pictures of the existing building

Existing building @ Ruiz Larrea

2.6. Envelope of the existing building

External walls

Material:	Brick with interior and exterior plaster
Thickness:	80 [cm]
Surface (Render / Brick / Cladding):	Brick
U-Value:	1.78 [W/(m²K)]

Basement ceiling

Material:	Unheated ceiling
	Reinforce concrete floor
Thickness:	25 [cm]
U-Value:	2.09 [W/(m²K)]

Roof / Top floor ceiling

Material:	Reinforce concrete floor
Surface (Render / Brick / Cladding):	Ceramic floor
U-Value:	4.24 [W/(m²K)]

Windows

Material:	Wooden exterior frame with simple glazing
Thickness:	5 [cm]
Material (Wood / Plastic / Aluminium):	Wood
U-Value (Uw, installed):	2 [W/(m²K)] (standard value)

2.7. Technical equipment of the existing building

Ventilation

Ventilation concept:	Window ventilation

Heating, Cooling and DHW

Heating:	Not available yet
Cooling:	Not available yet
Domestic hot water:	Not available yet

2.8. Energy efficiency of the existing building

There are not calculations available for the existing building.

3. Renovation approach description

In this retrofit, the EnerPHit standard will be achieved through the Energy Demand Method. It is a complete renovation including the following actions:

-Building envelope insulation (facades, roof, floor towards basement)

-Windows, doors, and roller shutter replacement

-Airtightness improvement

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Renovation Approach Description

-Ventilation system with heat recovery installation

-Heating and cooling systems renovation

-Existing thermal bridges improvement

Protected historical façade @ VAND arquitectura

3.1. EnerPHit standard approach

EnerPHit standard target (class):	Classic
Climate Zone	Warm-temperate
EnerPHit verification method:	Demand method

