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The MEZeroE open innovation platform is now a reality.
Get involved to contribute to and benefit from our
evidence-based sustainable housing community.

MEZeroE
Measuring Envelope systems
for Zero Energy buildings

WE ARE
**live &
open**
TO INNOVATION

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In the ever-evolving landscape of architecture and construction, innovation is more than a buzzword—it's the foundation for sustainable living. From nanotechnology-based coatings to bio-based polyurethane materials, the building industry is transforming to meet the demands of an eco-conscious world. Each breakthrough brings us closer to creating spaces that are not just functional but also resilient and environmentally friendly.

Projects like MEZeroE exemplify this commitment, pushing the boundaries with cutting-edge solutions. The new approaches and products from the project's partners tested in the platform facilities redefine energy efficiency and durability while optimizing indoor comfort.

At the heart of these developments is a shared vision: to create buildings that harmonize with their surroundings, prioritize occupant well-being and minimize environmental impact. Together, industry and science are charting a path toward a future where sustainability is the standard, not the exception. Welcome to a world where innovation drives meaningful change. We're open—and ready to build the future, with the aim of providing a community of experts and open innovation services for a community of manufacturers and builders.

Driving progress, certifying the future

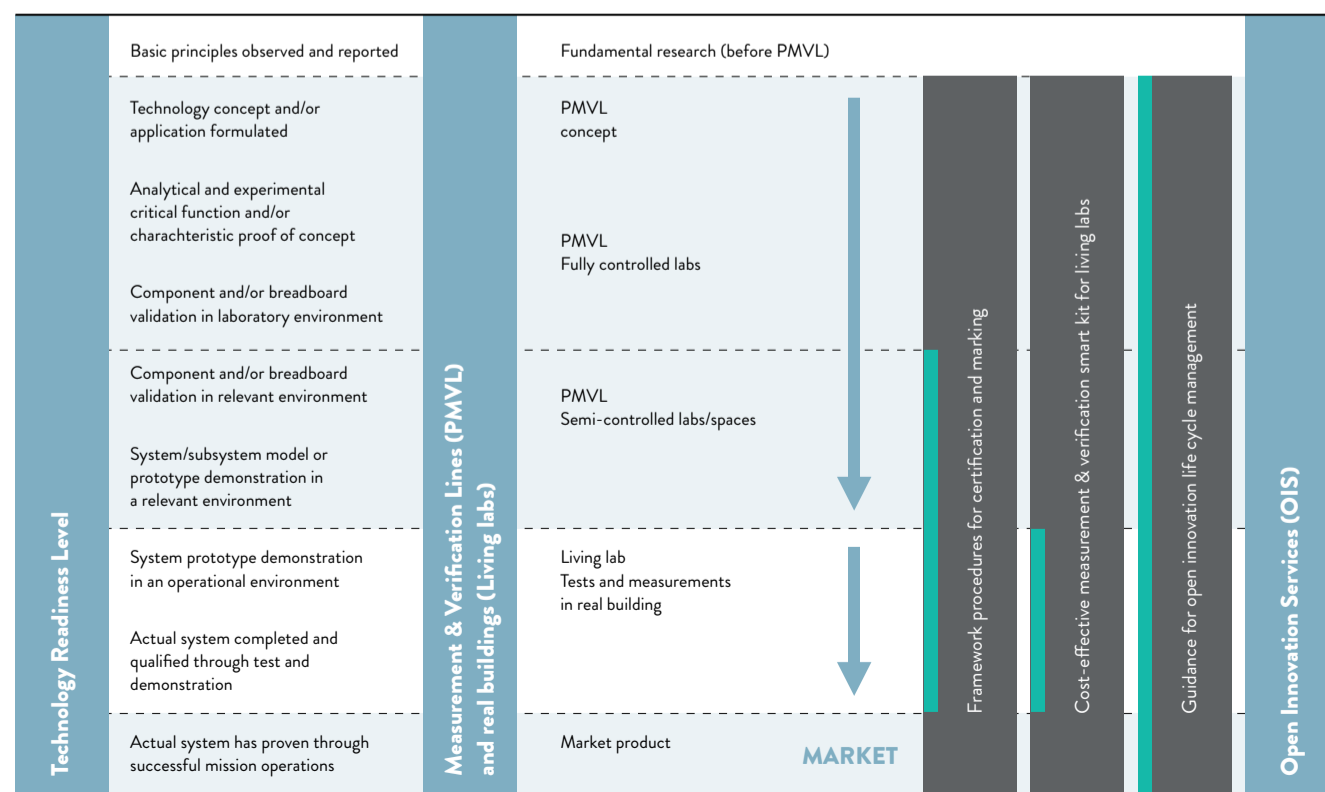
As we stride toward a more sustainable construction future, MEZeroE is delivering on its promise to redefine the built environment. With innovative solutions, we've achieved notable milestones in energy performance, safety and environmental consciousness. Our living labs serve as a dynamic testing ground, where advanced materials are demonstrating their potential in real-world conditions. Together, these efforts are reshaping how we approach building modernization.

But we're not stopping here. The journey ahead is filled with potential. Upcoming projects will focus on integrating multifunctional façades, refining nano-coatings for enhanced durability and scaling up the use of eco-conscious materials in both residential and commercial applications. Our commitment to innovation is unwavering as we continue to bridge the gap between cutting-edge technology and practical, sustainable solutions. A critical enabler of these advancements is MEZeroE's certification support service. Navigating the complex landscape of product

certification and compliance can be daunting. That's why we offer tailored guidance to help you secure the necessary certifications and markings, ensuring your innovations meet industry standards and regulatory requirements. From emissions testing for VOC compliance to evaluating mechanical resilience and thermal performance, our state-of-the-art facilities and expert teams are ready to accelerate your path to market.

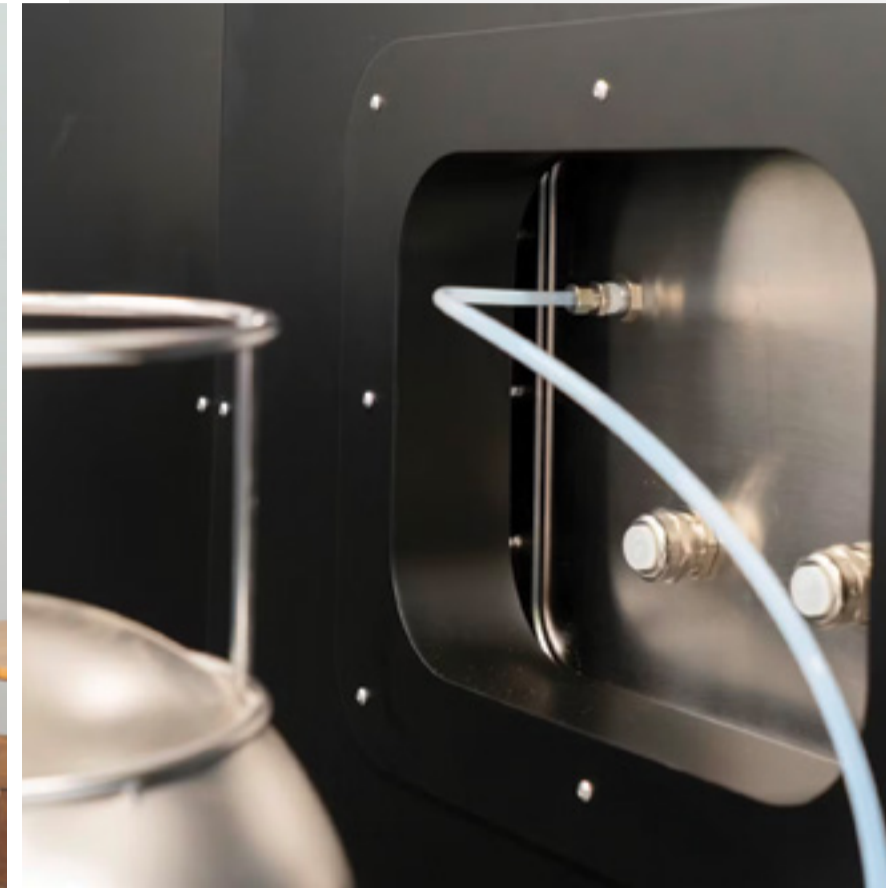
The platform, designed as a meeting place for construction players and materials manufacturers, makes it possible to speed up and simplify procedures with a single entry point to a full range of tests lines and services.

