BOOK OF PROCEEDINGS

# 1st International Conference on Built Environment

# ICBE 2026

MAY 08th-09th, 2026
POLIS University, Tiranë

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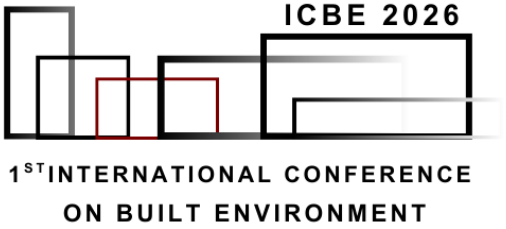
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# 1st International Conference on Built Environment

# ICBE 2026

## Conference Theme and Rationale

The 1st International Conference on Built Environment (ICBE 2026) was conceived as an international and interdisciplinary forum for advancing knowledge, critical discussion, and innovation across architecture, urban planning, engineering, construction, materials, design, and the wider built environment. Organized by POLIS University in collaboration with the National Agency for Scientific Research and Innovation in Albania (AKKSHI), the Academy of Sciences of Albania and the University of Ferrara in Italy, the conference brought together academics, researchers, practitioners, students, and industry representatives to exchange research findings, professional experience, and emerging perspectives on the transformation of contemporary cities and territories.

The conference theme reflected the increasingly complex challenges shaping the built environment, with particular attention to sustainability, resilience, technological innovation, heritage preservation, and socially responsive design. Contributions addressed sustainable architecture and green building, innovative construction technologies and materials, climate-responsive and energy-efficient design, disaster risk reduction, circular approaches to construction, and the integration of renewable energy. Equal emphasis was placed on digital transformation through Building Information Modeling, Geographic Information Systems, artificial intelligence, data analytics, automated solutions, digital fabrication, and advanced manufacturing.

ICBE 2026 also recognized that the future of the built environment cannot be approached through technological innovation alone. Urban transformation, cultural heritage, adaptive reuse, inclusive design, ecological thinking, art, and interdisciplinary research were therefore integral to the conference rationale. The scientific sessions examined topics ranging from seismic resilience, geotechnical engineering, and structural safety to urban fragmentation, public space, heritage conservation, adaptive environments, and new relationships between human and non-human systems.

Through keynote lectures, scientific presentations, case studies, and interdisciplinary debate, the conference encouraged connections between research and practice while promoting approaches capable of responding to environmental, social, cultural, and technological change. The breadth of contributions demonstrated the value of bringing engineering, architecture, urbanism, design, heritage, and emerging technologies into a shared academic framework for more resilient, sustainable, adaptive, and human-centered environments.

Held on 8-9 May 2026 at POLIS University in Tirana, with in-person and online participation, ICBE 2026 welcomed guest speakers and participants from Albanian and international universities, research institutions, professional organizations, and industry. Its sessions established a platform for presenting current research, exchanging expertise, strengthening meaningful collaboration, and identifying future directions for the built environment.

## The event

The **1st International Conference on Built Environment (ICBE 2026)** is an interdisciplinary academic and professional forum dedicated to exploring contemporary challenges, emerging research, and innovative approaches shaping the future of the built environment. Bringing together researchers, academics, architects, engineers, urban planners, designers, practitioners, and industry professionals, the conference promotes the exchange of knowledge and encourages collaboration across traditionally interconnected disciplines. Its thematic scope encompasses sustainable and resilient construction, technological innovation, advanced building materials, urban transformation, cultural heritage, and interdisciplinary design approaches. Particular attention is given to the growing role of digital technologies, data-driven methodologies, intelligent design processes, and advanced analytical tools in supporting more informed and responsive approaches to architecture, engineering, and urban development. At the same time, ICBE 2026 recognizes the importance of environmental responsibility, cultural identity, social needs, and human-centered design in shaping contemporary cities and territories. Through keynote lectures, scientific sessions, case studies, and interdisciplinary exchange, the conference provides a platform for presenting current research, discussing professional experiences, and developing new perspectives capable of contributing to **safer, more sustainable, adaptive, inclusive, and resilient built environments**.

## Objectives

- Promote interdisciplinary collaboration among researchers, academics, practitioners, and professionals in architecture, engineering, urban planning, construction, design, heritage, and related fields of the built environment.
- Advance the use of digital technologies and innovative methodologies, including BIM, GIS, artificial intelligence, data analytics, digital fabrication, and parametric approaches, in research and professional practice.
- Encourage sustainable, resilient, and climate-responsive approaches to architecture, construction, and urban development through innovative materials, energy-efficient strategies, and environmentally responsible design.
- Address contemporary challenges affecting cities, buildings, and infrastructure through scientific research, applied case studies, evidence-based approaches, and innovative design solutions.
- Promote the conservation, transformation, and adaptive reuse of cultural heritage, balancing cultural identity, contemporary needs, structural safety, and responsible urban development.
- Support human-centered and socially responsive urban transformation, considering public space, mobility, ecological systems, community needs, and the wider social and economic impacts of the built environment.
- Provide a platform for knowledge exchange and emerging research, enabling scholars, young researchers, professionals, and students to present innovative ideas, strengthen international collaboration, and contribute to future directions in the built environment.

## Main Conference Themes

- Sustainable architecture and green building practices.
- Innovations in construction technologies and materials.
- Heritage preservation and adaptive reuse in the built environment.
- Digital tools and smart technologies in architecture and construction (e.g., BIM, GIS).
- Climate-responsive and energy-efficient design.
- Disaster risk reduction and resilience in the built environment.
- Circular economy approaches in construction and material usage.
- Integration of AI and data analytics in building design.
- Acoustic and thermal performance in building design.
- Renewable energy integration in building systems.
- Advanced manufacturing techniques in construction, such as 3D printing.
- Innovations in construction technologies and materials.
- Heritage preservation and adaptive reuse in the built environment.
- Disaster risk reduction and resilience in the built environment.
- Digital tools and smart technologies in architecture and construction.
- Advanced manufacturing techniques in construction.
- Geotechnical Engineering for Sustainable Development.
- Cartography and Geographic Information System.
- Computer Automated Solutions for Built Environment.
- Reliability in Civil Engineering.
- Urban planning strategies for resilient cities.
- Climate-responsive and energy-efficient design.
- Regulatory frameworks and policies impacting construction and urban development.
- Design in the Era of Anthropocene (Rethinking the Relation between Human and Non-Human Species)
- Speculative Design (with Attention to “Discursive” and “Critical” Design)
- Design and Cross-Disciplinarity (with Emphasis on Processes rather than Design Outputs)
- Inclusive Design
- Art and Urban Regeneration (Focus on Participatory, Collaborative, and Research-Based Practice)
- Relational Art and Architecture
- Monuments and ‘Anti-Monuments’ (Particular Attention to the Process of Designing and Building the City)

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The conference is structured around six thematic sessions, each addressing a specific area of research and practice within the built environment.
Each session is coordinated by experts in the relevant disciplinary field and is open to professors, researchers, PhD candidates, and other scholars and professionals contributing to the conference themes.