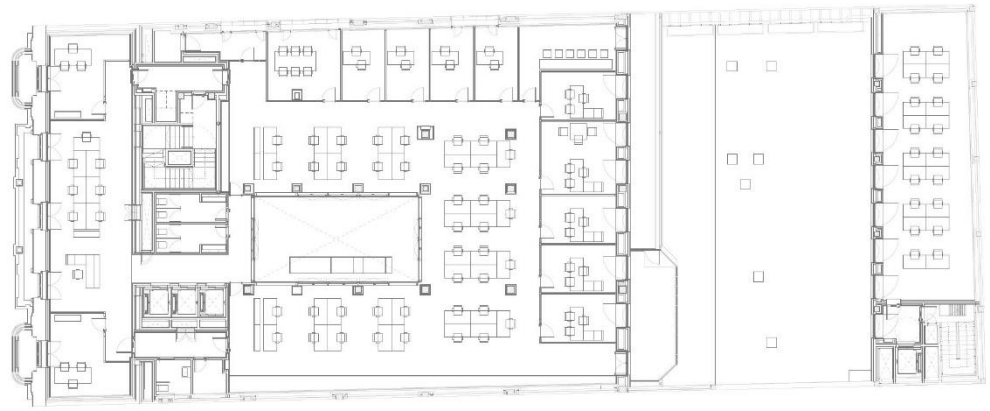
3.2. Design / Consultancy teams

Name:	Ruiz Larrea
City:	Madrid
Type (private / housing association)	Private

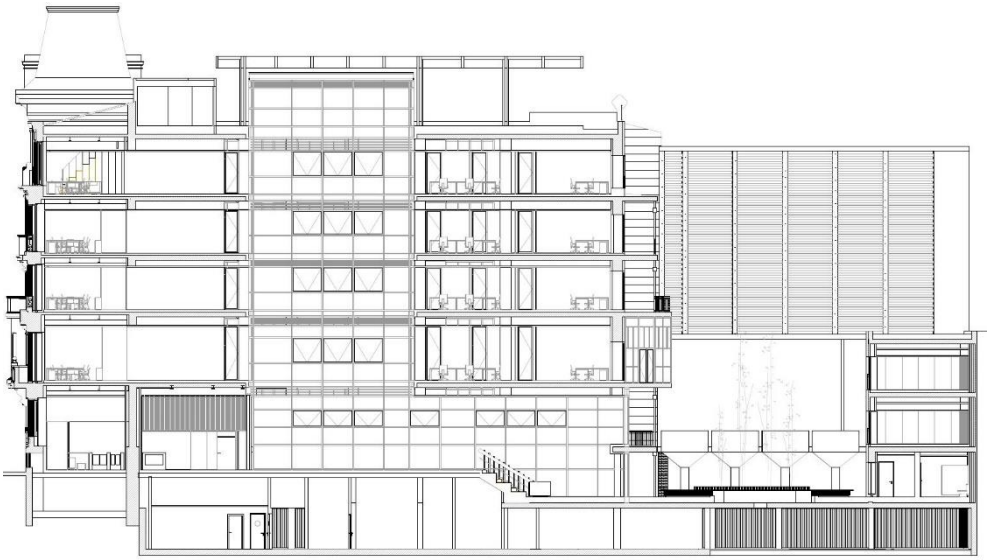
3.3. Design / Construction periods

Design period:	08.2018 – 12.2020
Construction period:	12.2020 –

