D7.2 – AccesS Suite v1

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DELIVERABLE 7.2 AccesS Suite v1

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Executive Summary

This deliverable presents the fully integrated AccesS Suite, which was developed as part of Task T7.2 AccesS Inclusive Toolbox - Integration of Components of WP7. It brings together all digital components from the technical work packages to create a single, modular, and customizable platform. This includes software libraries, service components, visualization interfaces, and adapters for platforms, devices, and hardware used in the project pilots. The platform is designed with user-friendly, accessible interfaces to ensure usability for people with disabilities and older adults. It also provides a unified authentication service, enabling secure and seamless access to all platform components and functionalities.

The AccesS Suite has been tested in controlled environments and iteratively refined based on insights from demonstrations. Its modular design allows for various configurations to meet the specific requirements of each pilot, ensuring flexibility and adaptability.

The deliverable provides a fully functional, integrated toolbox that is ready for pilot testing, demonstrating the platform's interoperability, accessibility, and readiness for deployment in real-world environments. An updated version is expected by M32 *(D7.5 AccesS Suite v2)*, reflecting any improvements on the platform's performance and functionalities.

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List of Acronyms and Abbreviations

Term	Description
API	**Application programming interface**
BIM	**Building Information Modelling**
BMS	**Building Management System**
BOMS	**Building Operation and Management System**
ECT	**Energy Comfortness Tool**
EESDT	**Energy Efficient and Sustainable Design Tool**
EVC	**EV Charging Optimizer**
IAM	**Identity and Access Management**
IFC	**Industry Foundation Classes**
LLMs	**Large Language Models**
OIDC	**OpenID Connect**
RAG	**Retrieval-Augmented Generation**
RE GIS	**Geographical Information System**
RBAC	**Role-Based Access Control**
SSO	**Single Sign-On**
VHs	**Virtual Humans**
VUMS	**Virtual User Models**

1 Introduction

1.1 Scope and objectives of the deliverable

This deliverable (D7.2) outlines the design and implementation approach of the AccesS Suite, a unified and modular platform that integrates the digital tools developed within the project. It describes the platform's architecture, integration mechanisms, core functionalities, and deployment strategy, with the aim of supporting accessible, inclusive, and sustainable built environments.

1.2 Structure of the deliverable

This document is organized into seven sections that describe the overall concept of the AccesS Suite, its architecture and integration approach, platform functionalities and services, technical infrastructure, validation activities, and future development directions. In particular, the structure of the delivarable is as follows:

- **Section 2** provides a general description of the platform.
- **Section 3** details the technical design, integration mechanisms, and relationships between the platform components.
- **Section 4** describes the key services, tools, and user interfaces provided by the AccesS Suite.
- **Section 5** outlines the deployment strategy, technical requirements, and infrastructure considerations.
- **Section 6** concludes with a summary and next steps.
- **Section 7** lists the references and source materials used.

1.3 Relation to Other Tasks and Deliverables

The AccesS Suite was developed and implemented as part of T7.*2 Access Inclusive Toolbox – Integration of Components* within WP7. This deliverable builds on the outcomes of previous project tasks relating to system architecture (WP1), tool development and methodological frameworks (WP4-WP6, T7.1). It consolidates and integrates these results into the AccesS Suite, the project's core platform. This task incorporates inputs from all technical tasks and deliverables from WP4, WP5, WP6 and WP7 (T7.1), ensuring that the interfaces and functionalities of the other tools are fully integrated into the unified AccesS Suite. This task is also closely connected with T1.3 in WP1 [1], where the Access Suite architecture is defined, as well as with T7.3 where the integrated suite is tested in a controlled environment and with WP9 and WP10–12, which enable the system to be validated and demonstrated in real pilot environments.

2 AccesS Suite Overview

2.1 Vision and platform goals

The AccesS Suite is a unified, modular, and customizable platform, designed to support accessible, inclusive, and sustainable urban built environments. Its primary goals are to integrate the digital tools developed throughout the project, to provide users with efficient and secure access, and to enable the system to be deployed on a large scale across different pilot sites. The platform emphasizes accessibility, usability, and adaptability, ensuring that people with disabilities and older adults can interact effectively with the system.

2.2 Value proposition

The AccesS Suite offers a comprehensive toolbox that consolidates software components, service modules, visualization interfaces, and hardware adapters into a single platform. By providing a modular structure and a unified authentication service, the platform reduces complexity, improves interoperability, and allows tailored configurations for specific pilot needs. Its design ensures both operational efficiency for project stakeholders and enhanced user experience for end-users.

2.3 High-level structure aligned with AccesS pillars

The platform's architecture reflects the core pillars of the project: accessibility, inclusivity, energy efficiency and a sustainable built environment. Components are organized to support modular deployment, flexibility, and easy extension. Core modules include service components, visualization interfaces, adapters for devices and protocols, and a unified authentication layer. Optional modules can be added or customized according to pilot requirements.

- **Accessibility and Inclusivity** (Pillar 1) is supported through user-centered design, accessible interfaces, and tools such as the Universal Accessibility Assessment Tool (T7.1).
- **Energy Efficiency and Sustainable Built Environment** (Pillar 2) integrates components like the Energy Efficient & Sustainable Design Tool (T4.1), Energy Comfortness Tool (T4.2), ErgoFlow (T4.3), Virtual User Models & VUM-based Virtual Humans (T5.1), and 3D Simulation Environments (T5.2).
- **Intelligent and Adaptive Operations** (Pillar 3) includes modules such as the BOMS Adaptive Building Operation & Management System (T6.1) and the EV Charging Optimizer (T6.3).

This structure ensures that the AccesS Suite is fully aligned with the project's objectives.

3 Platform Architecture and Integration

The Access Suite platform serves as a centralized digital hub that provides facility managers with unified access to a wide range of building management, accessibility, and energy efficiency services. Designed to streamline operations, enhance situational awareness, and support data-driven decision-making, it integrates seamlessly with heterogeneous systems and tools.

3.1 Overall system architecture

The platform follows a modular, service-oriented architecture, integrating multiple independent services under a common access and management layer. These services are deployed on distributed servers and communicate through standardized interfaces, which enables the scalability, maintainability, and independent evolution of each subsystem. The architecture is organized into four primary layers:

- **Representation Layer**: a web-based frontend developed in React, providing a responsive and user-friendly interface for accessing all platform functionalities.
- **Application Layer**: a backend implemented in Node.js, responsible for business logic, service orchestration, and secure communication.
- **Interoperability Layer**
    - **Integration Layer** (Central API): a unified API that enables standardized access to shared data and services based on a common information model.
    - **Data Layer**: a PostgreSQL database enhanced with TimescaleDB [2] extensions, optimized for managing relational and time-series data.

The following figure illustrates the key modules (green colour) of the "**AccesS Suite"** and the interactions with other components and tools.

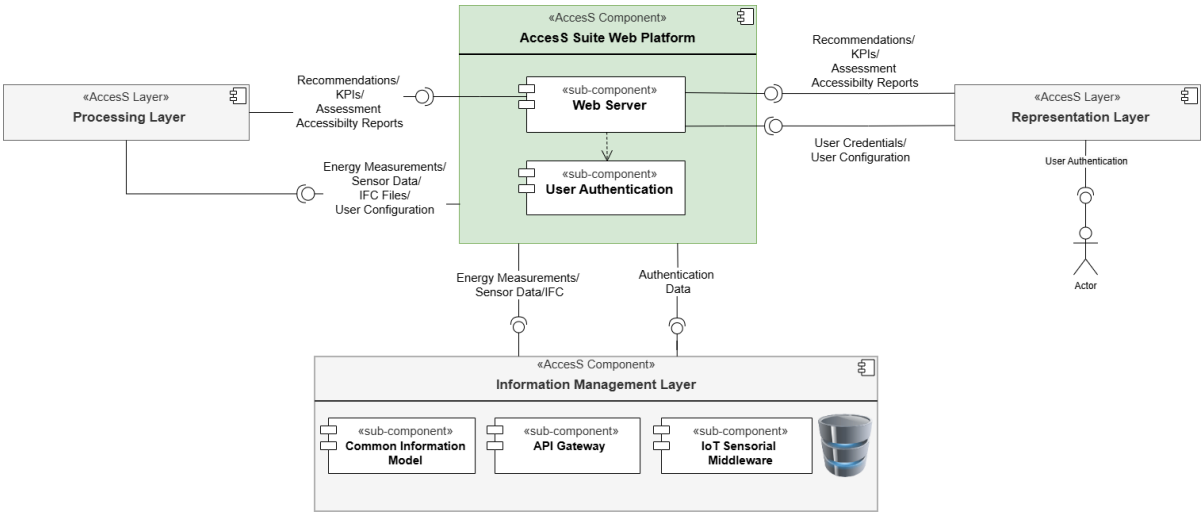

Figure 1 AccesS Suite Component Diagram

3.2 Identity and access management

The platform implements centralized Identity and Access Management (IAM) using Keycloak [3], an open-source identity and access management solution which provides:

- Single Sign-On (SSO) authentication
- centralized user management
- role-based access control (RBAC)
- identity federation capabilities

Authentication is based on OpenID Connect (OIDC) and OAuth 2.0 [2] protocols. The authentication flow typically follows these steps:

- The user accesses the platform interface.
- The user is redirected to the Keycloak [2] authentication server.
- After successful authentication, Keycloak issues a **JWT access token**.
- The token is included in subsequent API requests.
- Backend services validate the token and enforce access policies.

In addition to user-level authentication, the platform can enforce role-based and resource-level access control for backend services that interact with the Central API. Each service requiring programmatic access to the Central API is registered in Keycloak as a confidential client and is assigned a unique clientId / clientSecret credential pair. These credentials enable services to authenticate themselves when communicating with the platform via machine-to-machine interactions. The authentication and authorization process for backend services follows the sequence below:

Service Request Initialization: a backend service sends an HTTP request to the Central API including the x-client-id and x-client-secret headers with their respected values

Credential Validation: upon receiving the request, the Central API verifies the credential pair provided by performing a validation request against the Keycloak authentication API.

Authorization Context Resolution: if the credentials are successfully validated, the Central API queries the platform database to retrieve the **authorization configuration associated with the clientId**, which includes the client's assigned roles and permissions as well as building access.

This mechanism allows backend services to perform autonomous operations securely such as data ingestion, analytics processing, synchronization tasks, or scheduled procedures.

3.3 Central API and Common Information Model

A core component of the platform is the Access Suite Central API, which acts as the primary data exchange and interoperability mechanism among all integrated services. The Central API exposes standardized endpoints that provide access to harmonized data structures defined by a common information model. This model establishes a shared semantic framework for representing buildings, spaces, assets, sensors, users, accessibility features, and energy-related metrics across all pilot sites.By enforcing a unified data schema and vocabulary, the common information model ensures:

- Semantic interoperability between heterogeneous systems
- Consistent interpretation of operational data
- Simplified service integration and onboarding
- Reusable analytics and reporting components
- Cross-site comparability and benchmarking

All platform services retrieve and exchange data through the Central API, ensuring that information remains synchronized, validated, and compliant with the agreed model definitions.

3.4 Service Integration and Interoperability

Each service within the platform is developed and deployed independently, focusing on specific functional domains such as facility management, accessibility assessment, or energy performance analysis. This modular approach enables services to evolve autonomously while remaining interoperable within the wider ecosystem. Services primarily interact with the platform primarily through the Central API and complementary RESTful or event-driven interfaces. This integration model supports loose coupling between components, ensuring flexibility, scalability, and long-term maintainability, while preserving system-wide data consistency through the common information model.

To facilitate the continuous expansion of the platform, Access Suite incorporates a dynamic service management system that enables administrators to integrate new services without redeploying the system or making major configuration changes. Through a dedicated administrative interface, authorized users can register and configure new tools by defining:

- Service endpoint and deployment URL
- Service title and functional description
- Access roles and permission policies
- Visibility and availability parameters

Once registered, services are automatically incorporated into the platform's navigation, access control framework, and user interface, ensuring seamless integration with existing components. The figure below illustrates the User Interface (UI) for adding a new service to the platform.

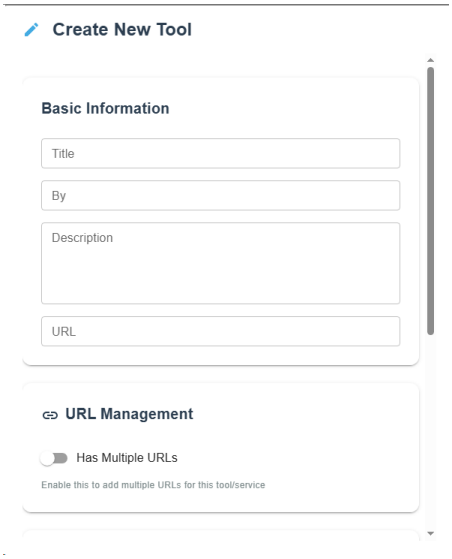

Figure 2 Create new Tool UI

The dynamic management mechanism is tightly coupled with the centralized identity and access management infrastructure. Role-based access control policies are automatically updated to reflect newly introduced services, ensuring that only authorized users can access specific tools and functionalities. This dynamic integration framework offers the following advantages:

- Rapid onboarding of new services and tools
- Reduced operational overhead for system administrators
- Consistent enforcement of security and governance policies
- Improved adaptability to evolving project and stakeholder requirements
- Support for long-term platform extensibility

By combining independent service deployment, standardized data exchange through the Central API, and dynamic service management, the platform achieves a high degree of modularity and operational flexibility while maintaining architectural coherence.