### SESSION I
### Urban Planning and Societal Impact

**Chair:** Dr. Gent Avdija

This session examines the relationship between urban transformation, spatial development, and their social implications within contemporary cities. Contributions address rapid urbanization, urban fragmentation, the transformation and loss of public space, informal and spontaneous development, and the challenges associated with balancing growth and modernization with human-scale urban environments. Particular attention is given to the evolving conditions of Albanian cities and to planning approaches capable of supporting more inclusive, sustainable, socially responsive, and livable urban environments.

### SESSION II
### Sustainable Materials, Resilient Construction & Smart Design

**Chair:** Dr. Endri Duro

This session explores innovative approaches to sustainable construction, resilient structural systems, and environmentally responsive design. Particular attention is given to sustainable materials, energy-efficient and climate-responsive strategies, prefabricated and lightweight construction technologies, and human-centered approaches to structural and architectural design. The session investigates how material innovation, technological development, and responsible design practices can contribute to safer, more efficient, adaptable, and environmentally sustainable built environments.

### SESSION III
### Technological Advancements and Seismic Design for Resilient Places

**Chairs:** Dr. Seyyed Behrad Emadi & Dr. Ornela Şen

This session examines the role of technological innovation and advanced engineering methodologies in developing safer, more resilient, and adaptable built environments. Contributions address seismic hazard and risk assessment, digital fabrication, parametric and computational approaches, transformations of building envelopes and prefabricated housing systems, and emerging concepts for future urban mobility. The session highlights how the integration of engineering knowledge, digital technologies, and resilience-oriented design can strengthen the capacity of buildings, infrastructure, and urban environments to respond to contemporary and future challenges.

## SESSION IV

### Cultural Heritage

**Chairs:** Dr. Nikolla Vesho & Dr. Marsela Demaj

This session addresses the preservation, interpretation, and transformation of cultural heritage within contemporary architectural and urban contexts. Contributions explore conservation strategies for historic buildings and sacred architecture, seismic assessment and strengthening of heritage structures, adaptive reuse, and the social implications of urban regeneration and heritage loss. Particular emphasis is placed on achieving a responsible balance between conservation ethics, cultural identity, structural safety, and the evolving functional requirements of historic buildings and urban environments.

## SESSION V

### Spaces of Connection: Art and Design for an Interspecies and Interdisciplinary Environment

**Chair:** Dr. Francesco Scasciamacchia

This session explores the intersections of art, architecture, design, technology, and the built environment through interdisciplinary and experimental perspectives. It investigates changing relationships between human and non-human systems, spatial perception, adaptive reuse, post-industrial landscapes, urban representation, digital heritage, and environmentally and socially engaged design practices. Through critical, speculative, participatory, and research-based approaches, the session examines how art and design can generate new forms of connection, reinterpret existing environments, and contribute to emerging cultural and spatial narratives within contemporary cities.

## SESSION VI

### Next-Generation Pioneers of the Built Environment

**Chair:** Dr. Flogerta Krosi

This session provides a dedicated platform for emerging researchers and students to present innovative, experimental, and forward-looking approaches to the built environment. Contributions span architecture, engineering, urban planning, environmental resilience, design, and related creative disciplines, reflecting the interdisciplinary character of a new generation of researchers and practitioners. Through projects addressing topics such as bioclimatic design, flood-risk management, structural technologies, architecture-inspired design, and critical interpretations of objects and social space, the session encourages critical inquiry, experimentation, and new perspectives on the future of the built environment.

**Layout & Design:**

Dr. Kristiana Meço

Msc. Erjon Çobani

## POLIS University Contact:

Rr. Bylis 12, Autostrada Tiranë-Durrës, Km 5, Kashar

Kodi Postar 1051, Kutia Postare 2995

Tiranë, Albania

Tel: +355.(0)4.2407420 / +355.(0)4.2407421

Fax: +355. (0)4.2407422

Mob: +355 (0) 69 40 88 111

Email: contact@universitetipolis.edu.al

Website: www.universitetipolis.edu.al

# Table of Contents


**SESSION I** ..... 14

**Urban Planning and Societal Impact** ..... 14

**The Fading Public Realm:** ..... 5

From Expansive Open Spaces to Morphological Compression in Durres' Rapid Urban Growth

**Arjola SAVA** ..... 5

**Spontaneous Architecture as Adaptive Metabolism in Post-Socialist Cities Renis Batalli** ..... 18

**The ground floor as an urban interface: the human-building relationship and the Loss of Urban Contact Avrili MESHI** ..... 35

**Urban Blueprint and Compatible Growth:** ..... 45

A Multi-Scalar Morphological Method for Sustainable Transformation in ..... 45

Erseke, Albania **Mario DINE** ..... 45

**Examining the Internal Anatomy of Socialist-Era Hotels in Albania:** ..... 58

Spatial organisation, Geometry, Structure, Circulation, and Function**Malvina Istrefaj(KOLIÇI)** 58

**Urban Construction Through Destruction Sotir DHAMO** ..... 73

**SESSION II** ..... 87

**Sustainable Materials, Resilient Construction & Smart Design** ..... 87

**Human Centered Design in Civil Engineering Ilda RUSI, Albi ALLIAJ** ..... 88

**The courtyard as a climate-responsive and resilient spatial strategy: the case of Novi Pazar Elma MAHMUTOVIĆ, Dragana KONSTANTINOVIĆ** ..... 103

**Numerical assessment of the thermal performance of a heated and cooled floor containing upgraded phase change materials Oumayma BABAHARRA, Khadija CHOUKAIRY** ..... 121

**Eco-Friendly Building Envelopes:** ..... 132

Thermal, Energy, Cost, and Time Performance of Prefabricated Lightweight MRC Panels in Residential Construction **Erjon ÇOBANI, Flogerta KROSI, Ornela ŞEN** ..... 132

**SESSION III** ..... 156

**Technological Advancements and Seismic Design for Resilient Places** ..... 156

**Identification and assessment of resident-driven façade interventions in prefabricated large panel buildings:** ..... 157