3.4. Plans and pictures of the renovation



Retrofitted floor plan @ Ruiz Larrea



Retrofitted elevation @ Ruiz Larrea

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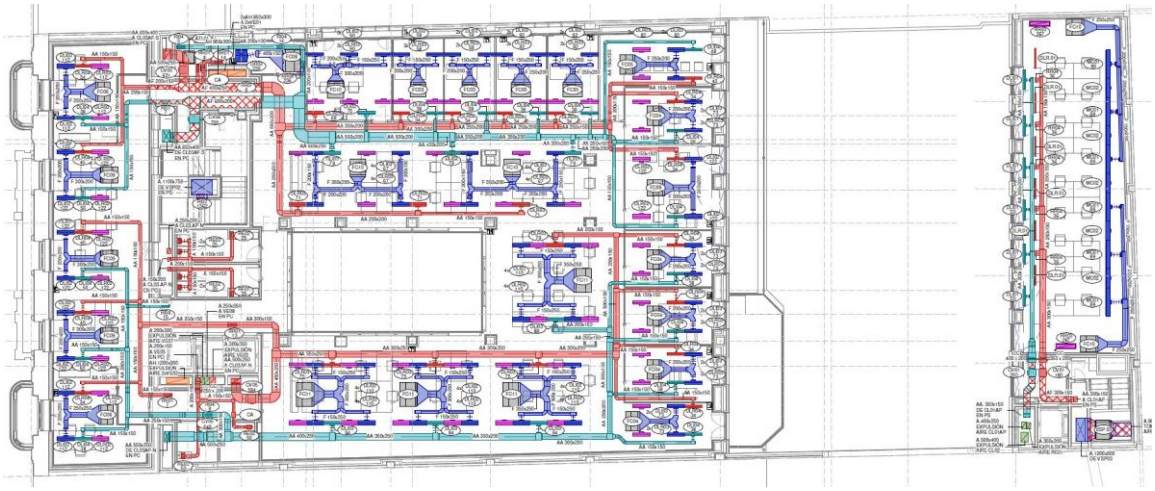
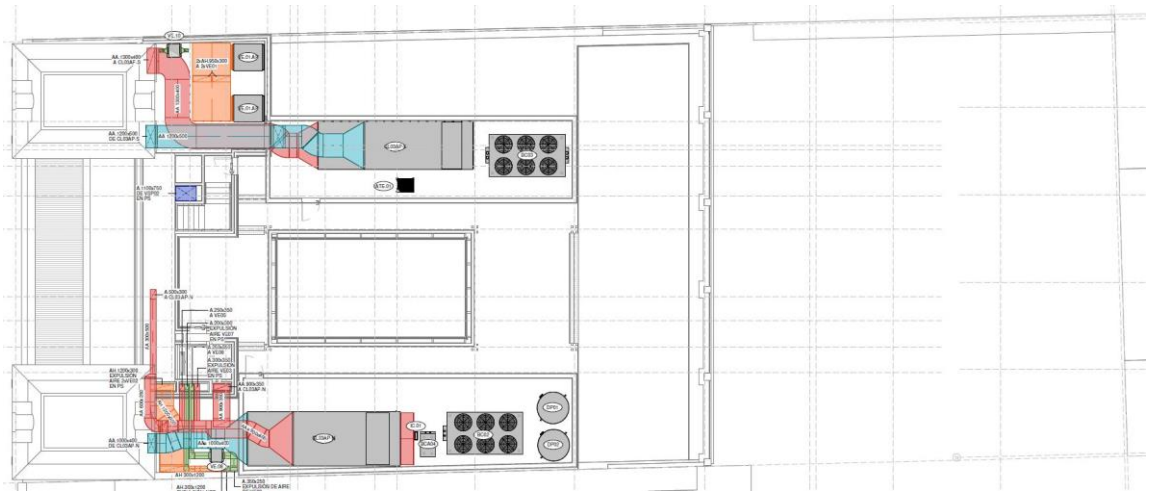
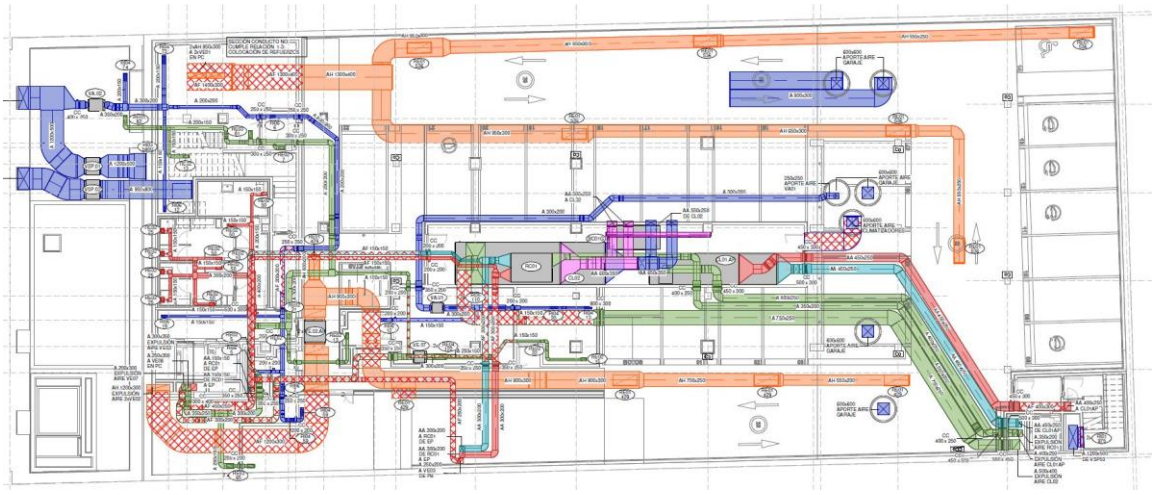
Renovation Approach Description



