DS²BE 2025

22 May 2025, Leuven

Doctoral Seminars on the Sustainability Research in the Built Environment

Book of Abstracts

KU LEUVEN UCLouvain

Venue
Leercentrum AGORA (114-01), Edward Van Evenstraat 4, 3000 Leuven, Belgium
22 May 2025

Organising Committee
Nick Adams (KULeuven), Karen Allacker (KULeuven), Emilie Gobbo (UCLouvain), Geoffrey Van Moeseke (UCLouvain),

Scientific Committee
Prof. Ahmed Z. Khan (ULB), Prof. Frank De Troyer (KULeuven), Prof. Emilie Gobbo (UCLouvain), Prof. Geoffrey van Moeseke (UCLouvain), arch. Giulia Caterina Verga (ULB), Prof. Griet Verbeeck (UHasselt), Prof. Jacques Teller (ULg), Prof. Lars De Laet (VUB), Prof. Karen Allacker (KULeuven), Prof. Marijke Steeman (UGent), Dr. Mattias Buyle (UAntwerp), Prof. Waldo Galle (VUB), Prof. Nathan Van Den Bossche (UGent), Prof. Shady Attia (ULg), Prof. Tim De Kock (UAntwerp)

ACTION ORIENTED RESEARCH: SUPPORTING THE SUSTAINABLE TRANSITION OF THE BUILDING SECTOR

Introduction

The sustainability of the built environment has been a topic of research for decades, resulting in the development of concepts, methods and technologies aimed at reducing the environmental impact of buildings and cities. Nevertheless, the majority of these developments fail to gain traction within the building industry. In an increasingly unstable global context, where planetary boundaries are repeatedly crossed and social minimums are continuously challenged, it is imperative to emphasise the practical and societal relevance of research outcomes. Consequently, transdisciplinarity and engagement with stakeholders at the material, building, city and territorial levels are vital to address the existential challenge that we face.

PROGRAM

8.30	Registration opening and posters display (Couvreur room)
9.00	Welcome address – Geoffrey van Moeseke, Karen Allacker
9.15 - 9-45	**Paper presentations: building stock scale** - Pristera Giulia: Assessing different methodological choices in two European building stock models through LCA modelling of circular and carbon reduction measures
9.45 - 12.45	**Poster session** Informal discussions. PhD students are asked to stay close to their poster. A thematic clustering will be looked for.
12.45 - 13.30	Lunch
13.30 - 15.00	**Paper presentations: Building scale** - Sonmez Nurefsan: Exploring International Policies on Heritage Building Conservation: A Focus on Optimizing Daylighting - Mouton Lise: Developing environmental benchmarks for buildings in Belgium: a review of the environmental policy context - Danlun Cao: How will green building shape occupants' living Experience — A systematic literature review
15.00 - 15.20	Coffee refill
15.20 - 17.20	**Paper presentations: Material scale** - Kale Eda: A Comparative Study of Vertical Greening Systems in Historic Buildings in Belgium - Devos Katrien: Evaluating the financial costs of material reuse: Insights from a contemporary case study - Leemans Ellen: Adjustable Connections for a Reusable Self-supported Modular Plate System - Adams Nick: Impact of radiative cooling concrete compositions on the net energy demand in buildings
17.20	Closing address

LIST OF ABSTRACTS

Oral presentations

ADAMS Nick – KULeuven 7
CAO Danlun – UCLouvain 8
DEVOS Katrien – Ugent 9
KALE Eda – UAntwerpen 10
KAWA Gabrielle – VUB 11
LEEMANS Ellen – VUB 12
MOUTON Lise – KULeuven 13
PRISTERA Giulia – KULeuven 14
SONMEZ Nurefsan – UAntwerpen 15