**the case of Tirana Flogerta KROSI, Alma GJONAJ, Merita GURI, Ornela ŞEN, Endri DURO** ..... 157

**Tirana_ toward a (non) resilient city of the future** ..... 173

Re-shaping mobility and bring back "La raison d'être of the city" **Ina MUSAI** ..... 173

**A Seismic Hazard Model of Albania** ..... 187

Case study: Kukes, Berat and Himarë **Anila XHAHYSA, Neki KUKA** ..... 187

**Phenomeno-Parametrism:** ..... 203

Translating Place Experience into Parametric **Markeljan LLESHI** ..... 203

**SESSION IV** ..... 217

**Cultural Heritage** ..... 217

**Preserving and Adapting Sacred Architecture:** ..... 218

A Case Study of the Jazak Monastery **Una RADIVOJEVIĆ**.....218

**Monumentality Reconsidered:** Heritage Preservation and Adaptive Reuse through the Theories of Robert Venturi and Aldo Rossi **Harika SHEHABI** .....233

**Seismic Performance Assessment of Historic Stone Masonry Buildings:** .....245

The Case of the Angonate Residence, Gjirokastër **Alma GJONAJ, Merita GURI, Endri DURO**... .....245

**Future Heritage by Design:** .....258

New Design Approaches to Heritage Reuse **Gregor ANDONI, Kristiana MEÇO** .....258

**SESSION V**.....267

**Spaces of Connection: Art and Design for an Interspecies and Interdisciplinary Environment** 267

**Heritage as Narrative:**.....268

Building City Image Through Adaptive Reuse in Durrës **Vjola ZIU, Remijon PRONJA** .....268

**The Extraordinary Everyday** Children's Spatial Agency as Anti Monumental Practice **Xhoi MUSLIAKA** .....281

**'Liminal Architectural Bodies' in Post-Industrial Kuçova:**.....298

From an Ecological Perspective to an Aesthetic realm **Dorina XHERIMEJA, Aishe BITRI**.....298

**IN Illyria, Episode I: Apollonia** .....311

A Pixel-Art Game Framework for Archaeological Interpretation and Cultural Heritage Learning **David KRYEMADHI, Nikolla VESHO, Skervi BAUSHI, Remijon PRONJA, Kujtim HALILI**.....311

**In the Age of Material Transformation:** Textile Design and Upcycling **Armela LAMAJ**.....326

**AI as a Designer:**.....336

The Future of Taste and Creativity in Automotive Design **Gregor ANDONI** .....336

**The Secondary Archive:** .....342

Collective Memory, Mental Images and AI-Assisted Representations in a Transforming Tirana **Dejvi DAUTI** .....342

**SESSION VI**.....352

**Next-Generation Pioneers of the Built Environment** .....352

**Performance-Based Bioclimatic Design of a Kindergarten in Tirana:** Integration of Passive Systems and Dynamic Simulation **Erald MEÇE, Afërdita MUHAMEDI, Verona HYSI, Klodjan XHEXHI**.....353

**Integrated Flood Risk Management in Albania:** .....363

Human drivers, Basin dynamics and Policy gaps **Zejd BUSHATI, Esad MALAJ, Erjon ÇOBANI, Merita GURI** .....363

**Steel frame technology for residential buildings:**.....383

A comparative thesis-antithesis study versus reinforced concrete systems **Elton AHMETAJ, Erjon ÇOBANI, Merita GURI** .....383

**DOUBLE SKIN:**.....394

How does the "Double Skin" concept interact with our body in the field of fashion design? **Desara LLESHI**.....394

**Chairs as instruments in the construction of social roles and human bodies Aurora BALLA** 401

**Autonomy as a Value:**.....409

Design and Branding in the Post-Fordist Era **Irena ALIAJ, Erson RAMAJ**.....409

# SESSION III

## Technological Advancements and Seismic Design for Resilient Places

Seismic resilience and risk mitigation: Seismic hazard assessment / Structural safety / Risk-informed design / Resilient buildings and infrastructure.

Digital and computational technologies: Digital fabrication / Parametric methodologies / Computational design / Technology-assisted decision-making.

Adaptive building systems: Façade transformation / Prefabricated housing systems / Adaptive architectural solutions / Building-envelope innovation.

Resilient urban systems: Future mobility / Technology-driven urban transformation / Resilience-oriented planning / Safer and adaptive urban environments.

# Identification and assessment of resident-driven façade interventions in prefabricated large panel buildings: the case of Tirana

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**Flogerta KROSI**
ORCID 0000-0001-7324-8734
POLIS University, Albania
flogerta_krosi@universitetipolis.edu.al

**Alma GJONAJ**
ORCID 0009-0005-3183-9057
POLIS University, Albania
alma_gjonaj@universitetipolis.edu.al

**Merita GURI**
ORCID 0000-0001-9363-2338
POLIS University, Albania
merita_guri@universitetipolis.edu.al

**Ornela ŞEN**
ORCID 0000-0001-8902-1120
POLIS University, Albania
ornela_sen@universitetipolis.edu.al

**Endri DURO**
ORCID 0000-0002-9690-5001
POLIS University, Albania
endri_duro@universitetipolis.edu.al

**Abstract**

*Prefabricated concrete large-panel buildings, built over 50 years ago, have undergone numerous interventions during their life span, which were often carried out without technical criteria or standardized guidelines. These interventions have significantly impacted the façade layout and its performance, as well as the overall functioning of the buildings.*

*This paper aims to identify and analyze resident-driven interventions in these buildings, located in selected areas of the city of Tirana. The main objectives are to identify the most common types of interventions, assess the extent of façade modifications, and evaluate their potential*

*impact on structural behavior. The study addresses the level of informal interventions and their possible implications for building performance. The working hypothesis assumes that 3D extension on the façade significantly alters the original building configuration and may introduce structural risks.*

*The methodology is based on visual field inspection and photographic documentation of the identified interventions, which are classified according to a basic typological scheme. The collected data are compared with the original drawings of the buildings, provided by the Central Technical Construction Archive.*

*The study's results are expected to identify the most frequent types of interventions carried out in these buildings, the degree of modification of the main facades, and the potential of these interventions to influence the structural behavior of the buildings.*

***Keywords:*** *large panel buildings, unregulated interventions, façade alterations, structural performance, integrated rehabilitation*

## 1. INTRODUCTION

Large panel buildings, as well as other construction technologies, are designed with a lifespan of approximately 50 years. Since those buildings were built in the late 70s, they have exceeded the design period. The major influence on the performance is the degradation of the building, as the main factor is age, but in order for the building to fulfill the demands of the changes created by the continuous change of the city, which, in our case study, Tirana, is one of the most dynamic cities. Those buildings have been adapted through maintenance, renovation, and refurbishment, which becomes a key essential to make those buildings livable.