Ventilation and heating/cooling system. Example floor @ Ruiz Larrea



Ventilation and heating/cooling system. Roof floor @ Ruiz Larrea



Ventilation and heating/cooling system. Basement floor @ Ruiz Larrea

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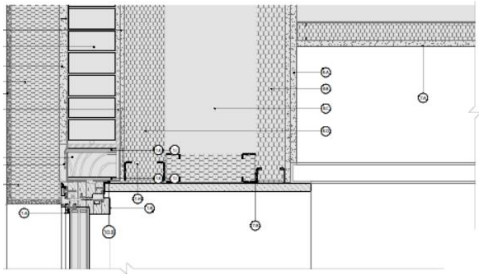
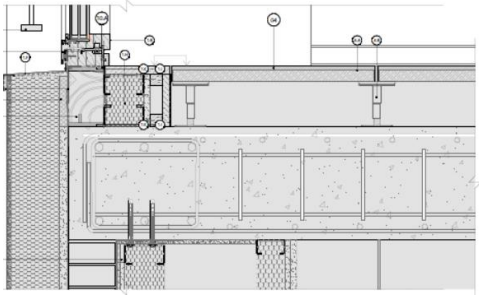
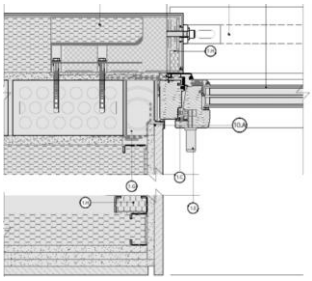
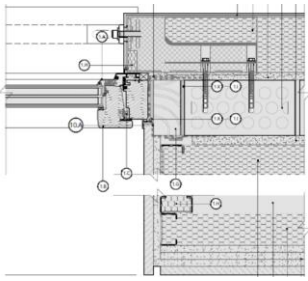
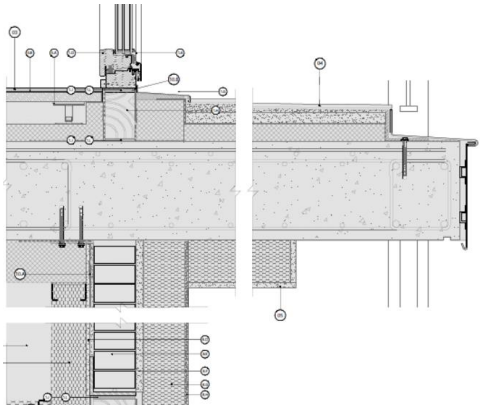
Renovation Approach Description

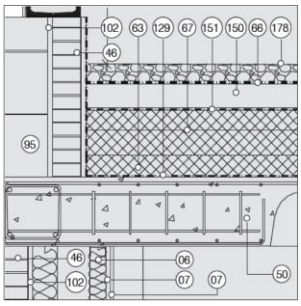


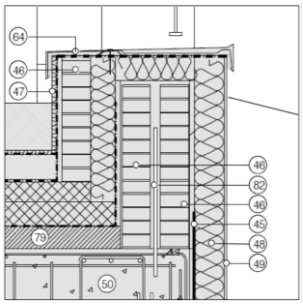


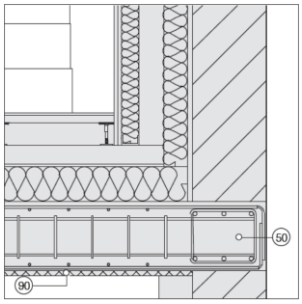


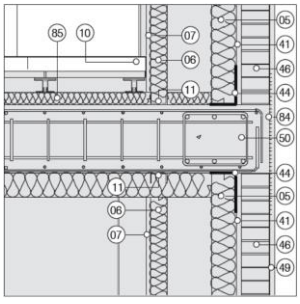












Details @ Ruiz Larrea

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Renovation Approach Description

Protected historical façade @ VAND arquitectura

Different kind of existing ceilings @ VAND arquitectura

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Renovation Approach Description

Exterior wall-interior ceiling connection. Existing situation @ VAND arquitectura

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Renovation Approach Description

Airtight implementation @ VAND arquitectura

3.5. Envelope of the renovated building

External walls 1

Material:	Protected historical brick façade with interior insulation
Thickness:	93 [cm]
Surface (Render / Brick / Cladding):	Plaster
U-Value:	0.298 [W/(m²K)]

External walls 2

Material:	ETICS façade with mineral wool and interior air chamber + insulation
Thickness:	72 [cm]
Surface (Render / Brick / Cladding):	Plaster
U-Value:	0.214 [W/(m²K)]

Basement ceiling

Material:	Composite slab with XPS insulation
Thickness:	39 [cm]
Surface (Render / Brick / Cladding):	Suspended ceiling
U-Value:	0.223 [W/(m²K)]

Roof / Top floor ceiling

Material:	Concrete floor with XPS insulation
Thickness:	55 [cm]
Surface (Render / Brick / Cladding):	gravel
U-Value:	0.186 [W/(m²K)]

Windows

Material:	PH certificated frame + triple glazing
Thickness:	12[cm]
Material (Wood / Plastic / Aluminium):	Wood
U-Value (Uw, installed):	Uf 0.93 [W/(m²K)]
	Ug 0.51-0,61 [W/(m²K)]
	Uw 0.82 [W/(m²K)]

