multiclimact

Adaptation in Practice: Climate-Proofing the Built Environment

MULTICLIMACT's Camerino demo site

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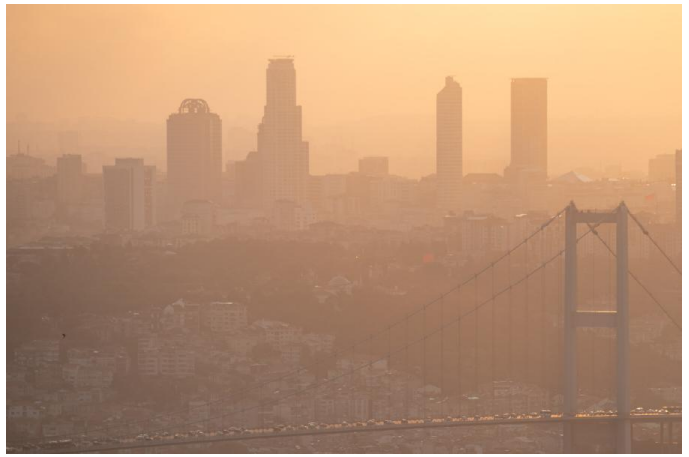
What about the “Built Environment”

80% of cities all around the world report significant climate-hazards:

- extreme *heat* (46%)
- heavy *rainfall* (36%)
- *drought* (35%)
- *flooding* (33%)

- **+135 %** - Increase of *extreme weather events* in Italy over the last past years
- **1 B$** - Market losses due to extreme natural events in 2023 per event
- **4 $** - the return you get for every 1 $ invested in resilient solutions
- **3%** - Extra investments needed to build resilience into the built environment worldwide



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CDP report “Protecting People and the Planet”4, 2022

This is MULTICLIMACT

Value Proposition: *To Enhance the **resilience of the built environment** against **climate-related threats**.*

- Innovation Action project
- Dedicated to safeguarding Europe‘s built environment and people‘s well-being
- Framework and tools for assessing resilience at various scales with a human-centric perspective
- Practical and cost-effective methods to enhance resilience, including design practices, materials, and digital solutions.
- Against the rising threats of natural & climatic hazards

MULTICLIMACT logo

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WHAT ARE THE KEY FACTS?

