



D9.1 –Pilot Cases I-III: Preparation and set up



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T9.2 Pilot Cases II preparation and set up: Case of Elderly Home Facilities
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Executive Summary

This deliverable presents the activities carried out within WP9 of the AccessS project, dedicated to the preparation and set-up of the project demo sites, covering the period from M13 to M24, June 2025–May 2026.

The activities focus on the selected pilot cases across three different building categories: cultural heritage buildings, people care facilities, and public services buildings. The document provides a comprehensive overview of the pilot sites involved in the project, including their architectural and functional characteristics, building topology, envelope properties, technical systems, monitoring infrastructure, and deployment timelines. Particular attention is given to the preparatory actions required to support the future deployment and operation of the AccessS Suite under real conditions.

The deliverable describes the activities undertaken to assess building conditions, define pilot-specific use cases, identify accessibility and energy-related requirements, and prepare the technical infrastructure for the integration of sensors, meters, digital platforms, and monitoring systems. The document also outlines the approaches adopted for data collection, interoperability, API integration, and stakeholder coordination across the different pilot environments.

Special consideration is given to the specific constraints and characteristics of each pilot typology, including heritage preservation requirements in cultural heritage sites, user comfort and assisted living needs in people care facilities, and operational and energy management aspects in public service buildings.

In addition, the deliverable presents the business mapping activities associated with the pilot sites, including the identification of key target groups, business scenarios, and use cases that support the validation and future exploitation of the AccessS Suite functionalities.

Overall, the deliverable establishes the technical and operational basis for the subsequent deployment, demonstration, monitoring, and evaluation activities foreseen in the following phases of the project (WP10, WP11, WP12).

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List of Acronyms and Abbreviations

Term	Description
AD	Assessment Dimension
ADRef	AccesS Disabilities Reference
AI	Artificial Intelligence
API	Application Programming Interface
BEPS	Building Energy Performance Simulation
BIM	Building Information Model
BOMS	Building Operation and Management System
CO ₂	Carbon Dioxide
D	Deliverable
DoA	Description of Action
DSE	Decision Support Engine
DT	Disability Type
EC	Evaluation Criteria
ECT	Energy Comfortness Tool
ECM	Energy Conservation Measures
EESDT	Energy Efficient & Sustainable Design Tool
EI	Expected Impact
EO	Expected Outcome
GUI	Graphical User Interface

IAQ	Indoor Air Quality
IDS	Information Delivery Specification
IFC	Industry Foundation Classes
IoT	Internet of Things
KPI	Key Performance Indicator
ML	Machine Learning
PMV	Predicted Mean Vote
PPD	Predicted Percentage of Dissatisfied
SRI	Smart Readiness Indicator
UCD	User-Centered Design
UI	User Interface
VOC	Volatile Organic Compounds
VHs	Virtual Humans
VUMRef	Virtual User Model Reference
VUMs	Virtual User Models
WP	Work Package
W/m ² K	Watt per square meter Kelvin

1 Introduction

1.1 Scope and objectives of the deliverable

This deliverable, D9.1 – “Pilot Cases I-III: Preparation and Set-up”, aims to describe the preparatory activities carried out for the implementation of the AccesS solutions across the selected pilot sites.

The main objective is to translate the conceptual framework defined in earlier project phases into practical deployment actions, ensuring that all pilot environments are adequately prepared for the installation and operation of the AccesS Suite. This includes the assessment of building conditions, identification of technical requirements, installation planning for monitoring systems, and alignment with site-specific constraints, particularly in culturally sensitive environments.

Furthermore, the deliverable provides a detailed overview of the characteristics of each pilot case, including building topology, envelope, and equipment, as well as the deployment timeline. These elements are essential to guarantee a smooth transition towards the implementation and demonstration phases foreseen in subsequent Work Packages (WP10, WP11, WP12).

The deliverable also contributes to ensuring consistency across pilot sites, enabling comparability of results and supporting the evaluation activities that will follow.

1.2 Structure of the deliverable

This deliverable is structured to provide a comprehensive overview of the preparation and setup activities for the AccesS pilot sites, organised across different building typologies.

Section 1 introduces the document, outlining its scope, objectives, structure, and its relation to other project tasks and deliverables.

Section 2 presents the first group of pilot cases, focusing on cultural heritage buildings. It includes the Christo and Jeanne-Claude Center in Gabrovo (Bulgaria) and the Brancacci Chapel in Florence (Italy), describing for each site the building topology, envelope characteristics, available equipment, and the deployment timeline.

Section 3 describes the second group of pilot cases, related to people care facilities. This section covers the Droom je Thuis Foundation in Naaldwijk (Netherlands) and Casa Girasole in Massagno (Switzerland), following the same structured approach adopted for the previous section.

Section 4 focuses on public services buildings, presenting the pilot cases of Palazzo di Città in Bari (Italy) and Mercado de Veronicas in Murcia (Spain), following the same structured approach adopted for the previous section.

Section 5 provides an overview of the AccesS business mapping activities, including the identification of key target groups and the definition of business scenarios and use cases mapped across the pilot sites.

Section 6 presents the main conclusions, highlighting different elements and information relevant to the pilot preparation phase.

1.3 Relation to Other Tasks and Deliverables

This deliverable builds upon the outcomes of D1.2, where the pilot sites were initially analysed in terms of their current conditions, user needs, and use case scenarios.

In particular, D9.1 translates the conceptual and technical framework defined in D1.2 into concrete preparatory and set-up activities required for the deployment of the AccesS Suite. Additionally, this

deliverable is closely linked with the activities carried out in WP9, which focus on ensuring the readiness of pilot sites through infrastructure assessment, stakeholder coordination, and installation planning.

WP9 plays a central and integrative role within the project, acting as a bridge between the technological developments and their real-world application in pilot environments. In this context, WP9 both benefits from and contributes to several technical work packages.

In particular, WP9 is closely connected with WP2, from which it inherits user-centered requirements and inclusive design principles that guide the preparation of pilot sites. At the same time, real-world constraints and feedback from WP9 support the validation and refinement of these approaches.

A strong interaction is also established with WP4, WP5, WP6, and WP7, which provide the core technological components of the AccesS Suite, including energy efficiency tools, simulation environments, adaptive building management systems, and accessibility assessment tools. WP9 ensures that these solutions are properly integrated, deployed, and tested within the pilot sites, while also providing feedback on their applicability in real conditions.

Furthermore, WP9 contributes to WP14/ WP15 activities by enabling communication, dissemination, and exploitation actions based on real pilot implementations and demonstrators.

The results of D9.1 will directly support the implementation and demonstration activities in WP10, WP11, and WP12, where the AccesS Suite will be deployed and tested under real conditions.

Moreover, it is linked with the evaluation framework developed in WP1, setting the foundations for the necessary real-world context and data for performance assessment and validation of the project outcomes.

2 AccesS Pilot Cases I: Case of Cultural Heritage Buildings

2.1 The Christo and Jeanne-Claude Center, Gabrovo, Bulgaria



Figure 1. Christo and Jeanne-Claude Center Building

The pilot Christo and Jeanne-Claude Center, representing a cultural heritage building currently in a pre-renovation phase, focuses on enabling the application of the AccesS Suite in a non-operational building context, where digital tools are used to support early-stage decision-making and scenario evaluation prior to physical intervention as part of the planned renovation. The objective is to assess how accessibility, energy performance, and user comfort can be integrated into the redesign of a public cultural space.

The activities include baseline building assessment, identification of accessibility gaps, definition of use cases, and preparation of requirements for the future deployment or conceptual integration of monitoring systems and digital tools. Special attention is given to inclusive design principles, addressing the needs of diverse user groups, including people with disabilities, elderly users, and visitors.

The pilot contributes to the validation of methodologies for applying AccesS tools in cultural heritage buildings undergoing transformation, supporting evidence-based planning processes. In this context, a scenario-based approach is considered in order to explore different renovation strategies, including both standard regulatory requirements and higher-performance solutions aligned with European best practices. This supports the evaluation of alternative levels of ambition in terms of energy performance, indoor comfort and building quality. Real renovation is planned outside the scope of the AccesS project and is being prepared through an ongoing investment process, including an architectural competition, design development and subsequent construction phases. The architectural brief for the Christo and Jeanne-Claude Center has been completed and an international architectural competition has been launched for the transformation of the former Textile Technical School. More information can be found here: <https://competition.cjcenter.gabrovo.bg/en/>.

2.1.1 Building Topology

The Christo and Jeanne-Claude Center is located in a former textile school building in Gabrovo, Bulgaria. The building has not been in continuous use for more than a decade, with only occasional cultural events taking place in recent years. The structure consists of multiple floors with large open spaces, corridors, and functional rooms originally designed for educational purposes. Its layout allows for flexible reconfiguration into a multifunctional cultural and creative space.

In recent years, the building has been partially activated through temporary cultural events, serving as a testing ground for future uses and user engagement. Due to its current condition, the building represents a suitable case for testing planning-oriented and simulation-based functionalities of the Access Suite. The pilot aligns with New European Bauhaus principles, addressing inclusiveness, sustainability and aesthetic quality in the transformation of the building.

The building consists of two parts, a main and a secondary that are connected by a transitional corridor (warm connection). The main building consists of:

- A ground floor and 3 above floors, each with a gross floor area of 2,200 m²/floor and a clear height of 4.5 m (structural height 5.3 m);
- A basement with a gross floor area of 2,485 m². and a clear height of 3.45 m (structural height 3.6 m).

During the extension and reconstruction carried out in 1965–66, the two parts were rigidly connected without a separation joint between them. The main load-bearing structural elements are reinforced (concrete slabs, beams, and columns). The vertical load-bearing elements, including walls and columns, are supported by individual and strip concrete foundations. The building's roof is flat.

A distinctive characteristic of the building and its structure is the construction of double floors, designed to allow installations to pass through the production areas. In the area of the passage to the connecting corridor ("warm connection"), intermediate levels were constructed, with the storey height divided into 2 × 2.65 m. The secondary building consists of:

- A ground floor with 3 above, each with a gross floor area of 398 m²/floor and a clear height of 3.65 m (structural height 3.8 m);
- A basement with a gross floor area of 209 m² and a clear height of 2.35 m (structural height 2.5 m).

The section is divided by expansion joints into three separate structural subsections. The first two were put into operation in 1970, and the third was commissioned in 1972. The structure is a skeletal-beam system, executed in monolithic construction. The main load-bearing structural elements are reinforced concrete slabs, beams, and columns. The vertical load-bearing elements, including walls and columns, are supported by individual and strip concrete foundations. The building's roof is flat.

The existing connecting corridor ("warm connection") building is two floors high, with a service corridor for installations beneath it. The structural height of both levels is 3.40 m. The roof of the section is flat. The warm connection was commissioned in 1970. The structure is a skeletal-beam system, executed in monolithic construction. The main load-bearing structural elements are reinforced concrete slabs, beams, and columns. The vertical load-bearing elements, including walls and columns, are supported by individual and strip concrete foundations.

Over the years of operation, no reconstructions or modifications were made to the main load-bearing structure, except for routine repairs within the building.

The building was designed and executed in compliance with the regulations in force at the time of its design and construction.

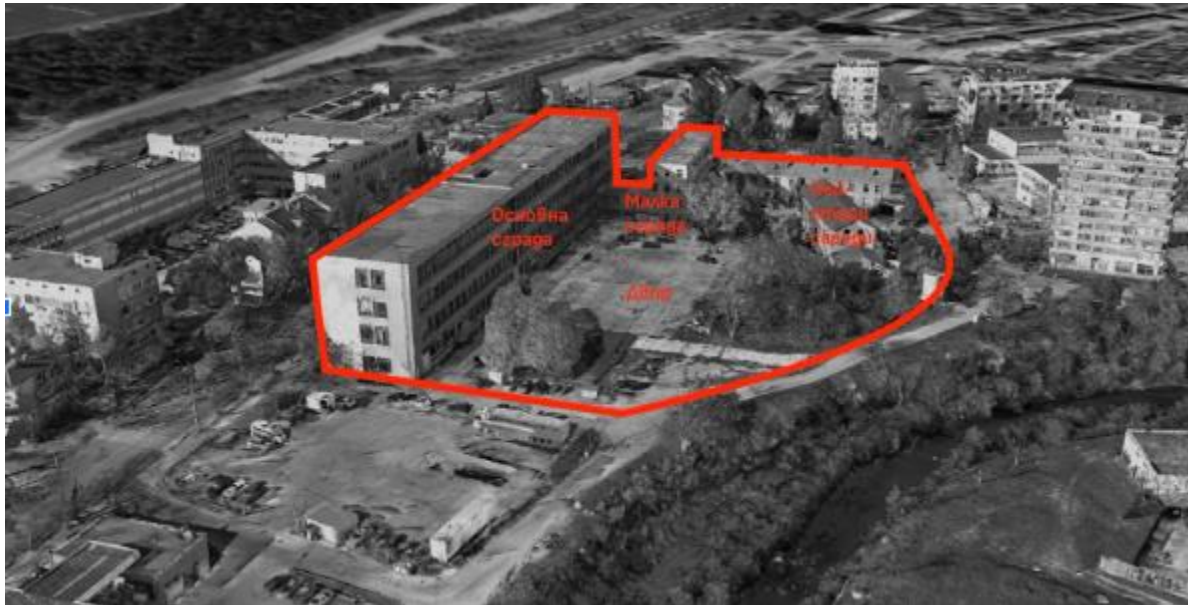


Figure 2. General overview of Christo and Jeanne-Claude Center Building

The following figure provides the ground floor plan of the building, outlining its architectural layout and spatial organization.

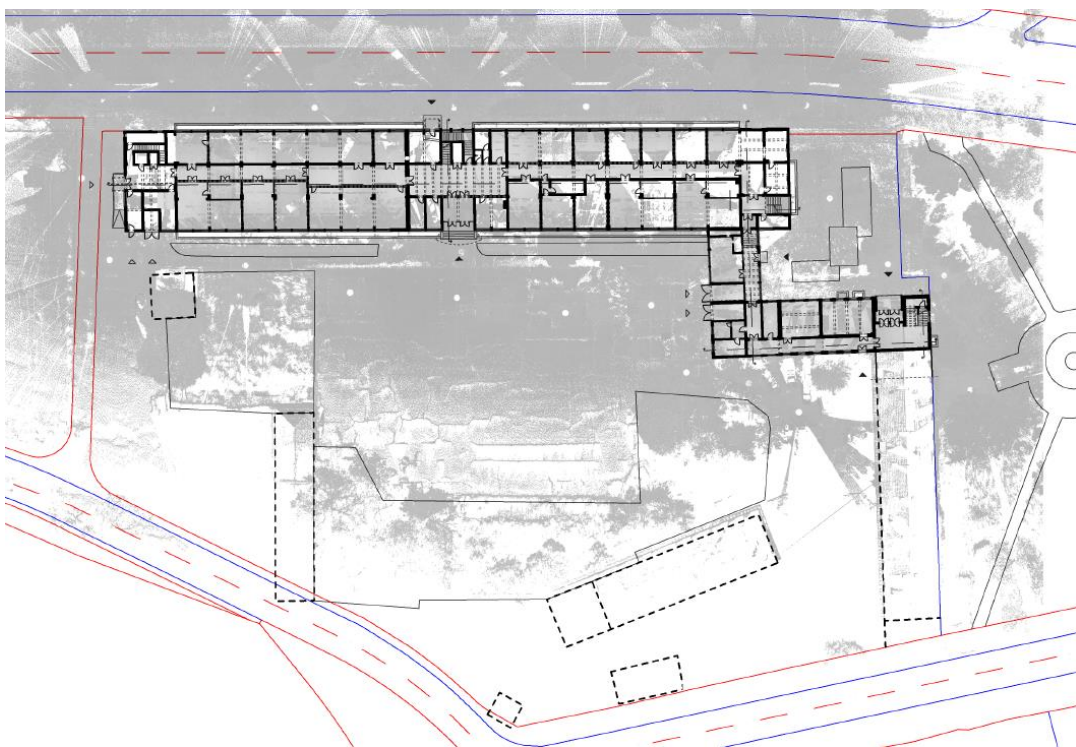


Figure 3. Ground floor plan of Christo and Jeanne-Claude Center

A digital Building Information Modeling (BIM) model was developed. The model was generated based on the building's Industry Foundation Classes (IFC) file, providing a structured and interoperable representation that includes both geometric elements and key building information.



Figure 4. 3D BIM model representation of Christo and Jeanne-Claude Center

In its current state no specific information are available regarding the materials and thermal properties, the uses of the spaces or the heating/cooling/ventilation systems. The Christo and Jeanne-Claude Center is part of an architectural competition. Thus, it will follow the developed architectural and technical plans proposed.

For the development of the BIM model, baseline assumptions and renovation scenarios were defined to support the needs of the project. Theoretical u values and systems, and the suggested space uses from the competition as listed below:

- Dedicated to art production: workshops for metal, wood, casts, ceramics and glass, textile, prints, photo and video, media lab for AR/VR, fab lab;
- Dedicated to knowledge production and collaboration: book library, material library for fabrics, institute for public art, art school, coworking area;
- Public areas dedicated to exhibitions and events: spaces for permanent, temporary exhibitions and events;
- Hospitality: café, gift shop, wardrobe;
- Artist studios and residential area for visiting artists;
- Storage and technical spaces;
- Offices.

Table 1. Spaces Topology

Space Name	OccupiableType		Conditioned	Number of Occupants
art production	Yes	Semi-public, production oriented	Yes	10-20 (per day)
knowledge production and collaboration	Yes	public	Yes	50-100 (per day)
exhibitions and events	Yes	public	Yes	500 (per day)
hospitality	Yes	public	Yes	500 (per day)
artist studios and residential area	Yes	private	Yes	10 – 20 (per day)
storage and technical spaces	No	private	Yes	none
offices	Yes	private	Yes	30 – 50 (per day)