3.5 Data Management

The PostgreSQL–TimescaleDB infrastructure provides a scalable foundation for storing and processing both transactional and time-series data. Structured operational records coexist alongside high-frequency sensor streams and historical energy measurements. This hybrid data architecture enables:

- Real-time and near-real-time monitoring
- Long-term trend analysis
- Predictive analytics
- Performance optimization and anomaly detection

The common information model further enhances data usability by providing standardized metadata and contextual relationships.

4 Platform Functionalities and Services

4.1 Core Platform Tools

The platform provides a comprehensive environment designed to support building management, operational monitoring, and user interaction across multiple pilot sites. It integrates a variety of tools and services that facilitate the configuration and organization of building-related information, visualization of building models, management of user access, and exchange of operational data.

A centralized authentication and authorization system allows users to access all platform services through a single login while ensuring secure management of user accounts and roles. Role-based access ensures that users only interact with the functionalities and data relevant to their responsibilities, supporting both security and operational efficiency.

The Building Management System (BMS) enables administrators, facility managers, and building owners to create building profiles, define characteristics, and configure system components for each deployment. By centralizing building information, the platform ensures consistency across pilot sites and supports monitoring, planning, and operational decision-making.

The integrated Building Information Modelling (BIM) Management System and IFC Viewer give users access to standardized digital building models. They can use these to explore layouts, view structural elements, and examine detailed building information. These functionalities enhance planning, asset management, and collaboration, while allowing interoperability with external BIM tools and systems.

The platform also provides API access for secure data exchange between the suite and integrated tools. APIs support the collection, management, and sharing of measurements and operational data, enabling coordinated operation and interoperability across platform components.

To support communication and continuous improvement, the platform offers tools for submitting contact messages, reporting issues, and providing feedback. These tools allow administrators to monitor inquiries and technical issues, respond efficiently, and implement improvements to ensure the platform operates smoothly.

A chatbot assistant is available to guide users, offering real-time answers to common questions and support for routine tasks. This improves usability, helps users navigate platform functionalities efficiently, and reduces the need for direct support.

Finally, accessibility features ensure that the platform can be used by a wide range of users, including older adults and individuals with disabilities. With clear navigation, interface adjustments, and accessibility-oriented tools, the platform provides an inclusive and user-friendly environment for all users.

4.1.1 Role Management

The Role Management interface allows administrators to define and customize user permissions across the platform. The main dashboard provides an overview of existing roles, such as admin, building manager, and engineer, offering a clear summary of each role's purpose. From this view, users can select an existing role to modify its settings or click the "new role" button to create a completely new set of permissions. This interface ensures that a new role can be added to the system whenever specific access requirements change.

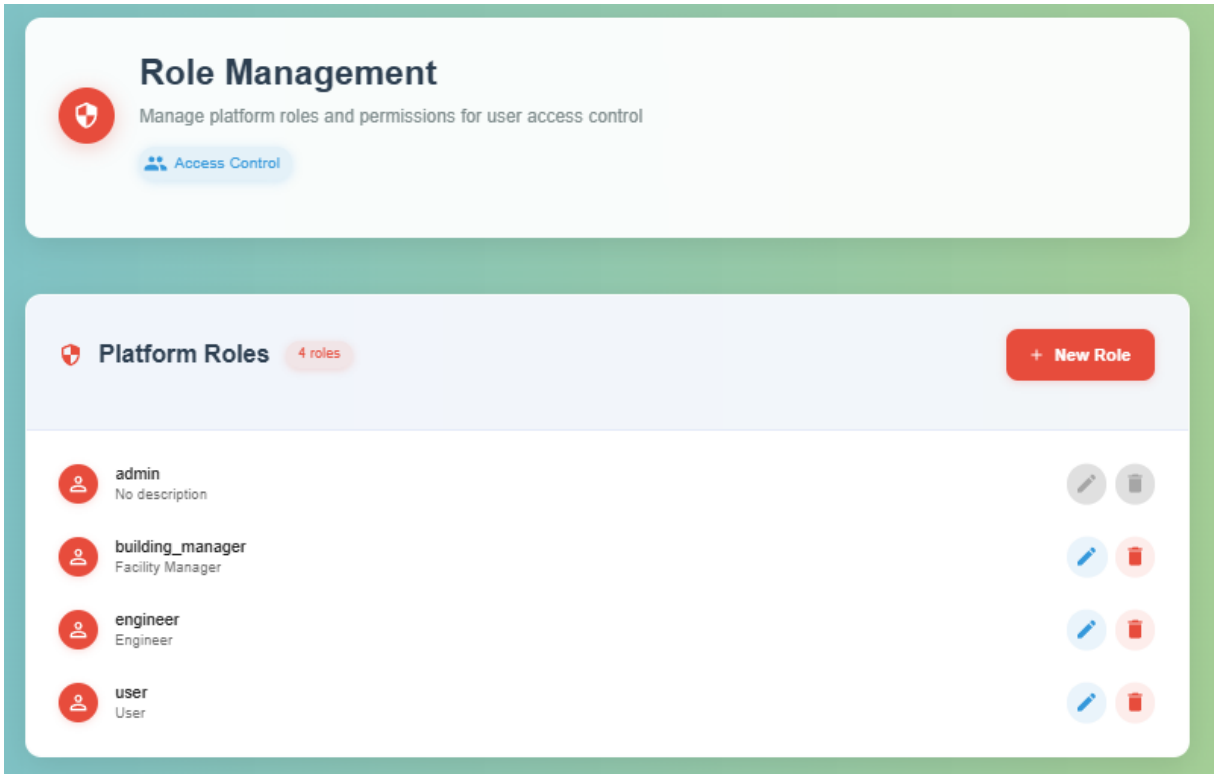

Figure 3. Role Management dashboard showing the list of defined platform roles and their descriptions.

When editing a role, the configuration window provides granular control over system capabilities. Administrators can update the role name and description before managing a detailed list of permissions categorized by function, such as building management, data measurement, and alarms. For each category, the system shows exactly how many individual permissions are enabled out of the total available, allowing precise tailoring of security based on the user's actual responsibilities.

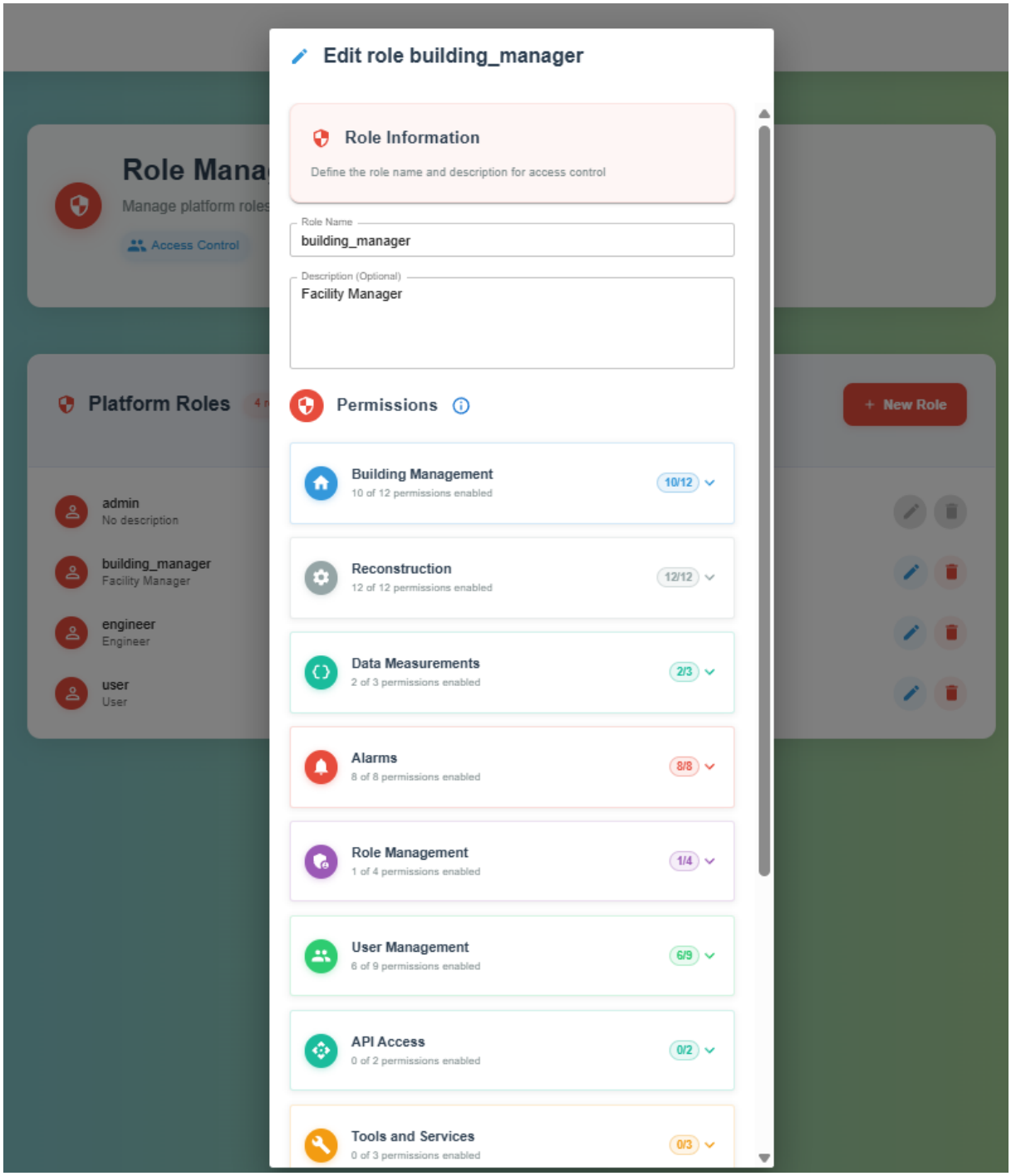

Figure 4. Detailed permission configuration screen for specific roles, illustrating the categorical breakdown of system access rights.

For example, in the **Building Management** section of the Facility Manager role:

- **View Buildings** is enabled, allowing users to access and review building information.
- **Edit Buildings** is enabled, giving users permission to modify existing building data.
- **Create Buildings** is disabled, preventing users from adding new buildings to the system.
- **Delete Buildings** is disabled, ensuring that critical assets cannot be removed.

This configuration reflects a typical Facility Manager setup, in which users are responsible for maintaining and updating existing assets but are restricted from performing high-impact actions such as creation or deletion. The interface uses visual cues such as checkmarks, color highlights, and status labels (e.g., “Enabled”) to clearly indicate which permissions are active.

Such granular control allows administrators to precisely align system access with job responsibilities. For instance, a role can be configured to allow operational edits while restricting structural or administrative changes, thereby reducing the risk of accidental or unauthorized modifications. This approach ensures both security and efficiency, as each user is equipped with precisely the tools they need - no more, no less.

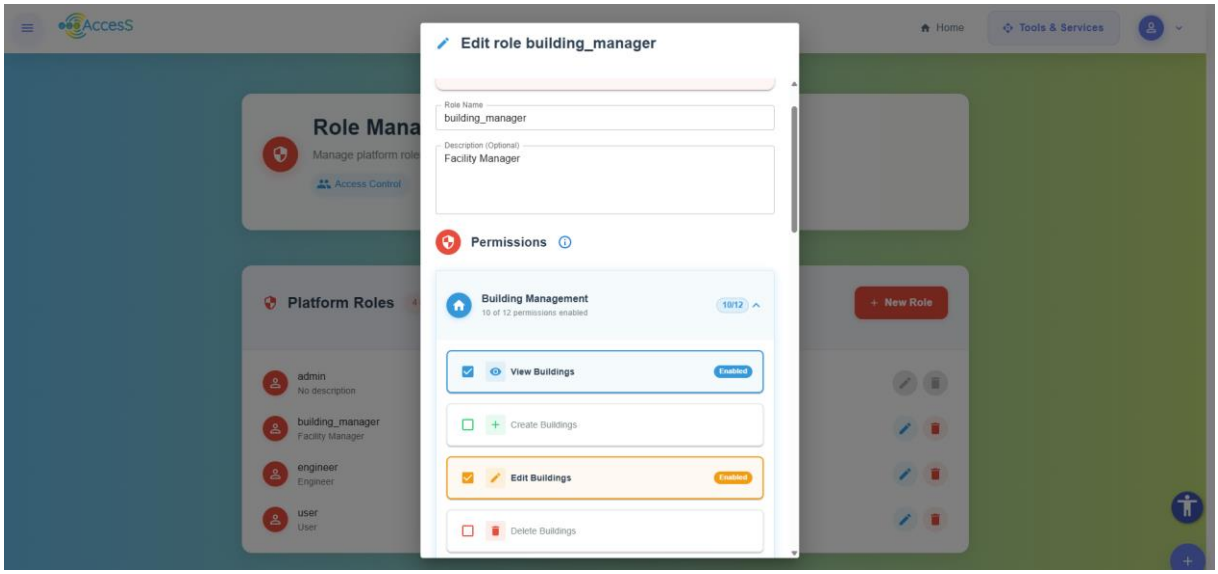

Figure 5 Permissions Management

4.1.2 Buildings Management System

The Building Management System (BMS) allows users to configure buildings, add new buildings, and manage building information. Administrators, facility managers, and building owners can create building profiles, define characteristics, and update details. As shown in the figure below (Figure 6), user can click the Add New Building button to configure a new building.