START — 01.10.2023

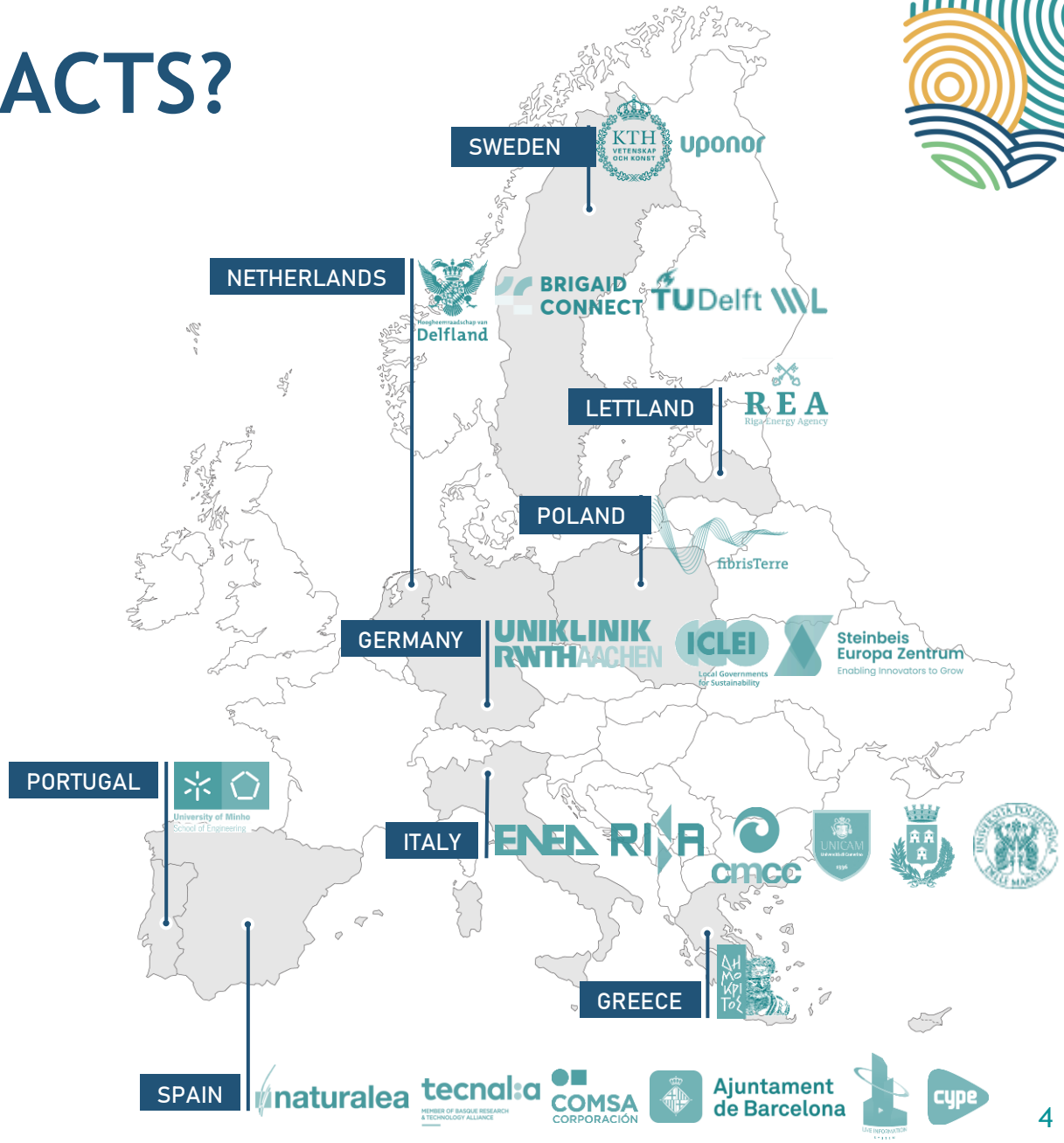
END — 31.03.2027

42 months

7,5 M.€ funds

25 partners

9 countries



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WHERE ARE THE DEMO SITES?

- **Netherlands**: Dike in Leidschendam-Voorburg & movable barrier in Roermond
- **Latvia**: Riga city & Central Market
- **Spain**: Barcelona city
- **Italy**: Carmelitane building in Camerino

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Italian demo: Carmelitane Building

UNICAM
University of Camerino

University of Camerino is the site of the natural place to learn, where spaces and appropriate tools are available for students, and where continuous relations with teaching staff are possible thanks to the student/teacher ratio in favour of the students.

Schools:
Architecture and Design
Bioscience and Veterinary Medical Science
Law
Pharmacy
Science and Technology

HR-Excellence in Research
Acknowledgement of the institution since 2010

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Italian demo: Carmelitane Building

Located in **Camerino, Marche region**, in a hilly landscape typical of the Umbria-Marche Appenines, characterized by a high seismic risk.