At MEZeroE, innovation is not just a goal—it's a pathway. And with our services, we're making sure your sustainable solutions reach the world with credibility and impact.



Building tomorrow

How science and industry
are shaping sustainable
architecture



Volatile Organic Compounds Lab
© Eurac Research
Polyurethane joints by Flex & Robust
Shear resistance of connection

In a world where the call for sustainability is growing louder, the boundaries of architecture are being redefined by groundbreaking innovations in building materials. At the heart of this transformation lies the collaboration between scientific research and industry, an alliance that is driving meaningful progress in how we construct and inhabit our spaces.

Recent breakthroughs in nanotechnology exemplify this synergy, particularly in the development of advanced coatings. These coatings not only enhance energy efficiency but also improve moisture control—essential features for maintaining the integrity of modern building envelopes. Beyond their immediate functionality, they promise enduring benefits, offering a glimpse into a future where efficiency and resilience go hand in hand.

Equally promising is the rise of biopolyurethane, a material whose exceptional mechanical strength and thermal performance are setting new standards. These innovations are not just incremental improvements but represent a paradigm shift, demonstrating how science can influence the aesthetic and functional aspects of construction while keeping sustainability at its core.

As we inch closer to the ambitious goal of carbon neutrality, high-performance membranes and multi-functional façades are emerging as game-changers. These materials embody a dual mission: achieving superior building performance while, at the same time, reducing environmental impact. They symbolize a commitment to eco-friendly practices, resonating with a global demand for solutions that align with ecological priorities.

This evolution is more than a technological leap—it reflects a deeper, human-centred narrative. Each advancement underscores a collective aspiration to create spaces that are not simply structures but ecosystems, harmonizing with their surroundings. By uniting innovation with environmental responsibility, the partnership between science and industry is both reshaping the built environment and redefining what it means to build a future that sustains us all.

Cleaner air, safer spaces: Low-VOC materials in modern construction

As energy efficiency and sustainability take centre stage in construction, the air quality inside our buildings is attracting overdue attention. The MEZeroE project, is advancing this conversation by addressing both performance and safety in building materials. One notable focus is on polyurethane flexible joints, engineered for structural demands in areas prone to earthquakes and hurricanes.

These joints, developed with durability in mind, are also tested for their impact on indoor air quality—specifically for emissions of volatile organic compounds (VOCs). VOCs, released as gases from certain materials, can accumulate indoors, posing potential health risks with prolonged exposure. This concern makes rigorous emissions testing a critical step in material development. In controlled tests at the MEZeroE VOC Lab, these joints demonstrated low VOC emissions, aligning with stringent indoor air quality standards. The results affirm their suitability for long-term use in enclosed spaces, offering a balance between structural resilience and occupant health.

This approach reflects a growing priority in construction: creating safer, healthier environments without compromising performance. As the sector evolves, addressing indoor air quality alongside sustainability and durability marks a significant step forward for the people who live, work, and gather in these spaces.

Nanotechnology and the future of sustainable building envelopes

The integration of nanotechnology into construction materials is reshaping how we approach energy efficiency and indoor comfort. In a collaborative effort with TECNAN, the MEZeroE project is exploring nanoparticle-based coatings designed to elevate the performance of building envelopes. These coatings address critical challenges like energy consumption and indoor air quality, offering innovative solutions rooted in material science. TECNAN's coatings aim to optimize energy use while controlling moisture and enhancing air quality—factors essential for creating sustainable, liveable spaces. Ongoing testing ensures these advancements are not only effective but adaptable, signalling their potential to influence the trajectory of sustainable architecture across Europe and beyond.



Heatshield Coating: Enhancing Thermal Comfort Through Innovation

One highlight of this partnership is TECNAN's TECNADIS HEATSHIELD, a nanotechnology-based coating designed to regulate heat transfer through glass surfaces. This product tackles a common issue in modern architecture: the thermal load from solar radiation on large glazed façades. When applied to glazing systems, HEATSHIELD blocks over 40% of infrared (IR) solar radiation, reducing the solar heat gain coefficient (g-value) by 30-37%. Rigorous tests at MEZeroE's G-Value Lab have confirmed its consistent performance across varying environmental conditions, including different angles, temperatures, and light intensities.

By mitigating solar heat gain, HEATSHIELD reduces the demand for air conditioning during hot weather, lowering energy consumption and improving indoor comfort. For buildings with extensive glass façades, this innovation represents a step forward in balancing modern design with sustainability, contributing to a future where energy-efficient solutions support both the planet and the people who live and work within these spaces.

Coatings that protect: Moisture defence and air quality innovation

Beyond addressing thermal challenges, advancements in building materials are taking aim at two persistent threats to structural integrity and indoor health: moisture and pollutants. TECNAN's nanoparticle-based hydrophobic coatings, for instance, are redefining how porous materials like stone and plaster withstand water exposure without compromising breathability. One standout, a solvent-based hydrophobic treatment dubbed Coating B, demonstrated remarkable efficiency in testing, reducing water absorption by up to 98% while maintaining essential vapor diffusion. This balance is particularly valuable in damp or humid climates, where unchecked moisture can erode building materials over time.

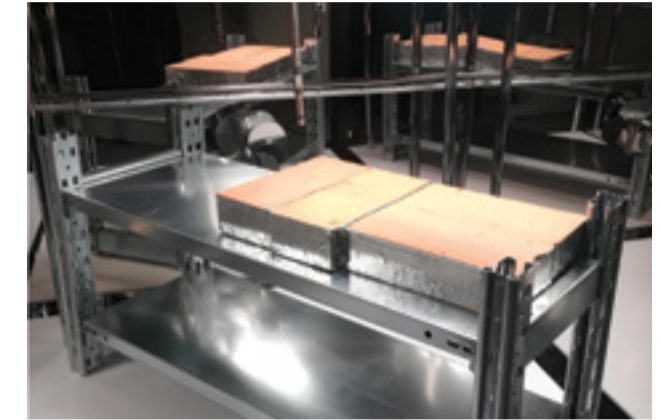
Photocatalytic Coatings and Air Quality

TECNAN's innovations also extend to indoor air quality, with photocatalytic coatings designed to combat harmful volatile organic compounds (VOCs) like formaldehyde. These coatings use photocatalytic nanoparticles to degrade pollutants, though recent tests revealed that the degradation rates under light exposure have room for improvement. Adjustments to experimental conditions could enhance their potential, signalling ongoing opportunities for optimization in air-purifying technologies.

Testing in Real-World Conditions

Validation of these coatings took place at the BEEpilot facility at Politecnico di Milano, where they were subjected to real-world conditions. The controlled testing highlighted the coatings' effectiveness, particularly the TECNADIS HEATSHIELD's ability to reduce heat flow through treated windows during daylight hours. By mitigating solar heat gain, the coating not only improved thermal comfort but also reduced reliance on energy-intensive cooling systems.

These developments underscore a growing focus on durable, adaptable solutions that enhance the resilience of buildings while addressing human-centred priorities like air quality and comfort. In combining technical performance with environmental awareness, these coatings reflect the evolution of construction materials toward a more sustainable future.