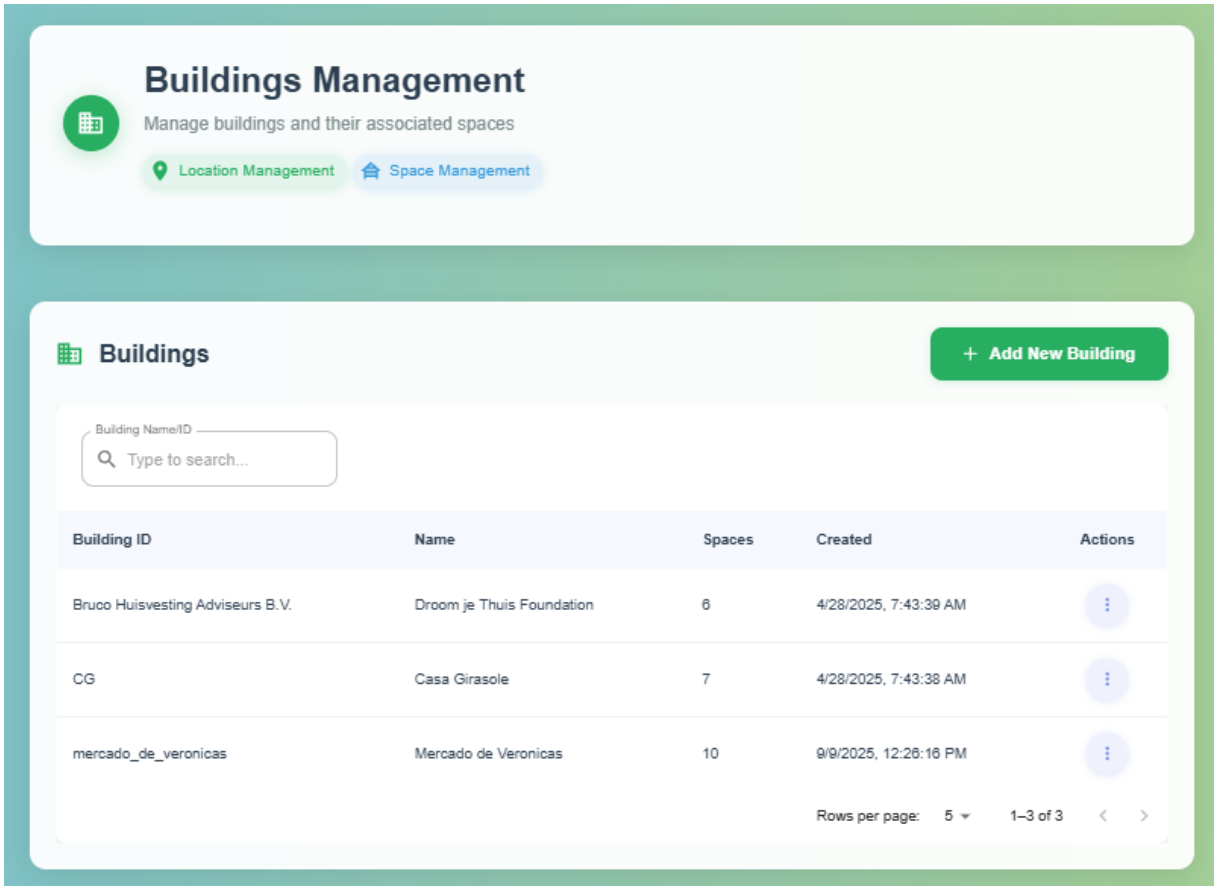

Figure 6. Buildings Management System Overview

As shown in Figure 7, users can enter the BMS tab and click the “Add New Building” button to create and configure a new building. When this option is selected, a pop-up form appears where users can enter all the relevant building information. Required fields include the building ID, building name, and location coordinates. Once completed, the new building is added to the system, and its information becomes accessible across the platform, enabling efficient management and coordination of building data.

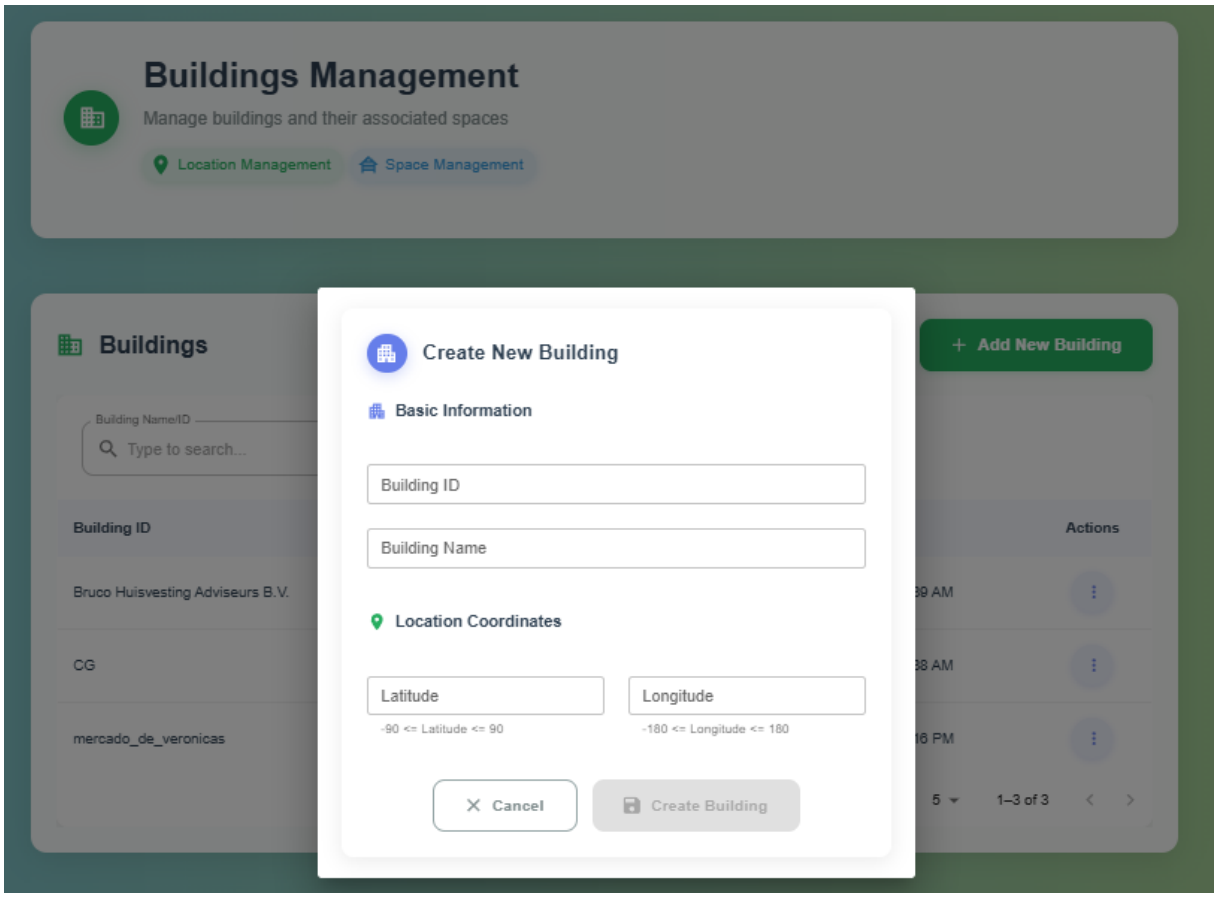

Figure 7. New building entry in the BMS.

4.1.3 BIM Management System

The IFC Viewer enables users to view digital building layouts and structures using standardized IFC files. It facilitates building visualization, helping facility managers, building owners, and administrators to understand the design of a building and plan activities more effectively. Through the BIM Management System, users can access all relevant information relating to a building's IFC file, as shown in Figure 8.

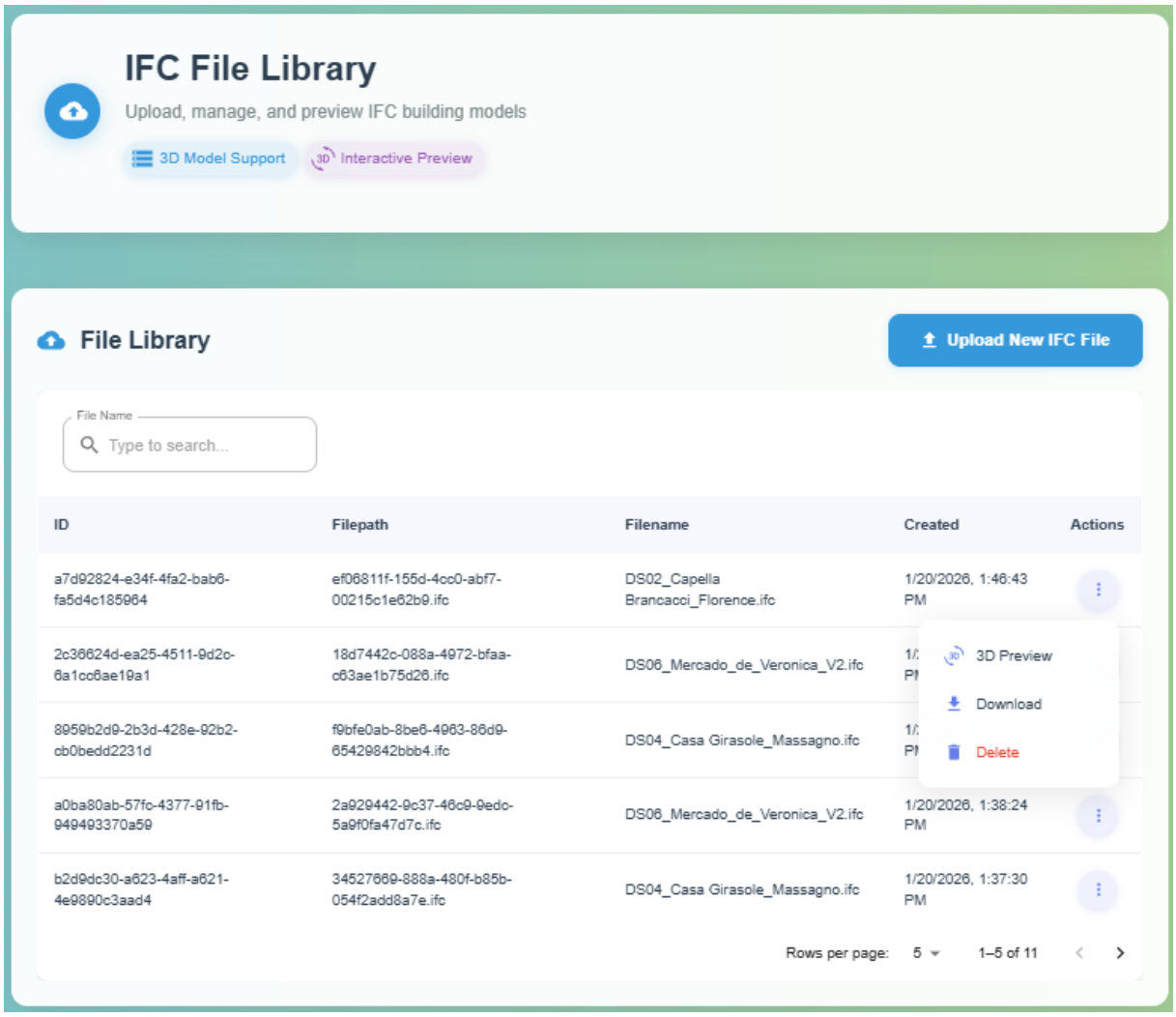

Figure 8. BIM Management System Overview

The platform also provides options to download or delete the IFC file, or to view a 3D preview of the building model, as illustrated in Figure 9. This functionality enables easy exploration of building elements and supports collaboration by allowing teams to share and interpret building information directly within the platform.