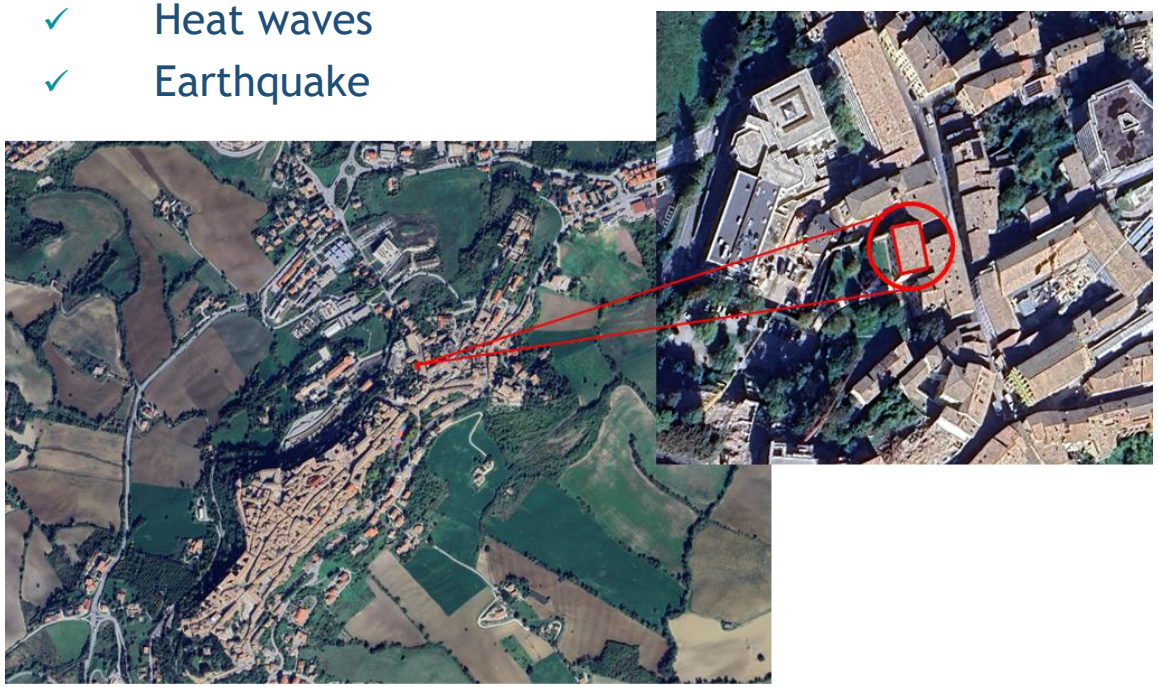
Climatic region: Mediterranean

Brief overview of the demo:

- ✓ High value for its role in the educational ecosystem of the city, hosting spin off and officer of the University of Camerino
- ✓ The structure of the building is made in historic masonry and was renovated following the seismic events of 1997 (Marche-Umbria)
- ✓ Building was undamaged by the seismic events of 2016 (Centro Italia earthquake)

Addressed natural and climatic hazards:

- ✓ Heat waves
- ✓ Earthquake



Italian demo: Objectives & Results to Achieve

WHAT DO WE TEST IN ITALY?

- Test the CREMA Tool and MULTICLIMACT toolkit solutions
- Installation of the natural-based thermal insulation panel covered with multifunctional mortar plaster
- Installation of self-sensing materials in one main structural element of the building
- Installation of distributed sensor network acquired to LIS platform, necessary to monitoring the structural health, thermal comfort, and energy efficiency as well as for early warnings generation
- Performing the measuring people's well-being in the built environment using both wearable physiological sensors and environmental sensors as well as subjective responses according the protocol test developed in T8.5
- Analysis of the acquired data for prediction of thermal sensation, to optimize HVAC systems operation (energy consumption of the building, the dwellers' indoor QoL and general well-being)