Test specimens in the test chamber with the experimental set-up
© Eurac Research



Hydrophobic Coating applied to porous building materials
© TECNAN



Measurement of the G-Value under different conditions
© Eurac Research - G-Value Lab



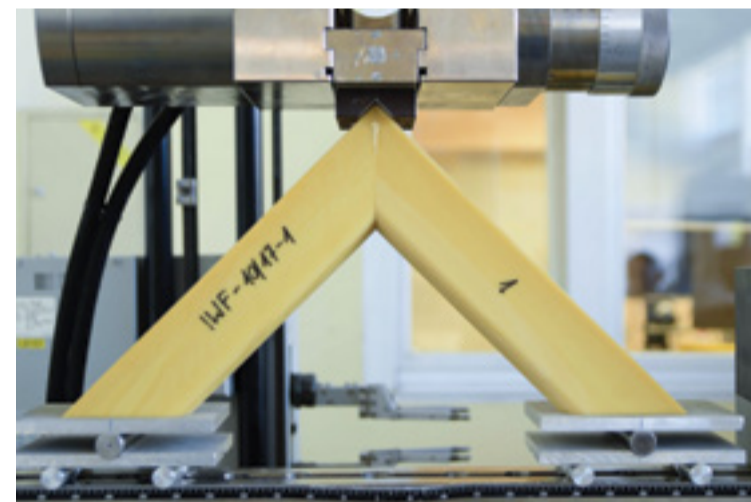
Application of the product in the BEEpilot test facility
© Politecnico Milano

Biopolyurethane: A Sustainable Shift in Construction Materials

As part of the MEZeroE project, INDRESMAT is charting a new course in sustainable construction with biobased polyurethane materials. Founded in 2017, the company has focused its efforts on developing window frames and sandwich panels that blend energy efficiency with environmental consciousness. These innovations highlight the role biopolyurethane can play in shaping the future of building envelopes.

Recent MEZeroE testing underscores the potential of biopolyurethane as a pivotal material for the construction industry. INDRESMAT's window frames and sandwich panels demonstrate a compelling mix of mechanical durability, thermal performance, and acoustic insulation. Such qualities not only enhance energy efficiency but also address key challenges in modern construction. Products like the KLIMA-PUR window frames and SAFE-PUR sandwich panels show promise in meeting the demand for sustainable solutions while maintaining structural and environmental standards.

Looking ahead, INDRESMAT plans to refine its designs and pursue certifications to bring these products to market. By combining research, rigorous testing, and a focus on sustainability, the MEZeroE project and INDRESMAT are paving the way for construction practices that balance performance with environmental stewardship.

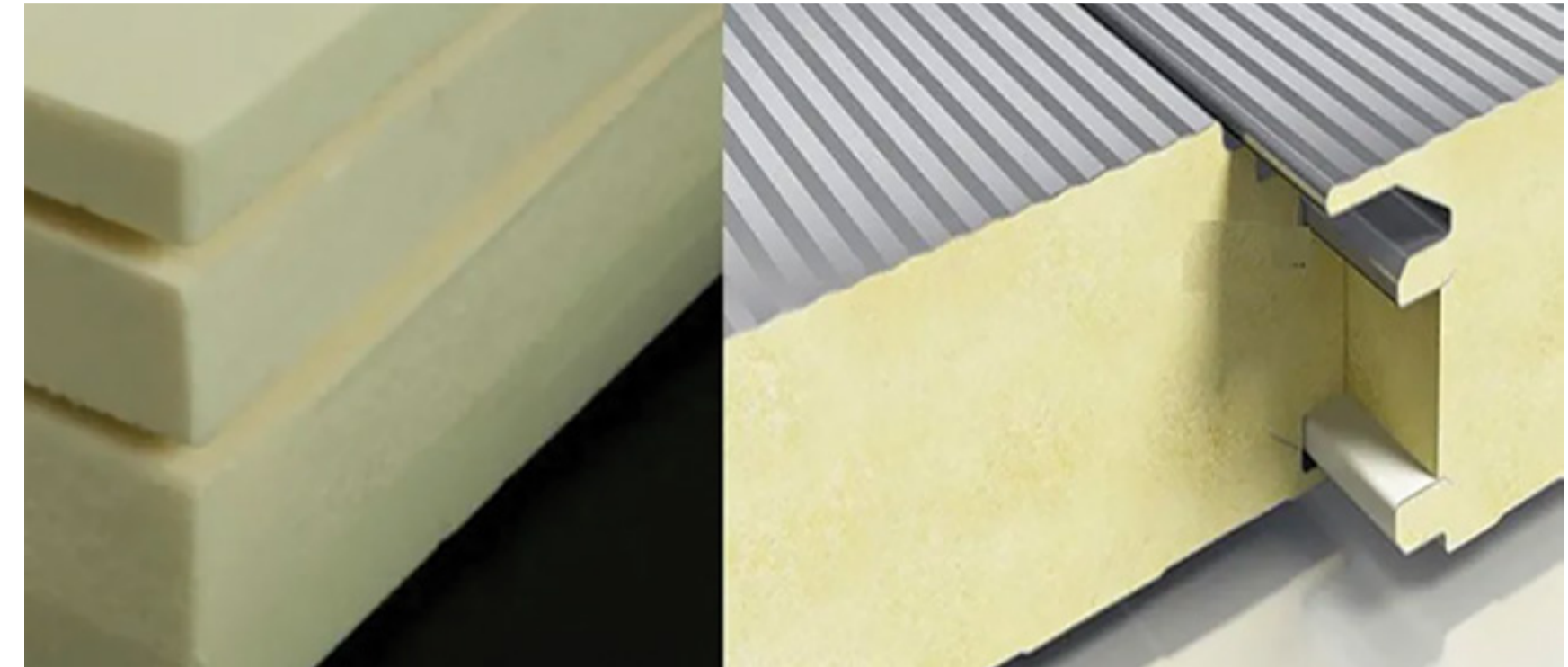


Window frames: Redefining efficiency and durability

INDRESMAT's KLIMA-PUR window frames exemplify the practical benefits of biopolyurethane in construction. Designed as part of the MEZeroE initiative, these frames underwent extensive testing to ensure their durability, acoustic performance, and thermal efficiency. Results revealed exceptional mechanical resilience, withstanding low-temperature cracking and enduring freeze-thaw cycles without significant degradation. The frames' acoustic stiffness enhances soundproofing—a valuable asset for urban buildings—while thermal simulations confirmed their ability to prevent condensation and mould formation under typical residential and office conditions.

This dual benefit improves both indoor air quality and the longevity of building components. However, the analysis highlighted the importance of pairing the frames with appropriate glazing configurations to optimize performance further.

INDRESMAT's work on biopolyurethane frames and panels signals a thoughtful approach to advancing construction materials, where sustainability and functionality coexist.



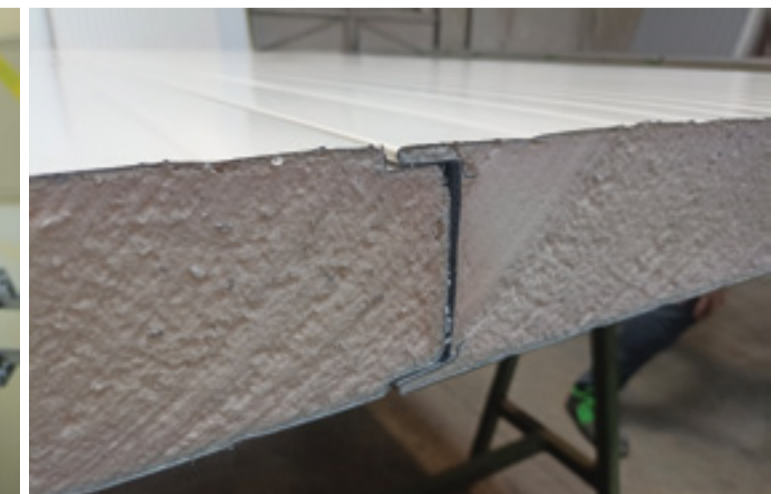
Sandwich panels: Balancing strength and efficiency

Expanding its portfolio of sustainable building materials, INDRESMAT has introduced SAFE-PUR sandwich panels, which leverage biopolyurethane as their core material. Designed with insulation and structural stability in mind, these panels have undergone rigorous testing to evaluate their shear strength, thermal performance, and moisture resistance. In shear resistance tests, the panels withstood a maximum load of 1.56 kN when connected to aluminium substructures. While this highlights their potential for robust applications, the primary failure mode—hole elongation—suggests room for improvement in connection design to enhance long-term durability.