2.1.2 Building Envelope

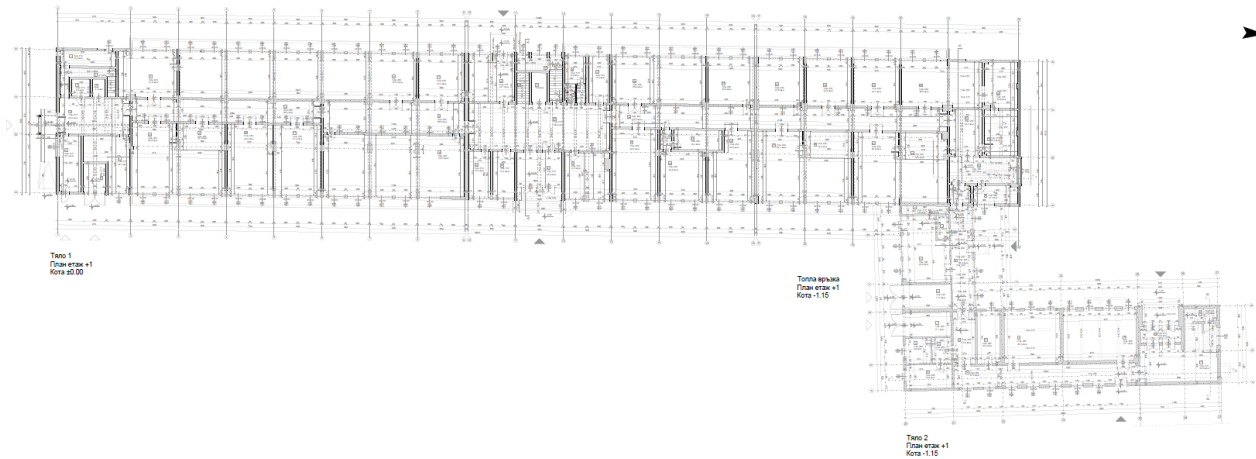


Figure 5. Ground Floor

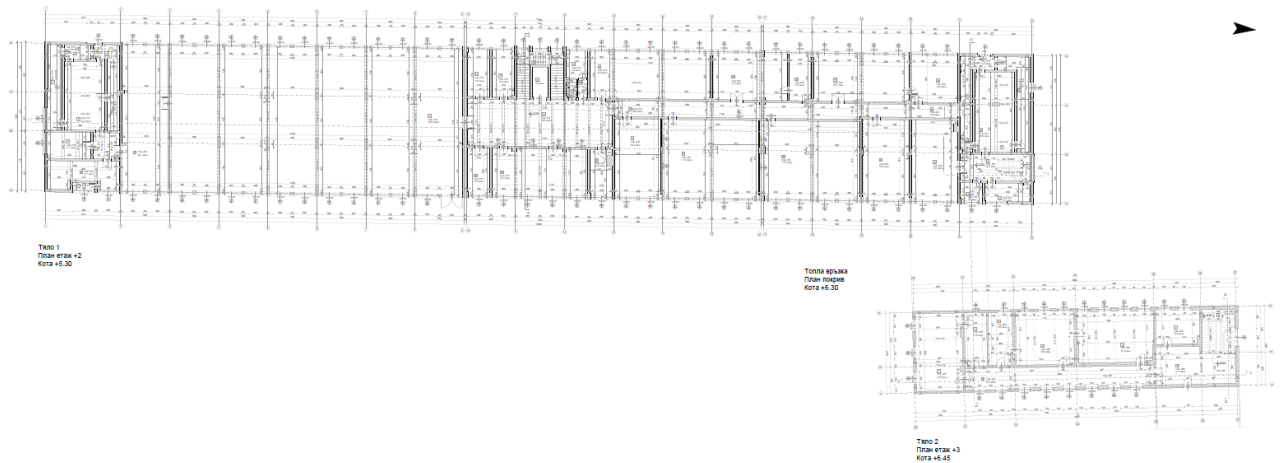


Figure 6. First Floor

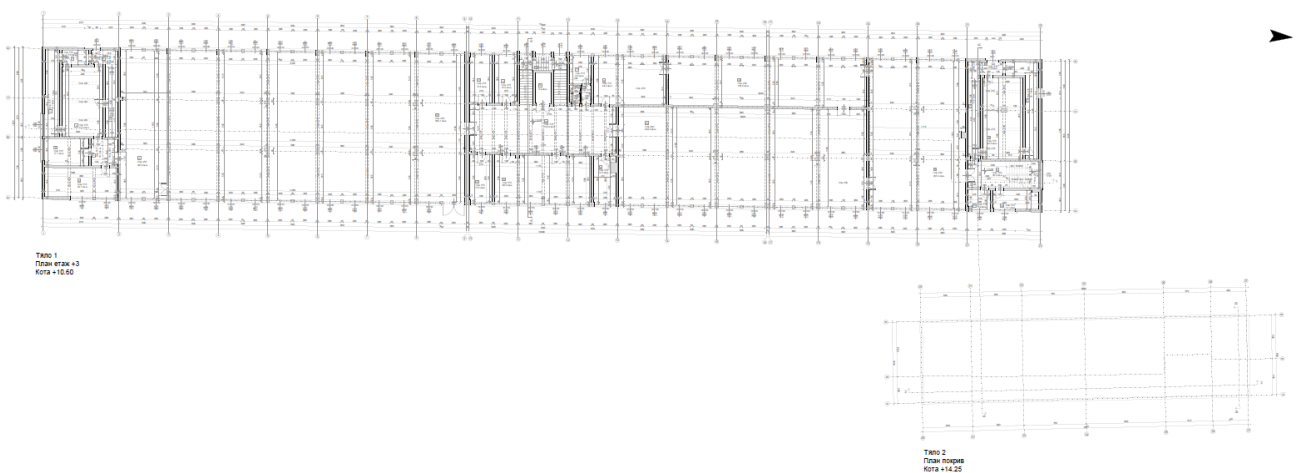


Figure 7. Second Floor

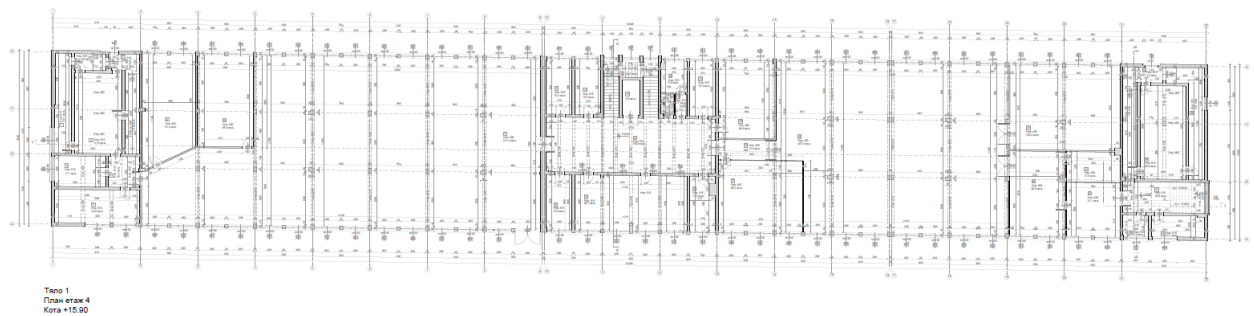


Figure 8. Third Floor

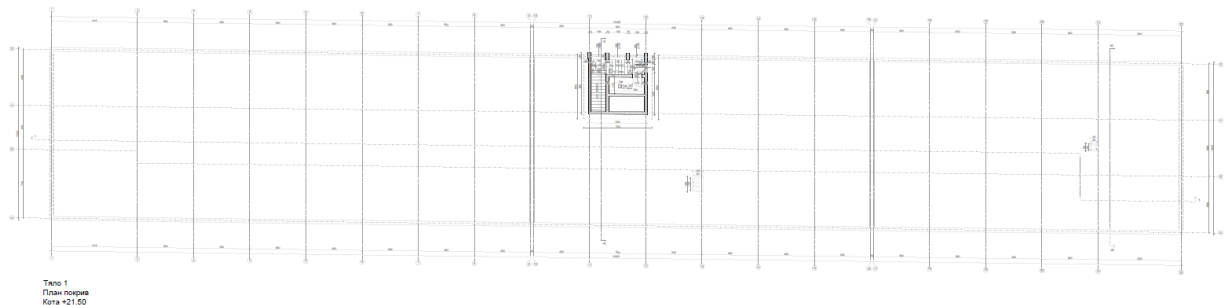


Figure 9. Rooftop

2.1.2.1 Vertical Walls

The building features solid masonry external walls typical for mid-20th century public buildings. Thermal performance is limited and requires upgrading.

The external walls are expected to be improved aiming to achieve a target thermal transmittance of **$U = 0.026 \text{ W/m}^2\text{K}$** , significantly enhancing insulation performance and reducing heat losses through the building façade.

In the scenarios and BIM models created for the project, the values used for the thermal transmittance are:

- The target $u=0.026 \text{ W/m}^2\text{K}$;
- The construction year $u=1.67 \text{ W/m}^2\text{K}$;
- The Passive house standard for renovation $u=0.15 \text{ W/m}^2\text{K}$.

2.1.2.2 Roof

The roof structure is in need of technical assessment, particularly in relation to thermal insulation and potential integration of renewable energy systems.

The roof will be upgraded aiming to reach a thermal transmittance of **$U = 0.025 \text{ W/m}^2\text{K}$** , minimizing heat gains and losses and contributing to better overall thermal regulation of the building.

In the scenarios and BIM models created for the project, the values used for the thermal transmittance are:

- The target $u=0.025 \text{ W/m}^2\text{K}$;

- The construction year $u=1.28 \text{ W/m}^2\text{K}$;
- The Passive house standard for renovation $u=0.15 \text{ W/m}^2\text{K}$.

2.1.2.3 Windows

Existing window systems are outdated and do not meet current standards for energy efficiency or accessibility.

The windows will be replaced or upgraded aiming to achieve a **U-value of $1.1 \text{ W/m}^2\text{K}$** , improving airtightness and thermal performance while reducing energy losses and enhancing indoor comfort.

In the scenarios and BIM models created for the project, the values used for the thermal transmittance are:

- The target $u=1.1 \text{ W/m}^2\text{K}$;
- The construction year $u=2.66 \text{ W/m}^2\text{K}$;
- The Passive house standard for renovation $u=0.85 \text{ W/m}^2\text{K}$.

2.1.3 Building Equipment

The building is currently not equipped with active or integrated technical systems. Existing installations are either obsolete or not operational.

The existing building systems have been decommissioned and are no longer in operation. All systems, including electrical, HVAC, plumbing, and fire protection, will be completely replaced as part of the renovation.

Although the specific solutions will be determined through an architectural competition, it is expected that the new building systems will incorporate high-efficiency technologies, including ventilation with heat recovery, energy-efficient lighting, and modern HVAC and plumbing systems. All systems will be designed to achieve high performance, reliability, and energy efficiency, fully complying with current national and international standards. This approach will ensure optimal indoor comfort, reduced operational energy consumption, and long-term sustainability of the building.

Within the scope of the AccessS project, the pilot focuses on assessing current conditions and identifying requirements for future system configurations in relation to accessibility, energy performance and user comfort that could support the architectural competition, design development and subsequent construction phases.

2.1.3.1 Sensors

The building is not currently equipped with any operational sensing infrastructure, and no sensors will be installed during the project period due to its non-operational and under-renovation status.

Instead, the pilot addresses the potential role of IoT-based monitoring systems at a conceptual level, supporting future building operation and decision-making processes. Relevant parameters are considered as design requirements rather than active measurements:

- **Temperature, Humidity and CO₂:** Indoor environmental quality is identified as a key design and performance target for future systems;
- **Luminance:** Lighting conditions are addressed in relation to accessibility, usability, and occupant comfort requirements;
- **Weather data:** External environmental conditions are considered through available external/local data sources and modelling assumptions.

2.1.3.2 Meters

No metering infrastructure is currently available, and no systems will be installed during the project implementation phase.

Energy metering and monitoring are therefore addressed at a requirements level. The pilot considers future deployment needs for energy consumption tracking and performance evaluation systems, based on best practices and lessons learned from comparable pilots within the AccessS framework.

2.1.3.3 Systems

Heating and Domestic Hot Water

No operational systems are currently in place. Heating and domestic hot water solutions will be defined during the renovation design phase. Within the AccessS project, potential configurations are assessed through simulation-based scenarios.

Cooling

No cooling systems are installed. Cooling demand and possible solutions are evaluated through scenario-based analysis, supporting future design decisions.

Ventilation

Natural ventilation is currently the only available mechanism. Its role is considered in relation to indoor environmental quality requirements and future mechanical ventilation strategies with heat recovery.

Lighting

Only basic, non-optimised lighting infrastructure exists in the current state. Lighting requirements are considered in relation to accessibility, usability, and energy efficiency targets for the renovated building.

Photovoltaic installation

No photovoltaic systems are currently installed. Their potential integration is considered at conceptual level through scenario analysis and reference design approaches.

Solar Thermal collector

Not currently available and not included in the current pilot scope for implementation, though it may be considered in future design alternatives.

Building (Energy) Management | Automation and Control System

No building management or automation systems are currently implemented.

Within the AccessS framework, the pilot explores potential digital tools for monitoring, simulation, and decision support at a conceptual level. The focus is on defining functional requirements and identifying best practices from other pilots, rather than implementing on-site systems during the renovation phase.

2.1.4 Deployment Timeline

The deployment of the Gabrovo pilot followed a structured approach aligned with the specific characteristics of a pre-renovation building.

The initial stage focuses on baseline assessment activities, including the analysis of the building's current condition, identification of accessibility and usability gaps, and engagement with relevant local stakeholders.

This is followed by the definition of pilot-specific use cases, aligned with the functionalities of the AccessS Suite, with particular emphasis on accessibility, user comfort, and energy performance.

Subsequently, analytical approaches are used to support the evaluation of potential interventions, including the comparison of alternative renovation strategies with different performance levels in terms of energy efficiency and indoor comfort.

The architectural competition was launched in early May 2026, followed by design development later in 2026 and planned renovation works in 2027–2028.

Due to the pre-renovation status of the building, the pilot focuses on assessment, analysis and validation of approaches rather than physical installation or real-time operation, while remaining aligned with the ongoing parallel renovation process.

2.2 The Brancacci Chapel, Florence, Italy



Figure 10. Brancacci Chapel

The Brancacci Chapel, located within the Church of Santa Maria del Carmine in Florence, is renowned for its exceptional frescoes by Masaccio, Masolino, and Filippino Lippi, marking a pivotal moment in Early Renaissance art. After a two-year diagnostic and restoration project, the chapel reopened to the public on May 2024. Founded in 1268 by Carmelite friars from Pisa, the Church of Santa Maria del Carmine was constructed with contributions from the municipality and prominent Florentine families. The church was consecrated in 1422, with construction completing in 1475. Notably, the facade remains unfinished, showcasing a raw stone and brick exterior. The Chapel is situated within the boundaries of the UNESCO area and operates as a civic museum, owned by the Municipality of Florence.

2.2.1 Building Topology

The Brancacci Chapel is part of the Church of Santa Maria del Carmine in Florence and represents a cultural heritage site of high historical and artistic value. The chapel is located in the right transept of the church and adjacent to the cloister and to the room used as ticket office and entrance to the civic museum.

The building in the UNESCO area impose strict constraints on spatial modifications and interventions. The rest of museum spaces as ticket office, the great cloister and other rooms for visitors is located around the chapel, in the religious complex of Carmelite convent next to the church.

The entrance to the civic museum is from Piazza del Carmine 14. Through a corridor, the visitor comes into the cloister of the church of Santa Maria del Carmine, in which a door leads to the ticket office, an heated area. In the ticket office there are stairs, also equipped for users with mobility disabilities. Up the stairs, visitors enter a corridor that leads to the right transept of the church via a ramp designed for users with mobility disabilities. The area of the right transept includes the seating for the civic museum and three chapels. The Brancacci Chapel is the central one. Visitors come inside the civic museum in groups of 20. At the end of the visit, by using elevator or stairs, they return to the church cloister. Crossing it again, they exit into Piazza del Carmine.

The building layout includes controlled access points, internal pathways for visitors, and limited spatial flexibility due to heritage preservation constraints. The site is equipped with accessibility features such as elevators, controlled visitor flows and small-group visits.

Table 2. Spaces Analysis

Space Name	Occupiable	Type	Conditioned	Number Of Occupants
Cloister	Yes	Cloister	No	25
Ticket Office	Yes	Ticket Office	Yes	4
Chapel	Yes	Chapel	No	25

Zone	Spaces
Office	Ticket Office
Museum	Cloister, Chapel

2.2.2 Building Envelope

As part of the historical Santa Maria del Carmine complex, Brancacci Chapel has all its faces (walls, floors, and roofs) that are in contact with the internal environment of the church and the convent around. The structure of the building consists of ancient thick walls composed with stone, bricks and plaster. Unfortunately, detailed material specifications are not available.

The upper vault of the chapel is in contact with another ambient at the third floor of the convent. So, the Chapel is never in direct contact with an external area because even the central wall with the window is adjacent to a room with a staircase covered from the outside with a transparent roof.

The building envelope of the Brancacci Chapel is subject to strict conservation constraints due to its historical and artistic heritage. Walls and roof are not insulated; in fact, any intervention must comply with heritage protection regulations, according with the Superintendence.

Environmental conditions within the chapel play a critical role in the preservation of the frescoes.

Because of its historical construction, Brancacci Chapel has all its faces (walls, floors, and roofs) that are in contact with the internal environment of the church and the convent around. Because of its ancient and fragile condition, faces and roof are not insulated but walls are really thick and composed with stone, bricks and plaster. Unfortunately, detailed material specifications are not available.

The upper vault of the chapel is in contact with another ambient at the third floor of the convent as you can see on the section drawing. So, the Chapel is never in direct contact with an external area because even the central wall with the window is adjacent to a room with a staircase covered from the outside with a transparent roof.

Being an historical site, Brancacci Chapel has no heat and no conditioned air differently from the ticket office where workers need a heating system of two fan coil units used during winter season.

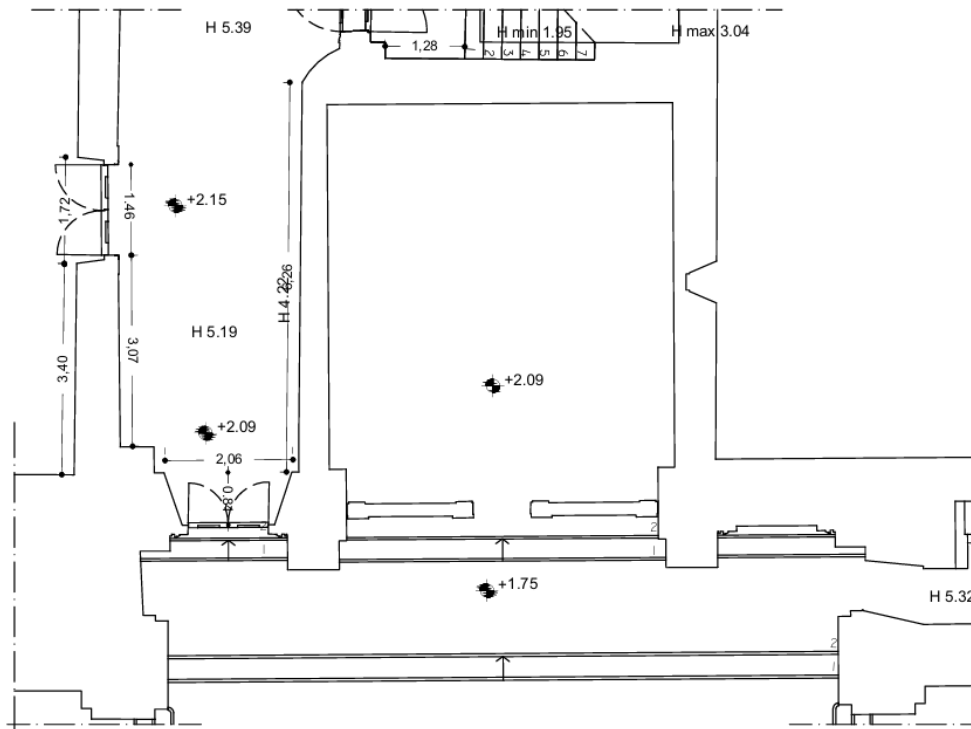


Figure 11. Floor plan of Brancacci Chapel

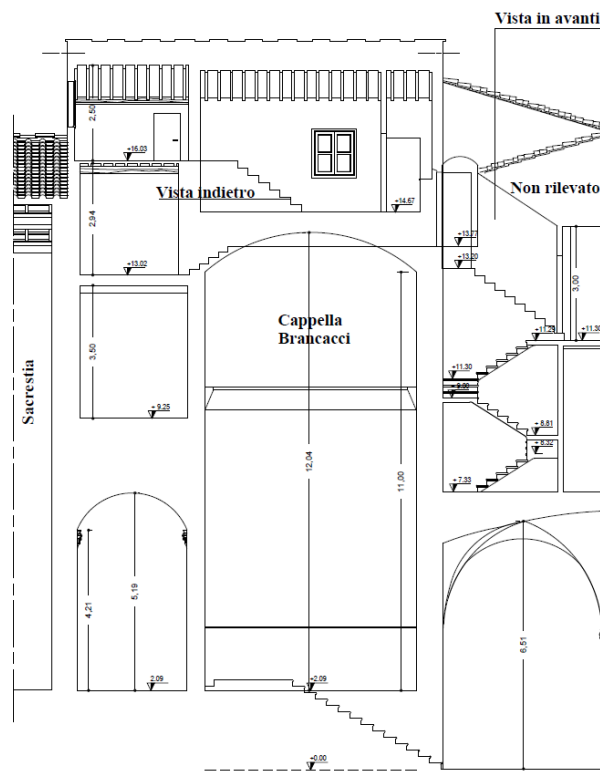


Figure 12. Section of the Chapel

2.2.2.1 Vertical Walls

The building's vertical envelope consists of external walls with varying thicknesses due to its existing construction characteristics. The chapel is a space with three walls and a big entrance through an archway from the transept of the church. Their height reach to 12 meters high.

The following table summarises the main wall typology, including their general composition and thermal properties.

Table 3. Walls Details

Walls				
Name	Thickness	Use	U-value	Materials (Exterior->Interior)
Walls	50-72 cm	External	-	Plaster, bricks, stones, plaster

2.2.2.2 Roof

Both Brancacci Chapel and all other museum spaces have not a roof in contact with the outside because Carmelite convent has a second floor with rooms of the religious community. Most of museum spaces are historical room with cross vaults in raw bricks or plaster finishing. The vault of the chapel is realized in the XVII century while the cycle of frescoes are more ancient, realized around 1424-1428 and 1480-1485 A.D.

Table 4. Roofs Details

Roofs			
Name	Thickness	U-value	Materials (Above->Below)
Roof	80 cm	-	bricks, wood

The following tables present the main characteristics of the building's floors. They include information about dimensions, construction types, materials, and thermal properties where available.

Table 5. Floors Details

Floors		
Name	Use	Materials (Above->Below)
Chapel Floor	Basement	Plaster, bricks, concrete, marble

2.2.2.3 Windows

The chapel hosts a single window of XVII century in the central wall. Window looks out into inner yard with staircase and it is made of single glass and iron.