Poster presentations

ALVAREZ GUTIERREZ Rafael – UAntwerpen 17
BEECKMANS Paulien – VUB 18
BERTINI Aurora – ULiège 19
BRASSEUR Amandine – ULiège 20
BUI Phuong Ngoc – ULB 21
DASSE Maxime – UCLouvain 22
DEBOLI Sofia – UAntwerpen 23
HALBACH Amélie – ULiège 24
HAMILTON Fiona – UAntwerpen 25
HAVERBEKE Maud – UGent 26
LI Rachel Qiuxian – KULeuven 27
LIEUTENANT Loïc – UCLouvain 28
LINDENBERGH Ilse – UAntwerpen 29
MORALES Dean Richard – UAntwerpen 30
NICOLAS Gabrielle – VUB 31
PAEZ PEREZ Camilo – ULB 32
VAN DEN BOSSCHE Ruben – UGent 33
WANG Tianyi – ULiège 34
ZITOUNI Dyna Chourouk – ULiège 35

BOOK OF ABSTRACTS

Papers

IMPACT OF RADIATIVE COOLING CONCRETE COMPOSITIONS ON THE NET ENERGY DEMAND IN BUILDINGS

Nick ADAMS
KULeuven

The increasing urban heat island (UHI) effect and rising energy demands for cooling in buildings necessitate innovative, passive cooling strategies. Radiative cooling (RC) materials, which reflect solar radiation and emit thermal energy through the atmospheric transparency window (8–13 μm), offer a promising solution. However, their implementation in different climatic conditions presents challenges, particularly concerning potential heating penalties in colder seasons. This study evaluates the cooling and heating performance of photonic meta-concrete (PMC), a novel RC material, using EnergyPlus simulations in four distinct climates: Brussels (marine), Madrid (Mediterranean), Phoenix (desert), and Singapore (tropical).

A test building is modelled with conventional concrete and six PMC compositions, assessing their impact on surface temperatures, net cooling and heating energy demand, and associated CO_2eq. emissions. Results indicate that PMC significantly reduces roof surface temperatures by up to 16°C in Brussels, 29°C in Madrid, and 32°C in Phoenix. In hot climates (Phoenix, Singapore), cooling demand is reduced by up to 69%, leading to substantial CO_2eq. emission savings. However, in cooler climates (Brussels, Madrid), heating demand increases by up to 60%, partially offsetting cooling gains.

An environmental payback period analysis reveals that high-performance PMC mixtures (e.g., M6) are particularly effective in tropical and desert climates, achieving a payback period of just 0.57 years in Singapore and 1.30 years in Phoenix. In contrast, in temperate climates, the heating penalty outweighs the environmental benefits. These findings highlight the potential for PMC to enhance urban sustainability, particularly in hot climates, while emphasizing the need for climate-specific material optimization to balance cooling gains and heating trade-offs.

Supervisors: Karen Allacker

HOW WILL GREEN BUILDING SHAPE OCCUPANTS' LIVING EXPERIENCE — A SYSTEMATIC LITERATURE REVIEW

Danlun CAO
UCLouvain

Since the 1990s, green certification has incentivised sustainable practices in the construction industry by implementing quantifiable metrics to enhance environmental performance. While there is a prevailing assumption that certified buildings improve the quality of the built environment together with occupants' living experiences, empirical evidence remains inconsistent, particularly in light of shifting lifestyles, mobility patterns, and workplace expectations. Existing gaps in knowledge include a) how green certification might drive the perception of well-being among building users; b) if perceived well-being, particularly at the workplace, can promote pro-environmental behaviours; and, c) whether these behaviours can be sustained outside the certified building.

To consolidate existing knowledge, a systematic literature review was conducted using two databases: Scopus and Web of Science. The PICOC (Population, Intervention, Comparison, Outcome, and Context) criteria guided keyword selection and search string definition, leading to retrieve 303 articles published between 2014 and 2024. After excluding irrelevant records following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart, 107 papers were retained using Quality Assessment checklist. Finally, 16 studies were included in this review.