Thermal performance testing yielded encouraging but nuanced results. Before undergoing ageing processes, the panels demonstrated a thermal conductivity of 0.036 W/mK,

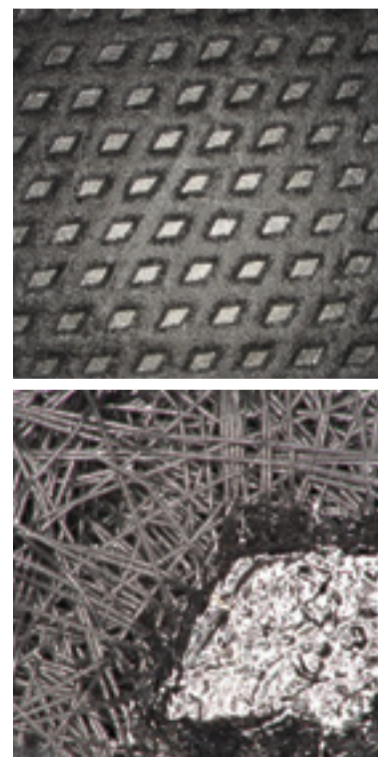
comparable to widely used insulation materials like mineral wool and expanded polystyrene. However, significant deformations during ageing prevented further testing, pointing to the need for refinements in material resilience. One area where the panels excelled was moisture management. Tests revealed no condensation or moisture issues at the joints, an essential feature for maintaining insulation integrity over time.

While these findings emphasize the potential of SAFE-PUR panels to support sustainable construction, they also underscore the importance of continued optimization. As INDRESMAT refines these designs, the panels could offer a practical, eco-conscious alternative for future building projects, balancing strength, efficiency, and environmental responsibility.





Paving the way for better durability, thermal efficiency and moisture management of tomorrow's sustainable building envelopes



Rothoblaas is a well-known Italian company that specializes in advanced energy efficiency and timber construction solutions. It has evaluated and improved a number of products designed to transform building envelopes, particularly in the key areas of durability, thermal performance and moisture management. Thorough testing is carried out in the MEZeroE project's specialized laboratories, confirming that the innovations not only satisfy the requirements of contemporary construction but also comply with stringent energy regulations.

Rothoblaas's contributions to the MEZeroE project have already highlighted the transformative potential of innovative materials in building envelope design. From high-performance membranes that adapt to moisture conditions, to advanced fasteners that reduce thermal bridges, these products are paving the way for more sustainable, energy-efficient buildings. As Europe moves towards its 2050 carbon neutrality goal, the innovations tested within MEZeroE are setting new standards for durability, efficiency, and comfort. By integrating advanced testing methods, such as the real-life simulations at BEEpilot and rigorous mechanical characterizations, Rothoblaas ensures that its products not only meet current regulatory standards but also anticipate future building challenges. Through its commitment to research, testing, and continuous improvement, Rothoblaas – along with its MEZeroE partners – is helping redefine the future of sustainable construction, one membrane, one screw, and one adhesive tape at a time.

Enhancing thermal and moisture control: cutting-edge membranes

One of the cornerstones of energy-efficient building envelopes is the control of moisture and heat transfer. The high-tech membranes developed by Rothoblaas adapt to environmental conditions, providing better thermal and hygrothermal regulation. The CLIMA CONTROL 80, a moisture-adaptive vapor control membrane, is specifically designed to regulate water vapor movement based on changes in relative humidity. When it was tested in a flat-roof assembly, the membrane demonstrated excellent moisture control, adapting to both winter and summer conditions. During the summer phase, the membrane allowed the roof structure to dry out, effectively reducing humidity levels across all test positions. When faced with the challenges of winter, it acted as a vapor retarder, limiting moisture transfer from the interior, while promoting redistribution within the roof structure to prevent the buildup of condensation. These results are particularly promising for flat roofs, where moisture buildup can lead to long-term structural damage. While further testing in real-world conditions is recommended, these initial findings highlight the membrane's potential to significantly improve the longevity and performance of roofing systems in various climates.

Durability under intense UV exposure: membrane and connection testing

In order to achieve long-term performance, Rothoblaas membranes have undergone extended UV and heat exposure tests. The TRASPIR EVO UV 115 membrane, a key product in the portfolio, was subjected to 5000 hours of UV exposure—well beyond standard requirements. The test results indicated that while the membrane showed visible degradation, including microcracks and fibre fragmentation, it retained structural integrity throughout the test. Additional tests combining UV exposure and heat showed an accelerated degradation process, emphasizing the importance of considering heat alongside UV rays in product development. The connections between membranes and adhesive tapes were also tested under similar conditions. The FLEXI BAND UV tape was evaluated for its ability to maintain its adhesive strength when paired with the membrane under UV and heat exposure. While shear resistance decreased slightly after ageing, the adhesive tape remained effective. Notably, the failure modes shifted from tape-membrane separation in the reference specimens to membrane peeling and tape breakage in the aged connections, highlighting areas in material bonding that will benefit from further improvement.



Hygrothermal Performance:
Insights from real-world testing at BEEpilot

The performance of Rothoblaas products was further confirmed and validated in a real-world testing environment offered by the BEEpilot testing facility in Lecco, Italy. It was there that the hygrothermal performance of membranes was monitored over an 18-month period in both winter and summer conditions. The tests focused on how membranes with varying vapor resistance, such as TRASPIR EVO 160 and TRASPIR WELD EVO 360, responded to changes in temperature and humidity.

The results indicated that bituminous membranes resulted in higher relative humidity in winter, while other membranes provided more stable performance across the seasons. This in-depth analysis plays an important role in informing future product development, ensuring that Rothoblaas membranes continue to meet the needs of high-performance buildings in diverse climates.



Mechanical characterization:
Shear and peel resistance of adhesive tapes

Beyond membranes and screws, Rothoblaas also focuses on the performance of adhesive tapes used in conjunction with its membranes. The mechanical characterization of tapes like FLEXI BAND UV and SMART BAND revealed their resilience under a wide range of conditions. The tests measured the tensile resistance, shear resistance, and peel adhesion properties, demonstrating that these tapes maintained strong mechanical performance even after exposure to UV and freeze-thaw cycles. For example, the FLEXI BAND UV tape showed only a minor reduction in tensile strength and peel adhesion after a full year of UV exposure, while the freeze-thaw cycle tests demonstrated even higher performance in certain cases. This resilience is crucial in ensuring that building envelope components remain tightly sealed over the long term, preventing air and moisture infiltration that could degrade insulation and reduce energy efficiency.



Tensile properties and resistance to tearing
© Cracow University of Technology



DGZ screws for continuous connection
of the insulation layer
© Rothoblaas

High-performance connections:
DGZ screws for minimizing thermal bridges

Thermal bridges are a common problem in building envelopes, contributing to heat loss and energy inefficiency. Rothoblaas has effectively tackled this issue with its DGZ screws. Designed for continuous fastening of roof insulation layers, DGZ screws eliminate the interruption in insulation seen with traditional, partially threaded screws. Thermal simulations showed that the use of DGZ screws resulted in a lower thermal transmittance (U-value) than their traditional counterparts. This benefit was most pronounced in structures with timber beams, as the uninterrupted insulation significantly reduced the effect of thermal bridges. Additionally, the advantage was more apparent with thinner insulation layers, making DGZ screws a highly effective solution for a wide range of building types, particularly those that rely on timber as a primary construction material.

Future-proofing building design

Focchi is one of the MEZeroE partners active in the development of prefabricated multifunctional façades, designed to achieve Nearly Zero Energy Building (nZEB) standards while ensuring optimal indoor environmental quality. These façades, tested rigorously in both laboratory and real-world conditions, are redefining the integration of energy efficiency, comfort, and automation in building design.

Focchi's prefabricated multifunctional façades represent a significant step forward in sustainable construction, providing a model for integrating building services within the envelope itself. As Europe moves towards its 2050 carbon-neutrality goals, solutions like these will be essential for both new buildings and retrofits. Focchi's work offers a blueprint for future buildings, where energy efficiency and occupant comfort go hand in hand. With continued development and testing, Focchi's multifunctional façades are set to play a pivotal role in creating buildings that are smart, energy-efficient, and comfortable and which can adapt to the challenges of tomorrow's climate.