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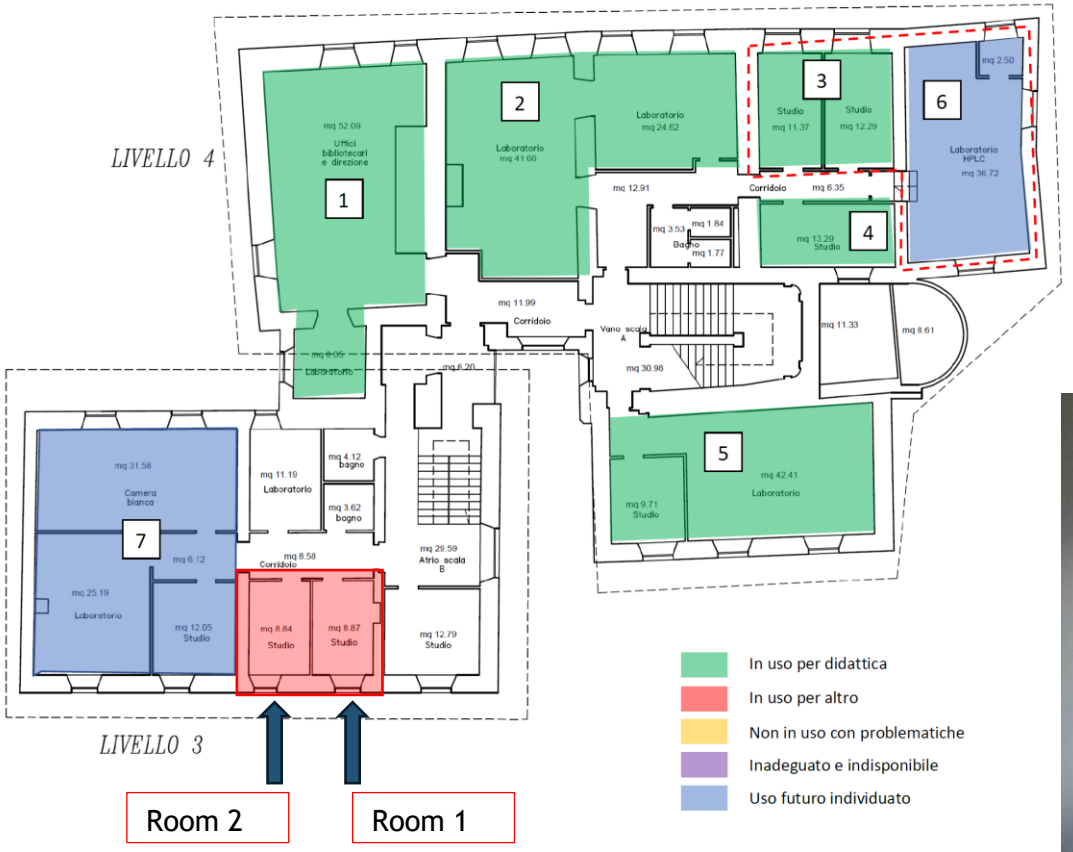
Italian demo: Carmelitane Building

1° Floor - selected Rooms



Room characteristics

- ✓ Climatic exposure south-west
- ✓ Same room dimensions (8.85 m^2) and internal characteristics

Engineered Cementitious Composites (ECCs) - UNIVPM

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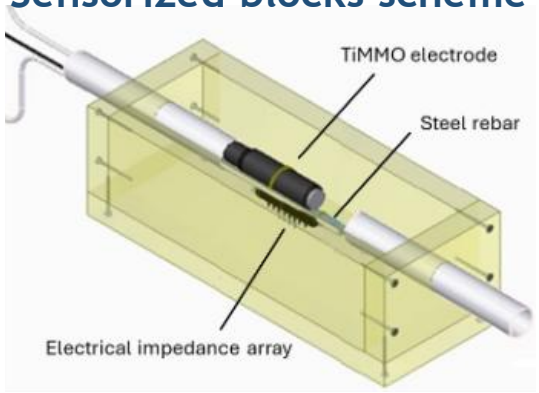
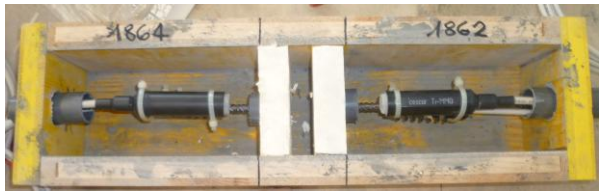
Installation of Engineered Cementitious Composites with self-sensing materials and embedded sensor for structural health monitoring in one main structural element of the building