The findings highlight a general positive impact of green building certification on occupants' perceptual and behavioural experiences. However, this positive impact is not consistently sustained, owing to multiple contextual factors, individual characteristics, and other influencing variables. Furthermore, due to the complexity of the relationships at play, particularly regarding subjective well-being and related concepts such as comfort and satisfaction, there is still a lack of clarity in definitions and implementation scopes. No conclusive evidence was found on how pro-environmental behaviours might effectively be enhanced among building users. The results of this paper represent the initial steps of a broader research effort aiming to support rating bodies and accredited professionals towards more effectively integrating occupant-centred aspects into the design and implementation of green building certification systems.

Supervisors: Sergio Altomonte

EVALUATING THE FINANCIAL COSTS OF MATERIAL REUSE: INSIGHTS FROM A CONTEMPORARY CASE STUDY

Katrien DEVOS
UGent

The construction sector is a major contributor to environmental degradation, consuming nearly half of the world's raw materials. However, adopting circular economy principles, particularly material reuse, offers a pathway towards sustainability. While material reuse is often perceived as cost-effective due to the absence of production costs, the need for labour-intensive reclamation processes—such as deconstruction, cleaning and testing—along with logistical expenses, can make reuse more expensive than using new materials. To address this issue, this study investigates the financial viability of reclaiming materials from a contemporary Belgian dwelling that was not designed for disassembly. The research inventories reclamation processes—including deconstruction, cleaning, transportation, and storage—and quantifies associated costs using data from literature and expert interviews. These costs are then compared to different market value scenarios to assess financial viability.

Findings reveal that reclamation costs are primarily driven by labor-intensive deconstruction and material processing, while transportation and storage contribute minimally, except for high-volume materials like insulation. Financial analysis reveals that glulam is the most economically viable material for reuse due to its high market value and low reclamation costs. Timber frames, doors, façade bricks, faience wall tiles, and windows also demonstrate financial viability under specific market conditions. Conversely, materials such as concrete and insulation are consistently unprofitable to reclaim due to high processing costs and low resale value. The study concludes that selective reclamation focusing on high-value, low-processing-cost materials enhances financial feasibility. Furthermore, regulatory incentives, such as tax reductions or subsidies, and advancements in dismantling technologies could further improve the economic viability of material reuse.

Supervisors: Marijke Steeman, Lionel Devlieger

A COMPARATIVE STUDY OF VERTICAL GREENING SYSTEMS IN HISTORIC BUILDINGS IN BELGIUM

Eda KALE
UAntwerpen

The sustainable preservation of heritage buildings is increasingly at risk due to environmental stressors and socio-economic challenges. Vertical Greening Systems (VGS) offer a contemporary solution to address these challenges, providing environmental, social, and economic benefits. However, integrating VGS into historic buildings presents unique challenges, including structural compatibility, maintenance demands, and potential impacts on heritage value. This study aims to address these complexities by comparing two distinct case studies: the Plantin Moretus Museum in Antwerp, a UNESCO World Heritage property emphasizing historical continuity, and the MARTA project in Mechelen, an adaptive reuse initiative for a decommissioned Neo-Romanesque church.

Using the comparative approach, this research examines design strategies, heritage integration, environmental impact, conservation, legal aspects, financial implications, and social contributions. Data were collected through semi-structured interviews, archival research, project documentation, and site observations, analysed through qualitative thematic analysis.

Both case studies highlight the different possibilities of integrating VGS into historic settings. MARTA's approach fosters biodiversity, urban cooling, and community engagement, whereas the Plantin Moretus Museum focuses on historical continuity. Both emphasize heritage-sensitive planning, conservation strategies, and legal compliance.

This study highlights the significance of careful planning, adaptability, and community involvement when integrating VGS into historic settings. Future research should explore long-term strategies for VGS that ensure built heritage preservation, environmental enhancement, adaptive policies in legislation, socio-economic accessibility and effective maintenance.