The following table lists the characteristics of the window.

Table 6. Windows Details

Windows		
Name	Construction Type	Material
Window toward close yard	Single glass panel	Iron and panel with glass

Additionally the following table lists the characteristics of all the doors present in the church of Santa Maria del Carmine. The chapel doesn't host any doors, but is open to the rest of the spaces through an arched opening.

Table 7. Doors Details

Doors		
Name	Construction Type	Material
Ticket Office External Door 1450x3000	Double glass door	Iron with double glass panel
Fist Door on the way to the Chapel 930x2100	Single door	Wooden
Second Door on the way to the Chapel 1290x3000	Double door	Wooden and leather
Third Door on the way to the Chapel 1290x3000	Double door	Wooden, historical

2.2.3 Building Equipment

The only systems present are located at the ticket office: one fan coil unit for heating at the ticket counter entrance. For cooling demand, a portable fan is placed at the ticket counter when needed.

The Brancacci Chapel was not previously equipped with advanced monitoring and management systems relevant to the objectives of the AccesS project. As part of the pilot site preparation and set-up activities, a comprehensive set of technologies has been newly deployed to support data-driven accessibility and conservation strategies.

The equipment installed within the AccesS framework includes:

- Sensors for temperature, humidity, CO₂, and VOCs;
- A new lighting system;
- New camera systems;
- Sensors for people counting.

These monitoring systems provide essential data for both accessibility management and the preservation of the site. To support this system, we have integrated latest-generation infrared people-counting sensors, capable of detecting entrances, exits, and attendance in real time, even in the fresco area. These devices guarantee maximum precision and complete privacy, as they do not record images or personal data.

This infrastructure allows us to scientifically correlate visitor presence with changes in environmental parameters. All data is collected and displayed on an interactive digital platform, accessible to conservation managers, who can continuously monitor the situation and make decisions based on concrete evidence. This approach allows to:

- Assess access restrictions at critical times;
- Optimize air conditioning systems;
- Plan preventative maintenance.

2.2.3.1 Sensors

As part of the AccesS project, the Civic Museum has been equipped with systems for environmental monitoring and visitor flow analysis. The monitored spaces within the Brancacci Chapel are organized to reflect the main functional and architectural areas of the chapel. They include the entrance and exit points (PC Ingresso and PC Uscita), areas near the windows (AQ Finestra and TS Affresco Finestra), and the central altar zone (AQ Altare and TS Affresco Altare). Together, these spaces allow detailed

observation of different microclimates inside the chapel, especially around the frescoes and the altar, where environmental conditions such as air quality and temperature are particularly important for preservation. Each space is equipped with a dedicated sensor, providing localized monitoring across all seven areas of the building.

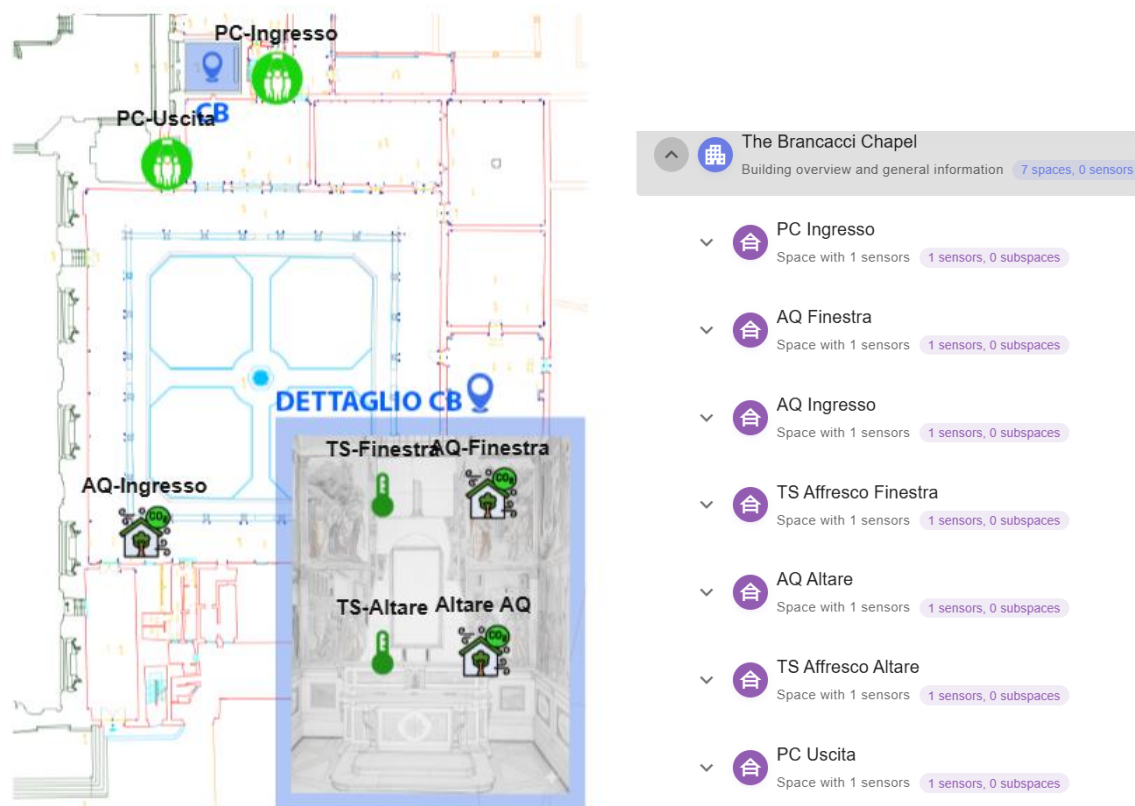


Figure 13. Data collection platform interface showing the position of the sensors installed



Figure 14. Location of higher sensors next to the window



Figure 15. Installation of higher sensors next to the window



Figure 16. Counting people sensor installation

Temperature, Humidity and CO₂

Ambient temperature: Constantly monitored to prevent temperature fluctuations that could damage the frescoes.

Contact temperature: Using industrial sensors positioned directly on the frescoes' surfaces, we accurately detect temperature variations affecting the works.

Relative humidity: A crucial parameter for the stability of materials, monitored to prevent condensation or excessive dryness.

CO₂: A direct indicator of human presence, useful for correlating visitor traffic with environmental changes.

Luminance

Natural lighting of Brancacci Chapel is provided by the only ancient window with glazed glass that filtered most of natural light from the outside.

In the rest of Santa Maria del Carmine church lighting is provided by ancient system of chandeliers hung to the vault of transepts and central nave.

2.2.3.2 Meters

The civic museum of the Brancacci Chapel currently lacks systems for monitoring or measuring energy consumption separately. This is because the Santa Maria del Carmine complex hosts various entities: the convent and the rooms adjacent to the Brancacci Chapel are used by both the religious order of the Carmelite friars and the lay community. Since the electrical system is shared by the entire complex, including the church, it is currently not possible to monitor the energy consumption of the museum spaces and the chapel separately from the rest of the building.

2.2.3.3 Systems

Heating and Domestic Hot Water

Being an historical site, Brancacci Chapel has no heating system. Ticket office instead, where workers stay for more hours than visitors, has a heating system of one fan coil units used during winter season.

Cooling

Ticket office is equipped with an electrical system for heating and lighting. The type of heat generation and supply is a fan coil units system. One fan coil unit is installed on the wall on the left of the entrance.

During summer season the ticket office has a portable air conditioner for cooling demand.

Brancacci Chapel, as part of Santa Maria del Carmine church, has no cooling system because of heritage protection regulations.

Lighting

The previous lighting of frescoes in Brancacci Chapel consisted of an old metal pendant system, positioned in the middle of the chapel's entrance arch, installed in 2002.

The system housed eight E27 LED lamps, 2700K, and a CRI of 80. The lamps all had fixed, wide-beam optics and lack a light-emitting diode (CRI) control system.

Visually, the dimensions of the pendant system appeared overwhelming and incongruous with the context in which it was installed. Optically, the type of light sources used did not allow for constant illumination levels on the frescoes.

The use of wide-beam optics and the lack of a dimming system made it difficult to aim the light at the frescoes or the central wooden altarpiece. This resulted in numerous reflections on the central altarpiece, making it impossible to focus the light on specific portions of the frescoes, thus creating a visual hierarchy within the space.

Through measurements taken using a lux meter, the illumination levels on the fresco cycle were particularly low, especially in the lower quadrants, where they are around 20 lux.

The low illumination levels, combined with the low color rendering index (CRI) and color temperature of 2700K, resulted in an unfaithful rendering of the frescoes' colors, as well as poor visibility of the details.

New lighting system

The lighting fixtures included in the new lighting system are all equipped with LED sources and offer a degree of protection appropriate to their location.

The choice of fixtures was dictated by a series of key requirements: the ratio between the size of the fixture and its luminous flux, the optical system used, and a high color-rendering index (CRI).

The LED technology used for all the fixtures in the project guarantees particularly favorable performance.

The following are some of its features:

- High efficiency = high light output (Lumens/Watt);
- Long life;
- No UV or IR radiation;
- Very compact dimensions;
- High color rendering index (CRI);
- No environmentally hazardous materials (such as mercury);
- Instant on, i.e. 100% luminous flux at once;
- No start-up, warm-up, or cool-down times;
- Precise digital dimming, no color shifts;

In this case, luminaires with 4° Narrow Spot, 16° Spot, and 29° Flood optics have been used, together with dedicated accessories such as snoots and cross baffles, in order to reduce glare and uncontrolled light spill.

Specific color temperatures were selected based on the surfaces to be illuminated.

A color temperature of 3500K will be used to illuminate the fresco cycle on the walls and the vault. This color temperature was chosen following a field comparison of fixtures with different color temperatures and through a comparative selection of the spectral diagrams of the lighting fixtures.

It was found that this color temperature, combined with a particularly high color rendering index, guaranteed the best color rendering of the frescoes, given their color range.

All fixtures have a high color rendering index (CRI), in order to allow the most faithful possible vision of the colors of the works and the illuminated surfaces.

The following table provides the main information, broken down by device type:

Lighting fixtures	CRI	Optic	P[W]	Color temperature
Lamp 1	92	4°	4,5	3000K
Lamp 2	92	16°	15,4	3500K
Lamp 3	92	29°	15,4	3500K

Energy Saving

One of the key aspects of the project is energy saving. This objective is achieved through the adoption of three factors:

- Lumen/watt efficiency of the latest-generation LED lighting fixtures, which allows for significant energy savings compared to the existing system.
- Efficient optics and reduced light dispersion towards unwanted areas.
- Efficient home automation system with Casambi protocol, which allows for the adjustment of lighting intensity on a specific basis or by sector.

Lighting fixtures	P[W]	Number of fixtures	Total P[W]
Lamp 1	4,5	2	9
Lamp 2	15,4	14	215,6
Lamp 3	15,4	4	61,6
Total absorption			286,2



Figure 17. Lighting tests to find out correct Kelvin measurement

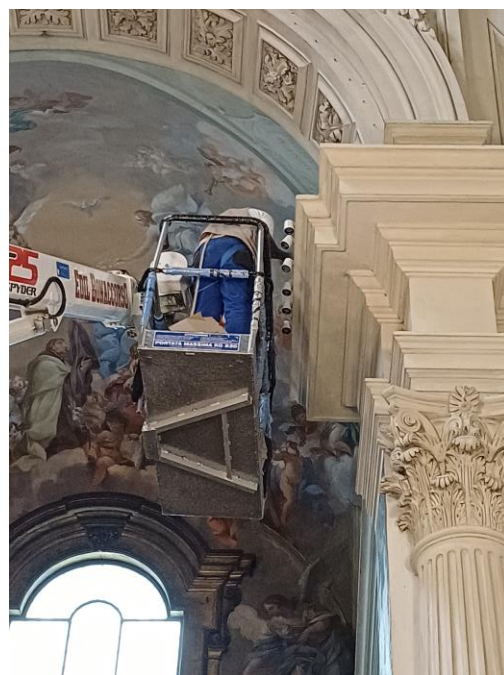


Figure 18. New lighting system installation



Figure 19. New lights of Brancacci Chapel

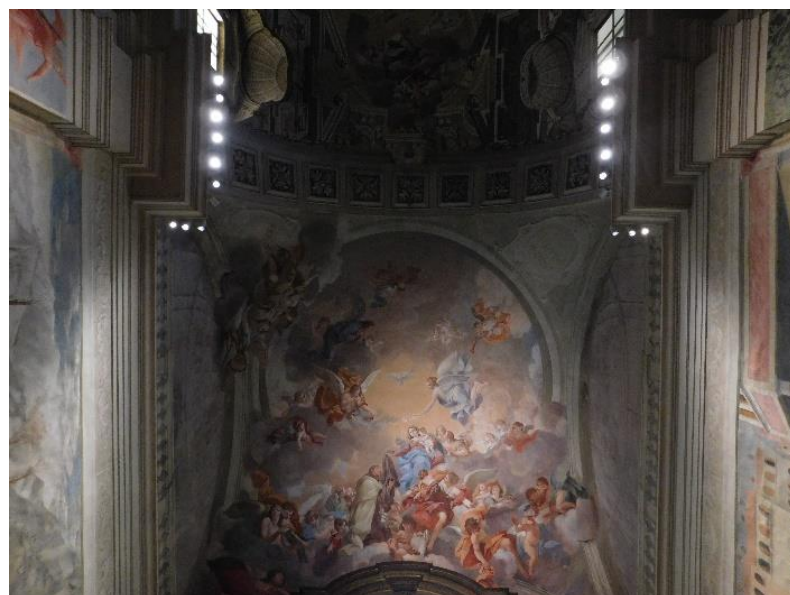


Figure 20. New ceiling lighting system of the Brancacci Chapel

2.2.4 Deployment Timeline

The deployment of the AccesS solutions at the Brancacci Chapel followed a phased approach. Initially, the preparation phase focused on the assessment of the existing infrastructure, data availability, and integration requirements. This phase was supported by on-site inspections, coordination with heritage authorities, and the definition of sensor placement and technical specifications.

The subcontracting agreement with the National Research Council (CNR) for technical support in the design and deployment of the sensor network was finalised in June 2025 (M13). The sensor network design was then defined between June and July 2025 (M13–M14).

The administrative procedures required for the installation of the sensor system were carried out between August and September 2025 (M15–M16), leading to the first phase of sensor installation in

October 2025 (M17). Following this initial deployment, further refinements to the sensor design were planned in October 2025 (M17) in order to improve the accuracy of the data provided by the camera.

A second phase was subsequently undertaken, including additional administrative procedures between November 2025 and March 2026 (M18–M22), resulting in the completion of the sensor network installation in April 2026 (M23). The APIs of the sensors installed in the first phase were made available to project partners in February 2026 (M21), while the APIs of the camera were made available in May 2026 (M24).

In parallel, the deployment of the new lighting system followed a coordinated timeline. On-site surveys and lighting tests were carried out between July and August 2025 (M14–M15). The related administrative procedures were completed in August and September 2025 (M15–M16), leading to the installation of the new lighting system in October 2025 (M17), concurrently with the first phase of sensor installation.

Regarding the replacement of the seating in the transept area, the evaluation of ergonomic seating solutions started in October 2025 (M17). In March 2026 (M22), ergonomic assessment activities were conducted using the ErgoFlow Evaluation Tool, part of the AccesS Suite and developed by CETEM that led to the procurement of new seating elements (M24) that will be installed during summer 2026.

This phased approach ensured the progressive deployment, validation, and optimisation of the AccesS solutions under real operating conditions.

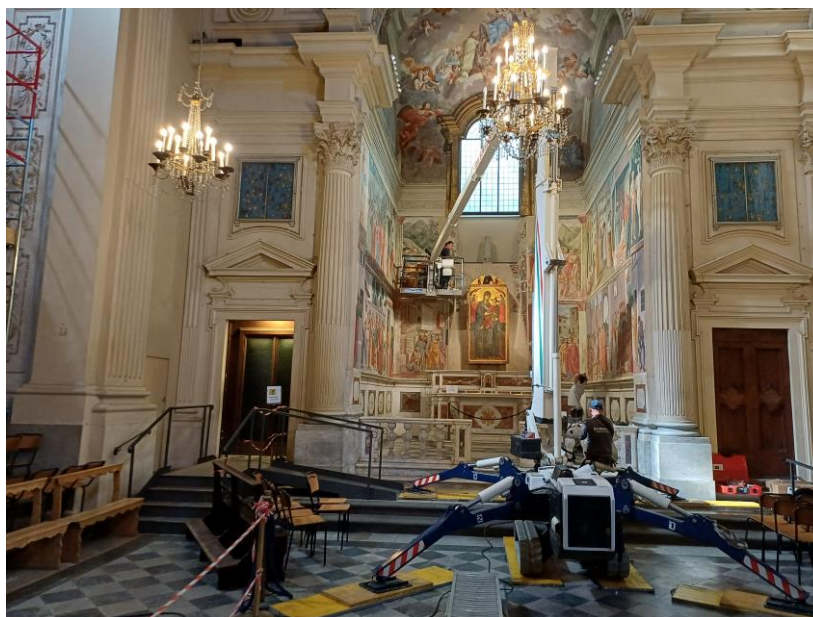


Figure 21. Mobile elevating work platform used for installation

3 AccesS Pilot Cases II: Case of People Care Facilities

3.1 Droom je Thuis Foundation, Naaldwijk, Netherlands

Droom je Thuis, located in Naaldwijk, the Netherlands, was founded by parents of 12 children with disabilities and represents a so-called parent initiative. The foundation aims to provide people with multiple or intellectual disabilities with a safe, supportive, and homely environment where warmth, comfort, and a sense of belonging can be experienced.

The residents require 24-hour care, meaning that professional care and supervision are continuously available during the day, while a sleep-in shift is present during the night to ensure safety and immediate response if needed.



Figure 22. Droom je Thuis Foundation

3.1.1 Building Topology

The building consists of 12 individual apartments, each with a private bathroom, bedroom, and kitchenette, with an average floor area of approximately 40 m². In addition, the building includes two communal living rooms, a shared kitchen, and an office space for staff.

Supporting facilities include a laundry room and an outdoor area suitable for parking and charging (mainly electric) mobility devices and vehicles. The central space on the ground floor can also be used for community-oriented activities involving residents and visitors.

The building is equipped with an accessibility system that enables residents with disabilities to independently access their apartments and communal spaces, thereby promoting autonomy and reducing reliance on staff assistance.

3.1.2 Building Envelope

The building envelope is designed with durability and energy performance in mind. All façades are constructed with brick masonry, combined with plastic (PVC) window frames and double-glazed, low-emissivity (Low-E) windows filled with argon gas.

The structural floors and roof are made of reinforced concrete. Load-bearing walls consist of calcium silicate (lime-sand) bricks. Thermal insulation is primarily achieved using PIR (polyisocyanurate) insulation materials.

The overall thermal resistance of the building envelope is:

- $R_c \geq 4.5 \text{ m}^2\text{K/W}$ for façades;
- $R_c \geq 6.0 \text{ m}^2\text{K/W}$ for the roof.

These values are in line with modern Dutch building standards for energy-efficient residential facilities.

3.1.2.1 Vertical Walls

The load-bearing vertical walls are constructed from calcium silicate (lime-sand) bricks, providing structural stability and good acoustic performance. Non-load-bearing internal partition walls are made of plasterboard systems, allowing flexibility in layout and ease of installation for building services.

3.1.2.2 Roof

The roof structure consists of wide slab reinforced concrete floors. Building service installations, including electrical conduits and ventilation ducts, are integrated on top of these slabs.

Above the structural layer, PIR insulation is applied, finished with a bituminous roofing system to ensure waterproofing. The roof also accommodates technical installations, including ventilation units and individual heat pumps.

The roof insulation achieves a thermal resistance of $R_c \geq 6.0 \text{ m}^2\text{K/W}$, contributing significantly to the overall energy efficiency of the building.

3.1.2.3 Windows

The window frames are made of PVC and fitted with low-emissivity (Low-E) double glazing filled with argon gas. This configuration ensures good thermal insulation, reduced heat loss, and improved indoor comfort.

3.1.3 Building Equipment

The building has been designed with a strong focus on energy efficiency and operates entirely without natural gas (all-electric concept).

A photovoltaic (PV) system consisting of 45 panels (375 Wp each) is installed, resulting in a total installed capacity of approximately 16.9 kWp. The system uses Enphase IQ7 microinverters and is supported by two load meters for monitoring energy flows.