- **Real-time monitoring** integrating sensors enable continuous health monitoring of structures and distributing IoT technology for the collection of real-time data, facilitating structure management and timely decision-making
- **Scalability and applicability in infrastructure** making the systems scalable and suitable for widespread use in infrastructures (e.g., bridges, buildings, pavements), enabling distributed and scenario-specific monitoring
- **Environmental sustainability** using recycled or bio-based materials (biochar, recycled fibers) to reduce environmental impact compared to materials like carbon nanotubes or graphene
- **Enhancement of infrastructure intelligence** enabling "resilient" and "smart" infrastructure equipped with predictive capabilities through real-time structural data integration

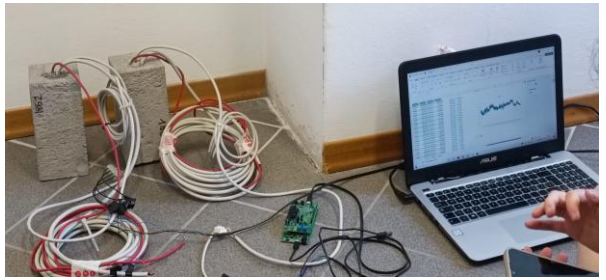
Sensorized blocks scheme



Eembedded sensors



Monitoring system



installation in an internal wall

Natural-based thermal insulation panel -UNIVPM

Installation of the natural-based thermal insulation panel covered with multifunctional mortar plaster for the improvement of indoor air quality (IAQ) pilot and compared with traditional finishing to be tested in the selected rooms

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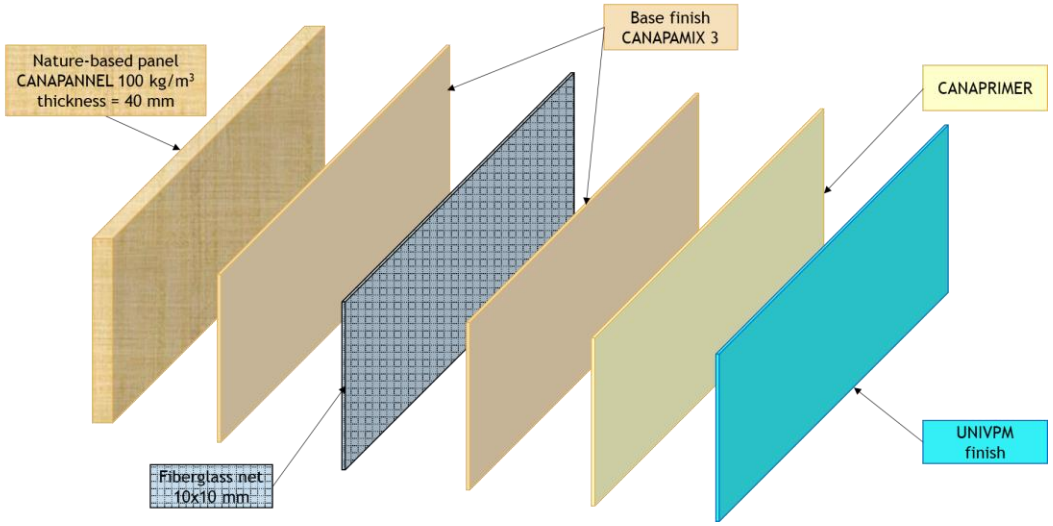
- **Indoor Air Quality (IAQ) improvement** passively decreasing the concentration of Volatile Organic Compounds (VOCs) and regulating the Relative Humidity (RH) to improve the comfort and health of occupants
- **Energy Efficiency** reducing need for active ventilation or dehumidification systems and building energy demand for climate control
- **Sustainability and Eco-Friendly** made from natural lime, lightweight aggregates, and industrial by-products and low environmental impact and circular material use