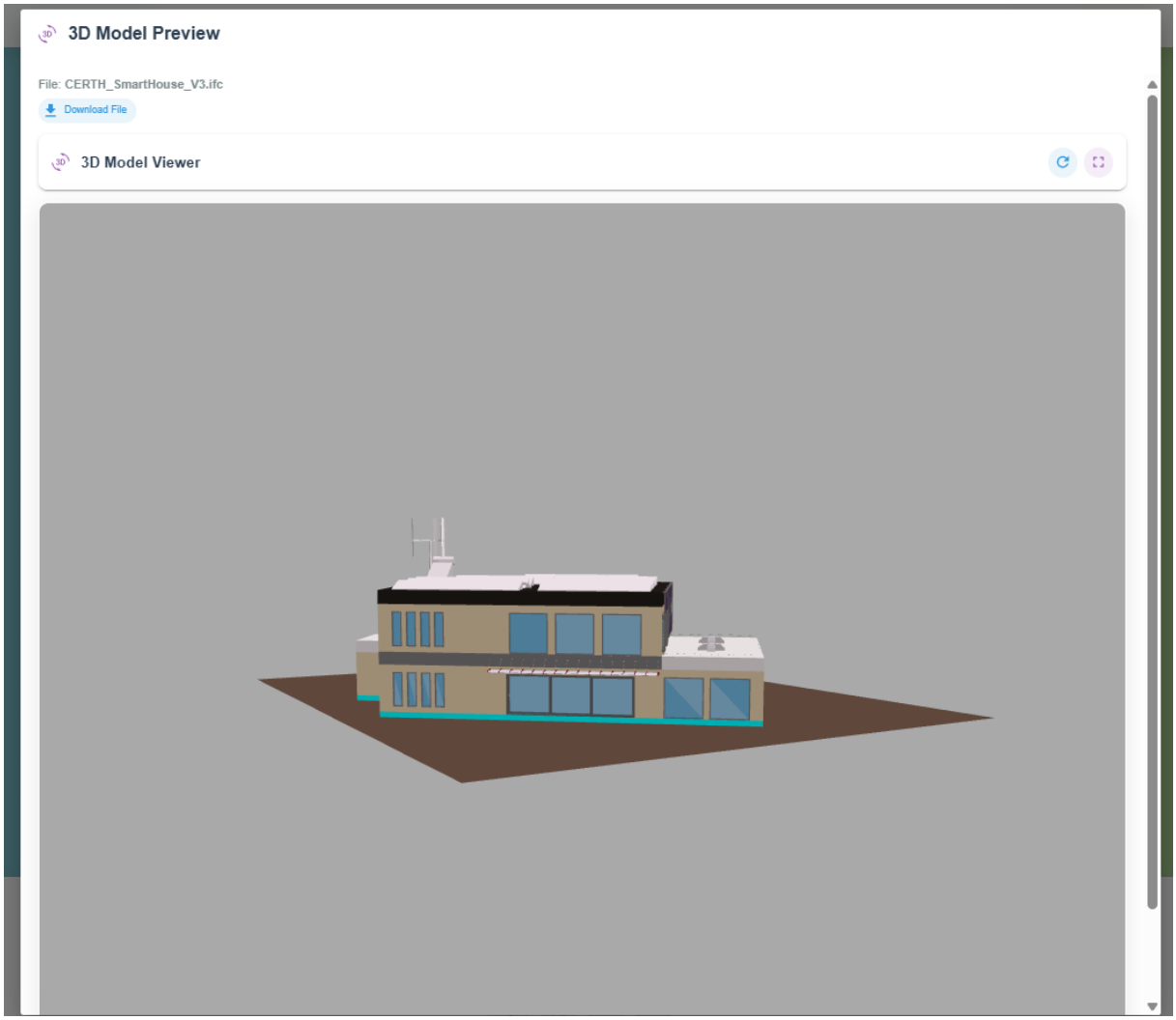

Figure 9. IFC Viewer - Building 3D Model Preview of CERTH/ITI nZEB Smart House

4.1.4 API Access

This module provides a centralized interface for managing the interaction between different applications and services and the system's data. It ensures that each API client has specific, restricted permissions based on its function. The main dashboard provides administrators with a clear, scrollable list of all eighteen configured API clients, such as the access-suite-client or vums-client. This high-level view allows for quick identification of every registered service currently in the system. When an administrator needs to update permissions, they simply click the edit icon next to the desired client to open the configuration settings.

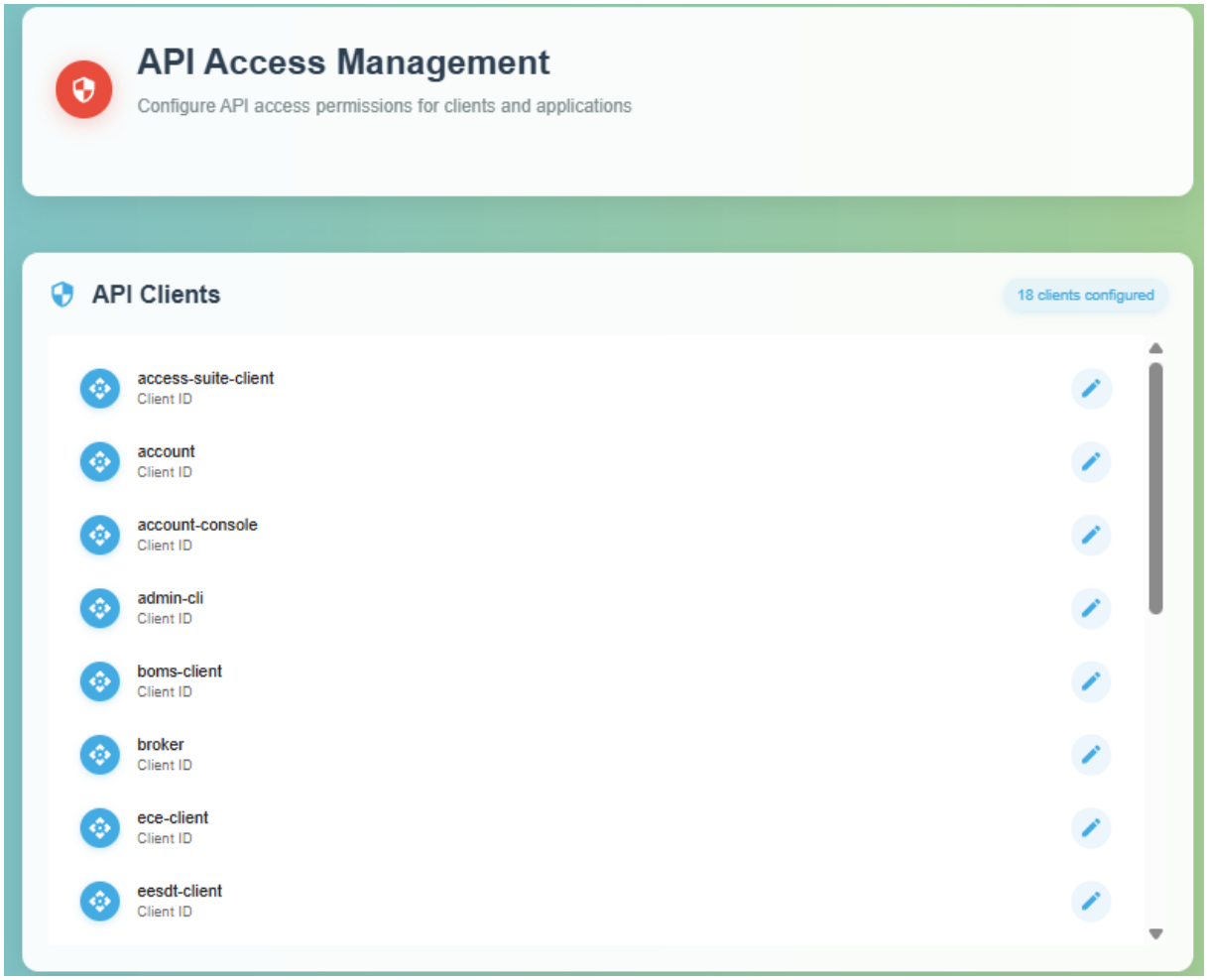

Figure 10. Dashboard displaying the inventory of registered API clients.

Once a specific client such as the boms-client has been selected, a configuration window appears to manage its specific access levels. To ensure accuracy, the window first displays the unique client ID, so the user knows exactly which service they are modifying. The administrator can then use a dropdown menu to assign a specific Role, which determines the actions the client is allowed to perform. To further tighten security, the system includes a Building Access filter. This ensures that the client's permissions are limited to specific physical locations, thereby preventing them from accessing data or performing actions outside of their assigned buildings.

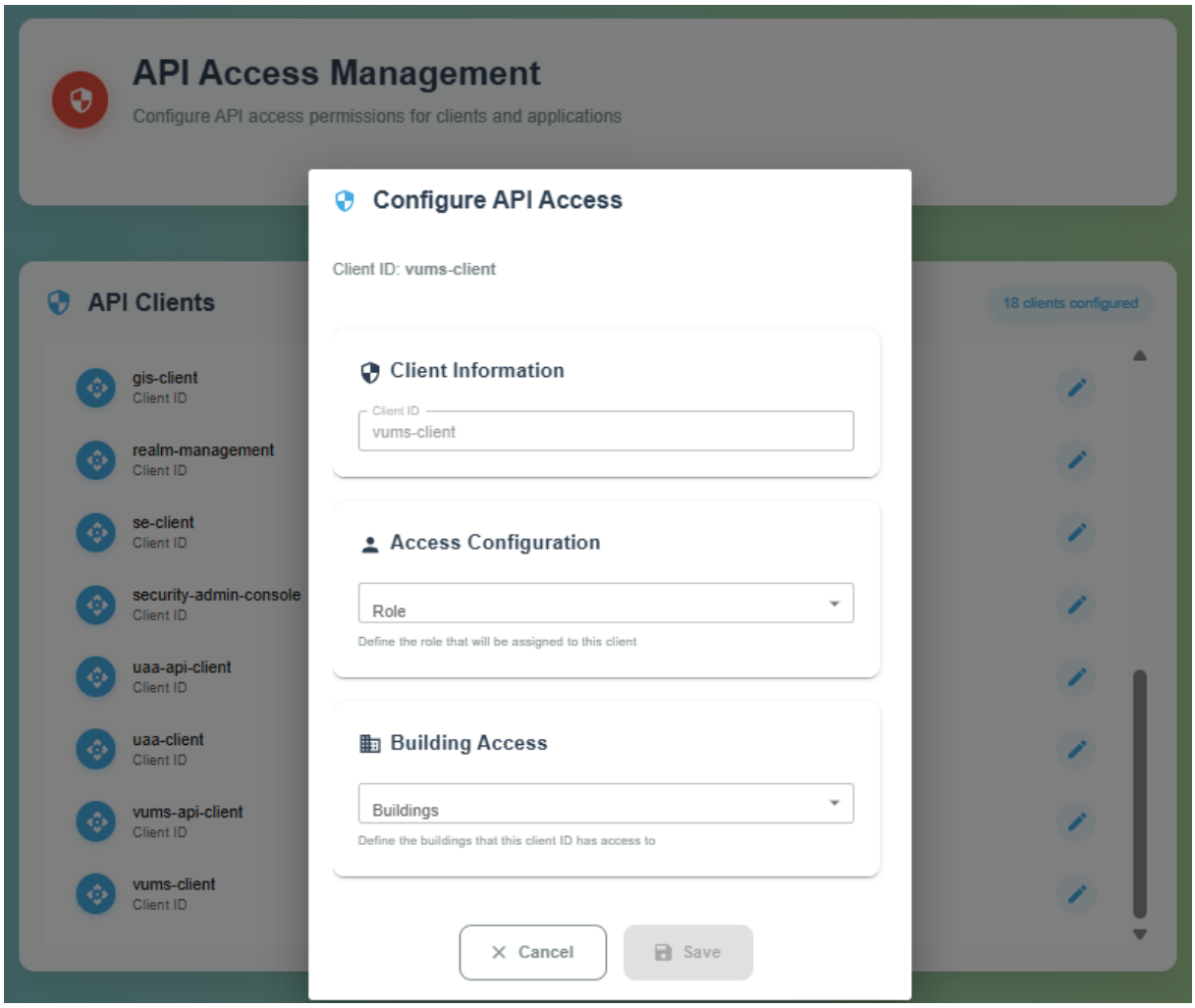

Figure 11. Configuration interface for managing client roles and building access permissions.

4.1.5 User Support and Feedback Tools

The user support and feedback tools, such as “Contact Messages”, “Report an Issue”, and “Bug Reports”, allow users to submit questions, report problems, and provide feedback directly within the platform. These tools help administrators monitor issues, respond efficiently and implement improvements over time. This supports smoother operation of the platform and ensures that users can work without disruption.

The Messages Management interface serves as a central hub for handling user requests. When a message is opened, the “Message Details” window displays the sender’s full name and email address, as well as the subject of their request. For example, this could be a formal inquiry for system access. The main body shows the full details of the user’s message and the timestamp tracks response times. This enables the support team to respond efficiently and maintain a high level of customer support.