3.6. Technical equipment of the renovated building

Ventilation

Ventilation concept	AHU unit for ventilation and heating/cooling system, one for each building
Ventilation heat recovery efficiency	85 %
Ventilation specific efficiency	0.45 [Wh/m³]
Ventilation standard air flow rate	0.43 [m³/h]
Add short description if required	-

Heating, Cooling and DHW

Heating:	AHU unit for ventilation and heating/cooling system, one for each building. This system will be used for areas like the interior courtyard. Additionally, the offices and work areas will be heated via fan coils and underfloor heating supplied by geothermal energy.
Cooling:	The same system than heating.
Domestic hot water:	Heat pump for domestic hot water production

3.7. Summer comfort

To improve summer comfort the following solutions have been implemented:

- Roller shutters to ensure temporary summer shading in windows, when users require it
- Optimized domestic hot water system: well insulated pipelines, low distribution temperatures
- Energy efficient appliances within the building
- Heat recovery bypass and higher ventilation rate in summer
- Active cooling: underfloor cooling and an additional fan coils.

3.8. Energy efficiency of the renovated building

Main Building

Passive House Planning Package (PHPP)

PHPP calculation:	PHPP_10.4
Space heating demand:	1 [kWh/(m²a)]

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Renovation Approach Description

Heating Load:	4 [W/m²]
Overheating frequency:	- %
Cooling demand:	15 [kWh/(m²a)]
Cooling Load:	- [W/m²]
Primary Energy Demand:	72 [kWh/(m²a)]
PER Demand:	41 [kWh/(m²a)]
Generation of renewable energy	- [kWh/(m²a)]
Airtightness n50 target:	1.0 1/h

Final Energy demand

Final energy demand electricity:	36 [kWh/(m²a)]

Second Building

Passive House Planning Package (PHPP)

PHPP calculation:	PHPP_10.4
Space heating demand:	13 [kWh/(m²a)]
Heating Load:	8 [W/m²]
Overheating frequency:	- %
Cooling demand:	11 [kWh/(m²a)]
Cooling Load:	- [W/m²]
Primary Energy Demand:	97 [kWh/(m²a)]
PER Demand:	58 [kWh/(m²a)]
Generation of renewable energy	- [kWh/(m²a)]
Airtightness n50 target:	1.0 1/h

Final Energy demand

Final energy demand electricity:	59 [kWh/(m²a)]

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PHPP verification sheet after retrofit

Valores específicos del edificio con referencia a la superficie de referencia energética						Criterio	Criterios alternativos	¿Cumplido?[2]
	Superficie de referencia energética	m²	3231,5					
Calefacción	Demanda de calefacción	kWh/(m²a)	1	≤		20	-	Sí
	Carga de calefacción	W/m²	4	≤		-	-	
Refrigeración	Demanda refrigeración & deshum.	kWh/(m²a)	15	≤		15		Sí
	Frecuencia de sobrecalentamiento (> 25 °C)	%	-	≤		-		-
	Frecuencia excesivamente alta humedad (> 12 g/kg)	%	0	≤		10		Sí
Hermeticidad	Resultado ensayo de presión n50	1/h	1	≤		1,0		Sí
Protección contra la humedad								
	Factor de temperatura más bajo $f_{Rsi=0.25\ m^2K/W}$	-	1	≥		1,00	1,00	Sí
Confort térmico	¿Requisitos cumplidos?	-						Sí
	Valor-U	W/(m²K)		≤		1,43		
	Valor-U	W/(m²K)		≤		1,70		
	Valor-U	W/(m²K)		≤		1,86		
	Valor-U	W/(m²K)		≤		0,78		
Energía Primaria no renovable (EP)	Demanda EP	kWh/(m²a)	72	≤		100		Sí
Energía Primaria Renovable (PER)	Demanda PER	kWh/(m²a)	41	≤		-	-	-
	Generación ER (en relación al área huella proyectada)	kWh/(m²a)	-	≥		-	-	