Nature-based panel + UNIVPM finish



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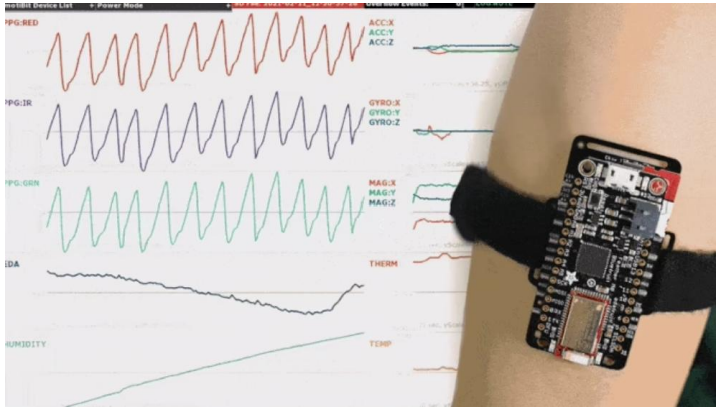
People's well-being

Measurement of people's well-being in the built environment using both wearable physiological sensors and environmental sensors as well as subjective responses according to the protocol test specifically developed

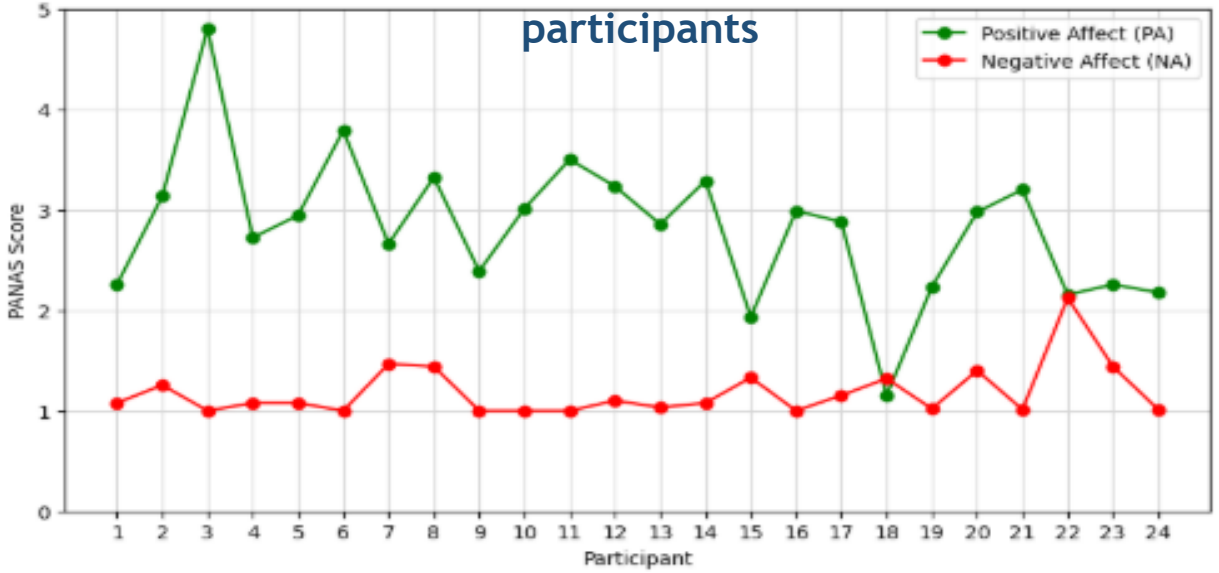
- **Comprehensive well-being assessment framework** (physical, mental, social) designing and implementing a holistic study protocol combining subjective and objective wellbeing data
- **Best-practice example of person-centred design for future replication** involving occupants in the tests using repeated comfort and wellbeing tests and questionnaires (ASHRAE scales, PANAS, etc.)
- **Deployment of wearable sensors (Emotibit) and environmental sensors (DomX)** to assess the occupant's comfort
- **Optimization of personalized comfort models (PCMs) and well-being prediction** through the inclusion of different types of signals, hence obtaining a wider overview of the subject's status along with the possibility of exploiting the derived information for controlling purposes in view of energy optimization