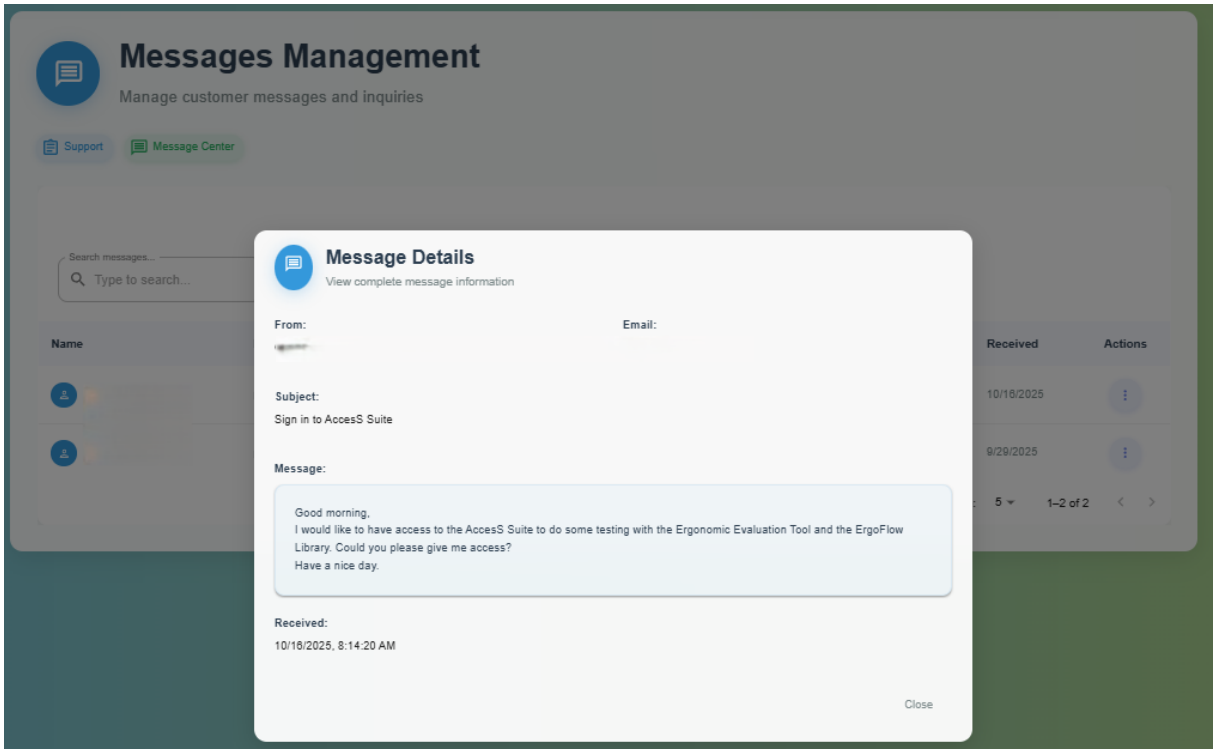

Figure 12. User message details view.

The “Report an Issue” tool enables users to contribute to platform improvements by reporting bugs or making suggestions in a structured way. The interface combines a guide to the bug tracking process with a form for entering issue details. Users can select the affected tool or service, categorize the type of report and provide a detailed explanation using a rich text editor. By prompting users to include information such as browser versions and console logs, the platform ensures that the development team receives high-quality data for review and prioritization.

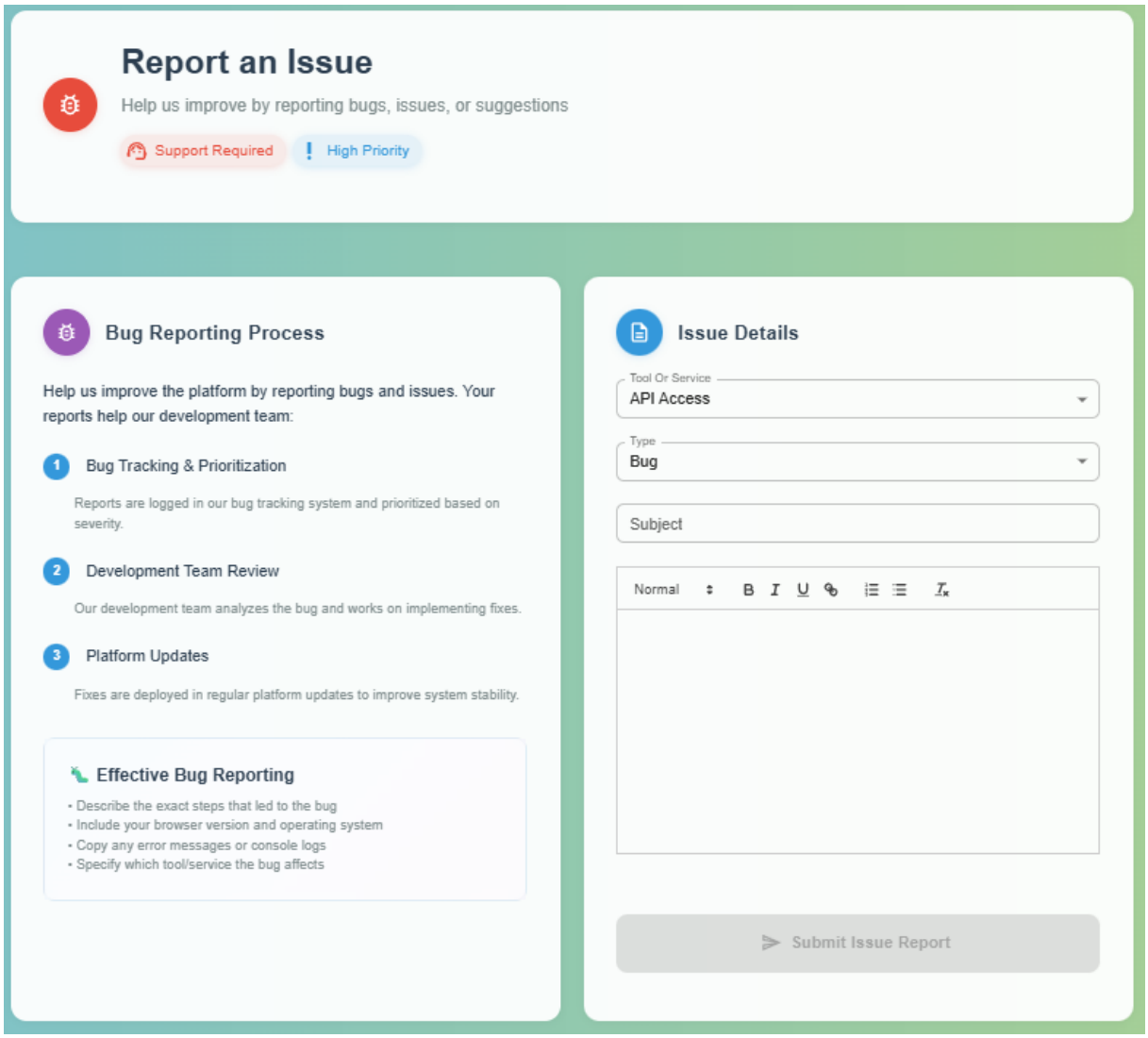

Figure 13. The report an issue interface where users can categorize and describe technical problems or bugs.

The Reports and Bugs Management dashboard allows administrators to oversee the lifecycle of all reported technical issues. Filters are available for status, priority, type, and affected tool or service, while the main table provides a snapshot of each report's progress, including its creation and last update dates. This systematic approach ensures that high-priority bugs are addressed promptly and that user feedback is consistently tracked and acted upon during platform updates.

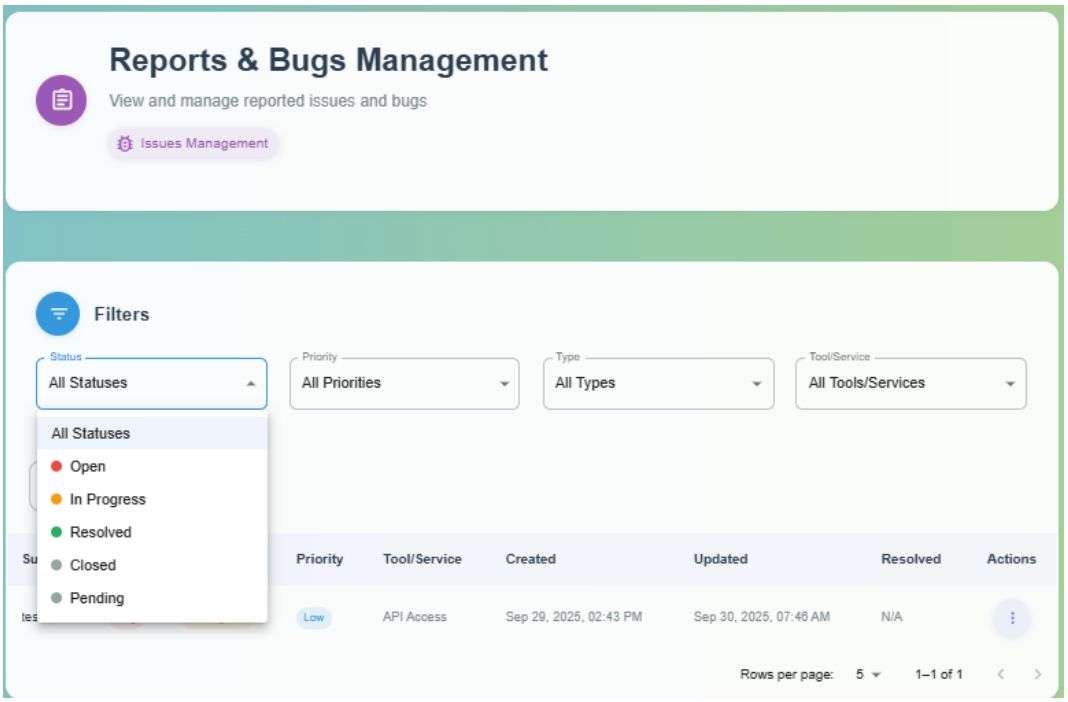

Figure 14. Reports & Bugs Management dashboard used by administrators to track, filter, and manage the resolution of reported issues.

4.1.6 Chatbot Assistant

The chatbot assistant helps users to navigate the platform and quickly find information relating to project tasks, pilot sites, and partner activities. It provides real-time answers and an overview of the platform's services and functionalities, enabling users to understand and use the system effectively without having to wait for manual support.

By leveraging a Retrieval-Augmented Generation (RAG) [5] architecture with Large Language Models (LLMs) and a vector database, the chatbot retrieves and synthesizes relevant information to deliver accurate and context-aware responses. While it does not handle complex technical issues, it independently resolves routine and informational queries, reducing the workload for administrators and offering users a fast and reliable self-service support option.

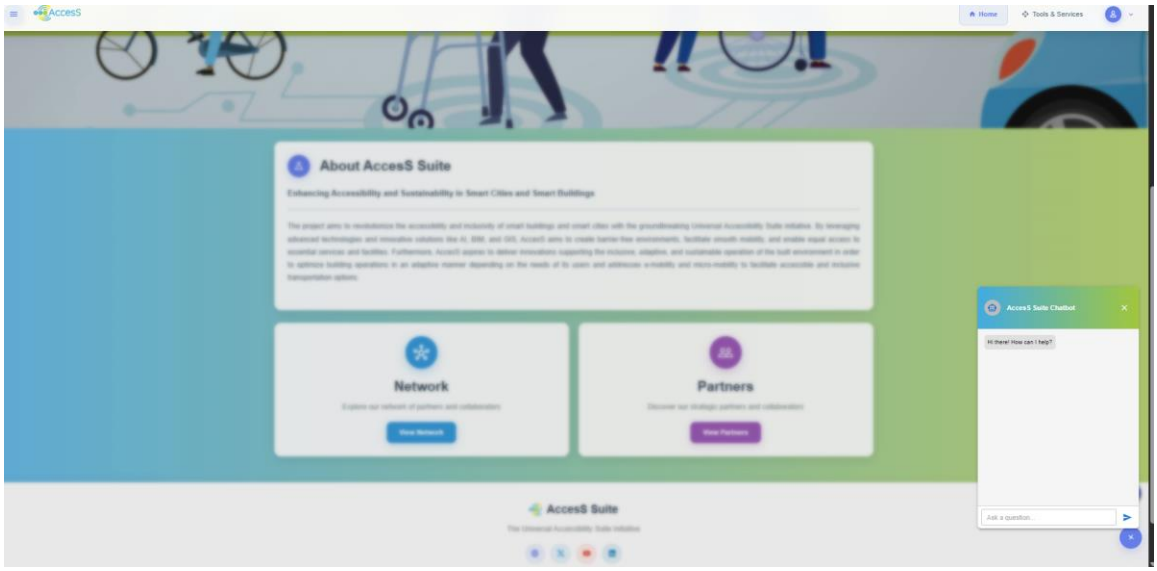

Figure 15. Interactive chatbot interface for instant user guidance and support.

4.1.7 Accessibility Features

The accessibility features are designed to make the platform inclusive and easy to use for everyone, regardless of their physical or cognitive abilities. The platform provides a dedicated set of tools that allow users to customize the interface to suit their specific requirements. These adjustments can be made instantly to help remove barriers and ensure that all information is legible and easy for everyone to navigate.

Users can access an accessibility menu offering a wide range of visual and functional adjustments. These include options to increase text size, adjust letter and line spacing, and invert colours for better contrast. Additionally, the tool provides specialized aids such as a large cursor, a reading guide, and the ability to underline links or disable animations. These features empower users to create a personalized browsing environment that meet their unique comfort and accessibility standards.