Multifunctional façade
Testing experiment set-up
© Eurac Research

A multifunctional approach to façades

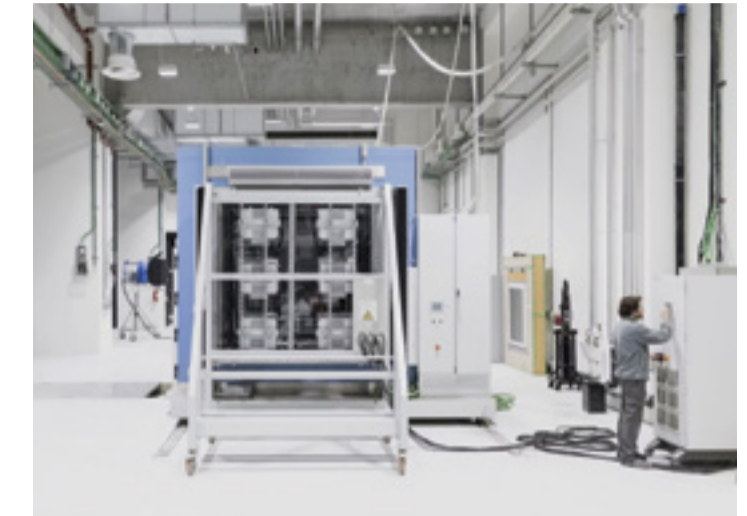
The key to Focchi's approach is its multifunctional façade system, which integrates heating, cooling, ventilation, and shading into the very fabric of the building. These façades do more than provide thermal insulation—they actively contribute to the building's overall energy management by embedding systems such as heat pumps, heat recovery units, and automatic blinds within the façade itself. The result is a holistic solution that not only supports energy efficiency but also addresses thermal, acoustic, and visual comfort as well as indoor air quality.

Real-world testing in living labs

Focchi's façade system has undergone extensive testing in MEZeroE's living labs, particularly at its own office building in Poggio Torriana, Italy. This two-storey office building, equipped with a 1,300 square meter triple-glazed unit façade system, became a testing ground for Focchi's prefabricated solutions. The façade integrates automatic ventilation controls and sensors, which adjust the indoor environment based on real-time data on temperature, humidity, CO2 levels, and even particulate matter. Through these tests, Focchi's façade system has demonstrated significant improvements in thermal comfort and indoor air quality. Participants in a post-occupancy evaluation reported a higher satisfaction level, particularly regarding the thermal neutrality of their environment. Indoor temperatures were more consistently maintained within a comfortable range, while the automated shading and ventilation systems helped both to reduce glare and enhance natural lighting.

Overcoming technical challenges

While the results of Focchi's tests were largely positive, the project did face some challenges, notably in maintaining set-point temperatures during extreme weather conditions. In controlled summer tests, the HVAC system struggled to reach the desired indoor temperature under certain conditions, suggesting a need for further optimization of the integrated heat pumps. However, these insights have provided valuable feedback for improving the façade system's performance and ensuring that future iterations are even more resilient and effective under a variety of climatic conditions.



Eurac Façade Laboratory
© Eurac Research - Fabrizio Giraldi



Facade System Interactions Lab
© Eurac Research



System integration
© Focchi

Impact in Real life

Living labs as catalysts for sustainable innovation

As Europe strides towards a carbon-neutral future, the MEZeroE project's living labs (LLs) are emerging as essential grounds for testing nearly Zero Energy Building (nZEB) solutions in real-life settings. These LLs are not conventional test sites but are real buildings where occupants interact daily with advanced building envelope technologies, providing direct feedback and data on the performance delivered by these innovations. This approach offers unique insights that go beyond laboratory testing, capturing the nuances of user interaction and environmental adaptation essential to sustainable design. The power of these living labs lies in their diversity. Spread across Europe, the MEZeroE LLs span various building types, climates, and occupancy patterns, offering a comprehensive picture of how sustainable technologies perform under distinct conditions. From residential spaces in historic neighbourhoods to industrial sites and office buildings, these LLs test a wide array of envelope products—from multifunctional façades to smart membranes and bio-based insulation solutions.



The solution for cost-effective measurement and verification

This real-world data collection, complemented by occupant feedback, gives manufacturers invaluable information on product resilience, energy efficiency, and user comfort. The LLs have also shown that true innovation in sustainable building design requires balancing technical performance with human-centric design, adapting to user needs, and environmental factors over time. As we look to the future, MEZeroE's living labs underscore the importance of collaboration among stakeholders—innovators, building owners, and residents—to drive the adoption of sustainable solutions across Europe's building sector. These LLs are not only testing grounds but also pioneers in the shift towards buildings that meet energy standards while enhancing the lives of those within them.

Nine industrial partners provided 16 products for installation in the living laboratories. When the project has been completed, each of the products tested – assuming effective performance – will remain in the buildings.

In the following pages, all of the products will be introduced, along with brief descriptions of their functions and an overview of how they performed in the testing.

ID-CARD

LL1

Office building Poggio Torriana, Italy

BUILDING ARCHETYPE:
Office building (Focchi HQ)
to be renovated and with a new
office space addition.
Building envelope designed
to be multifunctional.

YEAR OF CONSTRUCTION: 2008
NUMBER OF OCCUPANTS: 121

INSTALLED PRODUCTS:
Multifunctional prefabricated
façade by Focchi

MEASURED PARAMETERS:
Indoor air temperature
Relative humidity
CO2
PM1, PM2.5, PM10
TVOC



Focchi's multifunctional prefabricated façades integrate different tools geared toward achieving nearly zero energy building balance and optimal indoor environmental quality. The heating/cooling pump as well as the heat recovery and ventilation systems are embedded in the envelope, which can be applied in both new and existing buildings. The multifunctional prefabricated façade is a dedicated platform that includes internet of things components for real-time monitoring of information relevant to energy efficiency, comfort, well-being, and indoor environmental quality.

From traditional façades to multi-comfort solutions

The existing building is outfitted with a traditional curtain wall façade system, which will be replaced in part by a 450 m² multifunctional façade. This upgrade has been designed to address various aspects of indoor comfort – thermal, visual, and acoustic – while ensuring high indoor air quality through the inclusion of new heating, cooling, ventilation, and shading systems. Its automation-ready design, featuring actuators and embedded sensors, enables dynamic adjustment to changing environmental conditions, which is essential in the reduction of energy consumption and the enhancement of occupant comfort.

This solution relies on a closed cavity design, with an external glazed chamber, which is filled with dry air to prevent condensation and dust accumulation. The façade is able to interact with the building's automation system, which controls heat recovery and shading based on real-time indoor and outdoor conditions. If all goes according to plan, the result will be a balanced indoor microclimate that not only minimizes energy costs but also improves occupant health and well-being.

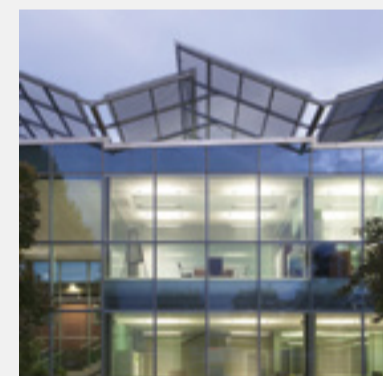
Monitoring and evaluation: The role of data

The success of MEZeroE is predicated on detailed monitoring and analysis of the façade's impact. Environmental sensors, installed in key office areas, will track thermal comfort, air quality, and sound pressure. Improvements in these areas will be quantified by comparing baseline data gathered before the façade installation with post-installation metrics. A post-occupancy evaluation will also be made to gauge occupant satisfaction, yielding insights into the perceived impact of these environmental changes.

Beyond efficiency: A new paradigm for building façades

The Poggio Torriana living lab exemplifies the shift towards integrated building systems that support sustainable healthy working environments. By testing this multifunctional façade in real-world conditions, MEZeroE advances our understanding of how such solutions can be scaled across various climates and building types, making zero-energy buildings a more attainable goal across Europe.

As the project moves forward, the data from this living lab will be used to guide future applications of the façade, offering a model for next-generation building envelopes that combine energy efficiency with enhanced comfort and environmental awareness.



The building to be reconstructed is nearly 130 years old. It was built in 1895 and is located in the historic centre of Aviles. The aim of the renovation is to obtain a passive house certification and accordingly, all materials used have to be in line with that goal.