Main building

Valores específicos del edificio con referencia a la superficie de referencia energética						Criterio	Criterios alternativos	¿Cumplido?[2]
	Superficie de referencia energética	m²	317,3					
Calefacción	Demanda de calefacción	kWh/(m²a)	13	≤		20	-	Sí
	Carga de calefacción	W/m²	8	≤		-	-	
Refrigeración	Demanda refrigeración & deshum.	kWh/(m²a)	11	≤		15		Sí
	Frecuencia de sobrecalentamiento (> 25 °C)	%	-	≤		-		-
	Frecuencia excesivamente alta humedad (> 12 g/kg)	%	0	≤		10		Sí
Hermeticidad	Resultado ensayo de presión n50	1/h	1	≤		1,0		Sí
Protección contra la humedad								
	Factor de temperatura más bajo $f_{Rsi=0.25\ m^2K/W}$	-	1	≥		0,32	0,14	Sí
Confort térmico	¿Requisitos cumplidos?	-						Sí
	Valor-U	W/(m²K)		≤		1,43		
	Valor-U	W/(m²K)		≤		1,70		
	Valor-U	W/(m²K)		≤		1,86		
	Valor-U	W/(m²K)		≤		0,78		
Energía Primaria no renovable (EP)	Demanda EP	kWh/(m²a)	97	≤		100		Sí
Energía Primaria Renovable (PER)	Demanda PER	kWh/(m²a)	58	≤		-	-	-
	Generación ER (en relación al área huella proyectada)	kWh/(m²a)	0	≥		-	-	

Second building

PHPP @ Velmar ingenieros

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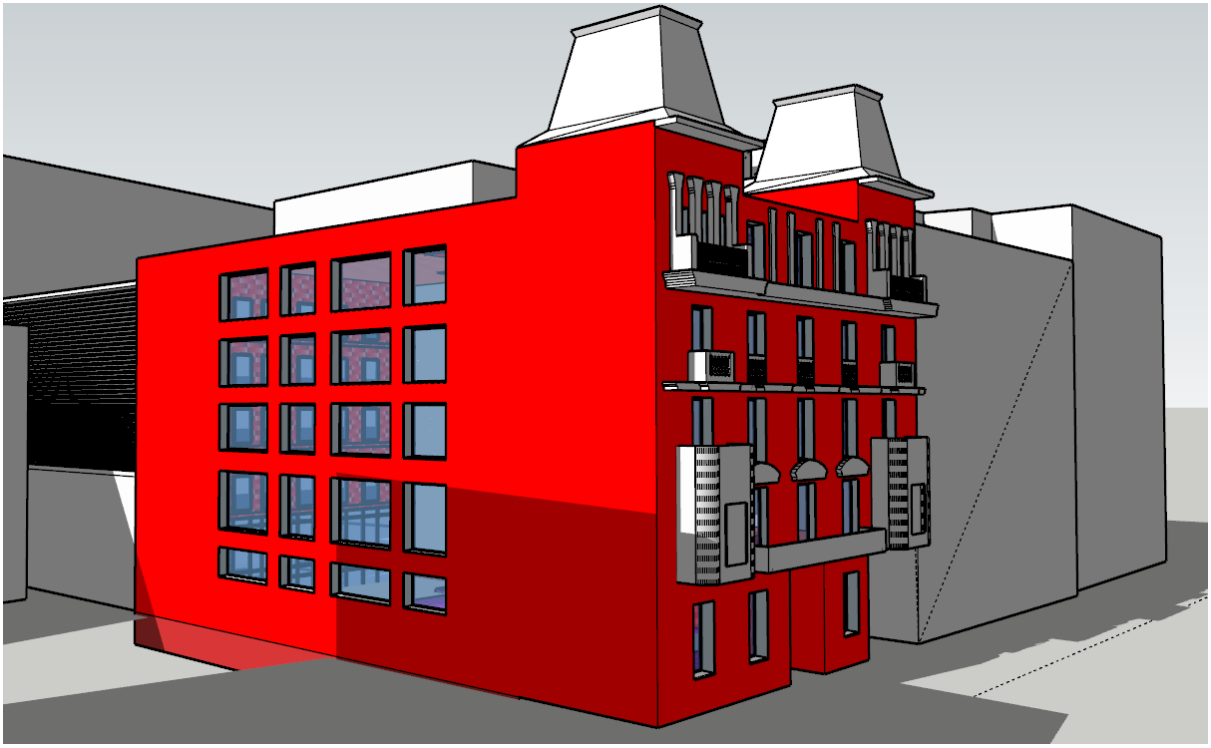