For heating, cooling, and domestic hot water production, the building is equipped with 14 individual Remeha Eria Tower 11 kW heat pump systems (one per apartment plus additional units for common areas such as the ground floor and sensory room).

The building includes a central air handling unit, the Ned Air EveryLine 4000, equipped with a UTP interface for integration into building systems. Additionally, an energy meter is installed at grid level.



Figure 23. Aerial view of Droom je Thuis Foundation, including rooftop technical installations and PV system

Underfloor heating is applied throughout the building and can also be used for low-temperature cooling. Fire detection and alarm systems are installed and can be monitored remotely. The building is further equipped with a data and Wi-Fi network.

Access control is managed via a Salto access control system, with strict data access procedures due to privacy considerations.

Lighting and window blinds are controlled through the ABB Free@Home system.

All monitored data, including PV production and smart home controls, can be accessed via APIs and/or WLAN connections.

Future plans for the building have been realized with the installation of an EV charging station in December 2025. A Zaptec Pro 22 kW charging point has been installed to support the charging of an electric vehicle, specifically a Mercedes eSprinter 56 kWh.



Figure 24. Zaptec Pro charging station for the Mercedes eSprinter at Droom je Thuis Foundation

This enables the building to further optimize its energy usage, including the potential to benefit from flexible energy tariffs and future smart charging strategies based on day-ahead electricity market pricing.

3.1.3.1 Sensors

Installed Hardware:

- Zaptec Pro 22 kW → installed in December 2025 for charging a Mercedes eSprinter 56 kWh; supports smart charging and load balancing. Accessible by an API;
- 6 × AirCheq Aero sensors → provide CO₂ levels, temperature, humidity, particulate matter, ultrafine particles, VOCs, and NOx. Accessible by an API;
- Embion Energy Management System → integrated monitoring and control platform for energy data. Accessible by an API.

The AirCheq Aero Sensors are installed on the following positions:

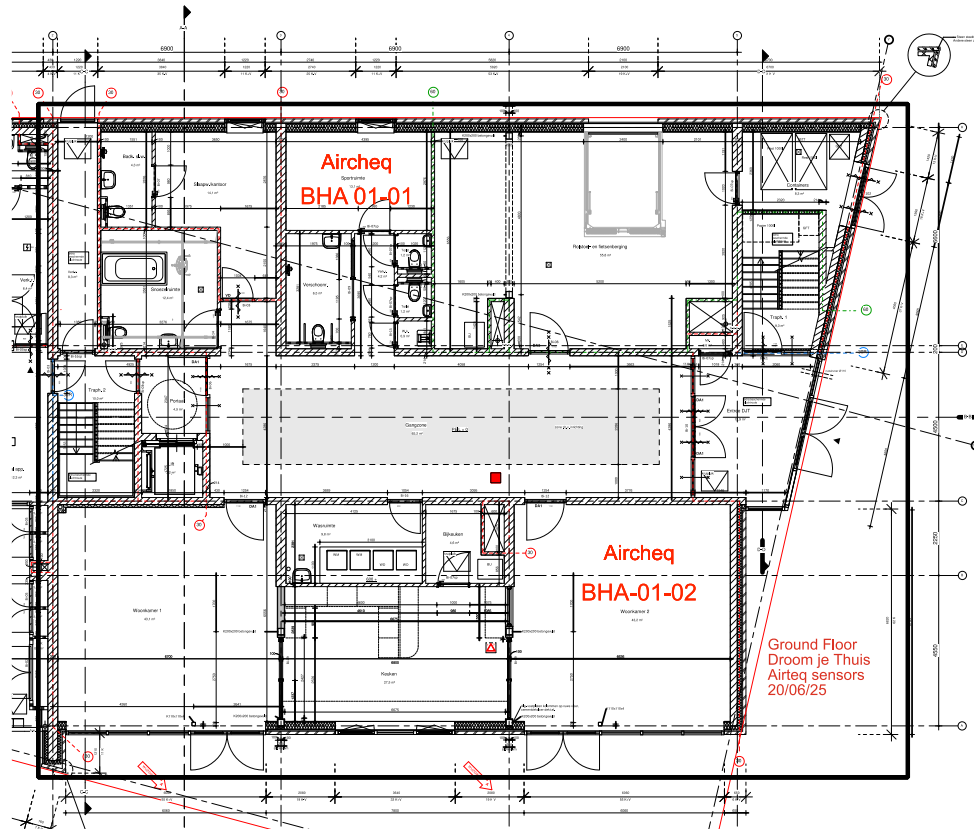


Figure 25. Droom je Thuis Foundation Ground Floor

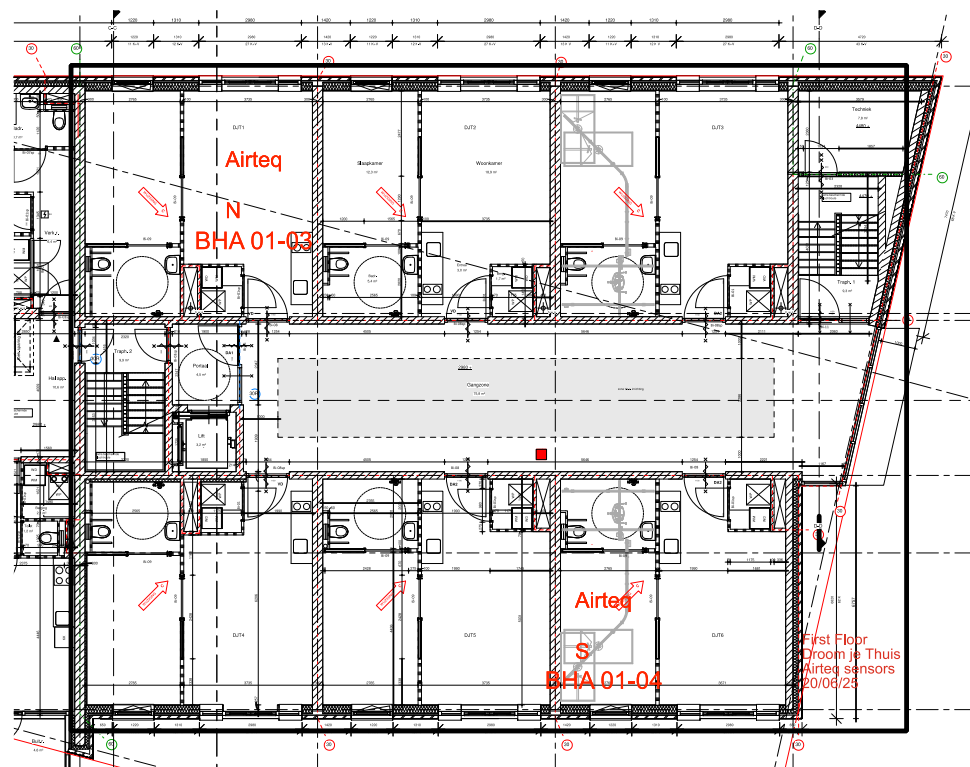


Figure 26. Droom je Thuis Foundation First Floor

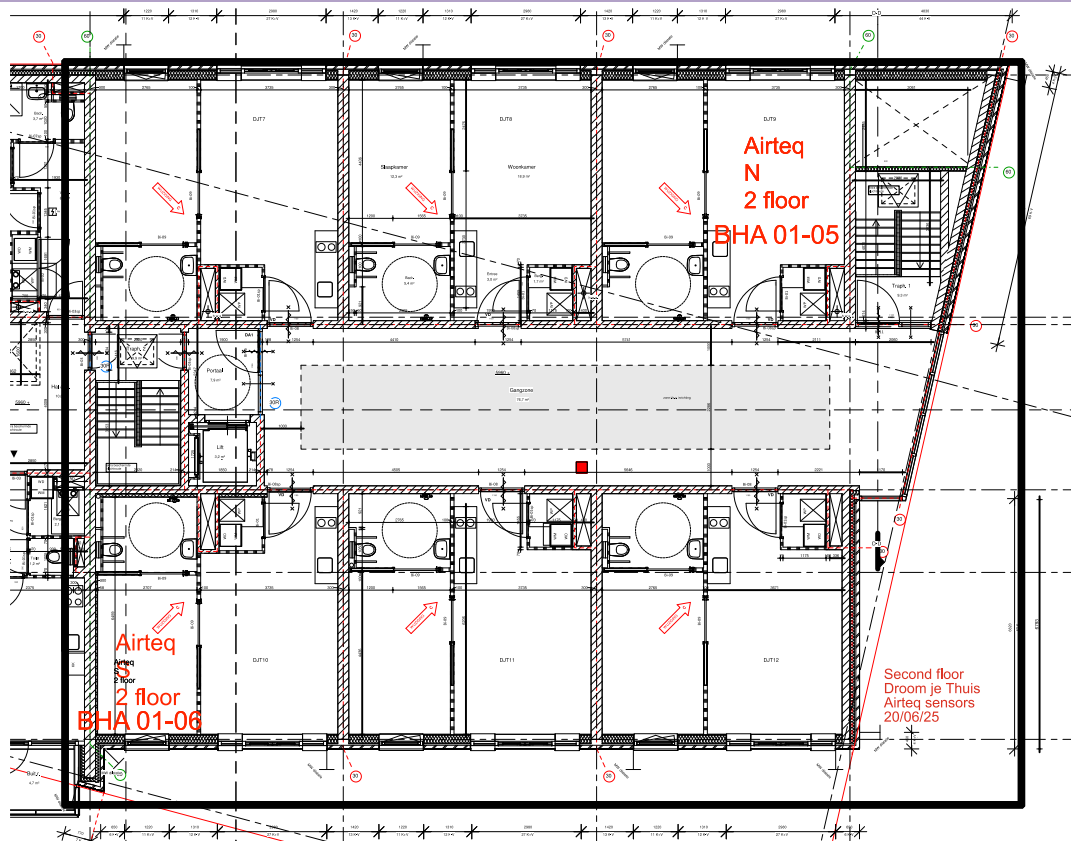


Figure 27. Droom je Thuis Foundation Second Floor

3.1.3.2 Meters

The building is equipped with kWh meters integrated within the Embion Energy Management System, enabling real-time and historical energy monitoring.

Additionally, PV production data is accessible via an API connection provided through a solar gateway (linked to the Enphase system).

3.1.3.3 Systems

Heating and Domestic Hot Water

Each apartment is equipped with a Remeha Eria Tower 11 kW heat pump, providing space heating, cooling, and domestic hot water. The common areas are served by two additional units of the same type, ensuring redundancy and sufficient capacity.

Cooling

Cooling is achieved through the underfloor heating system by circulating cooled water from the heat pumps. This provides low-energy, passive cooling, improving indoor comfort during warmer periods.

Ventilation

A Ned Air EveryLine 4000 is installed on the roof. This compact air handling unit with heat recovery provides centralized ventilation for both apartments and communal spaces.

Key characteristics:

- Airflow capacity: approximately 550–2,700 m³/h;
- Heat recovery efficiency: up to 87–88%;
- Components: filters, patented LSM heat recovery module, EC fans;
- Compliance with ErP 2018 requirements.

The modular design allows integration of additional components such as heating coils and dampers if required.

Lighting

Lighting and window blinds are centrally controlled via the ABB Free@Home system, allowing automation, remote control, and energy optimization.

Photovoltaic installation

The PV system consists of 45 panels of 375 Wp each, connected via Enphase IQ7 microinverters and supported by load meters for detailed monitoring of energy production and consumption.

Building (Energy) Management | Automation and Control System

The building is equipped with a decentralized but integrated building management approach, combining several systems:

- Embion Energy Management System for energy monitoring and data analysis;
- ABB Free@Home system for lighting and shading control;
- Modbus gateways (Remeha) for heat pump monitoring and control;
- Zaptec Pro 22 kW charging station;
- AirCheq Aero sensors;
- Local WLAN network for device communication.

Currently, there is no single fully integrated Building Management System (BMS).

3.1.4 Deployment Timeline

The preparatory activities for deployment at the Droom je Thuis pilot site were carried out under Task 9.2. These activities focused on preparing the technical basis for the subsequent deployment and evaluation activities in WP11. The work was structured into two main categories:

1. Electric mobility;
2. Building sensors and data infrastructure, including energy monitoring and indoor environmental quality.

The preparation and set-up activities were organised across two main phases: June 2025 – December 2025 and January 2026 – May 2026.

June 2025 – December 2025

This phase focused on completing the technical set-up and ensuring that relevant data sources would become available for use within the AccessS framework.

The relevant building systems and monitoring components were available and/or made operational for the pilot context, including:

- Energy systems, including heat pumps and the PV installation;
- Indoor AirCheq Aero environmental sensors;
- Energy monitoring via the Embion Energy Management System;
- Data access via APIs and local network infrastructure.

The main effort in this phase was dedicated to enabling structured data exchange. APIs and local connections were prepared to provide access to relevant datasets, including energy consumption, PV production, and indoor environmental quality parameters.

A further physical set-up step was completed in December 2025 with the installation of a Zaptec Pro 22 kW charging point, supporting the charging of a Mercedes eSprinter 56 kWh. This completed the main physical infrastructure required for the electric mobility component of the pilot.

January 2026 – May 2026

During this phase, the focus shifted towards technical verification, data availability, and preparation for operational use within WP11.

Key activities included:

- Verification of data continuity and reliability across the connected systems;
- Validation and refinement of API-based data exchange;
- Preparation of available data streams for use in the relevant AccessS tools;
- Initial technical testing related to energy management, indoor environmental quality, and electric mobility.

As the main hardware components had already been installed or made available, no substantial additional installation activities were required during this phase. Efforts were therefore directed towards improving data consistency, interoperability, and usability for project partners.

In parallel, initial coordination with stakeholders and technical partners was prepared, in order to support the transition from technical set-up in WP9 to practical deployment, use-case testing, training, KPI definition, and evaluation activities in WP11.

Electric Mobility

The pilot site is equipped with a Zaptec Pro 22 kW charging point, installed in December 2025, used for charging a Mercedes eSprinter 56 kWh.

The charging infrastructure provides a basis for monitoring charging patterns and electricity consumption. This contributes to the development and testing of electric mobility-related functionalities within the AccessS project.

No further expansion of the charging infrastructure is currently planned. The emphasis is placed on evaluating system performance and its interaction with the building's energy system during the subsequent deployment and evaluation phase.

Sensors and Data Infrastructure

The pilot site includes a deployed sensor and monitoring ecosystem, consisting of:

- Indoor environmental sensors: AirCheq Aero;
- Energy monitoring via the Embion Energy Management System;
- PV monitoring through the Enphase system.

Relevant data streams are accessible via APIs and/or local network connections and are available for integration with the AccesS tools where applicable.

The implemented data exchange framework provides structured access to data across the domains of energy, indoor environment, and mobility. This supports further analysis, tool testing, and evaluation activities within WP11.

Key Outcome

By the end of Task 9.2, the Droom je Thuis pilot site had achieved technical readiness for the next phase, with:

- The main required hardware systems installed or available;
- Relevant data streams accessible through APIs and/or local network connections;
- A technical basis for integration with the AccesS tools and platform during WP11.

This provides a solid foundation for further deployment, user interaction, use-case testing, KPI-based evaluation, and impact assessment in the subsequent project tasks.

3.2 Casa Girasole, Massagno, Switzerland

Casa Girasole, located in Massagno (Switzerland), represents the Swiss pilot within the AccesS project under the category of people care facilities. The building hosts elderly residents and is characterized by an existing infrastructure that already integrates basic monitoring systems, which are further enhanced within the project.

The pilot focuses on improving accessibility, indoor comfort, and energy efficiency through the deployment of digital solutions from the AccesS Suite, including IoT-based monitoring, user-centric services, and adaptive building management tools.



Figure 28. Casa Girasole Building

3.2.1 Building Topology

Casa Girasole is a residential care facility designed to accommodate elderly residents, featuring multiple housing units and shared spaces such as common rooms, corridors, and service areas.

The building layout supports assisted living conditions, with:

- private and semi-private residential rooms;
- shared functional areas (e.g., dining, social spaces);
- service and operational zones.

The building, shaped like an “L”, consists of six floors, including one underground level. The basement level (-1) accommodates the technical areas as well as the electrical panels that control the entire facility. The ground floor serves as the main access point for both guests and residents and includes several functional spaces such as offices for reception, administration, management, and secretariat activities, a kitchen, dedicated chef’s office, cold storage rooms, a storage area, a chapel, a dining room, and a multipurpose room used for resident activities.

The upper floors are organized around a common living room on each level and contain a variable number of bedrooms, including both single and double rooms. The first floor includes 13 double rooms, while each of the remaining upper floors contains 15 double rooms and one single room per floor. In total, the building comprises 58 double rooms and 4 single rooms, all equipped with private bathrooms. In addition to residential spaces, several floors also host areas dedicated to specific services and activities, including physiotherapy facilities, a hairdressing area, and laundry services.

A digital BIM model was developed to represent the building shown in the figure below. The model was generated from the building’s Industry Foundation Classes (IFC) file, providing a structured and interoperable representation that includes both geometric elements and key building information.

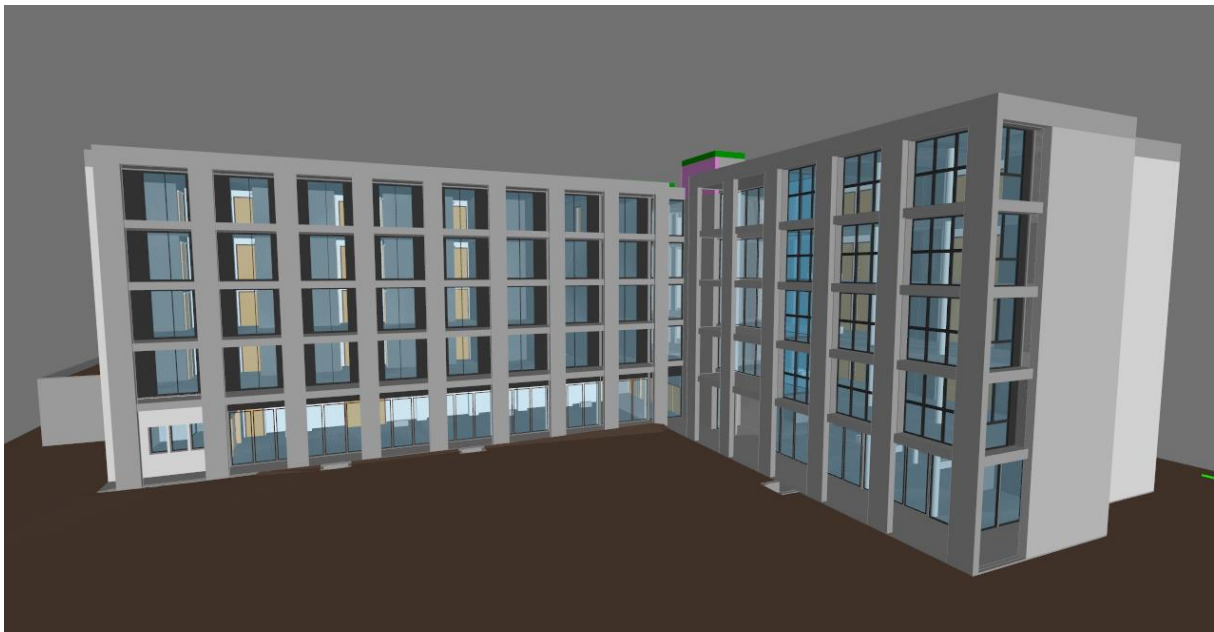


Figure 29. 3D BIM model representation of Casa Girasole

3.2.2 Building Envelope

The building was constructed in 2002 and its envelope elements are made of reinforced concrete, with double-glazed windows and aluminium frames.