Some of the buildings' stock have undergone so many changes, and there is a gap between the original design (as built) and the current condition, accounting for all the existing interventions and their influence on the buildings. The changes have different natures, they may be at a local level, a whole block, or a whole neighborhood, and it is important to mention that some of them are without proper technical documentation or without professional approval. The character of the intervention goes from aesthetic modification, improvement of the thermal layer, to structural alterations. One of the most widespread interventions, which in some places is found at the local level, made by apartment owners, that is done only on the façade of their apartment, is the use of thermal insulation layers on the façade. This intervention has also been carried out at the neighborhood level, with support from the municipality as part of the city revitalization project. Another common typology is closing balconies or turning windows into doors, especially on the ground floors.

All interventions made after construction have a direct or indirect impact on the building's overall performance. From a structural point of view, the building mass and the natural period are important factors in the building's dynamic performance, especially in high-seismic

regions. From an energy performance perspective, inadequate intervention can create a new thermal bridge or cause a malfunction in the HVAC system, leading to a significant increase in energy consumption.

The accurate identification of these interventions is crucial for any further technical assessment. Without a clear overview of the changes made over the years, engineering analyses risk being based on incorrect assumptions, leading to uncertain or economically inefficient decisions for the maintenance or reinforcement of the building. The use of diagnostic techniques and the systematic comparison of the initial state with the current state are necessary for modern engineering.

In this context, the following research question arises: to what extent do resident-driven interventions on the façades of large panel prefabricated buildings influence the structural behavior of these structures?

The aim of this study is to identify and classify the interventions carried out on the façades of large panel prefabricated buildings in selected neighborhoods of Tirana (Ali Demi, 21 Dhjetori, and Shkolla Teknologjike), and to discuss their potential impact on the structural behavior of these buildings. The study focuses on the documentation and typological analysis of resident-driven interventions, based on field surveys and photographic documentation of the investigated buildings.

## 2. LITERATURE REVIEW

Large panel buildings were chosen as the system that met the urgent housing needs of post-war Europe, offering rapid, cost-effective construction solutions. Widely implemented across the Soviet Union and Eastern Bloc countries, these buildings featured typical prefabricated elements. While in Western Europe their production declined in the late 1970s, in Central and Eastern Europe this industry experienced a new surge through "house factories" that produced standardized components for configuring urban micro-districts.

Over time, the need to rehabilitate this housing stock became inevitable. Many of them have shown deficiency, such as:

- Insufficient thermal insulation and low energy efficiency.
- Outdated architectural design that no longer responded to contemporary needs.
- Degraded urban infrastructure requiring regenerative interventions.

As a regulatory measure, many European nations have undertaken renovation initiatives, going from basic improvement in thermal insulation to complete structural and aesthetic modernization.

Krosi (2025) shows different interventions made with the focus to improve the quality of residents' lives, which focus on structural strengthening, façade renovation, and integration of renewable energy sources. Those measurements have changed the entire building block.

Even though the technology of prefabricated large panels is not used nowadays in Albania and

in Europe, all the buildings built with these technologies are habitable, and there is still the need to update those buildings. This global context provides a clear perspective on the possibilities and constraints of rehabilitation, providing as a roadmap for tackling urban infrastructure in the 21st century.

### 2.1 Global Context of Large Panel Systems

Interventions in large-scale prefabricated building structures are not only a problem in Albania but also in the region and in Europe. As a result of the interventions and the time of use, many European countries have started large-scale renovation programs to address the problems of degradation and deficiencies created by the interventions. These interventions range from basic improvements of insulation only to the facade layer to comprehensive renovations, including structural improvements, facade transformations and the integration of renewable energy systems, aiming to improve sustainability and living conditions.

The refurbishment of Large Panel Buildings (LPB) across Europe shows multiple strategies to specific national priorities, ranging from deep energy retrofitting to radical structural and architectural transformations. In countries such as Estonia and Austria, interventions are primarily technology- and energy-driven, focusing on high-performance solutions through modular façade systems, advanced insulation, and the integration of renewable energy technologies aligned with Passive House standards (Kalle Kuusk, Peep Pihelo, Targo Kalamees, 2019). In contrast, countries like Germany and France emphasize architectural "humanization" and the improvement of living quality through spatial expansions, façade redesign, and the addition of elements such as winter gardens and balconies, often without displacing residents (Houpt, Mochocka, & Wijas, 2019) (Pintos, 2019). Meanwhile, in Slovakia, Serbia and Romania, rehabilitation projects commonly integrate functional adaptation and vertical additions, such as transforming ground floors into community spaces and adding attic levels to improve housing capacity. This large range of possibilities provides an important framework of reference for considering the informal, resident-driven alterations reported in Tirana, illustrating the gap between coordinated, large-scale repair initiatives and unregulated individual adaptations. (Jakub Onyszkiewicz, Kajetan Sadowski, 2022) (Jovanović-Popović, Radivojević, Ignjatović, & Elezović, 2006).

### 2.2 The Albanian Context and Seismic Vulnerability

Throughout their lifespan, they have undergone various changes from factors such as natural factors, such as earthquakes, where they suffer joint damage, as presented in (Merita Guri, Svetlana Brzev, Diana Lluka, 2022). Another factor is the intervention of residents where buildings have undergone changes to their facades as part of municipal programs to maintain various civil buildings, as presented in the study (Guri, Krosi, & Klodjan, 2023).

### 2.3 Informal Interventions and Research Gap

Although some level of formal maintenance exists, a more visible and complex reality is shaped by the numerous informal and often uncontrolled interventions carried out by residents. As their spatial needs have changed over time, occupants have adapted their apartments in different ways. (Krosi, 2024) identifies several common types of resident-driven modifications, including the removal of interior panels, the addition of three-dimensional

elements—most commonly through balcony enclosures—the conversion of windows into doors (and vice versa), and the widespread practice of enclosing balconies.

While archival sources provide a clear picture of how these buildings were originally designed and constructed, much less is known about their current condition. In particular, there is still limited understanding of how these small, localized changes—when accumulated over time—affect the overall behavior of the buildings. This is especially relevant in Tirana neighborhoods such as Ali Demi, 21 Dhjetori, and Shkolla Teknologjike, where such interventions are widespread. This study aims to address this gap by systematically documenting and analyzing these modifications from a typological perspective.

It is important to note that in Large Panel Systems, façade panels are not merely architectural elements; they often play a structural role, either as load-bearing or shear-resisting components. As a result, unrecorded modifications to these elements may have direct implications for the overall stability of the building.