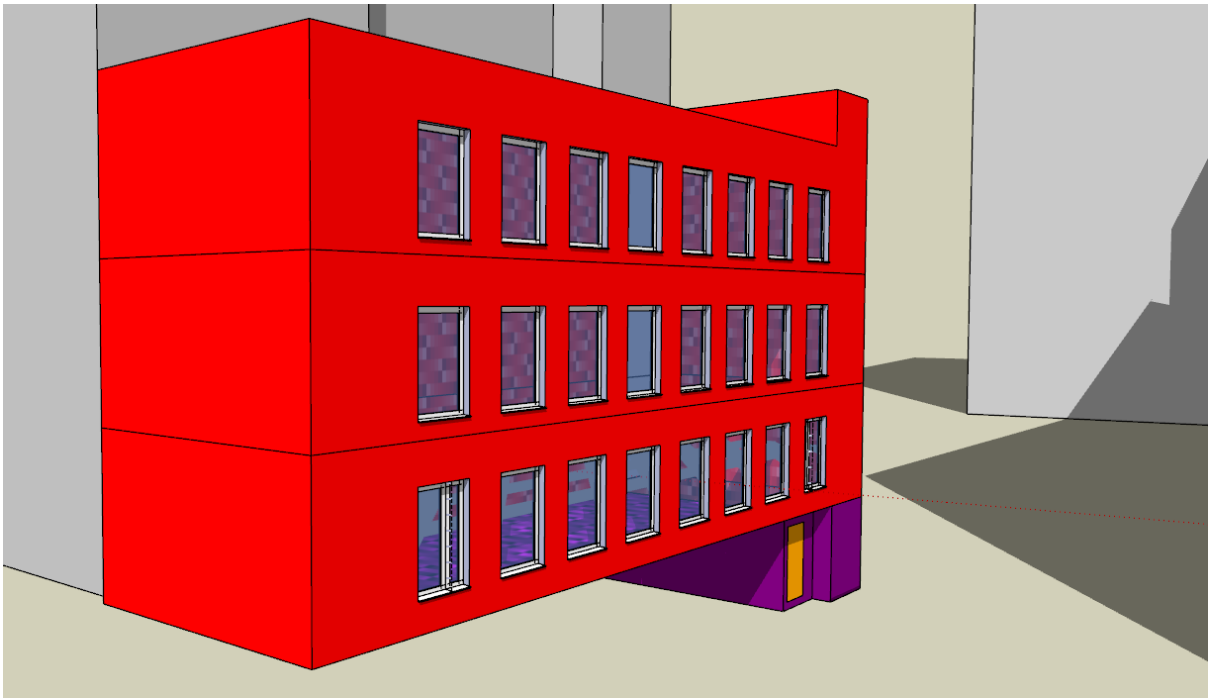

Design PH model @ Velmar ingenieros

3.9. RES strategy

There are not renewable energy systems in this project.

4. Project challenges and opportunities

The main challenges in this project are the connections of an airtight layer with the old historic buildings. There are plenty of different ceilings, wall constructions and slab layers, that make really hard to have a continuous layer, see schemes.

Another challenge is the additional weight of new installations like electric devices, fan coils etc fixed to old mixed slab constructions with new airtightness layer.

Regarding ventilation units for this size of buildings, although there are certified Passive House units, they are quite expensive, so evaluations from PHI were asked to evaluate local, national units in order to achieve a better cost effectiveness.

5. Current project status

Building construction works will finish in October 2022. Enerphit certification is planned for November-December 2022.

Users will move into the new offices in January 2023.

6. Lessons learnt and guidelines for replication

Not available yet

7. Pre-Monitoring description (if applicable)

No pre-monitoring works have been done as the building was already unoccupied when the project began.