Supervisors: Tim De Kock, Yonca Erkan

A CIRCULAR APPROACH TO URBAN VACANCY AND TEMPORARY USE

Gabrielle KAWA
VUB

The transition from a linear to a circular economy in the building industry is increasingly prioritised by the European Commission through initiatives such as the Green Deal and the Circular Action Plan. Concurrently, research on urban vacancy, though still niche within disciplines like architecture, urban planning, and social geography, has seen significant growth. This chapter aims to assess the state-of-the-art in the field of circularity concerning urban vacancy and temporary use, positioning this within the broader context of sustainability transitions. Through a comprehensive literature review, this chapter first articulates the rationale for adopting circular building practices in urban environments. It then examines the challenges and opportunities associated with urban vacancy, with a specific focus on the Brussels Capital Region. Utilising the Iceberg Model method, the chapter visualises and deconstructs the multifaceted nature of urban vacancy, mapping the actions of Brussels' stakeholders in addressing this issue. The findings highlight the importance of coordinated collaboration to achieve a circular approach to urban vacancy and temporary use, contributing to a more sustainable urban future.

Supervisors: Waldo Galle, Niels De Temmerman

ADJUSTABLE CONNECTIONS FOR A REUSABLE SELF-SUPPORTED MODULAR PLATE SYSTEM

Ellen LEEMANS
VUB

Modularity has gained attention in the event sector for its potential to increase reuse and sustainability. Currently, most event structures are discarded after use. However, if 75% of these structures were designed for reuse, the waste production could be reduced by a factor of 3.5. While modular structures are already in use, they typically rely on modular beams and non-modular elements for cladding, limiting their potential for reuse. This study explores how modular plate systems can integrate both structural and cladding functions. Specifically, it investigates how an adjustable connection system can enable the use of plates in a self-supporting, reusable structure.

The investigation identified key components for an adjustable connection system that facilitates ease of assembly and disassembly. Five types of connection systems, based on existing lightweight plate structures, were identified and analysed, including angulated plates, wood joints, bolted connections, hinged connections and flexible hinges.

The connection system was conceptualized with two main elements: a rotator, allowing the plates to be reconfigured in varying angles, and a connector, which physically joins the plates to the system and plays a critical role in simplifying assembly.

Prototypes of each connection type were developed and tested. Through iterative refinement, the initial five options were reduced to two viable systems. Preliminary structural analysis of these two connection systems confirmed their feasibility for use in temporary lightweight plate structures. While both options showed promise, further optimization is needed in terms of flexibility or stability. Larger prototypes will be constructed to further refine and test the selected connection systems.

This work highlights the potential for modular plate systems that integrate both structural and cladding functions, offering new opportunities for reusable building components in event structures. Further research will focus on refining these connection systems and testing their performance in full-scale applications.

Supervisors: Niels De Temmerman, Lars De Laet

DEVELOPING ENVIRONMENTAL BENCHMARKS FOR BUILDINGS IN BELGIUM: A REVIEW OF THE ENVIRONMENTAL POLICY CONTEXT

Lise MOUTON
KULeuven

Considering the most recent update of the European Commission's Energy Performance of Buildings Directive (EPBD), the Member States must develop a roadmap with benchmark values for the life cycle greenhouse gas emissions of buildings. Benchmark values for buildings can be derived in two ways: bottom-up, based on reference buildings, or top-down, by translating environmental targets to target values for buildings. Some countries have already developed and implemented bottom-up benchmark values, including legislative limit values and informative reference values. Belgium has not yet implemented legislative limit values, but two recent studies developed bottom-up and top-down benchmarks for houses in Belgium. For further development of these, e.g. for their implementation in building regulation, it is essential to understand the context around benchmarks for buildings in Belgium.