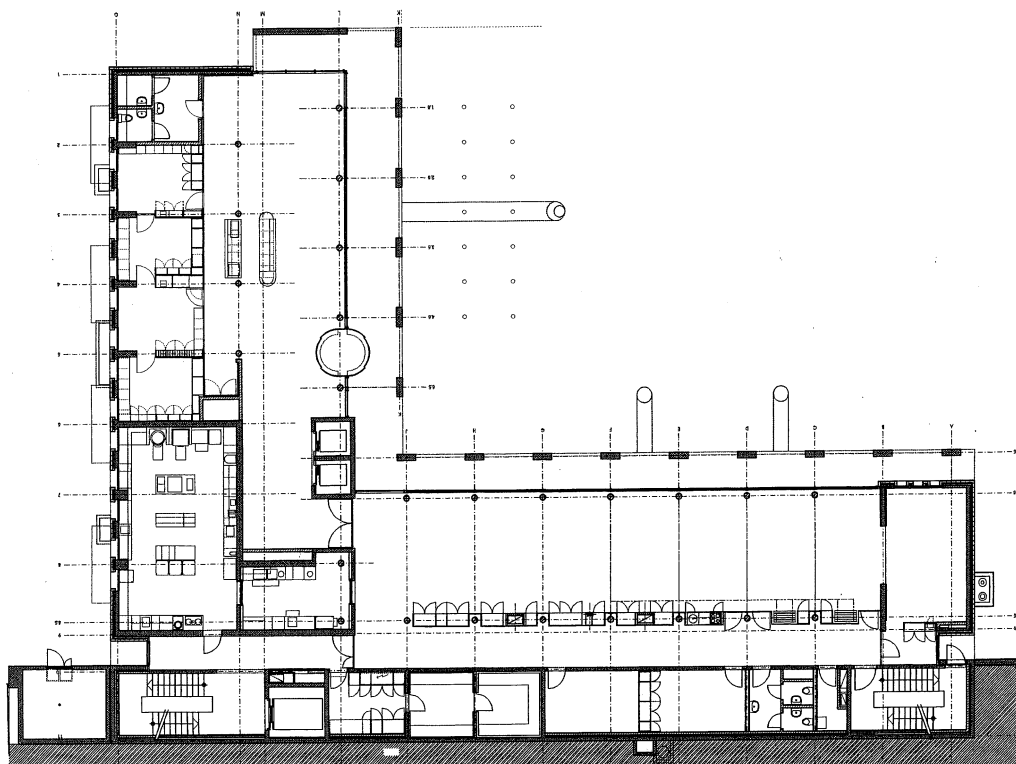


Figure 30. Ground Floor

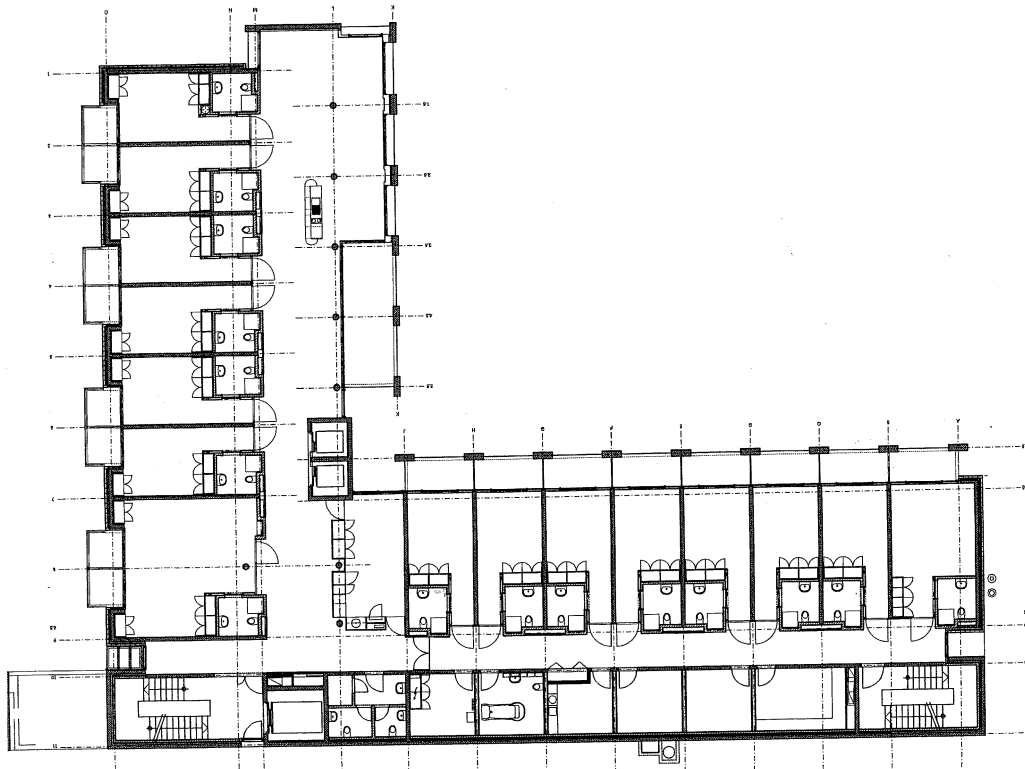


Figure 31. First Floor

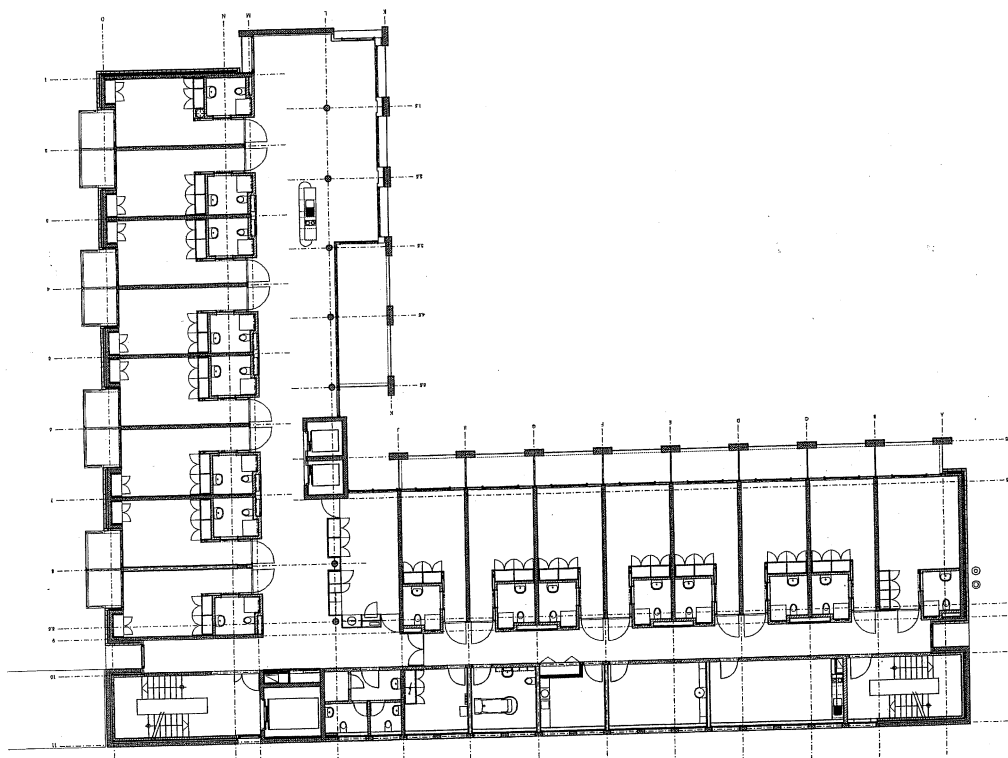


Figure 32. Second Floor

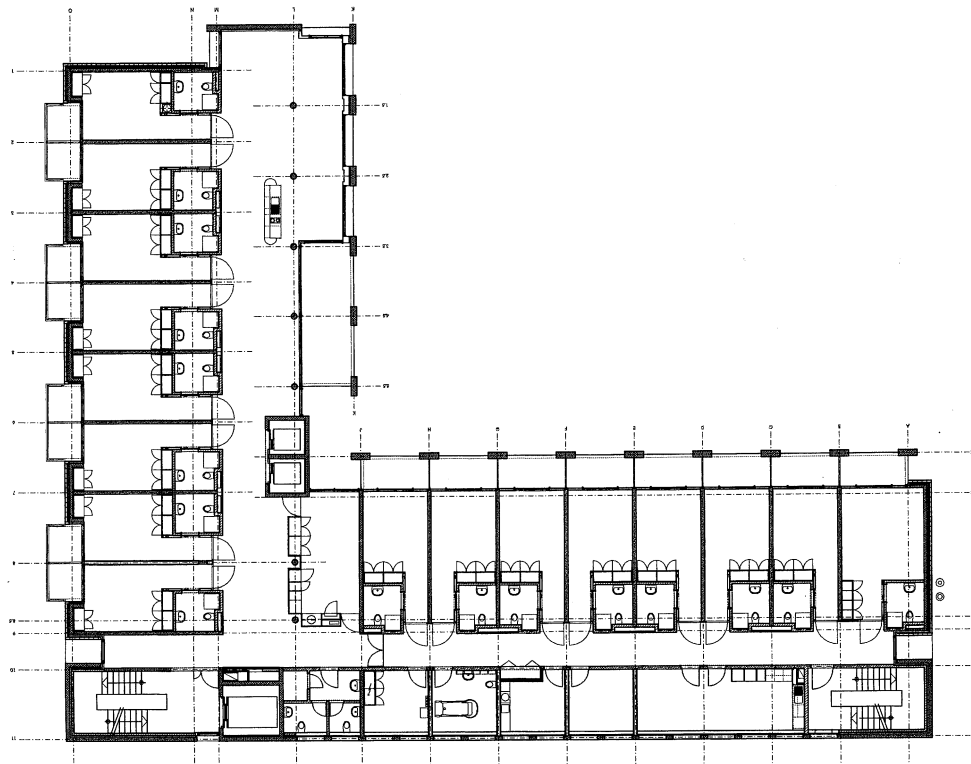


Figure 33. Third Floor

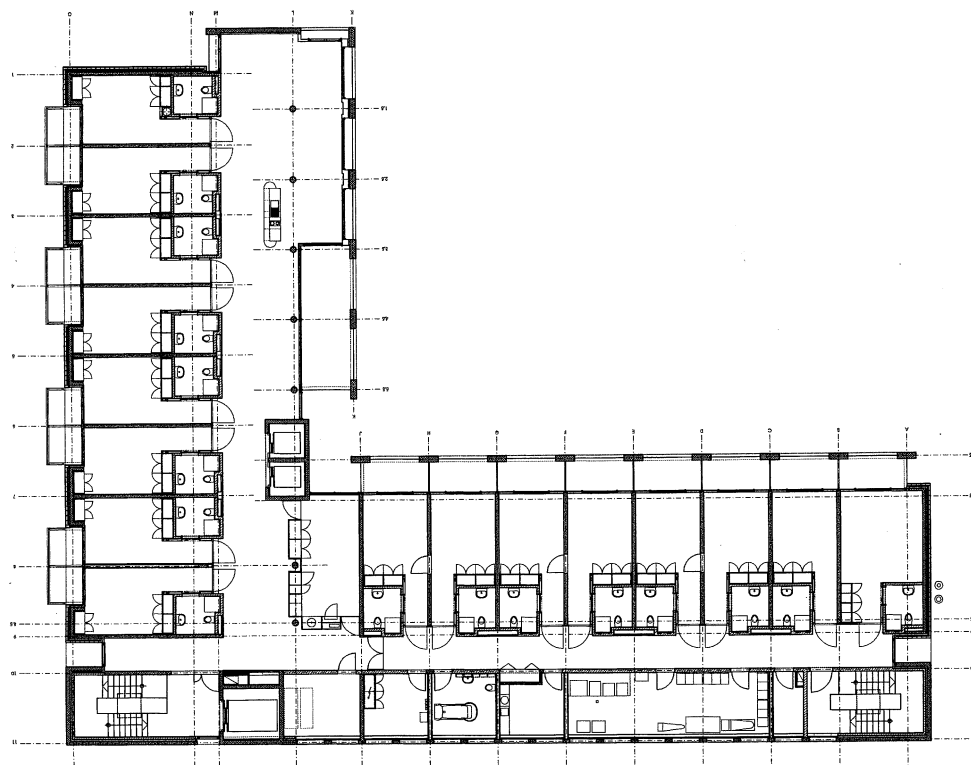


Figure 34. Fourth Floor

3.2.2.1 Vertical Walls

All the façades of the building are made of reinforced concrete, with double-glazed windows and aluminium frames. Some details about the construction material were able to be extracted from the

architectural plans. The facades are constructed with reinforced concrete and equipped with thermal insulation. All u values were calculated within Revit using the materials. The following table lists walls that were able to detect the materials. Others were assigned a default concrete with the thickness represented in the plans.

Table 8. Walls Details

Walls				
Name	Thickness	Use	U-value	Materials (Exterior->Interior)
Basement insulated	36-43 cm	Basement/In contact with ground	Calculated in Revit	Concrete, Insulation
Basement Gypsum	30 cm	Basement/In contact with ground	Calculated in Revit	Concrete, Air, Gypsum boards
External 1	30 cm	Exterior	Calculated in Revit	Concrete, Insulation
External 2	29.5 cm	Exterior	Calculated in Revit	Bricks cladding , Insulation ,Concrete,
External 3	36 cm-39 cm-42 cm-54 cm	Exterior	Calculated in Revit	Bricks cladding , Air, Insulation ,Concrete,
External 4	38 cm	Exterior	Calculated in Revit	Bricks cladding, Air, Insulation ,Concrete, Gypsum Boards
External 5	42 cm	Exterior	Calculated in Revit	Concrete, Insulation, Air, Bricks
External 6	43,5 cm	Exterior	Calculated in Revit	Concrete, Air, Insulation, Wall Finish

3.2.2.2 Roof

The construction of the roof was also extracted from the architectural plans. The building consists of one type of construction throughout the whole roof.

Table 9. Roofs Details

Roofs			
Name	Thickness	U-value	Materials (Above->Below)
Roof	46 cm	Calculated in Revit	Gravel, vapor Barrier, Insulation, waterproofing, Concrete

The roof hosts the photovoltaic system and is covered with gravel.

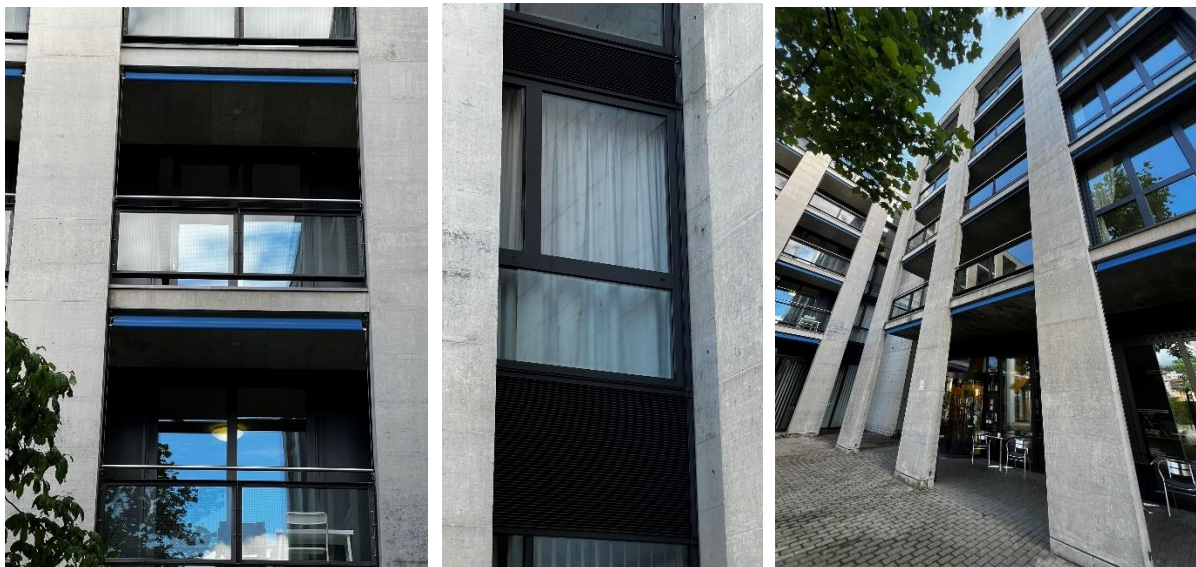


Figure 35. External view

3.2.3 Building Equipment

Casa Girasole is equipped with a combination of existing systems and newly deployed technologies under the AccessS project. The systems enable the monitoring of consumption and production for the entire Casa Girasole building. The electric vehicle charging systems, installed in the parking area adjacent to the building, are monitored by a dedicated meter. In addition to monitoring the overall energy performance of the building, further sensors have been installed to specifically monitor the consumption of the areas involved in the AccessS tool analyses, alongside air quality sensors.

The physical layout is branched into two main operational areas: Zone A and Zone B. Zone A focuses on communal utility, overseeing the Dining Room and Multipurpose Room, while Zone B manages the administrative and social hub, including the Cafe and two office spaces.

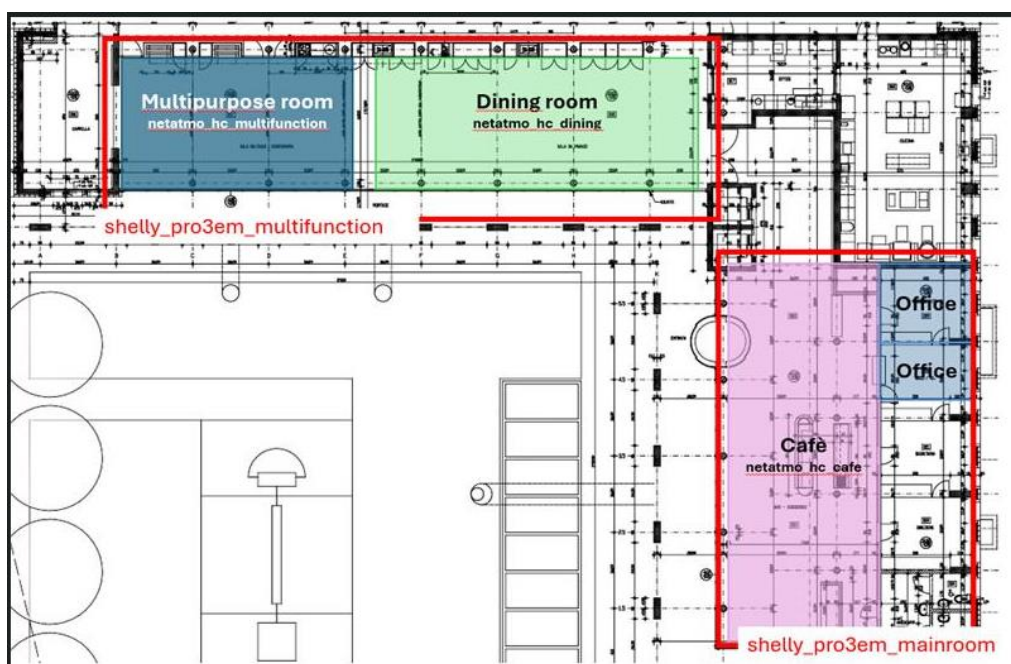


Figure 36. 2D floor plan and monitoring zones of Casa Girasole

3.2.3.1 Sensors

The building is already equipped with IoT-based environmental monitoring systems, which are further extended within the project. The following figure shows a snapshot of the sensor's installation.

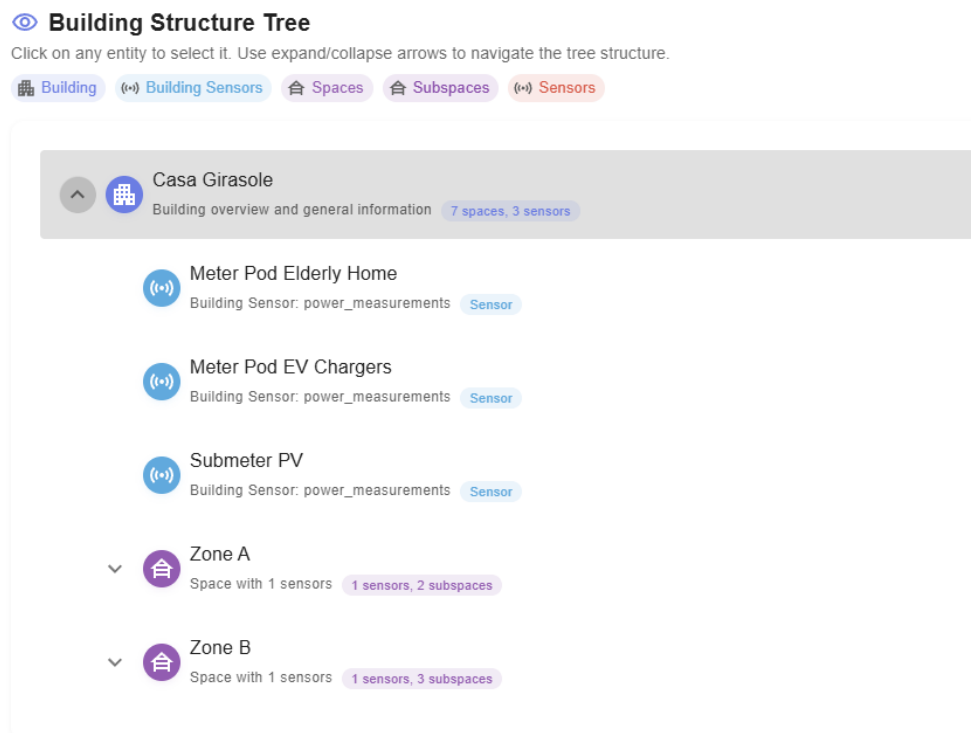


Figure 37. Hierarchical spatial structure of Casa Girasole sensor installation

IAQ sensor

Sensors continuously monitor indoor environmental conditions, providing real-time data on:

- temperature
- humidity
- air quality (CO₂ levels)
- noise level.