Durable advanced functional coatings for self-cleaning and air purification produced by Tecnologia Navarra de Nanoproductos SL (Spain)

Thanks to their self-cleaning, hydrophobic and photocatalytic properties, these advanced coatings can reduce pollutants and improve indoor and outdoor air quality. Unlike current commercial self-cleaning coatings, this one, with its special properties, is transparent to the eye. Photocatalytic products that are now on the market require UV activation, while the new coatings ensure protection against nitrogen oxides (NOx), sulphur oxides (SOx), and volatile organic compounds (VOCs), even in the visible range.

This multifunctional coating can be easily applied in an invisible layer and testing suggests that thanks to the advanced properties of the matrix employed, it will offer superior longevity. The coating's hydrophobic behaviour and its interaction with the photocatalytic material in visible light enables the market-ready product to reduce pollutants and soiling on the treated surface.



ID-CARD

LL8

Historical building Aviles, Spain

BUILDING ARCHETYPE:
Residential and architectural studio

USE OF BUILDING: Residential building
YEAR OF CONSTRUCTION: 1895
NUMBER OF OCCUPANTS: 4

INSTALLED PRODUCTS:
Advanced nanomaterials for energy
efficient glazing systems by Tecnan
Tailored smart membranes and
tapes by Rothoblaas
Durable advanced functional
coatings for self-cleaning and
air purification by Tecnan

MEASURED PARAMETERS:
Air purification
Glazing system efficiency

Tailored roof/façade smart membranes produced by Rothoblaas SRL (Italy)

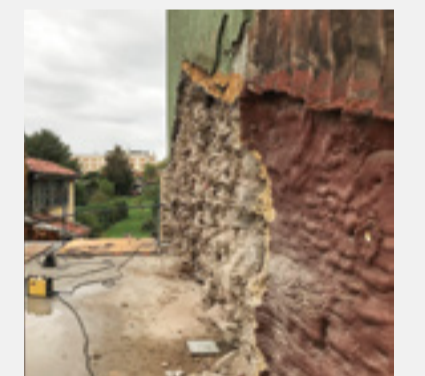
The special PA film gives the smart membrane the ability to adapt to the hygrometric conditions of the building. If the membrane comes into contact with high humidity levels, it is transformed from a vapour barrier into a breathable product, guaranteeing that the structure remains dry. The product is ready to be introduced commercially.

Tailored roof/façade sealing tapes produced by Rothoblaas SRL (Italy)

The tape achieves the highest level of protection against harmful emissions, thanks to the special formulation of the acrylic glue. The combination of carrier and acrylic dispersion glue is designed for good adhesion, even in extremely cold temperatures.

Tailored roof/façade fastening system produced by Rothoblaas SRL (Italy)

Rothoblaas SR has introduced galvanized carbon steel double-threaded screws, which provide a gap for the installation of insulation. These screws can be used in timber-based panels, solid timber, glulam (glued laminated timber), CLT (cross laminated timber), LVL and high-density woods (service classes 1 and 2).



ID-CARD

LL25

Research laboratory
Cracow, Poland

BUILDING ARCHETYPE:
Research laboratory of
the Cracow University
of Technology.

YEAR OF CONSTRUCTION: 1900
NUMBER OF OCCUPANTS: 4

INSTALLED PRODUCTS:
Flexible structural connectors
by Flex & Robust
(Bio)polyurethane frames
by Indresmat
Integrated microfilm shading
device by Pellini

MEASURED PARAMETERS:
Indoor air temperature
Relative humidity
CO2
PM1, PM2.5, PM10
TVOC



Revamping sustainable building envelopes

At the Cracow University of Technology in Poland, Living Lab No. 25 is a dynamic testing ground for advanced building materials under the MEZeroE project. Here, cutting-edge innovations converge to modernize ageing structures and push zero-energy building envelopes toward mainstream adoption. With products from Flex&Robust, INDRESMAT, and Pellini at its core, the lab explores how sustainable materials can transform thermal efficiency, indoor comfort, and structural resilience.

Structural resilience redefined

A standout in this initiative, Flex&Robust's flexible structural connectors are engineered to secure buildings in the face of seismic activity and high winds. Unlike traditional connectors that often fail and require replacement after disasters, these connectors excel in redistributing stress across large bonded areas, ensuring both durability and post-disaster functionality. In Living Lab No. 25, the connectors are applied to reinforce masonry by filling cracks, effectively extending the lifespan and stability of the building's ageing structure. As part of the lab's broader modernization efforts, the connectors play a key role in strengthening the bearing construction and improving the building's overall thermal and structural performance. For the four employees working daily within this space, the upgrades promise not just better energy efficiency, but a safer, more comfortable environment.

Advanced nanotechnology for glass

On the glazing front, TECNADIS HEATSHIELD, developed by Tecnología Navarra de Nanoproductos SL, introduces a nanotechnology-based treatment that significantly enhances energy efficiency. By blocking over 40% of infrared solar radiation, this innovative coating prevents excessive heat buildup in sun-exposed spaces, reducing the need for air conditioning while maintaining indoor comfort.

A vision for the future

Living Lab No. 25 demonstrates how advanced materials can seamlessly integrate into existing infrastructure, modernizing building envelopes without compromising on sustainability. The work being done here represents a tangible step toward making zero-energy construction solutions more accessible, practical, and effective for both ageing and new structures. Through these innovations, the lab embodies a commitment to safer, more energy-efficient buildings that meet the needs of both their occupants and the environment.



Thermal excellence with bio-based polyurethane frames

INDRESMAT's bio-based polyurethane window frames are a cornerstone of the lab's sustainable renovation. Known for their superior thermal insulation and eco-conscious design, these frames significantly enhance energy efficiency while maintaining durability. Their integration requires a meticulous process: outdated windows are carefully removed, and openings are restored to exacting standards to accommodate the advanced frames and their glazing counterparts. This detailed installation is essential to unlocking the full potential of INDRESMAT's high-performance systems, ensuring energy savings without compromising structural integrity or aesthetics.

Comfort redefined with smart shading solutions

Complementing the window frames, Pellini's microfilm shading devices introduce a new level of indoor climate control. These innovative shades optimize natural light and heat intake, reducing reliance on artificial lighting and cooling systems. By working seamlessly with the window frames, the shading devices maintain consistent indoor temperatures, creating a more comfortable environment for occupants. Together, these systems exemplify MEZeroE's commitment to enhancing both energy efficiency and day-to-day liveability within the building.



Measuring success: data-driven environmental monitoring

To evaluate the impact of these technologies, six Nuvap (N2Smart) sensors have been installed throughout the lab to monitor indoor environmental metrics such as CO2 levels, temperature, humidity, and particulate matter (PM1, PM2.5, PM10). This real-time data offers a clear picture of how these advanced systems improve air quality, thermal comfort, and overall environmental performance, providing an evidence-based framework for future applications.

A blueprint for sustainable renovation

As the phased upgrades to Living Lab No. 25 near completion, the project offers a glimpse into the future of sustainable construction. It showcases how innovative materials, thoughtful integration, and precise monitoring can transform existing buildings into energy-efficient, occupant-focused spaces. More than a renovation, this project serves as a model for how targeted advancements can help bridge the gap between today's building stock and the ambitious goals of nearly zero-energy construction.

ID-CARD

LL22

**Modular house
Ribnica, Slovenia**

BUILDING ARCHETYPE:
Modular house. Sustainable
prefab wooden all-in-one
envelope components.

YEAR OF CONSTRUCTION: 2022
NUMBER OF OCCUPANTS: 2

INSTALLED PRODUCTS:
Sustainable prefab wooden
all-in-one envelope and
external cladding components
by RIKO Hiše'

MEASURED PARAMETERS:
U-value
Indoor air temperature
Formaldehyde
Relative humidity
CO2
PM1, PM2.5, PM10
TVOC



Modular homes are rapidly gaining attention for their versatility and sustainability. These newly built structures offer flexible uses, from temporary offices to holiday homes, or even as part of a larger complex made up of multiple units. Designed with adaptability in mind, modular homes cater to diverse needs while maintaining a focus on sustainability. Built primarily from renewable materials such as wood and mineral wool, these homes are an eco-conscious alternative to traditional construction. Their energy consumption is minimal, and with the right setup, they can even be fully self-sufficient, offering a small but sustainable living space for anywhere from one to four people.