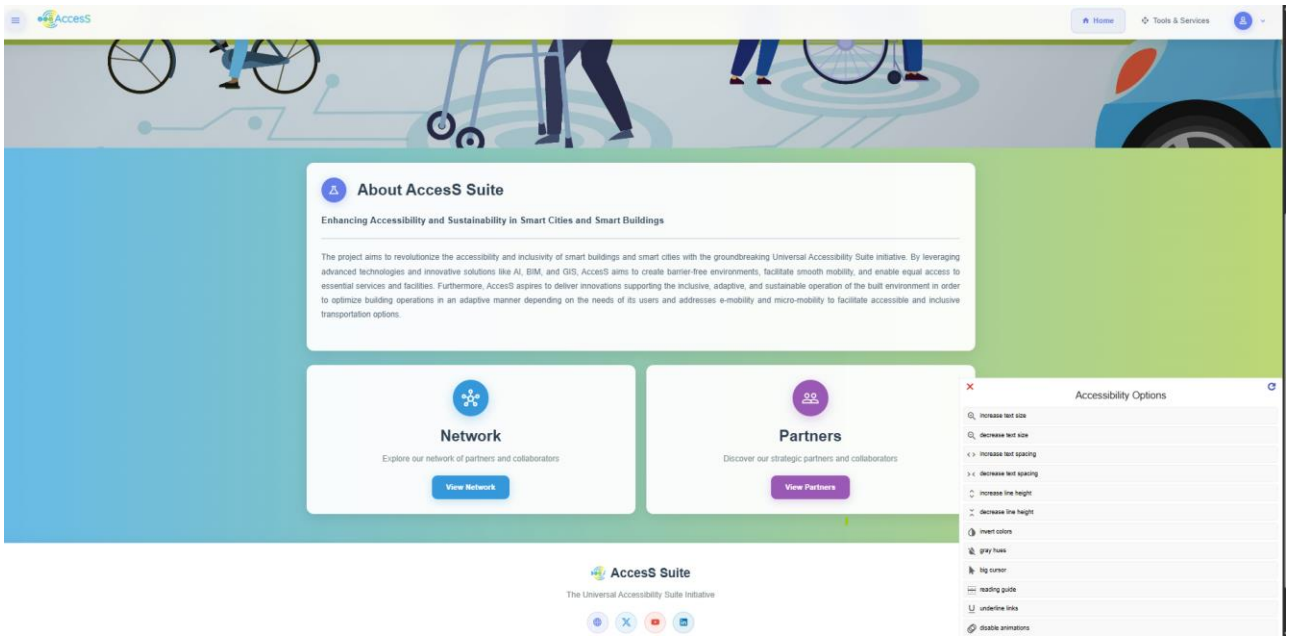

Figure 16. Accessibility options menu providing tools for visual and functional interface customization.

4.2 Integrated Technical Tools and Services

In addition to the core platform tools, the platform integrates the AccesS digital tools developed in the project technical work packages (WP4, WP5, WP6, T7.1). These include in alphabetical order, 3D Simulations, Building Operation and Management System (BOMS), Energy Comfortnes Tool (ECT), Energy Efficient Sustainable Design Tool (EESDT), EV-Charging Optimise (EVC), ErgoFlow, RE GIS, Accessibility Assessment tool, Virtual Humans (VHs), and Virtual User Models (VUMs). Since users are already authenticated when loggin into the Access Suite, they can access these tools directly without needing to log in again. This setup makes it easier for facility managers, building owners, tenants, and other users to manage building data, run simulations, and access information across different tools efficiently.

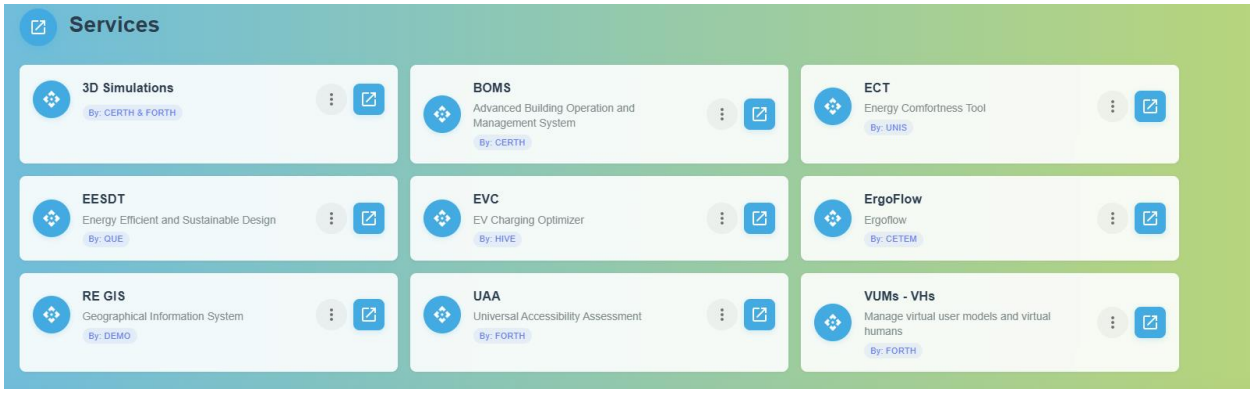

Figure 17. Centralized services dashboard providing access to integrated digital tools from other WPs.

Figure 17 illustrates the centralized services dashboard, which provides users direct access to all integrated digital tools. The dashboard serves as a single-entry point, simplifying navigation and allowing users to move between tools seamlessly. The interfaces of these tools are presented below, highlighting their main components, navigation structures, and key functionalities.

Starting with **3D Simulations** service that enables users to design and execute simulation scenarios to evaluate accessibility within virtual environments. Through an interactive editor, users define step-by-step scenarios that are executed inside a specific 3D Simulation Environment. Each simulation is built on three components:

- the 3D Environment,
- a Simulation Scenario, and
- a Virtual User Model (VUM).

Figure 18. 3D Simulation Environment

Through the **BOMS interface**, users can access the *"My Buildings"* section, where a list of pilot sites is displayed, offering a clear overview of the facilities and monitored spaces. BOMS supports the monitoring of sensors installed across buildings, enabling users to track and analyse indoor environmental conditions such as temperature, relative humidity, and other comfort-related parameters, alongside energy-related measurements.

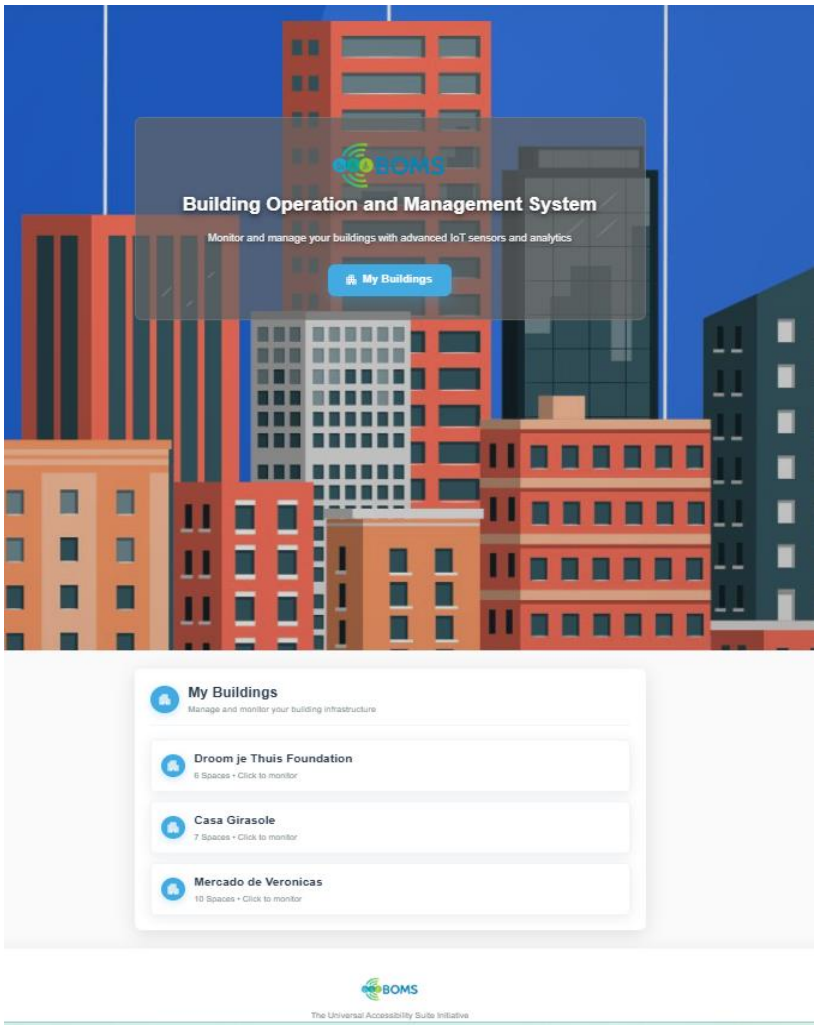

Figure 19. BOMS Interface Overview

The **RE GIS** module of the BOMS platform is an interactive tool that empowers users to explore and evaluate the accessibility of different locations. By leveraging geospatial data, it helps users to identify how accessibility-friendly places are, taking into account factors such as infrastructure, ease of movement and inclusivity.

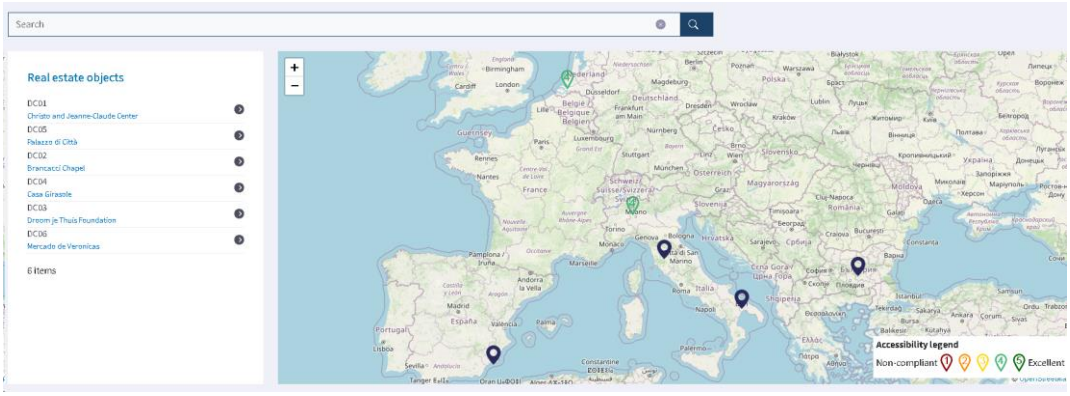

Figure 20 RE GIS Interface

The **ECT interface** provides comprehensive visualization and assessment of indoor environmental conditions. Users can evaluate comfort and performance across multiple domains, including thermal, acoustic, Indoor Air Quality (IAQ), energy, and visual factors, using established indices and metrics. The interface presents time-series visualizations of key parameters, helping users track trends and quickly identify anomalies in indoor environmental conditions.

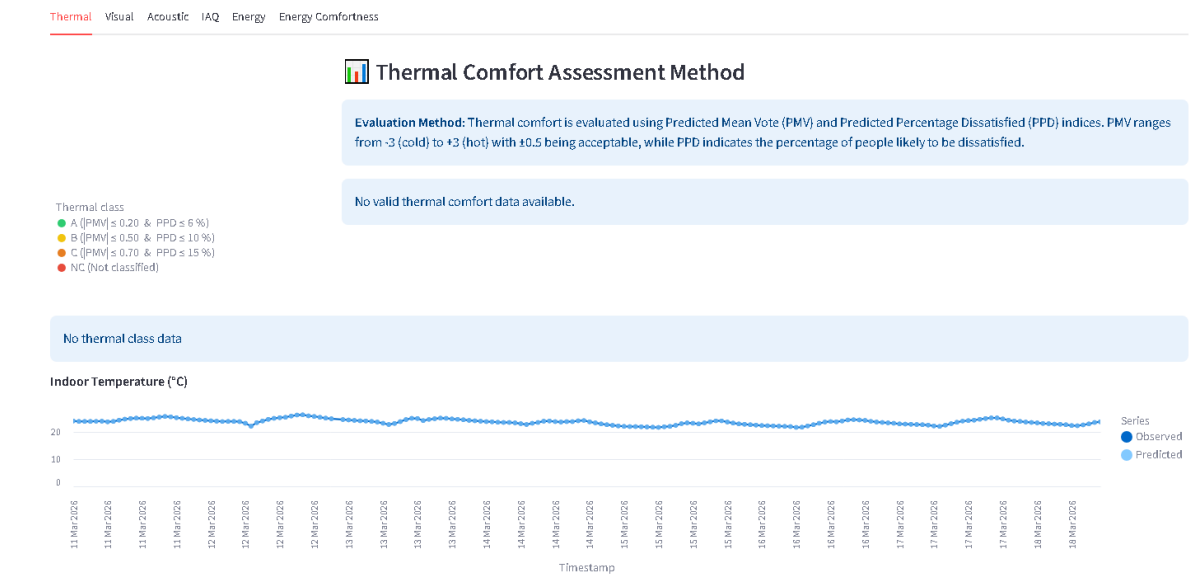

Figure 21. ECT Interface Overview

The **EESDT** interface supports the assessment and optimization of building renovation scenarios based on IFC-derived building data. First, the tool evaluates the baseline energy performance and smart readiness of the building through building energy performance simulation, smart readiness assessment, weather data processing, and the calculation of relevant key performance indicators (KPIs). EESDT offers an Energy Conservation Measures and the Smart Readiness catalogue, from which appropriate measures can be selected for the building under assessment. Based on these selected measures, the tool generates BIM-based renovation scenarios and evaluates their performance

through energy and smart readiness KPIs. Furthermore, EESDT supports the comparison and optimization of the proposed scenarios on the basis of energy, financial and smart readiness aspects, thereby assisting end-users and other stakeholders in identifying the renovation scenario that best meets their needs.