These data are used to assess comfort and support adaptive control strategies.

Were installed in the areas considered most important to monitor, following an assessment carried out with the building's stakeholders. The type of sensor was identified by considering several aspects, including the possibility of integrating data exchange directly with AEM's R&D servers, the suitability of the installation within the Casa Girasole context—taking into account space accessibility—and the ability to obtain the measurements required to meet the pilot's objectives.

3.2.3.2 Meters

Energy consumption is monitored through metering systems that provide data on electricity usage, enabling performance evaluation and optimization. Also, the PV installed on the roof of the building is monitored by its own meter, giving thus information on the production of the building.

Following discussions among the technical partners, AEM as the pilot manager, and the internal stakeholders of Casa Girasole, additional sensors were installed to monitor in detail the consumption of the spaces already monitored through IAQ sensors. The installed sensors make it possible to collect various electrical measurements of the power supply of the analyzed spaces, but the primary data used is the energy delivered.

3.2.3.3 Systems

Heating and Domestic Hot Water

The building is equipped with a centralized oil-based boiler system, which provides both space heating and domestic hot water (DHW).

The system operates using fossil fuel (oil) as the primary energy vector and supplies thermal energy across the building to ensure indoor comfort for residents.

The total annual energy consumption associated with heating and domestic hot water is approximately 635,975 kWh/year, representing a significant share of the building's overall energy demand.

Cooling

Cooling is available to ensure acceptable indoor conditions during warmer periods. The building was not originally designed with an integrated cooling system, as it was built in the early 2000s. In recent years, however, with rising summer temperatures, several cooling systems have been installed.

The systems currently installed are the following:

- 2 x Mitsubishi Electric City Multi (22.4 kWt / 9.00 kWe / 2.5 EER);
- Hidros LDA SA/XL/CO in cooling mode 50.40 kWt / 18.60 kWe / EER = 2.71;
- Carrier XPower in cooling mode 6.50 kWt / 2.49 kWe / EER = 2.61.

Lighting

The building is equipped primarily with LED-based lighting systems, which are deployed across most indoor spaces to ensure adequate illumination levels and energy efficiency.

Photovoltaic installation

Casa Girasole is equipped with an on-site photovoltaic (PV) system, contributing to local renewable energy generation. The PV installation has the following characteristics:

- Total installed capacity: 59.36 kWp;
- Inverters: 2 × 25 kVA (SMA Sunny Tripower);
- Total surface area: approximately 366 m²;
- Modules: 224 units (Jinko Solar, 265 Wp each);
- Orientation: East-West configuration;
- Tilt angle: 10°.

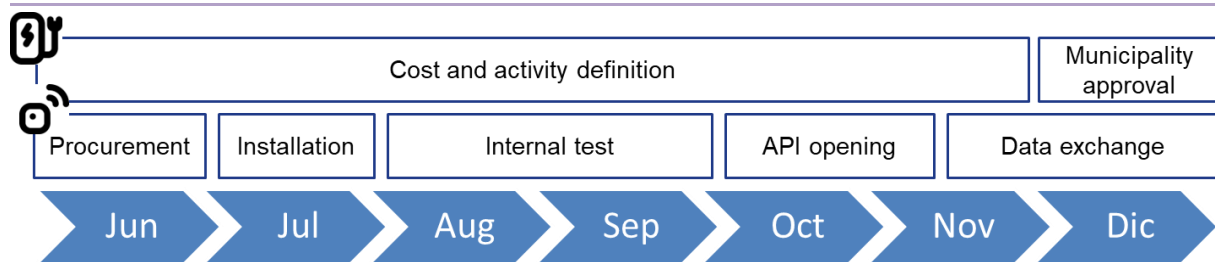
The system produces an estimated 59,360 kWh/year, contributing to the building's electricity demand and supporting sustainability objectives.

3.2.4 Deployment Timeline

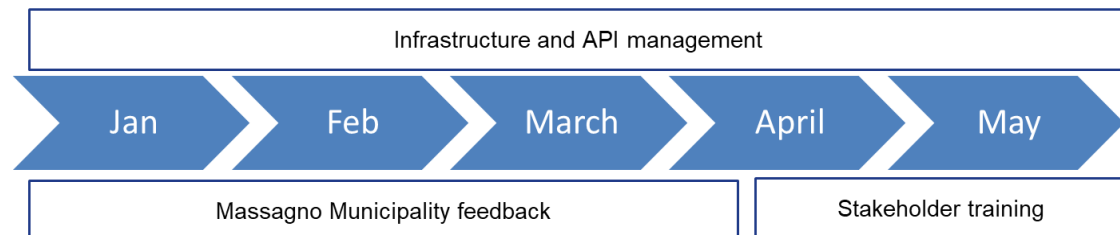
The activities required for the preparation of the pilot were carried out in Task 9.2. At the start of the activities, the actions were structured into two main categories:

- 1) Electric mobility;
- 2) IAQ (Indoor Air Quality) sensors.

The activities were further organized across two distinct timeframes: June 2025 – December 2025 and the subsequent period from January 2026 – May 2026.



From June to December 2025, the activities were primarily focused on the procurement and installation of sensors, as well as their integration into the AccesS tools.



From January to May 2026, the activities focused on verifying the stability of the data exchange system between sensors and the platform, training stakeholders, and assessing the potential deployment of an additional charging system alongside the existing ones.

In particular, the months of April and May were dedicated to the study and training of the stakeholders involved in the project, ensuring that by the end of Task 9.2 the functionality of each tool within the AccesS suite was clearly understood.

E-mobility

The pilot site already featured two AC charging systems (22 kW) installed in the parking area adjacent to the facility. These charging systems were utilized to provide data required by the technical partners for the development of the tool related to electric mobility management.

Within the project, AEM also planned activities to assess the feasibility of installing an additional charging system. This activity was included within a broader planning process for the expansion of the public charging network in the Municipality of Massagno. At the end of Task 9.2, the impossibility of further expanding the electric vehicle charging network within the project timeline is highlighted, due to the complexity and time required to revise the regulatory plan for publicly accessible parking. However, the inability to expand the charging network does not affect the objectives of the AccesS project, as it is still possible to carry out the planned use cases using the existing charging systems already in place and used during the development phase of the technical tools.

Sensors

The activities related to sensor deployment enabled the identification of the most suitable solutions, followed by the installation and commissioning of the selected devices. Netatmo Home Coach systems were installed for the monitoring of indoor air quality, while Shelly sensors were deployed for energy consumption monitoring.

These sensors were directly integrated into AEM's R&D server to ensure reliable data collection. The collected data are subsequently made available to project partners through dedicated APIs developed by the AEM team.

This data exchange system encompasses all data streams managed by AEM and delivered to the AccesS platform, ensuring a consistent and structured flow of information across the project ecosystem.

4 AccesS Pilot Cases III: Case of Public Services Buildings

4.1 Palazzo di Città, Bari, Italy

The Palazzo di Città is located in the city center of Bari and hosts the main municipal offices. The City Hall of Bari is the current municipal seat of the capital, having been moved there from the old town in 1860. The building is located along the edge of the Murat district, near the old city, as part of the 19th-century orthogonal expansion program that developed following the demolition of the city walls between the railway and the coast.

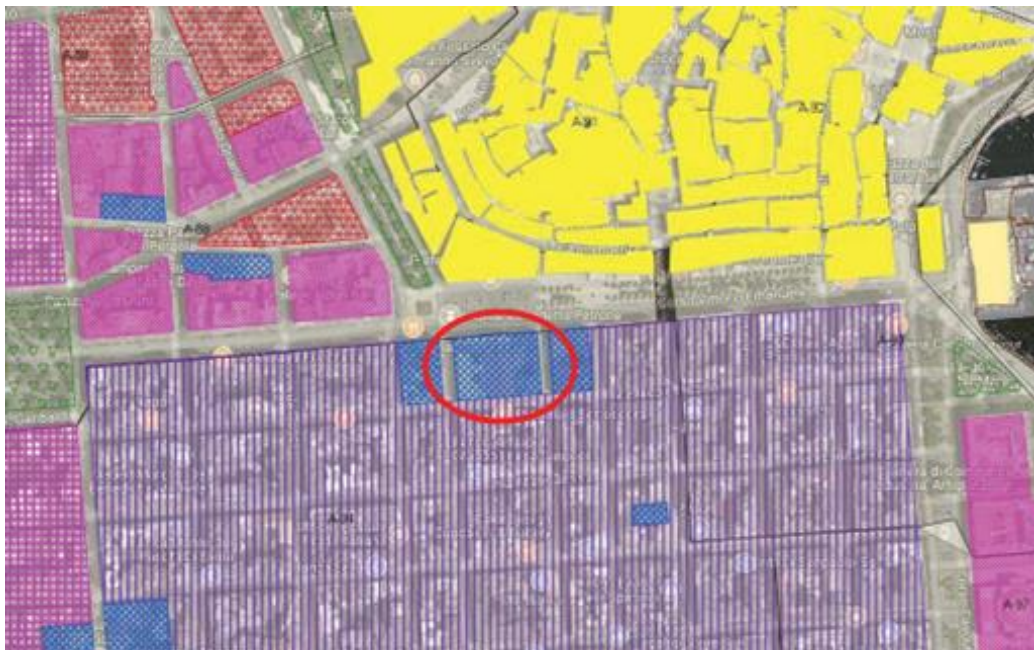


Figure 38. Extract from the General Urban Plan showing Palazzo di Città

4.1.1 Building Topology

The building, one of the first constructed in the vast urban planning program, incorporates the Piccinni Theater, the first permanent theater built in the city, and features numerous reception rooms of notable historical and architectural value. Within the urban planning scheme of Borgo Murattiano, the Palazzo di Città plays a prominent role, overlooking Corso Vittorio Emanuele and the adjacent Piazza Prefettura, one of the hubs of the city center.



Figure 39. Aerial perspective view of Palazzo di Città

4.1.2 Building Envelope

The building extends over a basement level and three floors above ground on the west side, and a basement level and four floors above ground on the east side. It features three internal courtyards that provide lighting and ventilation for the interior spaces.

4.1.2.1 Vertical Walls

The building also features a vertical load-bearing masonry structure, with thicknesses greater than 1 m for almost all of the rooms on the first three floors above ground. The opaque envelope of the third-floor area of the east wing, which was built later, is characterized by a thinner thickness, approximately 50 cm.

4.1.2.2 Roof

The roofs are mostly made with vaulted structures, which, for the area containing the reception rooms (Council Chamber, Council Chamber, Massari Hall), are of considerable architectural value. Some rooms on the second floor and the entire third-floor wing feature horizontal, flat-slab-style closures.

4.1.2.3 Windows

The Palazzo di Citta building has different types of window frames for each level in relation to the importance that each level has. The first floor of the building represents the true noble floor of the City Hall, housing the state rooms and most important offices. This level features similar window frames on the four main elevations, featuring very large openings, approximately 3.15 m high, which provide considerable light to the rooms. The second floor is highly structured, as the two wings of the building are not connected, but are separated by the volume of the Piccinni Theater's music hall, and are lower than the lower levels. In all cases, the window frames are painted white on the inside and brown on the outside. The top floor, covered by a flat attic, is lower than the previous ones: here, the window frames were recently replaced with PVC windows that retain their brown color to match the other windows that characterize the building's internal elevations. It was found that most of the windows are made of wood with single glazing and therefore have lost their insulating function, due to lack of maintenance and exposure to atmospheric agents.



Figure 40. Ground floor: large openings in the west wing of the building



Figure 41. Third floor: recently installed window frames



Figure 42. Second floor: openings on the external façade

4.1.3 Building Equipment

Palazzo di Città was not equipped with advanced monitoring and management systems relevant to the objectives of the AccessS project. As part of the pilot site preparation and setup activities, we are implementing a comprehensive suite of technologies to support data-driven accessibility and conservation strategies.

4.1.3.1 Sensors

As part of the AccessS project, the Palazzo di Città will be equipped with systems for environmental monitoring and visitor flow analysis.

Temperature, Humidity and CO₂

The building in question has an Energy Performance Certificate (ACE) certifying that the structure is classified as Class E and has an overall energy performance index of 8.63 kWh/m³ per year and CO₂ emissions of 2.28 kgCO₂/m³ per year. The heating energy performance index is 8.33 kWh/m³ per year.

Table 10. Main energy performance indicators from the Energy Performance Certificate of the building

Heated usable floor area (m ²)	Heat loss surface area / building envelope area (m ²)	Heated gross volume (m ³)	Shape factor (surface-to-volume ratio S/V)	CO ₂ emissions (kg/m ² per year)	EPgl, nren (kWh/m ² per year)	Energy class
4.763,13	12.130,60	39.582,57	0,31	43,42	195,44	D

Luminance

As explained above, the lighting system reflects the general organization of the building; it is different on the different floors of the building depending on the size of the windows and the lighting fixtures chosen.

4.1.3.2 Meters

About its electrical systems, the Palazzo Città of Bari can be divided into two independent sections, corresponding to the two currently active delivery points:

- Corso Vittorio Emanuele, hereinafter referred to as the EAST WING;
- Via Cairolì, hereinafter referred to as the WEST WING.

The first, on Corso Vittorio Emanuele, features a three-phase low-voltage supply with an available power of 132 kW and a TT distribution system. This system is powered via a switching panel, by two different ENEL cabins. The switch between the two is managed directly by technicians from the energy company, ensuring greater operational continuity.

The devices detected are mainly installed in two different configurations: ceiling-mounted or wall-mounted. The two types can be further subdivided based on the degree of protection of the lighting fixture itself (so-called waterproof device - IP44). Furthermore, the ceiling-mounted devices mostly consist of pendant luminaires installed in the offices and chandeliers in the reception area (first floor EAST WING); the wall-mounted devices are mainly wall lamps and projectors, the latter in the entrance halls.

4.1.3.3 Systems

Heating and Domestic Hot Water

The building's winter and summer air conditioning is handled by individual direct expansion units. It is therefore clear that most of the electricity drawn from the grid is attributable to the existing air conditioning system. The multiple fragmentation of the air conditioning system, whose activation and adjustment is left to the individual user for each room, and the inconsistencies in the correct installation of the units, result in higher energy consumption than actual needs.

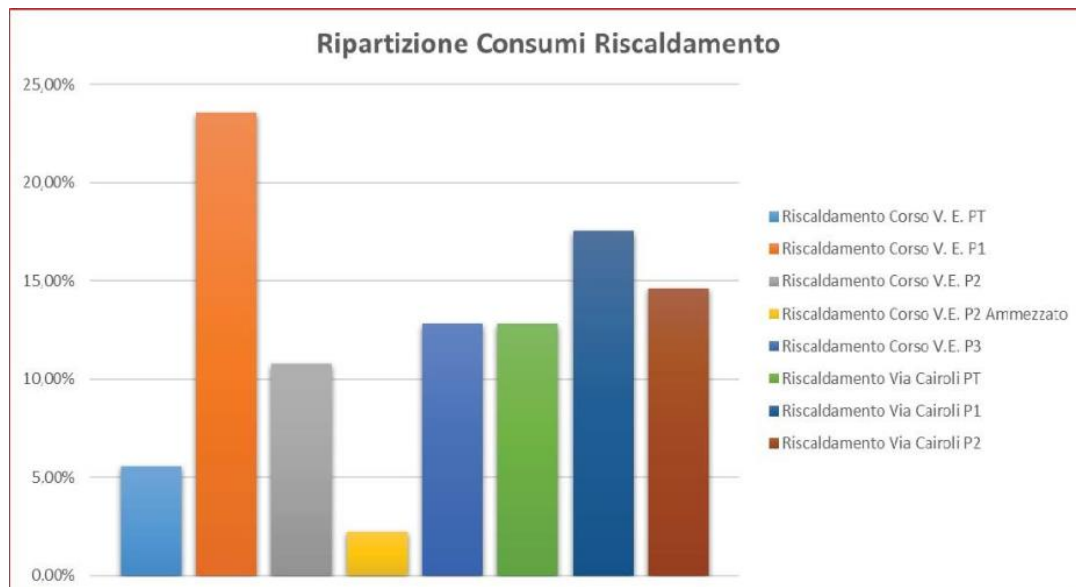


Figure 43. Heating consumption chart

Cooling & Ventilation

The air conditioning in the ground floor rooms, especially those facing Via Cairoli, is provided by individual direct expansion units installed back-to-back, with the outdoor units positioned partly on the walls of the internal corridors and partly in the niches above the windows. These units are switched on and regulated using their own remote controls. It was also noted that the rooms known as the former treasury currently operate without any refrigeration system.

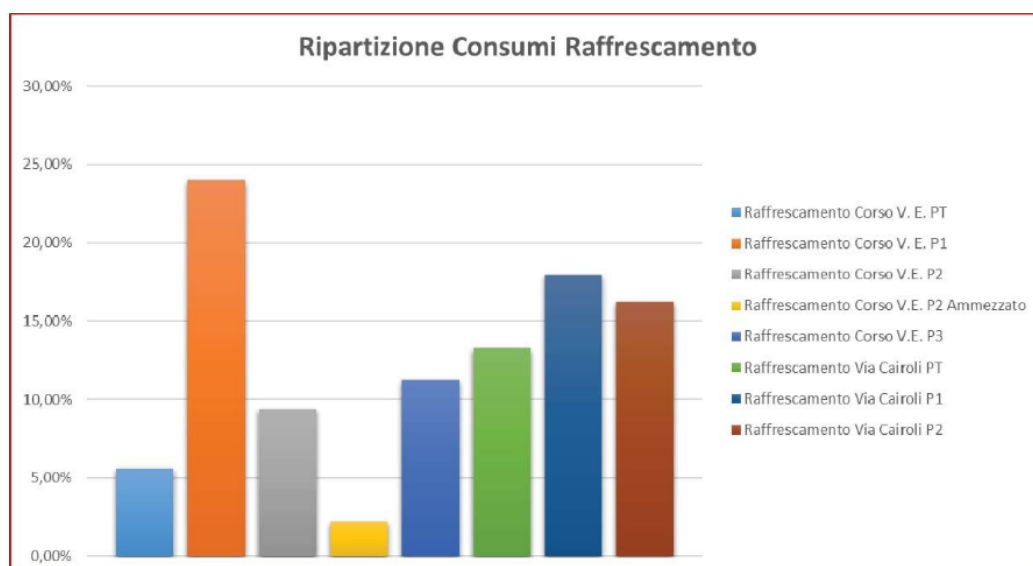


Figure 44. Cooling consumption chart

Lighting

In relation to the organization of the building, there is no uniformity in terms of technology, type of equipment, or color temperature of the lamps.

The maintenance company has already undertaken measures to modernize the system and achieve uniformity of the lighting system by installing LED lamps and, where this is not possible, by using energy-saving lamps. The following types of light sources have been identified for the lighting fixtures:

- Halogen;
- High-pressure sodium;
- Metal halide;
- Linear and compact fluorescent lamps;
- LED

The devices detected are mainly installed in two different configurations: ceiling-mounted or wall-mounted. The two types can be further subdivided based on the degree of protection of the lighting fixture itself (so-called waterproof device - IP $\geq$ 44). Furthermore, the ceiling-mounted devices mostly consist of pendant luminaires installed in the offices and chandeliers in the reception area (first floor EAST WING); the wall-mounted devices are mainly wall lamps and projectors, the latter in the entrance halls.

Building (Energy) Management | Automation and Control System

The system is organized as follows: cascading to the meter, there is a sub-meter panel with a 630 A circuit breaker, which feeds the main power line to the main panel. The meters, the switching panel, the sub-meter panel, and the main panel are installed inside a technical compartment.

4.1.4 Deployment Timeline

During the few months since taking over from the municipality of Bari, the Metropolitan City of Bari has been responsible for collecting the data described. On April 2026 an electricity sub-meter was mounted inside the zone board monitoring the two rooms where the public relation office is situated and on which the experimentation will focus. In the next months as part of WP12, installation of additional sensors is planned along with data collection while all anticipated activities during the demonstration and evaluation activities are expected to run smoothly.