Emotibit



DomX

Positive and Negative Affect Schedule of participants

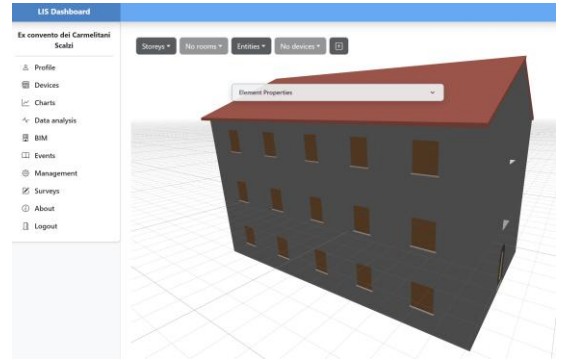


LIS-platform as a Smart Building OS

Implementation of LIS-platform as a Smart Building OS, aiding in the creation and management of energy-efficient, sensor-equipped structures protected against natural threats and climatic hazards

- **Innovative integration of IoT devices and sensors with a digital information model (BIM) in a multi-platform** which main innovative element is the combination between the IoT wireless communication system inside real buildings and the model of the building itself
- **Real-time monitoring and management** of building performance and critical events
- **Data analysis platform** to access and study key indicators such as indicators in energy efficiency, thermal and seismic structural health monitoring or other key indicators derived from the MULTICLIMACT set of digital tools such as accessibility, comfort and well-being

BIM model



Energy and Structural Simulation

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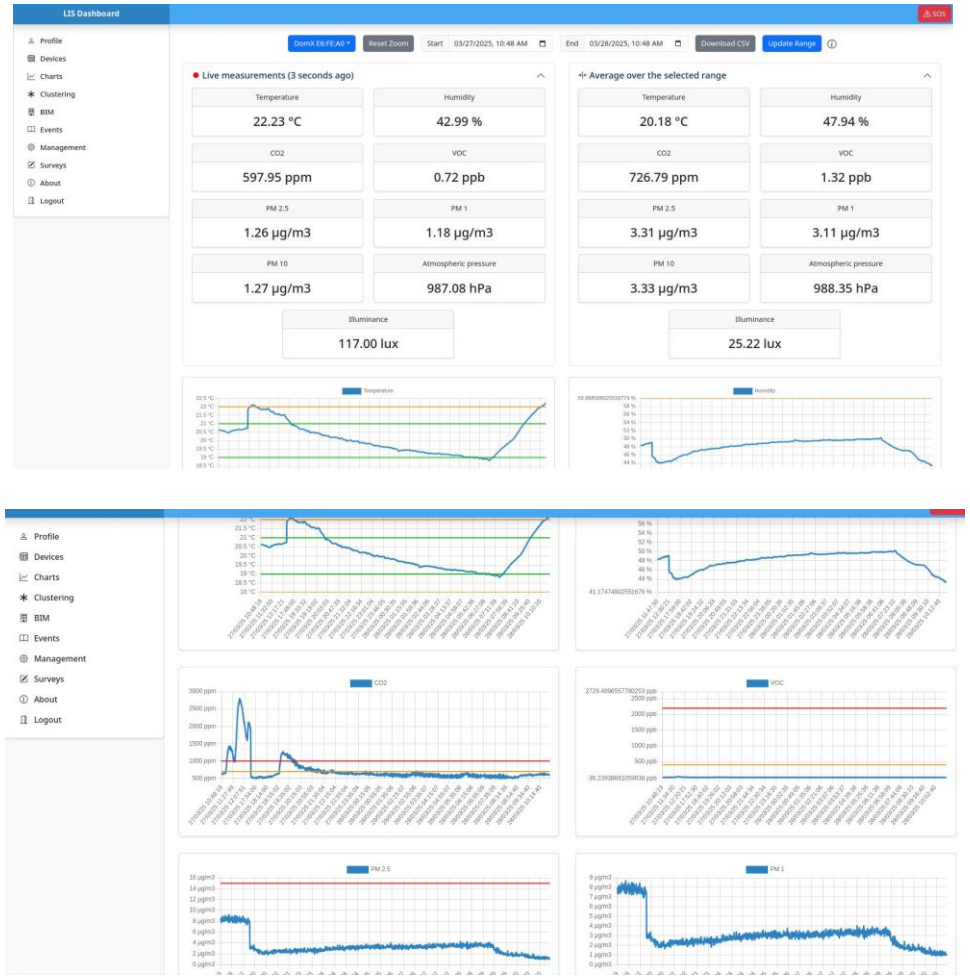
LIS-platform as a Smart Building OS