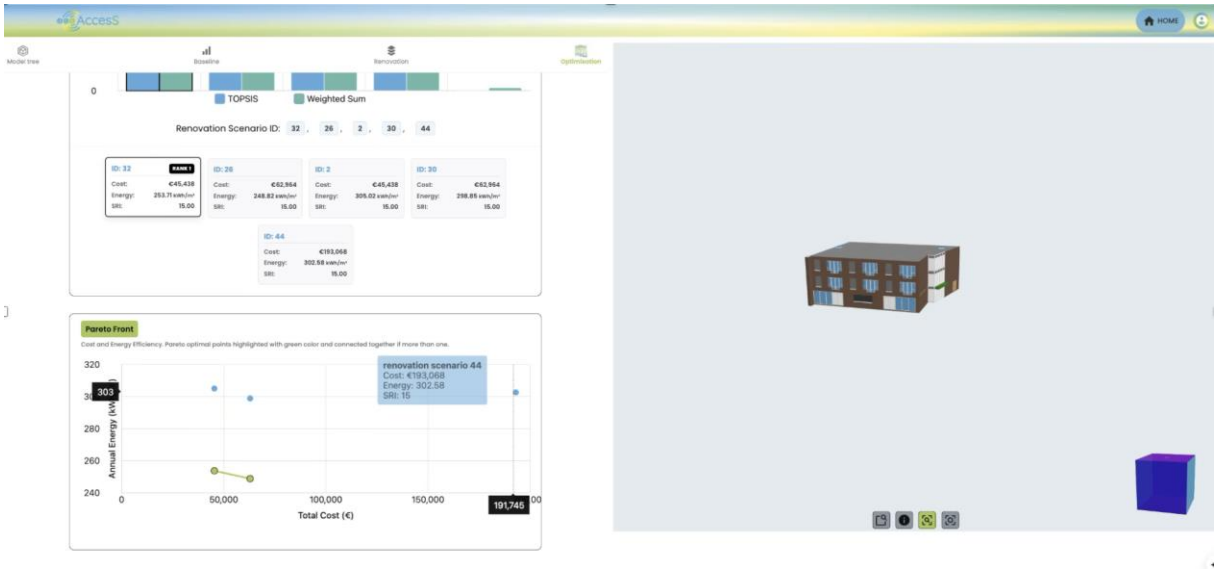

Figure 22 EESDT Interface

The **EV Charging Optimizer** (EVC) tool allows the users to enhance the efficiency and sustainability of electric vehicle charging operations. By analyzing real-time data such as total occupancy, energy demand, and grid conditions, it provides intuition on when and how vehicles should be charged. The system dynamically balances charging loads to prevent grid overload, reduce peak demand, and support overall grid stability

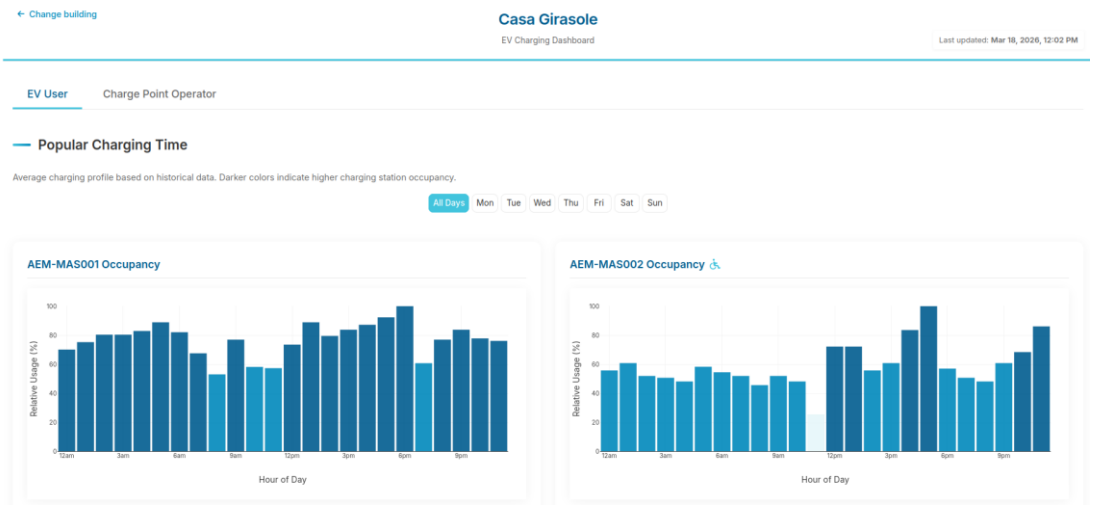

Figure 23 EVC interface

The **ErgoFlow** Library interface allows users to explore a catalogue of 3D furniture models, including desks, benches, and seating, each accompanied by an ergonomic score expressed as a percentage. Users can filter models by type and assess ergonomic properties to support informed space planning. Complementing the library, the ErgoFlow Validation Tool enables users to upload custom 3D models or design images for automated assessment of their ergonomic compliance against accessibility standards.

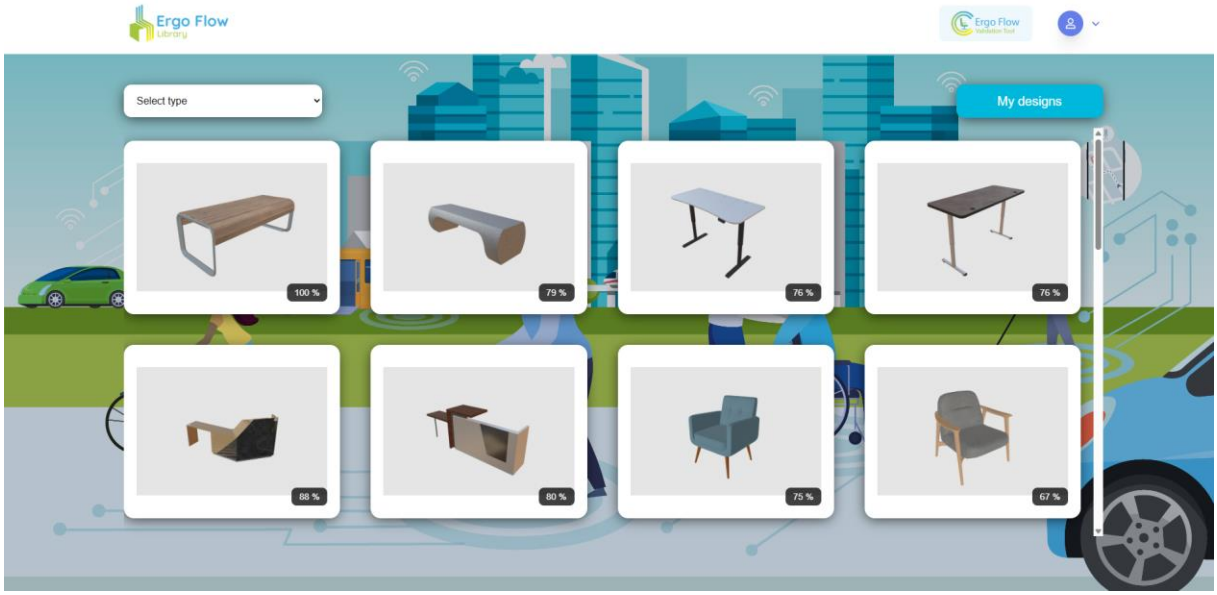

Figure 24. ErgoFlow Library Interface

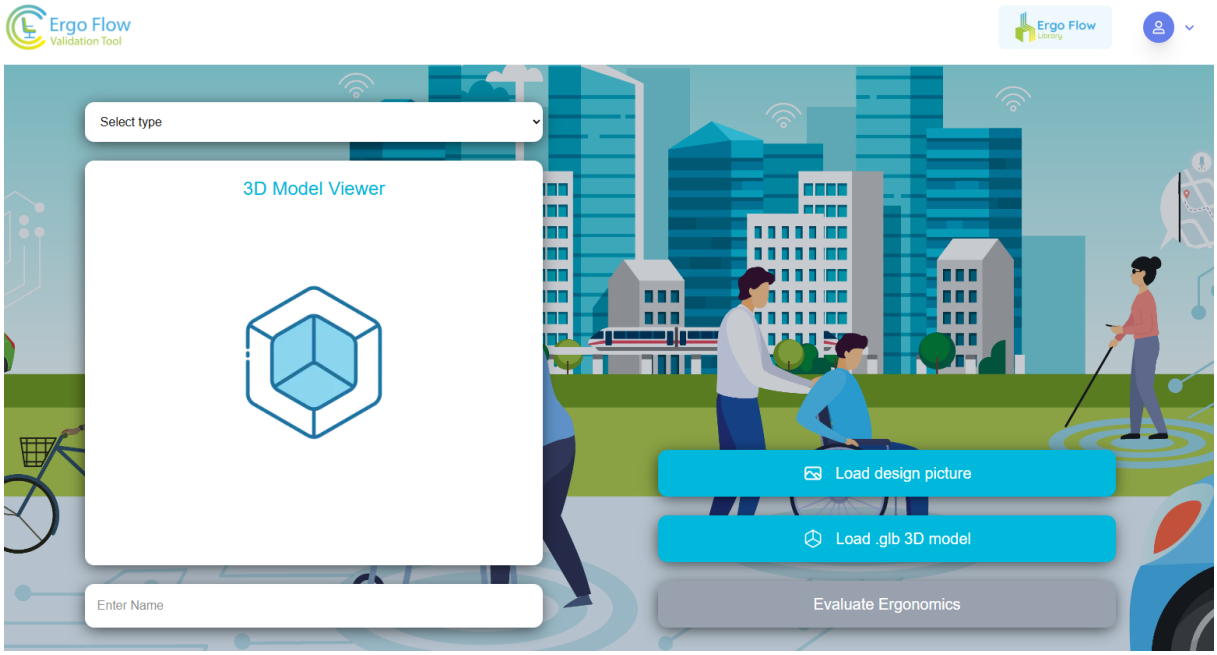

Figure 25. ErgoFlow Validation Tool

The **Accessibility Assessment tool** is a structured system designed to evaluate how accessible a building is for all users, including people with disabilities. It follows a predefined scheme of criteria—such as entrances, pathways, signage and emergency facilities—to systematically measure compliance with accessibility standards. By collecting and scoring data across these categories, the tool provides a clear, consistent overview of a building's strengths and shortcomings, helping stakeholders identify barriers and prioritize improvements toward a more inclusive environment.

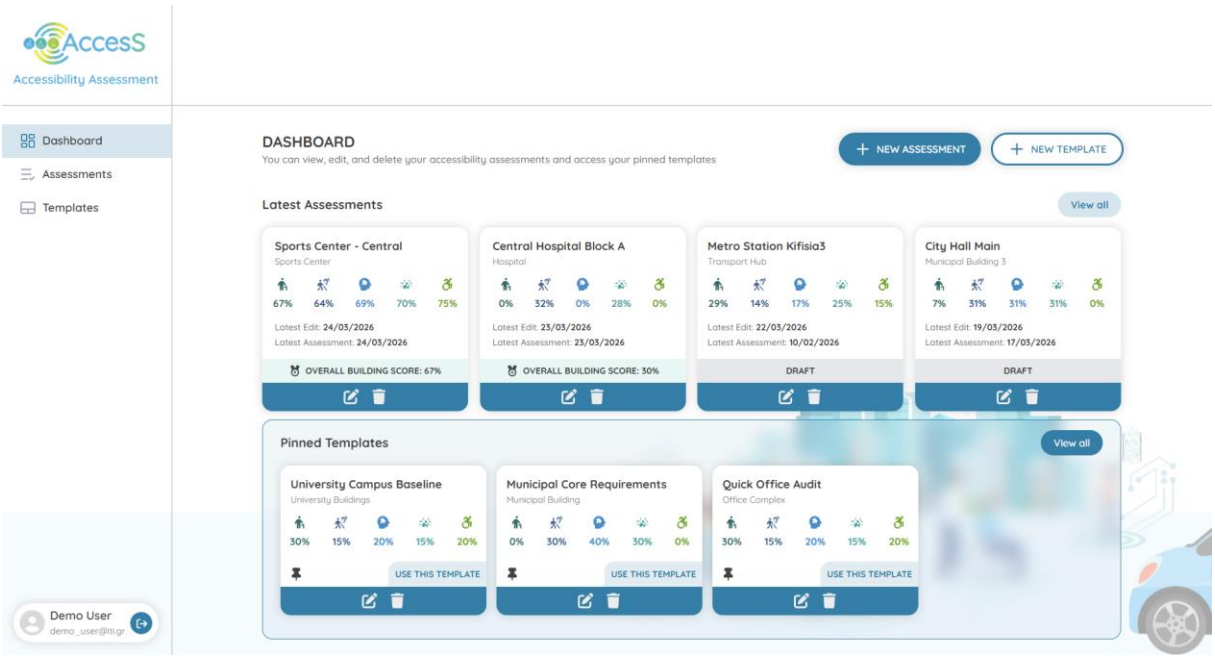

Figure 26 Accessibility Assessment tool Interface

Finally, the **VUMs and VHs** interface in AccesS allows users to create and manage digital representations of individuals. In the *General Information* section, users can enter essential details such as name, age, sex, height, and weight, as well as specify types of disabilities and adjust other characteristics. This structured input supports the generation of accurate virtual human models, which can be utilized through the VHs interface for accessibility analysis and simulation.