Figure 45. Installed electricity sub-meter for energy consumption monitoring

4.2 Mercado de Veronicas, Murcia, Spain



Figure 46. Mercado de Veronicas

The Mercado de Verónicas is a historic municipal market in the heart of Murcia, located next to the Segura River. It is one of the city's most recognizable public building, combining its architectural heritage with everyday commercial activity and continuing to serve as a meeting point for residents and visitors.

A first phase of rehabilitation, focused on the building envelope, has already been completed, improving its condition and performance. The market remains a lively and evolving space, gradually adapting to contemporary urban, social and environmental needs.

Mercado de Verónicas is a standalone building with a rectangular floor plan measuring **18.00 m x 110.08 m, occupying a surface area of 1,891.43 m²**. Although it was originally designed as a single-story structure, it currently has two floors due to a renovation carried out in 1975. The current building, with a sober Modernist style, was designed around 1910 by the distinguished Murcian architect Pedro Cerdán Martínez (1863–1947), and was constructed between 1912 and 1916.

The total built area is 3.697.04 m². The building has four entrances, one on each façade. The gabled roof includes a longitudinal skylight that also allows for ventilation. It houses **116 stalls** on the ground floor, distributed between two rows along the walls and a central row. Between these three rows are the two aisles for customer traffic.

Structurally, the original building consists of 22 parallel frames made of metal trusses supporting the roof, which rest on solid brick pilasters integrated into the North and South façades, alternating with large semicircular lattice windows. To support the mezzanine added during the 1975 renovation, a new structure of reinforced concrete columns was built independently of the existing one. However, due to the poor condition of the solid brick pilasters, braced metal columns were added between the mezzanine and the trusses, effectively connecting the two structural systems.

4.2.1 Building Topology

The Mercado de Verónicas is conceived as a predominantly open-plan volume organised around a large central hall. Its spatial structure is defined by a regular grid that allows flexibility in the arrangement

of stalls and facilitates clear and intuitive circulation. This configuration enhances visual continuity, accessibility and ease of use, reinforcing its role as a lively public space within the city of Murcia.

Originally, the building was developed only on the ground floor hosting the stalls for the market. Later an additional floor was added. Connecting the two levels are staircases on each far sides, elevators and escalators at the center of the building. In the recent developed restoration and renovation plans, the upper floor is scheduled to be removed returning to the original form of the interior.

The building combines a metallic structural system with traditional masonry elements, a characteristic solution of early 20th-century market architecture. This approach enables wide, unobstructed interior spaces while supporting a permeable and well-lit environment.

The figure below displays the ground floor plan of the Mercado de Verónicas, outlining the building's architectural layout.

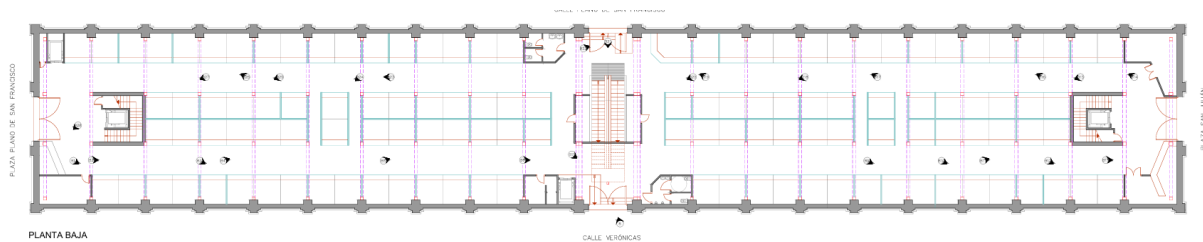


Figure 47. The ground floor plan of the Mercado de Verónicas

A digital BIM model was developed to represent the building shown in the figures below. The model was generated based on the building's Industry Foundation Classes (IFC) file, providing a structured and interoperable representation that includes both geometric elements and key building information.



Figure 48. 3D BIM model representation of Mercado de Verónicas

4.2.2 Building Envelope

The building envelope reflects this combination of structural clarity and environmental performance. It has been designed to ensure natural lighting and ventilation, in line with the original hygienist principles of market buildings.

The first phase of rehabilitation, focused on the envelope, has already been completed. This intervention has improved the building's conservation, watertightness and energy behaviour, while preserving its architectural character and heritage values.

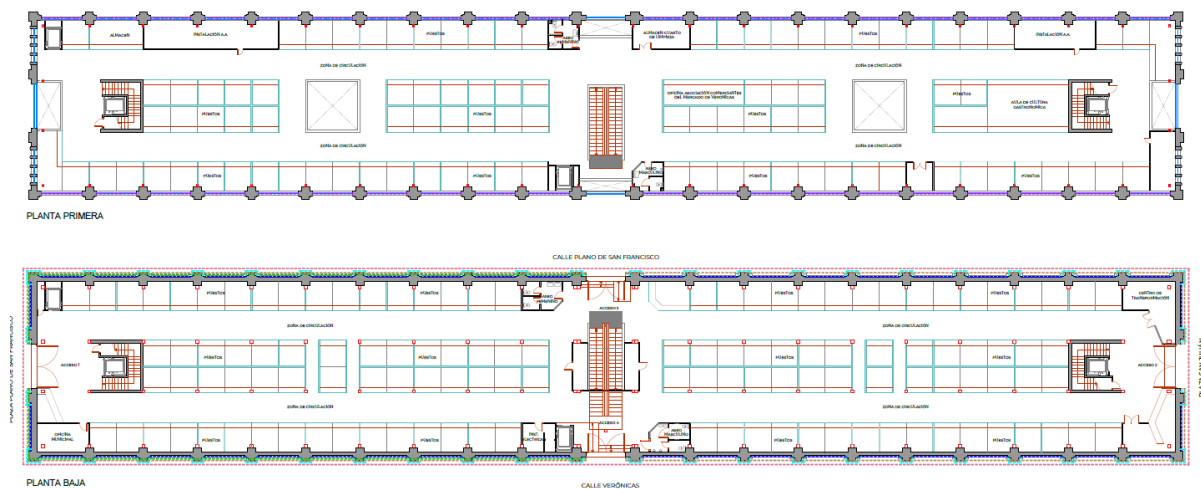


Figure 49. Ground floor and First floor in the current state

4.2.2.1 Vertical Walls

The façades are mainly composed of masonry walls that define the perimeter of the building and integrate a regular rhythm of openings. These elements contribute both to enclosure and to the overall structural behaviour in combination with the internal metal framework.

Recent interventions have focused on their repair and conservation, improving durability and moisture performance while maintaining their original appearance. The openings along the façades allow natural cross-ventilation and strengthen the connection between the interior and the surrounding urban environment.

According to the architectural plans, the building enclosure composed of vertical elements consists of a base wall made of limestone ashlar masonry bonded with mortar at a height of 1 meter and a thickness of 45 cm. Above this base wall, the enclosure continues with a wall composed of two rows of solid bricks, each brick measuring $11 \times 9 \times 4$ cm. Between the two rows, a reflective thermal insulation layer with a thickness of 8 mm is installed, consisting of aluminium foil and polyethylene (5 mm). The total thickness of this wall assembly is 38 cm, including 18 cm for the external brick wall and 18 cm for the internal brick wall with plaster.

On the interior side, the wall is finished with an internal lining based on a drywall system composed of a 15 mm laminated gypsum board mounted on an aluminium frame, incorporating a 65 mm rock wool layer that provides additional thermal insulation. The total thickness of the internal lining is 8 cm.

The global U-value of the building enclosure is $0.6 \text{ W/m}^2\cdot\text{K}$.

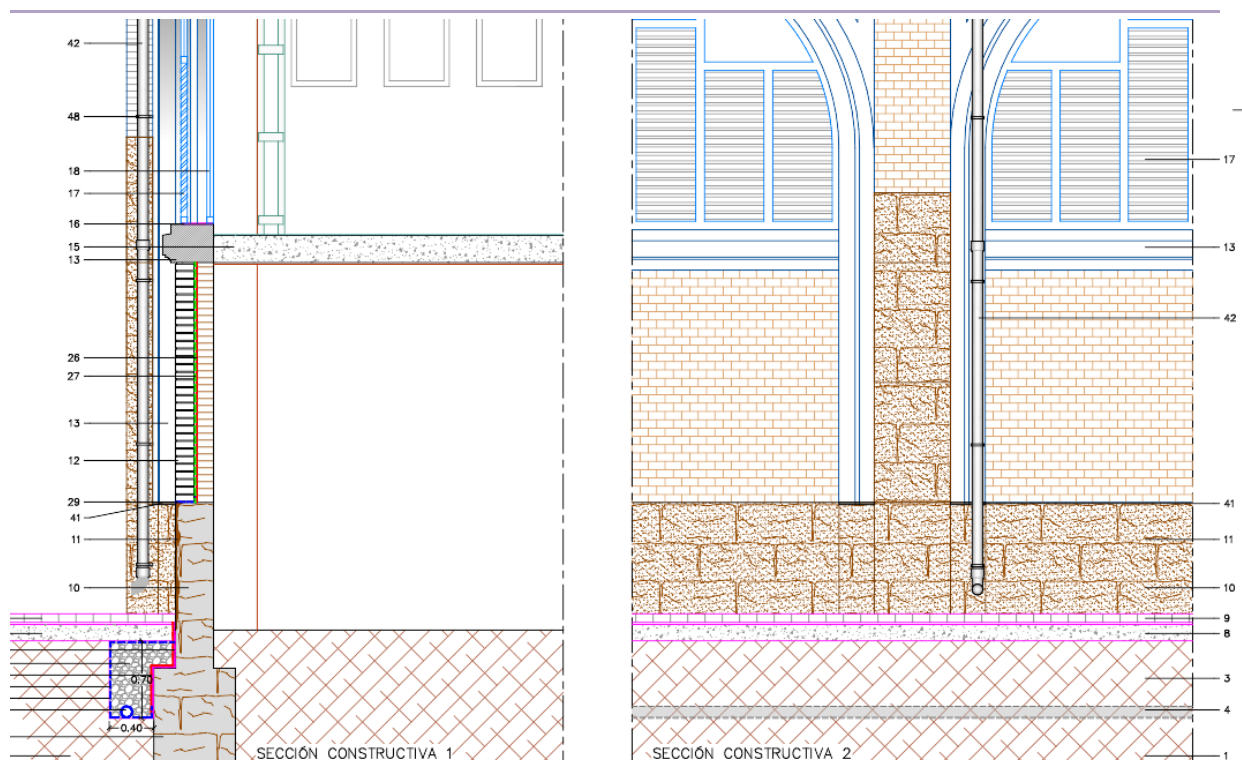


Figure 50. Walls details

The following table presents the construction layers and thermal characteristics of the external walls. It includes information on materials, thickness, surface area, and thermal transmittance values used to evaluate the building envelope performance.

Table 11. External Wall Construction and Thermal Properties.

Walls					
S and U	Name	Thickness	Use	U-value	Materials (Exterior->Interior)
S= 1746 m ² U = 0.35	External Brick 18 cm	18 cm	External	-	Brick/Mortar/Brick
	Reflective thermal insulation layer	8mm	Internal	0.025	Aluminium/polyethylene
	Internal Brick 18 cm		18 cm		Brick/Mortar/Brick
S=281 m ²	Stone low wall	45 cm	External	0.19	Limestone blocks

4.2.2.2 Roof

The roof is scheduled to be fully replace with one that is closer to the original design, which is assumed to have been a gabled roof with flat Alicante tiles, similar to other buildings of the same period. Under these tiles the roof will consist of sandwich panels, that include 10cm insulation, with the interior side a wooden inner finish.

The roof is supported by a lightweight metallic structure that spans the entire market hall, allowing for a continuous interior space without visual obstructions. The metal trussed will be retained, undergoing repairs and reinforcements to hold the roof.

Its design incorporates elements that enhance natural lighting and ventilation, contributing to indoor comfort. Rehabilitation works have improved waterproofing and insulation, reinforced its performance while respecting the original construction system.

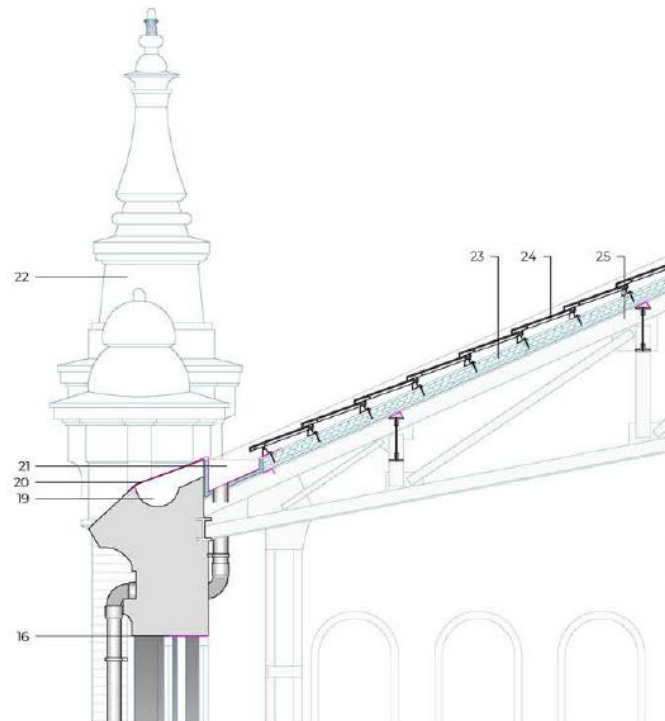


Figure 51. Connection between pitched roof and wall

The following table outlines the roof assembly, including material layers, thicknesses, and thermal properties. These components contribute to insulation, waterproofing, and overall indoor thermal comfort.

Table 12. Roof Construction Layers and Thermal Performance

Roofs			
Name	Thickness	U-value	Materials (Above->Below)
Exterior roof finish	20 mm	0.24	Ceramic roof tile
Insulation layer	80 mm		Extruded polystyrene (XPS) core, water-resistant chipboard, 19 mm thick
Asphalt membrane			
Indoor finish	10 mm thick		Slatted spruce board

The BIM model will follow the renovation state, thus the intermediate floor will be unaccounted. The ground floor slab, is a single 20cm thick concrete slab.

The table below summarizes the construction composition and thermal properties of the floors. It describes material layers, thickness, and thermal performance, particularly for elements in contact with the ground.

Table 13. Floor Construction and Thermal Properties

Floors					
S and U	Name	Thickness	Use	U-value	Materials (Above->Below)
S=1981 m ²	Ground Floor 20cm	20cm	In contact with Ground	0.22	Concrete

4.2.2.3 Windows

Openings are distributed along the façades and upper parts of the building, ensuring a balanced provision of daylight and air circulation. These elements are integrated into the architectural composition and adapted to the building's heritage character.

Their upgrading during the rehabilitation phase has improved airtightness and durability, while maintaining their original image. Together with the rest of the envelope, they support passive environmental strategies and reduce reliance on mechanical systems.

Table 14. Window Types and Thermal Characteristics

Windows					
Name	Construction Type	Material	U-value	Solar Heat Gain Coefficient	Visible Transmittance
Windows (379 m ²)	Mallorquina Windows	Steel	0.77	0.31-0.38	

Additionally, the table below lists the different door types within the building, including construction materials and thermal performance parameters. These elements influence air exchange, heat transfer, and overall building energy behaviour.

Table 15. Door Types and Thermal Characteristics

Name	Construction Type	Material	U-value
South East Gate, North West Gate, South West Gate, North West Gate	Wrought iron	Wrought iron	1.1

4.2.3 Building Equipment

Mercado de Veronicas was not equipped with existing technical systems and under the AccesS project a combination of sensors have been installed. The pilot focuses on the renovation so as to adapt the building to the current regulation with focus on accessibility and inclusiveness, improving energy efficiency and reducing energy consumption and CO₂ emission. The building is equipped with 6 air handling units for heating and cooling.

4.2.3.1 Sensors

To support high-resolution spatial analysis, the Mercado de Verónicas building was divided under ten functional zones. Each zone integrates IoT environmental monitoring and presence-detection systems. The resulting sensor topology and hierarchical spatial tree are mapped in the following figure.

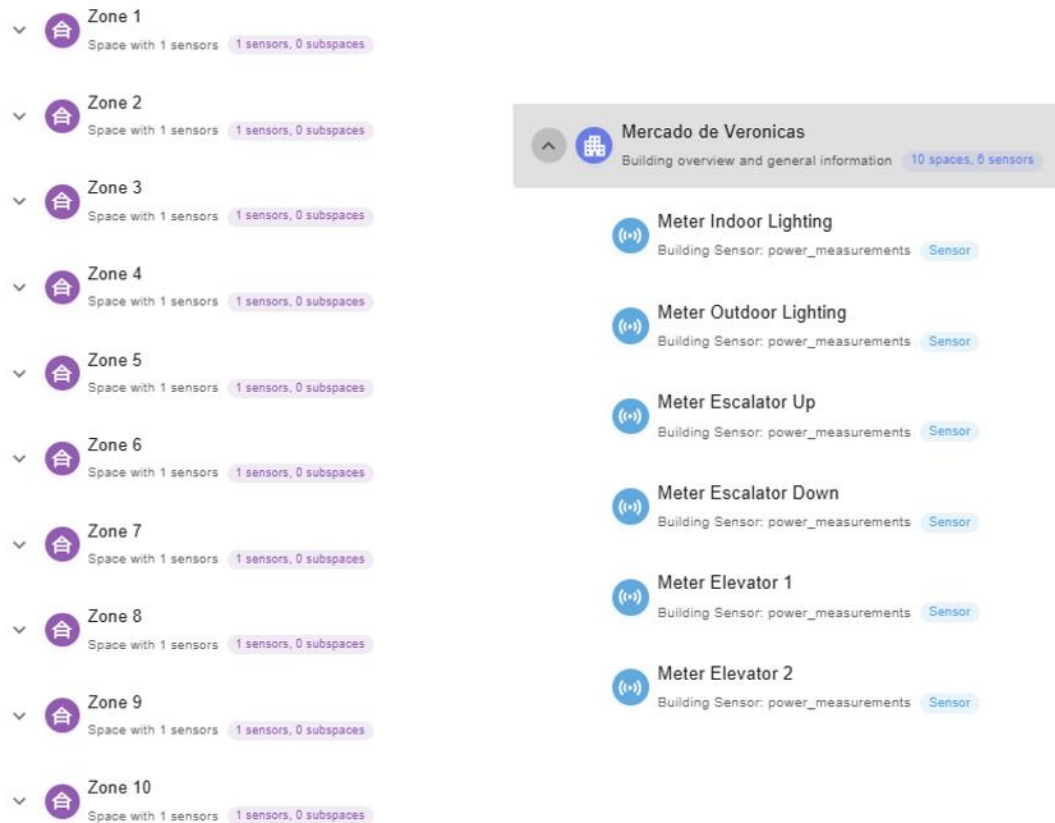


Figure 52. Hierarchical spatial and sensor tree of Mercado de Verónicas ground floor.

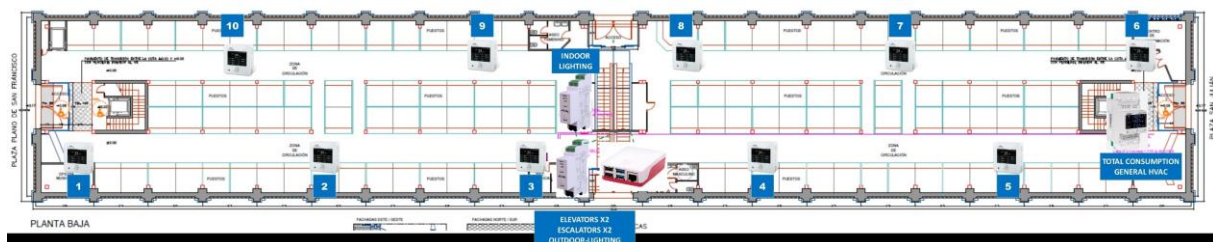


Figure 53. Sensor layout within the Mercado de Verónicas pilot site

These are the devices currently installed:

IAQ sensor

Sensors continuously monitor indoor environmental conditions, providing real-time data on:

- Indoor temperature;
- Indoor humidity;
- Noise level;
- Illuminance;
- CO₂ concentration;
- PM2.5;

- Total Volatile Organic Compounds (TVOC);
- Smoke.



Figure 54. MCO Home Multi Sensor

Additionally, presence/occupancy meters measure, by zones, the number of people inside the market based on their mobile phones and Bluetooth signals. The data are sent via API to a database, where it can be accessed by AccesS Suite (already integrated).