## 3. METHODOLOGY

### 3.1 Research Design and Study Areas

This study uses a qualitative, observational research design to identify and classify façade interventions in Large Panel Buildings (LPBs). The approach is exploratory in nature, focusing on understanding the types, characteristics, and distribution of resident-driven modifications rather than quantifying their frequency.

### 3.2 Study Area Selection

The focus of the study are three different zones in Tirana: 21 Dhjetori, Ali Demi, and Shkolla Teknologjike. These neighborhoods were selected based on the following criteria:

1. Representation of typical large panel prefabricated housing typologies in Albania
2. High concentration of LPB buildings
3. Visible presence of informal and resident-driven façade interventions
4. Urban relevance and accessibility for field investigation
5. These areas provide a representative sample of the transformation processes affecting LPB buildings in the Albanian context.

### 3.3 Data Collection Methods

Data collection was conducted through field surveys involving third-year bachelor students from Polis University, in collaboration with Co-PLAN, and was complemented by systematic photographic documentation of the study areas. The site visit focused on observing and recording the current condition of the façade. Meanwhile, the photographs and drone footage were used to capture various types of interventions. Also, to serve as a base reference in order to identify every potential deviation from the as-built project, the original planes and facades (see Figure 1), which were taken from AQTN, are used.

Visual inspection focused on identifying modifications such as:

- balcony enclosures
- window-to-door conversions
- volumetric additions
- panel removals or alterations

The data collection process aimed to document the buildings' actual condition, including all

visible interventions.

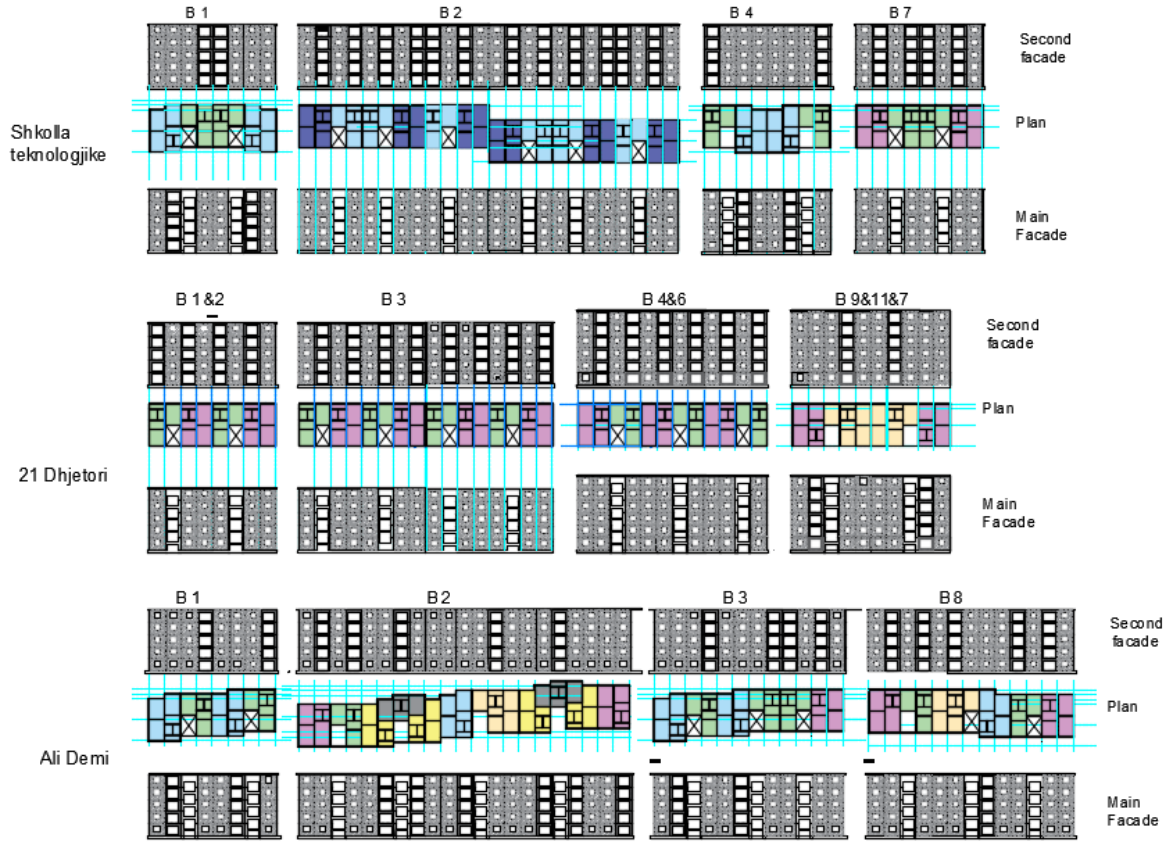



*Figure 1. Original floor plans and facade elevations of the selected residential blocks in Tirana, sourced from the National Technical Archive of Construction (AQTN).*

### 3.4 Data Analysis and Classification

The collected data were analyzed using a typological classification approach.
Interventions were grouped based on:

- type of modification (architectural/functional / structural-related)
- scale of intervention (minor vs. invasive)
- impact on façade composition

This classification enables a structured understanding of the most common patterns of resident-driven transformations and provides a basis for further discussion of their potential implications.

### 3.5 Limitations of the Study

This study is based on visual observation and qualitative assessment, which may not capture hidden structural modifications or internal alterations.
Additionally:

- The analysis does not include detailed structural calculations
- The findings are limited to selected case study areas in Tirana
- Informal interventions may vary over time, making the dataset dynamic

Despite these limitations, the study provides a valuable overview of façade transformations

and highlights critical issues for further technical investigation.

## 4. CASE STUDY

The case study focuses on identifying the current situation in selected residential blocks in Tirana city, such as 21 Dhjetori, Ali Demi, and Shkolla Teknologjike, where each building is numbered (see Figure 2). The objective of the study is to identify the types, distribution, and intensity of interventions on the building's facade made by residents through a comparative analysis of the original (redrawn from originals, see Figure 1) and current drawings of the building.



a) b) c)

*Figure 2. Location of the selected case study areas in Tirana: a) 21 Dhjetori, b) Shkolla Teknologjike,, c) Ali Demi, highlighting the analysed building blocks and study boundaries.*

Each study area is represented by a selected building that is considered representative of the dominant LPB typology and intervention patterns observed in the respective neighborhood.