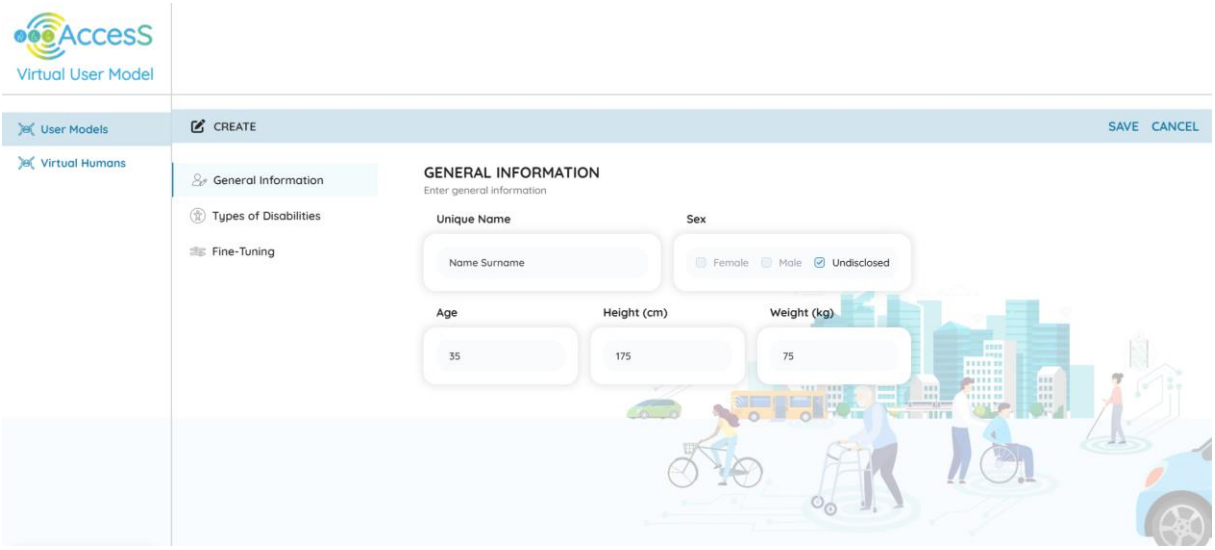

Figure 27. VUMs & VHs Interfaces

5 Deployment and Technical Infrastructure

The Access Suite is implemented as a single repository consisting of a Node.js API (Central API), a React frontend provided as a static build, TimescaleDB as the primary database, Keycloak for authentication, and a PostgreSQL database used by Keycloak.

In production, these components run as containers orchestrated with Docker Compose. Nginx serves the compiled UI and reverse-proxies API and WebSocket traffic to the backend, allowing the browser to communicate through a single origin.

The Ubuntu host that runs the deployment also operates a separate Nginx instance that listens on ports **80** and **443**. This host-level Nginx handles **TLS/SSL termination and external traffic routing**, by forwarding requests to the internal containerised Nginx service.

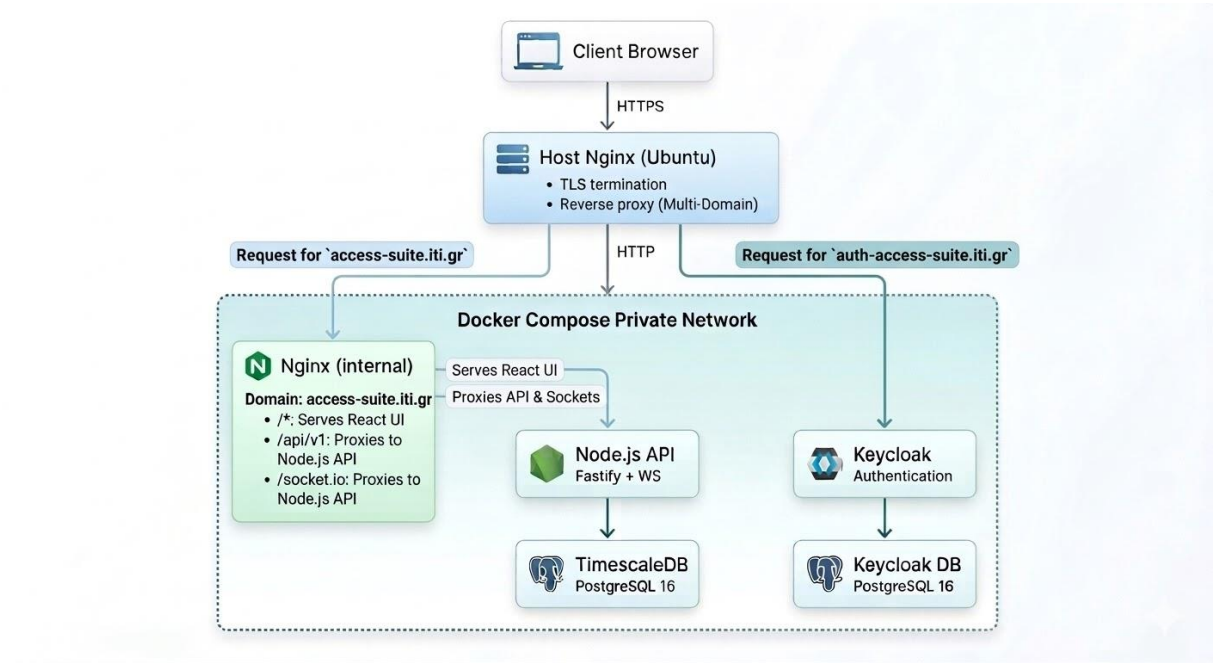

Figure 28 Deployment Diagram

The high-level deployment diagram below Figure 29 presents the system architecture, highlighting how the different software components are distributed across multiple servers. Each component delivers key functionalities that support activities such as energy efficiency analysis, accessibility assessments, simulation environments, and building operations. As many of these tools are developed as standalone applications, they are deployed on separate dedicated servers together with their respective user interfaces. All servers are interconnected through the central AccesS Suite Server, which hosts the AccesS Suite Web Platform. This platform acts as a gateway, allowing users to access the interfaces of the other tools via redirection.

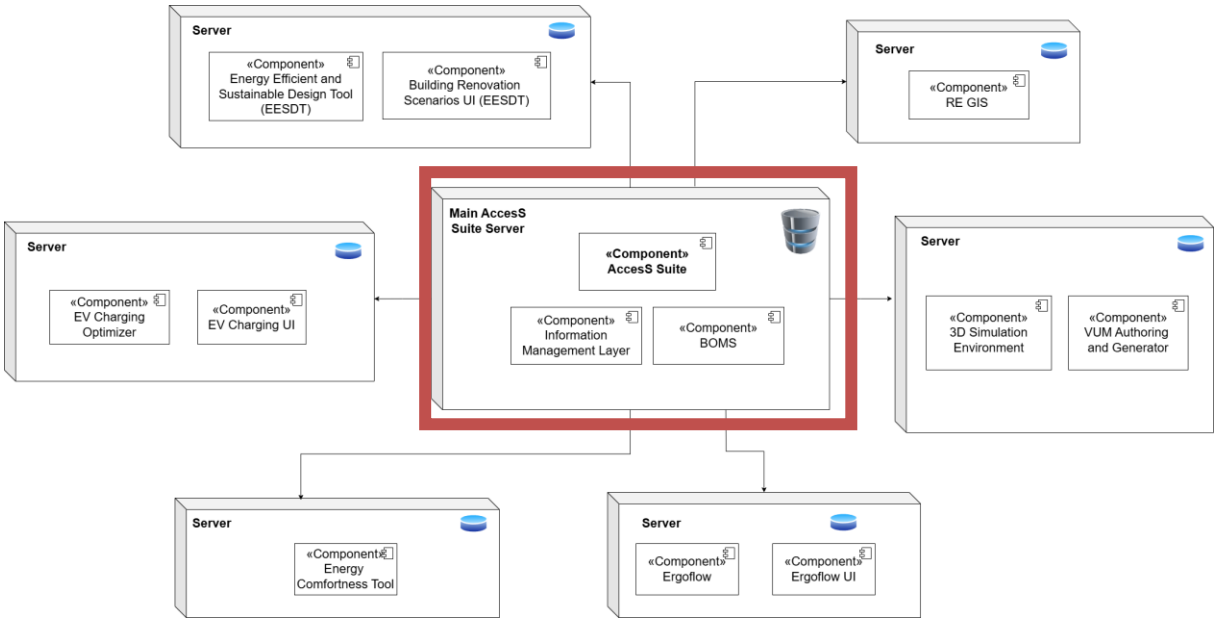

Figure 29. AccesS High Level Deployment Diagram

The table below (Table 1) provides an overview of the AccesS Suite hardware/software requirements from the deployment diagram.

Table 1. AccesS Suite hardware/software requirements

Component	Hardware/Software Requirements	Interaction
AccesS-Suite	- 8-core CPU - 32 GB RAM - 1 TB storage - Linux - PostgreSQL - Docker	Central server hosting the main platform, database, and management layer. Facilitates integration with all connected tools.

5.1 Hosting and deployment strategy

The deployment is hosted in an **Ubuntu Linux** environment. A single **Host Nginx** instance serves as the primary ingress point for all external traffic.

- **TLS Termination:** the Host Nginx manages all SSL/TLS handshakes, ensuring all client-to-server communication is encrypted via **HTTPS**. SSL certificates are managed and automatically renewed via **Certbot (Let's Encrypt)**.
- **Multi-Domain Orchestration:** the infrastructure uses two distinct subdomains to separate the application interface from the identity provider at the DNS level.
- **Application Domain (`access-suite.iti.gr`):** directs traffic to the internal UI and API services.
- **Authentication Domain (`auth-access-suite.iti.gr`):** directs traffic directly to the Identity and Access Management (IAM) provider.

All backend components are encapsulated within a **Docker Compose private network**. Communication between the host and the containers is conducted over **HTTP**, as encryption is terminated at the host

level to optimize performance. For requests originating from the application domain, traffic is routed to an **Internal Nginx** container which acts as the service orchestrator:

- **Static Assets:** it serves the compiled **React.js** frontend.
- **API Gateway:** it proxies RESTful requests (path: `/api/v1`) and WebSocket connections (path: `/socket.io`) to the **Node.js API**.
- **Business Logic:** the **Node.js API** (built on the Fastify framework) handles data processing and maintains a persistent connection with the **TimescaleDB (PostgreSQL 16)** instance for time-series and relational data storage.

To ensure robust security and separation of concerns, the authentication flow is handled independently:

- **Identity Management:** traffic for the authentication domain is routed directly to **Keycloak**.
- **Data Isolation:** Keycloak utilizes a dedicated **Keycloak DB (PostgreSQL 16)**. This database is isolated from the main application API to prevent cross-service data leakage.

All database state and user uploads are managed via **Docker Named Volumes**, ensuring data remains persistent across container restarts or updates. Security credentials, database passwords, and API keys are injected at runtime via encrypted environment files (`.env`)

6 Conclusions

The platform successfully provides a unified and modular environment that integrates all AccesS digital tools. It enables users to manage buildings, visualize digital models, access digital tools, exchange operational data, and receive guidance and support, all from a single interface. The platform's core functionalities, including the Building Management System, BIM Management System, API access, user support tools, chatbot, and accessibility features, have been validated and demonstrated to effectively support different user roles. Use cases across pilot sites have shown that the platform improves operational efficiency, collaboration, and decision-making for facility managers, building owners, and researchers.

Future work will focus on further improving the platform's performance and expanding its functionalities and any updates will be reported within the final (sensitive) version of the deliverable by M32 (D7.5 AccesS Suite v2). This will include optimization of workflows, integration of additional technical tools, enhanced simulation and visualization capabilities, and large-scale validation across multiple pilot sites. Continued user feedback will guide refinements, ensuring that the platform remains user-friendly, reliable, and adaptable to evolving operational and research needs.

7 References

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