**Renovation and modernization:
enhancing comfort and efficiency**

As part of a renovation initiative, the building's external envelope is being modernized to improve both thermal efficiency and internal comfort. This includes replacing outdated windows and reinforcing the building's structure with flexible connectors to address any wear and tear in the masonry. The goal is to create a more energy-efficient and comfortable living environment. For this project, as with many others, the focus remains on using sustainable materials and methods to achieve lasting, practical results.

**Sustainable façades:
natural wood for long-lasting beauty**

In addition to their energy-efficient design, modular homes often feature wooden façades, chosen for their aesthetic appeal and natural durability. These façades are available in a range of wood types, each offering distinct qualities—colour, texture, and strength—that contribute to the home's overall character. Whether used for residential spaces or larger buildings, wooden façades provide both beauty and function.

Wood, being a natural material, is subject to ageing and wear over time, especially when exposed to the elements. To ensure longevity, the wood used in these façades is carefully selected for its resistance to decay. The application of protective treatments and finishes further safeguards the material, ensuring the façade remains intact and visually appealing for years.



Rigorous testing for high performance

RIKO Hiše's wooden cladding components were subjected to comprehensive testing to verify their durability and performance under a range of conditions. Two designs were tested: tongue-and-groove boards and wooden slats with dilatation. The key assessments are outlined below.

Artificial ageing

The artificial ageing test simulated long-term exposure to environmental factors. Observations revealed minor colour changes, slight surface chipping, and raised knots on less than 0.01% of the cladding's surface. Water retention was noted at joint areas, particularly in configurations without gaps, though no severe deterioration was observed.

Impact resistance

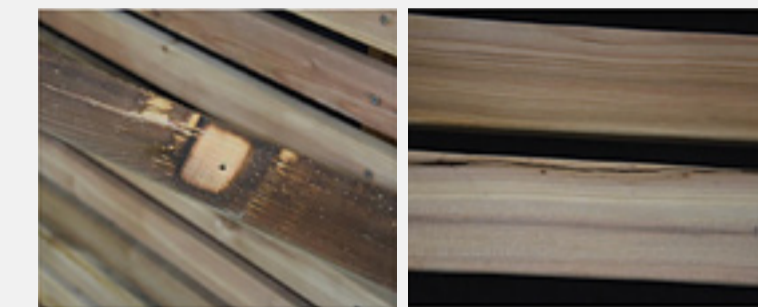
Simulating scenarios such as accidental hits or the debris from storms, steel ball impacts demonstrated that damage is influenced more by the wood's density at the impact point than by the energy of the impact itself. The findings also showed that artificial ageing has a minimal effect on the material's durability, though edges remain the most vulnerable areas.

Hail resistance

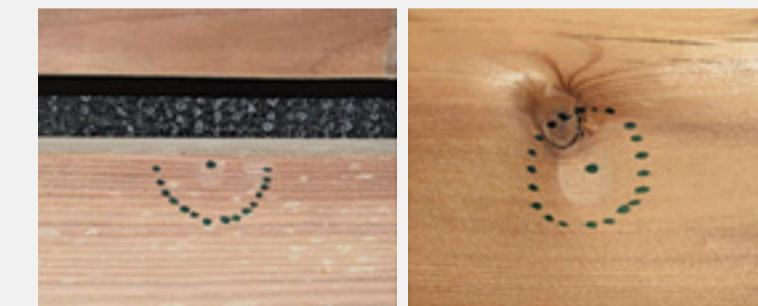
The impact of hail stones of varying sizes and weights was used to simulate hailstorms. Results indicated that the damage depended primarily on wood density rather than the ice ball's size or mass. As was the case with the impact resistance tests, aged specimens performed comparably to unaged ones, reinforcing their longevity under adverse weather conditions.

Key innovations and environmental impact

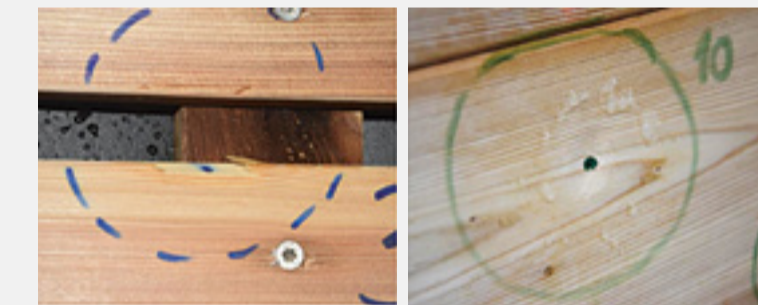
RIKO Hiše's cladding components combine aesthetic appeal, structural integrity, and environmental consciousness. By using wood—a renewable resource—these prefab solutions align with sustainable construction principles. Moreover, the adaptability of testing methods to product-specific needs underscores a commitment to precision and innovation.



Minor discolorations and chipping after artificial ageing. ©ZAG institute



Minor dent and discoloration at the point of impact of the steel ball. ©ZAG institute



Minor dent and edge chipping at the point of impact of the ice ball. ©ZAG institute

Findings and future applications

The testing highlighted one unexpected result: wood density plays a more significant role in damage resistance than initially anticipated. This insight provides critical guidance for future design and manufacturing processes, ensuring enhanced resilience. Despite minor discolorations and vulnerability at edges, the cladding components demonstrated remarkable durability and suitability for their intended use.

With results soon to be integrated into RIKO Hiše's product catalogue, this development sets a benchmark in sustainable prefab construction, offering builders and homeowners a reliable, eco-friendly solution that withstands the test of time and elements.

ID-CARD
LL24

**Reception in Sant
Sadurn d'Anoia, Spain**

BUILDING ARCHETYPE:
Reception of industrial
building

YEAR OF CONSTRUCTION: 1980
NUMBER OF OCCUPANTS: 4

INSTALLED PRODUCTS:
Integrated PV in an interwoven
steel wire mesh by Flexbrick

MEASURED PARAMETERS:
Electricity production



The modernization of this building will involve replacing windows and strengthening the building's bearing construction by filling the cracks with a flexible structural connector. The aim of the renovation is to modernize the external envelope and to improve the thermal and internal comfort parameters, not only of the envelope but also of the interior.

The planned intervention is to renovate the profile and use of the existing control building in the company's complex by enhancing the exterior space. The renovation will include a sunscreen that will allow exterior use by providing shade and sun control as well as electricity production. The activities constitute a part of an ongoing renovation. The use of active photovoltaic cells in the outside pergola will actively contribute to reducing the carbon footprint by generating energy for the users and improving the building's sustainability by decreasing energy use. The photovoltaics will be integrated in an interwoven steel wire mesh, enclosed in a mosaic of brick to control sunlight for energy production and lighting produced by Flexbrick SL (Spain). The result will be a flexible construction system that could easily be adapted to cover all kinds of archi-

tectural surfaces in a wide variety of spaces. It was envisaged as a kind of skin designed to dress buildings. The system's advantage lies in combining materials that have been used for centuries, like, for example, ceramic with stainless steel. Together, they would create a novel format, which we are calling ceramic textile. It has already proven itself to be superior to conventional manual, piece-by-piece installation. This is a unique combination of materials, which evolves every day and which can even successfully incorporate other materials like wood, bamboo, glass, steel, stone, marble, and glazed ceramics, among others. The large-scale system is made up of small pieces, which means that large sheets can be installed in a very short period of time. As an added benefit, the individual pieces can be replaced easily.



ID-CARD
LL18

**Primary school
Barcelona, Spain**

BUILDING ARCHETYPE:
Primary school

YEAR OF CONSTRUCTION: 2016
NUMBER OF OCCUPANTS: 250

INSTALLED PRODUCTS:
Integrated PV in an interwoven
steel wire mesh by Flexbrick

MEASURED PARAMETERS:
Electricity production

**Flexbrick's integrated PV in
an interwoven steel wire mesh**

The Virolai Petit kindergarten was built in 2016 in Barcelona. The building, which is attached to the sport hall, underwent renovation during the 2024 school summer break, where an extension of one more floor was built, allowing incorporation of new technologies, particularly in the façade areas. The building is occupied by 215 people, most of them children.