This paper reviews existing sustainability policies and targets relevant for developing environmental benchmarks for Belgian buildings. It presents global, European, Belgian and Flemish environmental policies and targets, including the Paris Agreement, Planetary Boundaries, European Climate Law, Belgian and Flemish climate strategies, and building environmental regulations and frameworks at different levels. It explains the link between the different policies and frameworks as well as their relevance in the context of environmental benchmarks. Specifically, the link with top-down benchmarks is explained, which are derived from such environmental targets. Furthermore, the paper addresses some of the challenges in top-down benchmarking, which are related to both the environmental target and the method of translating the target to buildings. These challenges along with the overall policy are essential to understand for the further development of environmental benchmarks for buildings in Belgium, building on two referenced studies

Supervisors: Karen Allacker, Damien Trigaux

ASSESSING DIFFERENT METHODOLOGICAL CHOICES IN TWO EUROPEAN BUILDING STOCK MODELS THROUGH LCA MODELLING OF A CIRCULAR AND CARBON REDUCTION MEASURE

Giulia PRISTERA
KULeuven

The building sector is central to several European policy initiatives for the reduction of carbon emissions and the transition to a circular economy. These legislative efforts can be aided using building stock models to assess the environmental impacts of buildings in the European area.

The present paper considers two EU-wide, life cycle assessment-based building stock models: the Basket of Products Indicator on Housing and the model created as part of the "Analysis of life-cycle greenhouse gas emissions of EU buildings and construction" project. Both were developed with for the purpose of serving as policy support instruments, but differ in terms of granularity, modelling approach and, to a certain extent, scope.

To test whether these differences might lead to discrepancies in the results, an impact reduction strategy is implemented in both models: specifically, the increasing substitution of conventional insulation materials with biobased alternatives. The different characteristics of the two models are compared, considering geographical and temporal scope, archetype modelling and data collection approach. The materials substitution scenario is implemented, and the results are assessed for a set of reference years.

Some significant differences in outcome emerge from the analysis, with different countries and impact categories being affected to various degrees; further steps are therefore required to ensure that the scenario modelling is carried out consistently across the models and identify potential updates to align the two models.

Supervisors: Karen Allacker, Serenella Sala

EXPLORING INTERNATIONAL POLICIES ON HERITAGE BUILDING CONSERVATION: A FOCUS ON OPTIMIZING DAYLIGHTING

Nurefsan SONMEZ
UAntwerpen

Heritage buildings represent cultural identity and architectural heritage, necessitating their conservation to ensure continued use for today and by future generations. While conservation policies emphasize authenticity, minimal intervention, and energy efficiency, daylighting remains underexplored. As a key component of indoor environmental quality, daylight enhances visual comfort, reduces artificial lighting use, and supports sustainability. However, excessive daylight exposure can lead to glare and overheating, requiring a careful balance through shading devices and glazing technologies. Therefore, examination of daylight in all aspects holds great significance.

This study examines international conservation policies and daylight-related standards to assess their alignment with sustainable heritage conservation. A qualitative analysis of policy documents issued by UNESCO, ICOMOS, ICCROM, and national guidelines reveals that existing frameworks prioritize energy efficiency but overlook daylight integration for occupant well-being. Additionally, daylight evaluation often relies on static metrics like the daylight factor (DF), while dynamic metrics such as Useful Daylight Illuminance (UDI), Spatial Daylight Autonomy (sDA), and Annual Sunlight Exposure (ASE) remain overlooked.

Findings suggest that conservation strategies should incorporate dynamic daylight metrics, adapt facade and roof interventions, and redefine policies to balance heritage building conservation with today's daylighting requirements. A holistic approach integrating daylighting strategies into energy-efficient methods can improve heritage buildings' liveability and functionality without compromising their integrity.

Supervisors: Arzu Cilasun Kunduraci, Yonca Erkan

BOOK OF ABSTRACTS

Posters

PCM AS COMPLEMENTARY RETROFIT STRATEGY FOR ENERGY EFFICIENCY

Rafael ALVAREZ GUTIERREZ
UAntwerpen

In the transition towards an energy-efficient building stock, there is a growing trend to enhance thermal insulation and airtightness of buildings to reduce heat loss. However, in such buildings, heat can be trapped within the envelope, leading to unintended consequences such as thermal discomfort and increased reliance on active cooling during the summer. These challenges are further intensified by climate change and renovation practices that cover high thermal mass materials with thermal insulation, preventing them from acting as thermal buffers and increasing the risk of overheating. In this context, PCMs offer a novel, lightweight solution to increase the thermal inertia of the building, particularly in retrofit scenarios where minimizing materials and preserving indoor space are priorities. Through reversible phase transitions – for building applications between solid and liquid – these materials store large amounts of latent heat at nearly constant temperatures, stabilizing indoor temperatures and potentially lowering cooling loads.