### 4.1 21 Dhjetori

During the field visit to the 21 December area, a high concentration of facade-related interventions and material degradation in the buildings was observed. The most frequent interventions identified include filling in balconies, modifications of openings and closing of windows and doors, installation of technical equipment (such as air conditioning units and antennas, water tanks), and volumetric additions, especially at the edges of the buildings. In addition, several forms of material degradation were observed, including cracking of facade panels, detachment of plaster layers, and moisture-related damage, especially in the lower areas of the facade. Localized damage was also identified at the panel joints. These interventions and deterioration processes have significantly changed the original configuration of the facade and can affect both the functional performance and the structural behavior of the buildings.

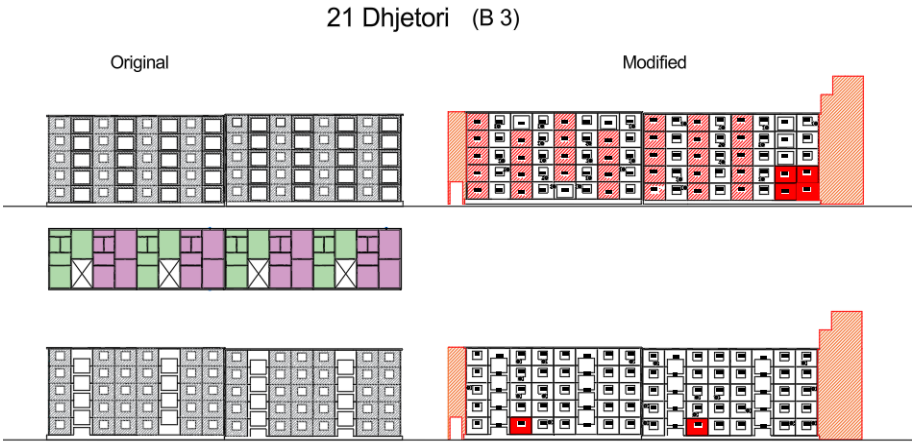



*Figure 3. Case study building "21 Dhjetori".*

The analysis of the selected representative building in the 21st December area (Block B3) shows a considerable level of interventions leading to the transformation of the facade. As illustrated in Figure 3 where the modified surface is identified in red, approximately 35–45% of the facade surface has been modified through interventions made by the residents. These include the enclosure of balconies, modifications of window openings and the addition of volumetric extensions, especially at the edges of the building. The distribution of interventions evidences both localized and continuous patterns along the facade, indicating a progressive and largely uncoordinated transformation process. One of the facades of the building has more than 50% of the facade modified and two side ones are 100% modified and thus we can say that the building has undergone many changes. The presence of horizontal volumetric additions results in increased loads and a change in the initial mass distribution, potentially affecting the structural behavior of the building, especially under seismic actions.

### 4.2 Ali Demi

Field observations in the Ali Demi area revealed a wide range of facade-related interventions and material degradation phenomena that affect the facade's appearance. The most common interventions found are comparable to those of 21 Dhjetorit and include balcony enclosures, small-scale volumetric additions at lower levels, modifications to openings (such as window-to-door conversions and new openings), and the installation of technical equipment (such as air conditioning units, antennas, and water tanks). In addition, material degradation was observed, including cracks in the facade panels, falling plaster, moisture, and damage to individual elements, affecting both the facade elements and the panel joints. These interventions and degradation processes have progressively changed the original configuration of the facade and can affect both the functional and structural performance of the buildings.

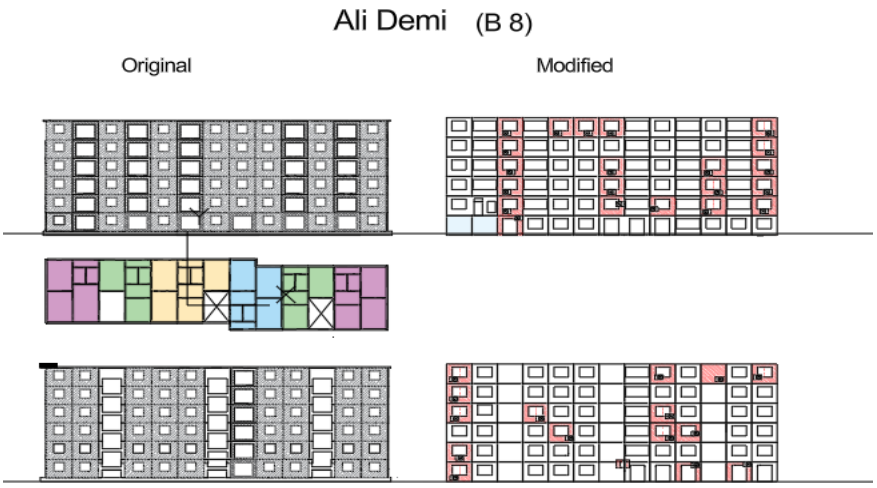



*Figure 4. Case Study Ali Demi*

Building B8 was selected as a case study to systematically and in detail analyse the identified changes in the façade configuration. The initial configuration of the façade, according to archival documentation, was presented as a conventional modular system with standardized openings. The material collected from the field visit shows that around 25-35% of the façade surface has been changed by interventions directed at the inhabitants, as shown in Figure X. These are generally arranged in vertical bands across the façade and include balcony enclosures, window opening adjustments and local additions. The predominance of individual interventions, in the absence of a coordinated approach, is reflected in their spatial organisation and suggests a fragmented and piecemeal transformation process.

### 4.3 Shkolla Teknologjike

Field observations in the area of the Shkolla Teknologjike revealed a wide range of interventions on the facade, as well as phenomena of material deterioration. The most common interventions, as in the two cases identified above, include the installation of technical equipment on the facades (such as air conditioning units and water tanks), the modification of openings, balcony enclosures or extensions, as well as small-scale volumetric additions, especially at the ground floor level. In addition, various forms of material degradation were observed, including cracks in the facade panels, detachment of plaster layers, the presence of moisture and localized damage to prefabricated elements and joints. These interventions and degradation processes have progressively modified the original configuration of the facade and can affect both the functional performance of the building envelope and the structural behavior of the prefabricated system.