There are currently 11 devices installed, covering virtually the entire market. The figure below shows the location of the installed devices and the approximate coverage area of each one

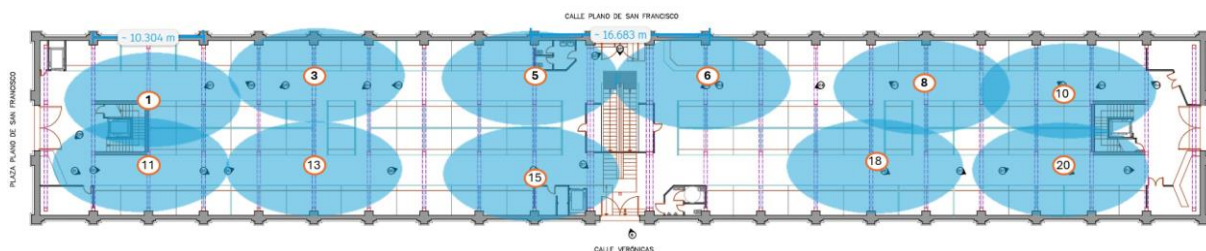


Figure 55. Location and approximate coverage area of the presence/occupancy meters installed at the Mercado de Verónicas

4.2.3.2 Meters

Energy consumption is monitored through different dedicated meters (Shelly Pro 3EM) that provide real time data on electricity use, enabling performance assessment and supporting optimization strategies.



Figure 56. Shelly Pro 3EM energy meters

The monitored consumption is disaggregated into the following categories:

- Total electrical energy consumption;
- Electrical energy consumption associated with indoor lighting;
- Electrical energy consumption associated with outdoor lighting;
- Electrical energy consumption associated with HVAC systems.

4.2.3.3 Systems

Cooling/Heating

The building is equipped with 6 HITECSA air handling units, each with a cooling capacity of 59.4 kW and a heating capacity of 63.4 kW. The nominal electrical power is 24 kW.

Lighting

The building is equipped primarily with lighting systems, which are deployed across most indoor spaces to ensure adequate illumination levels. Actually around 50% are LED-based lighting systems to ensure adequate illumination levels and energy efficiency.

4.2.4 Deployment Timeline

From June to December 2025, the activities were primarily focused on the procurement and installation of sensors. This includes the identification and selection of the most appropriate monitoring solutions, followed by the installation and commissioning of the selected devices. MCO Home multisensor were installed to monitor indoor air quality, while Shelly devices were deployed to measure electrical energy consumption. All sensors were connected to Voltiva's SQL-based infrastructure to guarantee stable and continuous data collection. The resulting datasets are then shared with project partners for integration in the AccesS Suite via custom APIs designed and operated by Voltiva team. CETEM installed the presence/occupancy sensors; these sensors are connected to an SQL infrastructure where all data is reliably received and stored via APIs managed by CETEM. Access was also provided to all partners via this API. From January to May 2026, the activities were focused on validating the continuous monitoring of data between the sensors and the platform and the maintenance of all the devices.

5 AccesS Business Mapping upon Pilots

5.1 AccesS Key Target Groups

Following the analysis that took place during WP1 and documented within D1.2, three Business Groups have been introduced aligned with the three pillars of project development as described in the Grant Agreement, in order to facilitate understanding the business value offered by AccesS. Those Business Groups reflect the needs and market demands of key target groups as identified in the Grant Agreement. The methodology adopted for the recognition of relevant stakeholders is specified by the Project Management Institute (PMI). This method applies a category approach to identify the important stakeholders based on three categories. According to this definition, a project stakeholder is, "an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project." AccesS Key Target Groups are analysed in the following table.

Table 16. Description of AccesS Key Target Groups

Key Target Groups	Description	Types of individuals/ groups
Those who affect the creation of an accessible and inclusive built environment	This category includes the stakeholders participating in the delivery of accessible and inclusive buildings and cities and those who determine the context for that. This category mainly includes organizations/companies designing and constructing the built environment and developing relevant software as well as the entities who set the legal framework and specific rules for accessibility. National policies and legal framework set the scope (tasks) for regulation and for the promotion of accessibility, comfort and inclusiveness within communities, standardization organizations develop standards with experts in Technical Committees developing the methodology for assessment.	Building Industry, Professional consultants (e.g., architectural, engineering and financial), Tool developers Energy service companies (ESCOs), Building Material and Product Industries, State/Governmental Departments – Public Bodies EU legislative instruments Standardization organizations
Those who are affected by the creation of an accessible and inclusive built environment	This category includes the stakeholders who are directly or indirectly affected by the creation of accessible and inclusive buildings and cities. Inclusive smart buildings should incorporate universal design principles, ensuring that the physical environment, infrastructure, and technologies are usable by all individuals, regardless of their abilities. The property value for rental or sale can also be affected by the accessibility in a building.	Users of the buildings, Owners/Users, Facility managers, General Public, Local community groups such as resident associations, social cooperatives or other community-based groups

Those who are interested in the creation of an accessible and inclusive built environment	The stakeholders under this category may be interested on the outcomes and methodology for creating environments that are accessible and supportive for all individuals for different applications according to the context.	Researchers/ Academia, Environmental/ social campaigning organisations, organisations representing people with disabilities, Potential users/clients for future projects
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Accordingly, the AccessS Suite is planned to engage the following stakeholders:

- **Engineer/ Building designer:** The person responsible for the design, construction/ renovation of buildings, who has an engineering background and additionally is qualified for the design and realization of an accessible and inclusive built environment. This stakeholder type can act as collaborators and catalysts for delivering AccessS and can help improve the proposed framework and services.
- **Owner/ Tenant of a building:** The owner of the property or multiple properties, which are managed under common access from one digital place. The tenants of the building also have access to the Suite. They receive useful information regarding the building, such as the energy consumption, indoor air quality, occupancy etc., as well as personalized suggestions towards building energy efficiency, comfort and accessibility.
- **Building/ Facility Manager:** In the case of larger buildings, building/ facility managers also have the opportunity to access the platform and to monitor the asset's operational condition, simulate user experience under different scenarios and receive actionable recommendations for optimizing energy performance and improving indoor conditions based on real-time data.
- **Product designers/ Manufacturers:** Designers and manufacturers stakeholders have the ability to insert information about their furniture items in the platform and assess their ergonomic compliance or access product designs that meet the accessibility and comfort needs of senior citizens and people with functional diversity.
- **Public bodies/ Authorities/ Policy Makers:** They can have access to aggregated data that may contribute to the redefinition or the update of the current policies for enhancing the accessibility and sustainability of the built environment.
- **Utilities, ESCOs:** Similarly to the building industry stakeholders, utilities can improve their services through the AccessS Suite (e.g., energy performance assessment, accessibility certification etc.). Furthermore, they can have access to the operational data of their customers.
- **Real Estate Agencies, Financial Institutions/ Banks:** They can have a general overview of the building market in terms of accessibility and energy efficiency. Such information may assist their decision-making process in various ways.
- **AccessS Suite Tool Developer/ Administrator:** The team of people responsible for the platform's and relevant tools' operation. Their main concern is to ensure smooth service delivery and identify and solve any issues that emerge during platform/ tool operation.

5.2 Business Scenarios and Use cases

The table provides an overview of the updated use cases across the different Business Groups of the project. These use cases cover the full scope of the AccessS Suite platform, from accessibility assessment and inclusive design of the built environment, to energy optimisation, comfort evaluation, and intelligent building operation, as well as the integration of electric vehicles as active components of the energy system. Each use case has been refined and aligned with the requirements and specifications defined in earlier project work, particularly Deliverable 1.2, to ensure consistency across all tools and pilots. Overall, the table shows how the different functionalities of the platform come together to support accessible, efficient, and sustainable building environments.

Table 17. AccessS Business Groups, Business Scenarios and Use Cases

Business Group A: Common evaluation and certification of Accessibility		Description	Pilot Mapping
BS1	Assessment of accessibility for the built environment		
UC1.1	Assessment of physical accessibility	This use case enables involved actors to systematically evaluate accessibility features in buildings and built environments in accordance with established accessibility guidelines and the assessment framework defined within the project. Users provide building information, assign weights to Disability Types (DT), and configure assessment dimensions and evaluation criteria related to physical accessibility. They then assess the building by scoring each criterion using a standardized scale, after which the tool calculates weighted results to produce an overall building score and detailed insights. The results are presented through an interactive dashboard, including the cumulative impact score of physical accessibility, scores per disability type and assessment dimension, and a detailed assessment breakdown, supporting informed decision-making and identification of improvement areas.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC1.2	Assessment of usability, safety and comfort	This use case enables involved actors to systematically evaluate accessibility features in buildings and built environments in accordance with established accessibility guidelines and the assessment framework defined within the project. Users provide building information, assign weights to Disability Types (DT), and configure assessment dimensions	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3

		and evaluation criteria related to usability, safety and comfort. They then assess the building by scoring each criterion using a standardized scale, after which the tool calculates weighted results to produce an overall building score and detailed insights. The results are presented through an interactive dashboard, including the cumulative impact score of safety and environmental comfort, scores per disability type and assessment dimension, and a detailed assessment breakdown, supporting informed decision-making and identification of improvement areas.	☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC1.3	Assessment of social inclusion	This use case enables involved actors to systematically evaluate accessibility features in buildings and built environments in accordance with established accessibility guidelines and the assessment framework defined within the project. Users provide building information, assign weights to Disability Types (DT), and configure assessment dimensions and evaluation criteria related to social inclusion. They then assess the building by scoring each criterion using a standardized scale, after which the tool calculates weighted results to produce an overall building score and detailed insights. The results are presented through an interactive dashboard, including the cumulative impact score of social inclusion and human experience, scores per disability type and assessment dimension, and a detailed assessment breakdown, supporting informed decision-making and identification of improvement areas.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC1.4	Issue an assessment report according to AccesS Accessibility Assessment Scheme	This use case will provide an assessment certification report detailing the results of the accessibility evaluation. In detail, it will provide a clear report based on the accessibility evaluation results for a specific building environment according to the AccesS Accessibility Scheme.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6

Business Group B: Design of accessible and inclusive built environment		Description	Pilot Mapping
BS2	Optimization of energy efficiency and user comfort		
UC2.1	Assessment of baseline building energy performance	This use case describes how the EESDT platform automatically evaluates a building's performance once a user selects a project from available IFC files. The system retrieves the selected building model, gathers relevant weather data, and processes the information through simulation and analysis engines. It converts the building model into the required formats for energy simulation and smart readiness assessment, runs the necessary calculations, and derives key performance indicators. Finally, it combines the energy and smart readiness results into a baseline evaluation and presents them to the user in a single, unified view through the interface.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC2.2	Generation and evaluation of BIM-based renovation scenarios	This use case describes how the EESDT platform supports users in evaluating different building renovation options. The user selects a set of renovation measures through the interface, after which the system generates multiple what-if scenarios based on the chosen interventions. Each scenario is processed through energy and smart readiness simulation workflows, where the building model is converted into the required formats, simulations are run, and key performance indicators are calculated. The system evaluates both energy performance and smart readiness for each renovation scenario and compiles the results. Finally, the user accesses results view where the baseline and all renovation scenarios are presented together with their associated KPIs for comparison.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC2.3	Visualization of baseline and renovation scenarios KPIs to support decision making	This use case describes how the EESDT platform supports building performance optimization. The user selects an optimization option through the interface and chooses a preferred strategy from the available methods. The system then sends this selection to the Decision Support Engine, which performs the optimization process to identify the	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3

		best-performing solutions based on the chosen approach. Once the optimization is completed, the results are returned to the platform. The EESDT interface then retrieves both the optimization outcomes and relevant renovation information and presents them to the user in a clear results view.	☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC2.4	Simulate occupant comfort levels and its impact on the building's energy consumption	This use case describes a workflow where a user runs a building comfort and energy simulation through the Energy Comfortness Dashboard. The system collects the selected building and user-defined settings, processes the building model, and evaluates indoor comfort and energy performance using simulations and standards-based calculations. It then aggregates the results into overall comfort and energy indicators and presents them to the user in a visual dashboard.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC2.5	Monitor occupant comfort levels and its impact on the building's energy consumption	This use case describes how the Energy Comfortness Dashboard continuously monitors and evaluates indoor comfort and energy performance for selected building spaces. After logging in, the user selects a space and occupant profile, and the system retrieves live and historical sensor data along with building information. It then processes this data using pre-trained models and simulations to calculate comfort indicators, energy metrics, and overall comfortness. The results are displayed in real time on the dashboard with visual trends and performance summaries. The system continues to update these evaluations periodically based on incoming sensor data, allowing ongoing monitoring of building conditions.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
BS3	Design of ergonomically adapted products		
UC3.1	Evaluate the ergonomics of 3D models of furniture items	This use case describes how the ErgoFlow tool evaluates the ergonomics of a new product design. A designer uploads a 3D model and provides basic information about the intended users and use case. The system retrieves relevant evaluation parameters from an ergonomics database and then guides the user through a set of questions to assess each	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2

		parameter. Based on the user's responses, it calculates the corresponding ergonomic indicators and compiles the results. Finally, ErgoFlow generates a full evaluation report covering ergonomics, accessibility, comfort, and safety compliance, which is presented to the user along with recommendations for improving the design.	☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC3.2	Visualisation of ergonomics results of products	An architect or product designer accesses the ErgoFlow library and selects a specific item from the catalogue of ergonomic products. The ErgoFlow library supports both uploading and downloading 3D models of furniture based on the project's use cases and categories (e.g., chairs, tables).	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
BS4	Realistic human representation and simulation of user experience		
UC4.1	Digital authoring of Virtual User Models (VUMs)	The editor offers intuitive user interfaces for configuring user model parameters in line with the VUM specification (the sematic representation of anthropometric and other parameters that describe aging individuals and people with disabilities).	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC4.2	VUM-based Virtual Human authoring	The editor offers intuitive user interfaces for configuring user model parameters in line with the VUM specification (the sematic representation of anthropometric and other parameters that describe aging individuals and people with disabilities).	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3

			☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC4.3	3D Environment Annotation (SANTO)	This use case describes how a user creates and annotates a 3D building model in the SANTO system. The user either uploads a new IFC file or loads an existing project, then prepares and opens it in the 3D environment. Inside the system, the user selects building elements and adds annotations such as object type, behaviour, and constraints, either manually or automatically. The annotated objects can be positioned, adjusted, and optionally previewed through simple simulations. Once the work is completed, the system saves the project and generates both a 3D model file and a structured annotation file describing the building elements and their properties.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC4.4	3D accessibility simulation for pilot sites	This use case describes a system where a user tests virtual human movement models (VUMs) in a 3D environment. After logging in, the user loads a selected environment and defines a simulation scenario made of navigation and interaction steps. The user then chooses a VUM and runs the simulation, where the avatar attempts to complete the defined tasks. The system evaluates performance by detecting errors when actions cannot be completed and warnings when movements approach physical limits. After execution, the results are displayed in a report showing issues and constraints in the model, and the user can easily rerun the simulation with a different VUM if needed.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
Business Group C: Intelligent, adaptive and sustainable operation of the built environment		Description	Pilot Mapping
BS5	Monitor and Optimize building operation		

UC5.1	Provide real-time/historical information on building's energy performance	This use case describes how a user monitors building energy data through the BOMS interface. The user selects a building and defines the monitoring preferences, such as time period, data type, and level of detail. The system then requests the relevant energy data from the information management layer, retrieves it through the API, and returns it to the interface. Finally, the data is processed and displayed visually in the chosen format, allowing the user to explore and analyze energy consumption or generation patterns.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☐ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC5.2	Provide real-time/historical information on building's indoor conditions	This use case describes how a user monitors indoor environmental conditions at space level through the BOMS interface. The user selects a building and navigates to the space monitoring section, where they configure the type of data they want to view, such as real-time or historical indoor conditions, along with the time range and visualization settings. The system then retrieves the relevant sensor data, including parameters like temperature, humidity, and CO ₂ levels, from the information management layer. Finally, the data is returned to the interface and displayed visually, allowing the user to analyze indoor conditions for the selected space.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC5.3	Provide recommendation for improving operational energy performance	This use case describes how the BOMS system generates an energy optimisation report for a selected building. After the user requests the report, the system gathers forecasted energy consumption and generation data along with external energy price information. A multi-agent process then analyses this data to identify trends, inefficiencies, and optimisation opportunities. Based on this analysis, the system produces a structured report with recommended actions for improving energy usage. The final report is stored and then presented to the user through the interface to support decision-making.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☐ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC5.4	Provide recommendation for	This use case describes how the BOMS system generates indoor conditions report for a selected building. After the user requests the	☐ The Christo and Jeanne-Claude Center, Demo site #1

	conditions in terms of health and comfort	report, the system collects current and historical sensor data such as temperature, humidity, and CO ₂ levels, along with forecasts of future indoor conditions. A multi-agent process then analyses the data, summarising the current environmental state and evaluating potential future risks. Based on both present conditions and predicted trends, the system produces a final report with recommended actions to mitigate or prevent issues. The report is stored and then displayed to the user through the interface to support building operation decisions.	☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
UC5.5	GIS-based visualisation and crowdsourced assessment of building accessibility features	This use case describes how a user views and rates the accessibility of a building through the platform. After selecting a building, the user can access detailed information and navigate to an accessibility section where they can evaluate it based on predefined criteria. The user assigns ratings for each criterion or marks them as unknown or not applicable, then submits the evaluation. The system processes the input, updates the building's accessibility score, and displays the updated results, allowing the user to repeat the process for other buildings if needed.	☒ The Christo and Jeanne-Claude Center, Demo site #1 ☒ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☒ Palazzo di Città, Demo site #5 ☒ Mercado de Veronicas, Demo site #6
BS6	Integrate Electric Vehicles as Active Building Element		
UC6.1	Optimise EV Charging in Building Infrastructure	This use case describes how the EV Charging Optimizer processes charging station data to support both drivers and operators. Charging stations send usage and session data to the system, which also receives grid capacity limits. The data is cleaned, processed, and analysed to identify charging patterns, station usage, and accessibility trends. The results are updated daily and visualised in dashboards. EV drivers use these insights to find less busy charging times, while operators and site managers monitor station performance, energy use, and overall charging behaviour through dedicated dashboards.	☐ The Christo and Jeanne-Claude Center, Demo site #1 ☐ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☐ Palazzo di Città, Demo site #5 ☐ Mercado de Veronicas, Demo site #6
UC6.2	Enable EVs to Act as Distributed Energy Resources (DERs)	This use case describes how the system evaluates the future scalability of EV charging infrastructure. The operator defines key parameters such as grid capacity and expected growth in charging stations, while the	☐ The Christo and Jeanne-Claude Center, Demo site #1

		system uses historical usage data to simulate future demand. The projected demand is then compared with grid limits to identify potential overload situations. When constraints are exceeded, the system applies load-shifting optimisation to redistribute charging demand more efficiently. The results are shown on a dashboard, allowing operators to understand future grid impacts and decide whether optimisation strategies are sufficient or if infrastructure upgrades are required.	☐ Brancacci Chapel, Demo site #2 ☒ Droom je Thuis Foundation, Demo site #3 ☒ Casa Girasole, Demo site #4 ☐ Palazzo di Città, Demo site #5 ☐ Mercado de Veronicas, Demo site #6
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6 Conclusions

This deliverable presented the preparation and set-up activities carried out within WP9 Pilot Cases I–III preparation and set up during the period M13–M24 of the AccesS project. The work focused on the six pilot sites involved in the project demonstrations, covering Pilot Cases I – Cultural Heritage Buildings, Pilot Cases II – Elderly Home Facilities, and Pilot Cases III – Public Services Buildings.

The activities performed during this phase included the analysis of the pilot sites and their operational context, the collection of technical and environmental baseline information, the development and update of BIM models where applicable, the preparation of monitoring infrastructures and sensor deployment strategies, as well as the identification of accessibility, usability and sustainability requirements relevant to the AccesS framework and digital solutions.

The deliverable also documented the different implementation conditions and operational characteristics of each pilot site, reflecting the diversity of building typologies, management conditions and deployment scenarios addressed within the project. The preparation activities were carried out in close coordination with the pilot managers and the technical partners involved in the related implementation and integration tasks.

Overall, the outcomes of WP9 provide the operational and technical basis for the forthcoming deployment, monitoring and assessment activities foreseen in the subsequent work packages of the project. The pilot sites are now prepared to support the implementation and validation phases of the AccesS framework, tools and services in the next stages of the project.

Enhancing Accessibility and Sustainability in Smart Cities and Smart Buildings: The Universal Accessibility Suite Initiative



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