This research explores the integration of PCMs in combination with thermal insulation to retrofit the interior of external walls, investigating the optimal trade-off to minimize overall energy demand. The study examines the effectiveness of the retrofit solutions across various residential building variants, including lightweight and heavyweight structures, with four different levels of thermal performance. The impact on energy efficiency and the indoor thermal environment is analysed for each retrofit scenario using dynamic building performance simulations, conducted for a building located in Brussels. The findings substantiate the effectiveness of PCMs as a retrofit strategy, particularly in well-insulated buildings where they lower cooling demands and outperform the addition of thermal insulation alone. For interior retrofits with a maximum thickness of 5 cm, combining thermal insulation and PCMs proves more effective than insulation alone in several cases, achieving up to 26.7% energy savings compared to the baseline scenarios and offering balanced heating and cooling reductions.

Supervisors: Stijn Verbeke, Amaryllis Audenaert

FROM OFFICE TO HOUSING: FACADE SOLUTIONS

Paulien BEECKMANS
VUB

The COVID-19 crisis has established remote work as a new standard for many people, leading to office space reduction by many large companies. Concurrently, there is a trend of companies relocating to modern offices equipped with the latest technological innovations, leaving older office buildings vacant. To address this, three strategies are considered: renovation, reconversion, or demolition. Demolition and reconstruction need to be avoided due to their high environmental impact, including building waste and CO2 emissions as well as higher costs compared to reconversion or renovation. When an office function is no longer desirable in this particular location, reconversion emerges as the most sustainable solution. In the Brussels Region, a trend of reconversion has been observed for a few years already with 20% of all new housing construction in 2018 and 2019 resulting from such projects.

Key aspects that influence the reconversion of offices include the structure, the facade, and circulation. Thirty cases were analyzed to understand how these elements were adapted to residential use. The focus here will be on the facade, exploring design solutions to facilitate the reconversion of office buildings into housing while also protecting future adaptability. The design solutions will be ranked according to their environmental impact, from simple solutions that retain the most material to more complicated building alterations. The goal is to provide an overview of these design solutions to communicate them to developers, architects, and other stakeholders. This will help to offer practical guidelines for the redevelopment and contribute to the efficient reuse of existing building stock.

Supervisors: Waldo Galle, Niels De Temmerman

DYNAMIC ENERGY SIMULATION OF BUILDING RENOVATION STRATEGIES

Aurora BERTINI
ULiège

This research investigates the integration of life cycle impact assessment (LCIA) and building performance simulation (BPS) to evaluate the whole-life carbon performance of residential building renovations. The renovation efforts are concentrated on three principal building components: envelope, technical systems and on-site renewable energy production. The study evaluates six one-stage renovation scenarios that incorporate both petrochemical and bio-based materials. These options are designed to balance the practical applicability within the current renovation market, the identification of optimal futuristic solutions, and the compliance with policy directives. A 50-year analysis is conducted to account for variations in the electricity mix, climatic conditions, and future energy demand patterns.

Preliminary analyses conducted on a representative post-World War II single-family house in Belgium demonstrate that ultra-low energy renovations can reduce operational emissions by up to 95%. However, embodied emissions represent over 80% of the total emissions, emphasizing the trade-offs inherent in material selection and renovation design choices. Sensitivity analyses further reveal that parameters such as heat pump efficiency, airtightness, and photovoltaic system performance have significant effects on emission outcomes, suggesting that envelope renovations should be implemented in conjunction with improvements to technical systems. Scenarios using bio-based materials result in up to a 7% reduction in embodied emissions compared to those employing petrochemical materials. The research also emphasizes the need for a dynamic approach; specifically, adopting hourly rather than annual emission factors increases annual operational emissions by up to 54%. Furthermore, considering long-term variation in the Belgian electricity mix and climatic conditions can increase in operational emissions by 20% by 2060 compared to a static analysis.