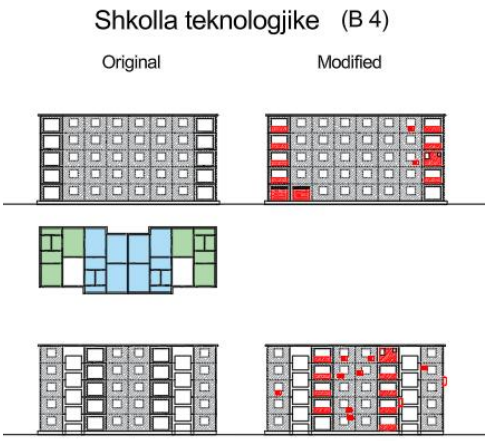



*Figure 5. case study: Shkolla Teknologjike.*

The case study in the Technological School area focuses on a representative LPB building (Block B4), selected for the identification and detailed analysis of facade interventions. Field observations show that the building has undergone a series of modifications made by residents, which directly affect the facade. As illustrated in Figure 5, approximately 20–30% of the facade surface has been modified. The typologies of the intervention include the closure of balconies creating new indoor living space, changes to window openings, the installation of technical equipment, and small-scale volumetric additions. The distribution of these interventions is also mainly at the apartment level, with modifications appearing at different points of the facade, without a unified organizational pattern. These changes reflect a gradual transformation of the building facade, mainly driven by individual inhabitant needs and the absence of a coordinated intervention approach.

## 5. RESULTS AND DISCUSSIONS

### 5.1 Problems Identified in Large Panel Buildings

Field surveys conducted in the three study areas in Tirana (Ali Demi, 21 Dhjetori, and Shkolla Teknologjike) revealed several key categories of problems related to the current condition of Large Panel Buildings (LPBs). These issues are the result of a combination of factors, including material degradation over time, environmental exposure, seismic activity, and resident-driven interventions carried out during the buildings' lifespan.

#### *5.1.1 Structural Problems*

As stated above, the structural load-bearing system of this typology consists of load-bearing panels and their connections. In both elements, we have stated degradation and interventions. In most cases, due to degradation, the concrete between panels at the joint has been removed, exposing the reinforcement (Figure 6d). In the load-bearing panels, new windows have been created (Figure 6b). And in one case in 21 Dhjetori, a hole new floor was added (Figure 6a). Also, in different parts of the façade and in the roof, there were spotted new load additions in the form of water storage (Figure 6c).



a) b) c) d)

*Figure 6. Structural Problems*

### *5.1.2 Joint Deterioration*

One of the most important elements of the structural system in LPB it the connection between the panels. Due to the degradation, slippage, and cracking of the filler material (concrete), the life span has exposed the reinforcement of the joint (see Figure 7a) and has increased the possibility of corrosion. As shown in (Merita Guri, Svetlana Brzev, Diana Lluka, 2022), even during the Durres earthquake of 2019, the damage occurred mostly in the joints.

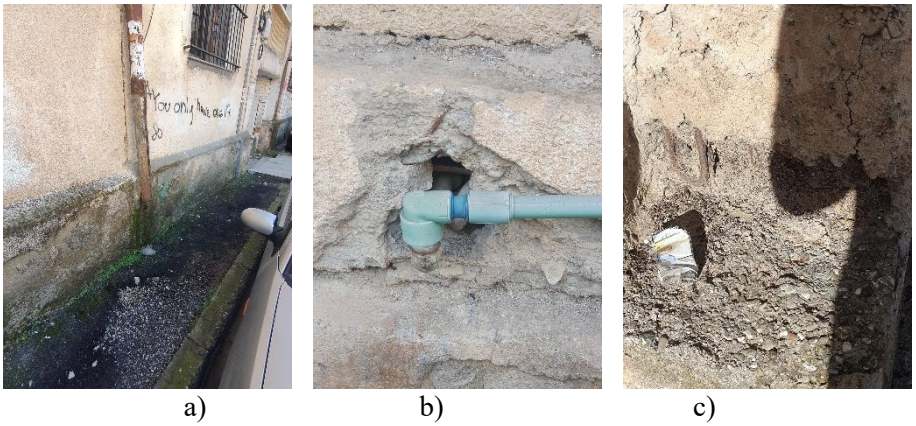


a) b)

*Figure 7. Joint damages*

### *5.1.3 Foundation Problems*

Various issues were also identified in the foundation zones of the buildings. These include material degradation (Figure 8c) , cracking at the base of walls, and interventions related to the installation of technical systems (Figure 8b). Modifications carried out in foundation areas, particularly for service installations, may negatively affect the long-term stability of the structure.



a) b) c)

*Figure 8. Foundation damages*

### 5.1.4 Water Damage and Material Degradation

In LPB structures, the system pipes are prone to water-related damage. Site visits revealed efflorescence, mold growth, and moisture strains on panel surfaces, all of which suggested that water had seeped into the structure. The drainage system along the facades and in the surrounding areas is a primary source of this problem. The system is not properly connected with the city drainage system, and it has leaking spots even in the building with new thermal layers, which can cause deterioration of the building envelope. The piping and electrical systems in a building are crucial for maintaining functionality, energy efficiency, and occupant comfort. The adaptation of those systems has caused some regulation on the building systems. Besides the building's piping system, we note additional systems for rainwater drainage and internal use. The electrical system it is a mess.
The main system is an HVAC system, which stands for Heating, Ventilation, and Air Conditioning, that is an essential component of modern buildings designed to provide indoor climate control and air quality management.



a) b) c) d)

*Figure 9. Drainage and electrical system*

### 5.1.5 Energy Performance Issues

Unlike the city of Kamza, where, as a result of a measure taken by the municipality to improve energy performance, the entire LPB typology is thermally insulated, in the case studies in this study, the thermally insulated additions appear fragmented. These were made by the residents; for example, in Figure 10a, only half of the building is thermally insulated. In Figure 10b, it is seen that interventions were made only at the apartment level. Base on the study of (ISLAMI, 2016) the current state of housing with prefabricated panels in Albania is problematic, with only 10% of the stock having no renovation interventions since construction. The rest of the stock has undergone renovation interventions but with minimal impact on energy performance. The thermal performance of prefabricated panels in Albania is affected by construction technology, construction materials, and depreciation. Thermal bridges contribute over 10% of general thermal losses, and condensation inside the panel's perimeter reduces the capabilities of heat-insulating panels.



a) b)

*Figure 10. Façade thermal layer intervention, a)*

### *5.1.6 Building Envelope Modifications*

One of the most seen modification on the façade of the building is the closure of the balconies not just with aluminum door elements but also with brick walls (see Figure 11a). Also, in some cases, small windows are enlarged, and new doors are opened (Figure 11d), especially on the base floor. 3D extensions are seen in the vertical (Figure 11b), horizontal (Figure 11c), and the new floor addition.



a) b)

c) d)

*Figure 11. Building envelope modification: a) closure of balconies, b) 3D vertical extension, c) 3 D horizontal extension, d) new door opening.*