Implementation of LIS-platform as a Smart Building OS, aiding in the creation and management of energy-efficient, sensor-equipped structures protected against natural threats and climatic hazards

- **Programmed web app for user management** to help in monitoring any critical situation identified by other partners within the building

- **Push Notification Service (PNS)** based on different profiles, including early warning systems and emergency protocols

LIS platform Dashboard



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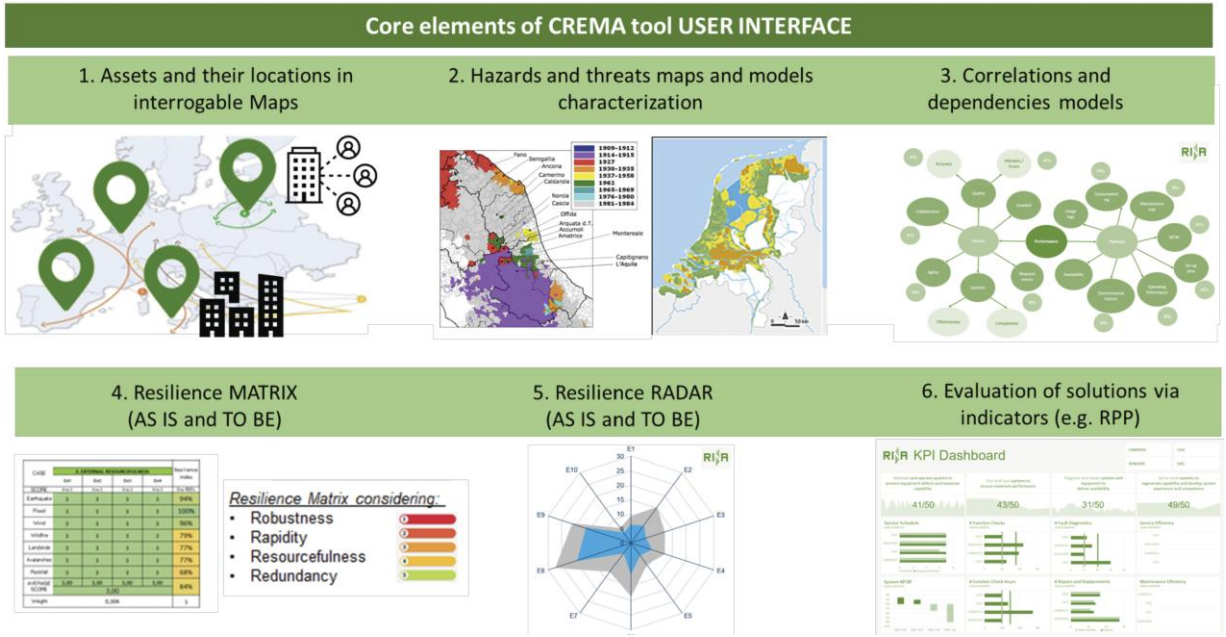
CREMA tool – RINA-C

Test of the CREMA tool, including both the “as is” and the MULTICLIMACT toolkit impact assessment on the resilience of building

- Climate REsilience Maturity Assessment is a tool for providing to different stakeholders a comprehensive maturity assessment of the resilience of the asset/s they own or operate in face of locally-relevant climatic and natural hazards
- It implements a new human-built environment integrated approach to resilience, as well as a quantitative framework for evaluating the impact of design and planning methods, materials, technologies and digital solutions
- Improvement of the resilience of the built environment taking into account (in designing and planning any intervention) of crucial aspects such as supply chain, life cycle approach, human health and well-being, energy efficiency
- Customization of solutions to the needs, as well as creating a broader consciousness about the protective role that resilience-enabling interventions could have for the built environment and the people living in it



CREMA tool core elements

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