Future work will focus on renovation costs, aiming to identify optimal renovation solutions that balance environmental sustainability and economic viability. Comparisons across diverse dwelling archetypes and geographic locations will be undertaken to enrich the understanding of the priorities essential for meeting building carbon reduction targets.

Supervisors: Shady Attia

CONSTRUCTION AND DEMOLITION WASTE, RECYCLING, BUILDING STOCK, INVENTORY

Amandine BRASSEUR
ULiège

This study aims to tackle the complex challenge of urban sustainability by repurposing construction and demolition wastes into valuable resources. To manage the use of waste as effectively as possible, it is necessary to have a precise overview of the stock of materials available after demolition. However, detailed data regarding the demolished buildings or the material composition is often insufficient or incomplete.

This research attempts to address these shortcomings by inventorying Walloon building stock using multisource data including construction plans, cadastral, land use, and LiDAR data to quantify residential buildings and materials available for recycling or reuse after demolition. We analyse building characteristics (area, height, volume etc.), classify residential buildings by age and type and then create a database of typical material compositions per building group. By cross-referencing material intensities (kg/m³), defined as the quantity of a material present in a cubic metre of a building, with building volumes, we estimate total material stocks. Combined with annual demolition rates, this provides projections of recyclable or reusable waste. Demolition rates from previous years are used. Various demolition scenarios will be examined to explore the relationship between buildings' general conditions and different levels of renovation and demolition.

These results show an estimate of the quantities of waste to be removed and processed and their spatial distribution in the Walloon region. They will be shared with existing recycling and demolition centres and industry stakeholders to support development in the waste recycling sector.

Supervisors: Jacques Teller, Luc Courard

EVERYDAY HERITAGE IN REDEVELOPMENT: PRESERVING THE "SPIRIT" OF THE SOVIET-STYLE COLLECTIVE LIVING QUARTER, BUILT IN HANOI, VIETNAM, BETWEEN 1954 TO 1986 IN THEIR REDEVELOPMENT PROJECTS

Phuong Ngoc BUI
ULB

The study focuses on heritage values of the group of Soviet-style collective living quarter architecture in 1954-1990, also known as the Khu tập thể (KTT) in Hanoi, Vietnam, discussing on the negotiation between the preservation of the area's "spirit" and the redevelopment toward urban area transformation. Soviet architecture as part of cultural heritage has recently become popular globally, especially in the former Soviet bloc countries and countries with the same socialist ideology, including Vietnam. However, the process of listing heritage and assessing the historical significance of most heritage assets in need of sustainable regeneration often lacks a detailed explanation of their values and attributes, leading to failure of many development projects.

Through the lens of the Everyday Heritage concept, formerly introduced by Saruhan Mosler (2019), this study seeks to expand the boundaries of what can constitute heritage by assessing the heritage significance of properties in non-listed neighbourhoods with different stakeholders' perspective. Highlighting the potential of heritage in its everyday context shows that symbolic, aesthetic, and broadly conceived affective factors may be as important as architectural, historical, and artistic issues when it comes to conceiving of heritage value.

This study intends to use Peter Howard's (2003) Heritage Cube framework to categorize and analyse the results from the investigation of specific KTT cases through conducting documentary research, observational research and semi-structured in-depth interviews. The investigation aims to understand how people sustain and reinvent elements of their everyday lives in innovative and often unpredictable ways.

Although there are many conflicting opinions, this is an opportunity to reconsider the assessment method to acknowledge the role of "new" cultural heritage and create sufficient tools to approach preservation and redevelopment projects of historical areas in contemporary Vietnam.