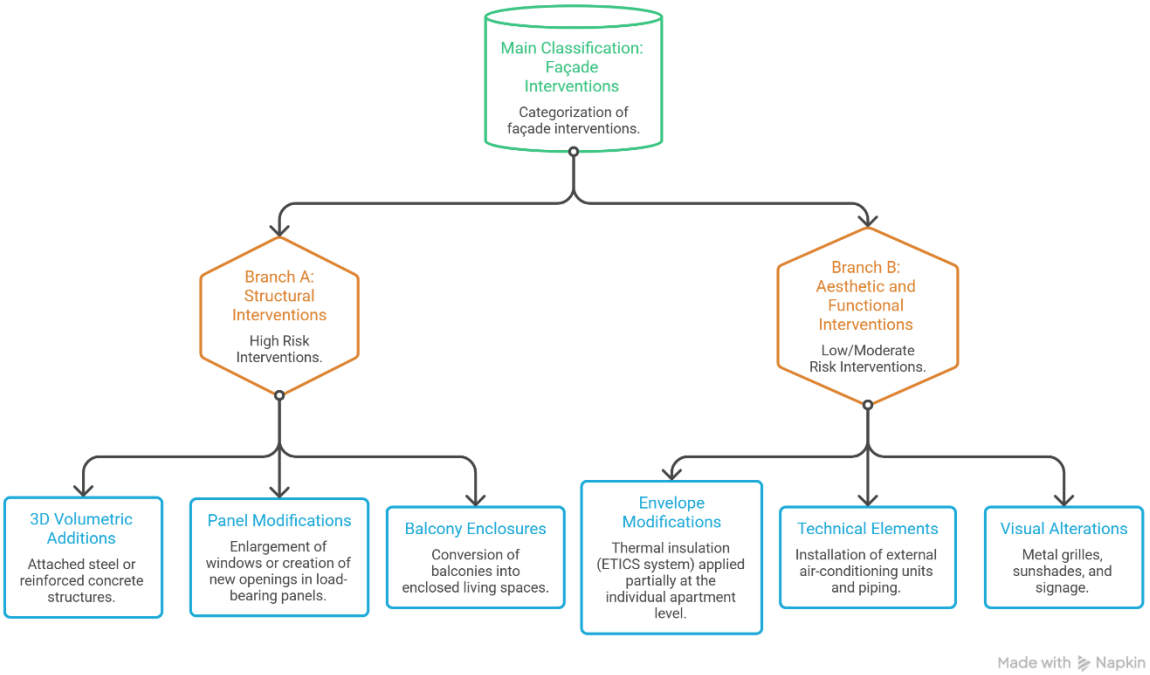



*Figure 12. Classification of the intervention.*

### 5.2 Discussion

The identified façade modifications and deterioration phenomena have important implications for both the seismic and energy performance of LPB buildings. According to Eurocode 8 (EN 1998-1, 2004), the structural response of buildings is highly dependent on the distribution of mass and stiffness, as well as the integrity of load-bearing elements and their connections.

Resident-driven interventions, such as the creation of new openings in load-bearing panels or the addition of volumetric extensions, may locally reduce stiffness and alter the global load path of the structure. These changes can lead to irregularities in stiffness distribution, which are known to increase seismic vulnerability, particularly in prefabricated panel systems.

Furthermore, deterioration of panel joints may significantly affect the behavior of the structure under seismic loading, as joints are critical for ensuring force transfer and overall structural continuity. The presence of cracking, sliding, and material degradation in these areas may reduce the energy dissipation capacity of the system and increase the likelihood of localized or progressive failure mechanisms.

In addition, the accumulation of non-structural elements on façades, such as enclosures, equipment, and informal additions, contributes to an increase in mass, which directly affects seismic forces acting on the structure. According to EC8 principles, an increase in mass results in higher seismic demand, potentially exceeding the original design assumptions of these buildings.

From an energy performance perspective, uncoordinated façade interventions significantly affect the thermal behavior of the building envelope. Partial insulation applied at the apartment level leads to discontinuities in the thermal layer, creating thermal bridges and reducing overall energy efficiency.

Modifications such as balcony enclosures, changes in window configurations, and the installation of technical equipment may alter ventilation patterns and solar exposure, further

affecting indoor thermal comfort. In addition, the presence of moisture and material degradation contributes to a decrease in thermal resistance and may accelerate heat loss through the envelope.

As a result, the actual energy performance of these buildings often deviates significantly from theoretical expectations, highlighting the need for integrated and building-scale refurbishment strategies rather than fragmented, individual interventions.

## 6. CONCLUSIONS AND RECOMMENDATIONS

In three residential areas of Tirana—21 Dhjetori, Ali Demi, and Shkolla Teknologjike—this study explored the range and effects of resident-driven façade alterations in Large Panel Buildings (LPBs). The outcomes emphasize the following important points:

Important Findings- Frequent and uncontrolled interventions: Balcony enclosures, opening changes, technological equipment installation, and small-scale volumetric expansions are among the most frequent homeowner-driven modifications, which are extensive and mostly unregulated.

- Façade transformation: A considerable portion of façade panel have been modified, resulting in a loss of façade consistency and creating a difference from the original architectural configuration.
- Structural implications: removal of load-bearing panels and modifications on the joints may change the load transfer mechanisms, reduce stiffness locally, and introduce irregularities, increasing the seismic vulnerability of LPB buildings.
- Joint and material degradation: Deterioration of panel joints, cracking of façade elements, and exposure of reinforcement contribute to reduced structural integrity and long-term durability issues.
- Energy performance : Not all types of intervention made by inhabitants are the correct ones and their results in terms of energy performance are not the expected ones. Also as stated at (Guri, Krosi, & Klodjan, 2023) the presence of air condition on the panels of the fasades creates thermal bridges.
- Increased vulnerability: The combined effect of ageing, material degradation, and unregulated interventions has led to an overall increase in the vulnerability of these buildings, particularly under seismic conditions.

The results show that interventions in LPB buildings made by residents are not only aesthetic or functional adoption, but they are critical factors that may influence both structural safety and energy performance. An urgent project is needed at the municipal level, including different experts (architect, engineers) to coordinate rehabilitation strategies that integrate structural assessment and energy efficiency improvements, ensuring the long-term safety and sustainability of the existing housing stock.

Limitations and suggestions for future research.

The limitation of this study is the small number of buildings taken into consideration, which is focused on 3 different neighborhoods. Also, another limitation is that the study is focused on visual inspection and photographic documentation just of the envelope of the building and not on the inside. Future research should create a more detailed current state of the building, what the changes are, and those should be documented. For each building, whether or not intervention should be conducted, a more detailed structural and thermal analysis should be conducted.

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