**Lightweight, easy-to-install organic
building-applied photovoltaics film
for existing roofs produced by Heliatek
GMBH (Germany)**

HeliaSol® offers ready-to-use organic solar film, which is ultralight, flexible, ultra-thin and truly green. Equipped with an integrated back-side adhesive, HeliaSol® can be glued on a variety of substrate materials such as glass, metal, or concrete without the requirement of elaborated substructures. HeliaSol® has been on the market since 2021.



**Glass integrated organic building integrated
photovoltaics elements for façade integration
produced by Heliatek GMBH (Germany)**

HeliaFilm® is an organic photovoltaics integration solution for building materials such as glass. The solar film, with a thickness of only 1 mm, can be integrated almost seamlessly into customers' products, adding a solar function. Therefore, co-developed tailored solutions with integration partners are being carried out to meet their specific integration requirements. HeliaFilm® entered the market in 2024.

ID-CARD
LL21

**Industrial building in
Barcelona, Spain**

BUILDING ARCHETYPE:
Industrial

YEAR OF CONSTRUCTION: 1973
NUMBER OF OCCUPANTS: 15

INSTALLED PRODUCTS:
(Bio)polyurethane windows
by Indresmat

MEASURED PARAMETERS:
Temperature
Relative humidity
CO2
PM 1.0, PM 2.5, PM 4, PM 10
TVOC
Formaldehyde
SO2
NO2
O3
Ambient light
Sound
Motion level



**Indresmat's SAFE-PUR: redefining
sustainable energy renovations**

Indresmat's foamed (bio)polyurethane frames are at the heart of an ongoing effort to modernize a 1973 industrial building, which houses 15 employees during the workweek. As part of a larger façade rehabilitation project, the plan is to replace outdated, single-pane windows with energy-efficient alternatives. This not only enhances the building's safety but also presents an opportunity to reduce its energy consumption and overall environmental footprint.

The renovation features SAFE-PUR, an innovative polyurethane foam developed by Indresmat. This new material is designed to offer improved fire safety, durability, and resistance to weathering, making it suitable for both indoor and outdoor applications. By using bio-based polyurethane, SAFE-PUR eliminates the need for multilayer materials that are often difficult to recycle, providing a more sustainable and efficient option for construction. SAFE-PUR foam can be applied in various forms—sprayed, injected, or used as sheets or sandwich panels—making it ideal

for insulating roofs, walls, and floors. Its versatile performance makes it especially effective in extreme climates, where minimal thickness is essential, and it operates across a wide temperature range, from -40°C to +70°C. This makes it a key solution for energy renovation projects, particularly in the residential sector, where both insulation and moisture control are crucial.

**High-performance frames
for energy-efficient living**

Alongside SAFE-PUR, Indresmat's KLIMA-PUR® window and door frames also contribute to the building's energy efficiency. These frames excel in thermal and acoustic performance, making them especially suitable for colder climates and environments with high humidity, such as coastal areas. With their chemical resilience and broad temperature range, KLIMA-PUR® frames are a practical choice for both new construction and retrofitting, providing long-term value in energy-efficient residential and commercial spaces.

ID-CARD
LL28

**Offices
Codogno, Italy**

BUILDING ARCHETYPE:
Offices and meeting rooms

YEAR OF CONSTRUCTION: 2020
NUMBER OF OCCUPANTS: 20

INSTALLED PRODUCTS:
Retroreflective shading
device by Pellini

MEASURED PARAMETERS:
Indoor air temperature
Relative humidity
CO2
PM1, PM2.5, PM10
TVOC



**Wave of innovation: Pellini's energy-
efficient shading for modern living**

Pellini's innovative shading solutions, integrated seamlessly within insulation glass units, are designed to enhance both comfort and energy efficiency in modern buildings. The ScreenLine® Wave system, for example, incorporates a thin, 23-micron polyester film within insulating glass, offering a sophisticated approach to controlling light and heat. This integrated shading system helps reduce the need for air conditioning and heating, ultimately contributing to lower energy consumption and improved indoor comfort.

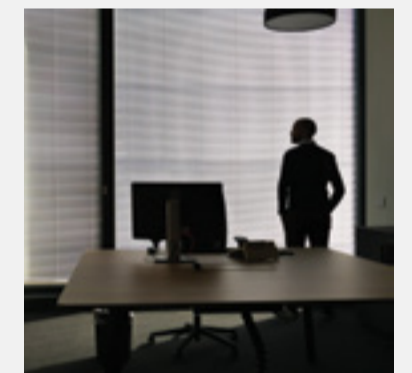
The Wave system stands out for its functional and aesthetic advantages. The PVD coating reduces solar heat gain while increasing thermal insulation, making it ideal for energy-conscious designs. A blackout version is also available. It can be fully lowered to block all incoming light and protect occupants from outside view when desired, enhancing both privacy and comfort. The system's horizontal wave design also adds a sleek, modern touch to the space, blending functionality with style.

Designed for durability, the Wave system has undergone rigorous testing, withstanding over 20,000 full up-and-down cycles. It operates through an internal motor, either powered by hard wiring or a rechargeable battery module, providing flexibility in installation.

A new approach to sustainable comfort

Pellini also offers a shading device that takes solar control a step further. Featuring a Venetian blind with a retro-reflective coating made from silicon dioxide microbeads, this shading solution reflects sunlight back towards its source. Even with the slats open, the system effectively reduces heat transfer into the building, preventing indoor overheating. Furthermore, the reflective surface directs radiation away from neighbouring buildings, helping to mitigate the urban heat island effect caused by reflective glass surfaces.

Both of these shading devices contribute to more energy-efficient and sustainable buildings, providing comfort, privacy, and improved environmental performance without compromising design.



SERVICE PROVIDERS



INDUSTRIAL PARTNERS



Revolutionizing construction through open innovation

In the race toward a sustainable and efficient construction industry, the MeZeroE platform has emerged as a beacon of innovation, bridging the gap between technological solutions and real-world applications. This cutting-edge platform is reshaping the landscape by bringing together key stakeholders in an open innovation community, creating unparalleled opportunities for growth and collaboration.

**For service providers:
Unlocking new frontiers**

The MeZeroE platform serves as a gateway for institutions and academic bodies wishing to make their testing and validation infrastructure and know-how available to the construction sector to accelerate innovation. The platform aims to increase access to additional test lines, enabling providers to test their solutions in real, comprehensive scenarios. These test environments are tailored to meet diverse needs, from energy-efficient façades to indoor air quality systems, ensuring that solutions meet the highest standards before entering the market. Moreover, solution providers can benefit from a rich network of experts and potential partners within the MeZeroE community. By participating, they gain visibility among manufacturers actively seeking cutting-edge technologies, accelerating their journey from prototype to market-ready product.

**For construction manufacturers:
A pipeline to innovation**

For manufacturers, MeZeroE offers an unparalleled opportunity to integrate the latest technologies into their product lines. The platform enables manufacturers to identify and collaborate with solution providers, ensuring access to state-of-the-art innovations that align with evolving industry standards and sustainability goals. By joining the platform, manufacturers can stay ahead of market trends, improve product performance, and enhance their competitive edge.

The platform also provides tools for assessing the environmental and economic impacts of new solutions, empowering manufacturers to make informed decisions while meeting regulatory demands and customer expectations.



The MeZeroE platform offers open innovation services connecting solution providers, construction product manufacturers, and stakeholders in the building sector. It enables real-life testing, validation, and refinement of technologies through specialized test lines. Participants can assess environmental and economic impacts, collaborate to integrate cutting-edge solutions, and drive sustainable innovation in construction.

The MeZeroE platform is more than a technological hub; it is a thriving ecosystem where ideas are exchanged, tested, and brought to life. Whether you're a solution provider with groundbreaking technology or a manufacturer ready to revolutionize your product line, MeZeroE invites you to be part of a transformative community driving the future of construction.



Join today and help shape a smarter, greener, and more innovative construction industry.

Visit www.mezeroe-platform.eu and take the first step toward a collaborative and sustainable tomorrow.



Measuring Envelope systems
for Zero Energy buildings



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