Supervisors: Victor Brunfaut

TOWARDS A RENOVATION OF BELGIAN RESIDENCES THAT MINIMISES GLOBAL WARMING POTENTIAL

Maxime DASSE
UCLouvain

Belgian residential buildings constructed before 1980 represent the largest energy consumers within the national building stock, primarily due to inadequate thermal insulation, outdated building systems, and lower compactness. Estimating the global warming potential (GWP) associated with renovating this substantial stock is inherently uncertain due to the lack of detailed data and the vast diversity in building dimensions, material compositions, and prior renovations. Furthermore, the timing of greenhouse gas (GHG) emissions is crucial, especially at the regional scale, to prevent emission peaks.

This research aims to define renovation strategies that minimize the GWP of the Belgian residential building stock renovation, explicitly considering uncertainty and GHG emission timing. Our approach decomposes the building stock into archetypes, each reverted to its original state by removing any eventual post-construction renovations. Variants of each archetype are then generated by applying various preliminary renovation measures, modifying HVAC systems, and altering material compositions, effectively recreating the initial building diversity represented by each archetype. Renovation strategies with operational energy performance targets are applied to each variant.

Embodied GHG emissions are calculated using the Ecoinvent database, while operational GHG emissions are simulated with EnergyPlus. The timing of GHG emissions is monitored and input into the Climate Change Impact (CCI) tool, which dynamically calculates the resulting Global Mean Temperature Change (GMTC). This process generates a database of renovation scenarios for archetype variants, populated with performance data for each case. Statistical analyses of this database should enable to identify optimal renovation strategies at the building stock level, accounting for the inherent diversity of its constituent buildings. This approach is carried out by a Python Engine currently under development. The purpose of this engine is to bridge the different tools employed in this research. It is also used to automate the generation of the variants and the evaluation of their whole life GHG emissions.

Supervisors: Emilie Gobbo, Shady Attia

BLACK CRUSTS AS GEOCHEMICAL ARCHIVES: LEAD CONTAMINATION IN ANTWERP'S URBAN LANDSCAPE

Sofia DEBOLI
UAntwerpen

Urban environments are particularly vulnerable to elevated pollution levels due to high population densities, industrial emissions, and architectural designs that limit natural airflow. This restricted ventilation promotes the accumulation of pollutants, deteriorating air quality and accelerating the degradation of building materials. Among pollutants, sulfur dioxide (SO_2) poses a notable threat to calcium-rich stones, contributing to the formation of black crusts through sulfation processes. These crusts, primarily composed of gypsum ($CaSO_4 \cdot 2H_2O$), act as passive samplers of urban pollution, trapping atmospheric particulates, including heavy metals like lead (Pb).

This study investigates black crusts collected from historical buildings in Antwerp to characterize their chemical and morphological properties and assess their potential as geochemical archives of urban pollution. A multi-analytical approach was employed, integrating X-Ray Fluorescence Spectroscopy (XRF), Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM-EDX), and Laser-Induced Breakdown Spectroscopy (LIBS) techniques to analyse the elemental composition, micromorphology, and stratigraphy of the samples.

Preliminary results revealed significantly elevated Pb concentrations, far exceeding typical safe background soil levels (10–200 ppm). Although the precise form of Pb remains undetermined, the data suggests it is concentrated within the outer crust layers, likely sequestered as lead sulfates through interactions with gypsum. This form of Pb is known to exhibit high mobility and, under certain climatic conditions, could be re-released into the environment, posing risks to public health and ecosystems.

These findings highlight the need for further research into the behaviour of Pb within black crusts, particularly in terms of its mobility and long-term environmental implications. Understanding these dynamics is critical for both the conservation of historical structures and the evaluation of urban Pb exposure risks. The insights gained from this research could help inform pollution mitigation strategies and contribute to the development of more sustainable urban environments.

Supervisors: Tim De Kock

TOWARDS A COLLABORATIVE DIGITAL MATERIAL PASSPORT

Amélie HALBACH
ULiège

The construction sector is a major consumer of raw materials and producer of waste. Reusing building materials can help address this, with Design for Disassembly and Adaptability (DfD/A) offering an effective solution. However, the effectiveness of DfD/A depends on the implementation of appropriate documentation strategies that ensure stakeholders have access to the needed information throughout the building's life cycle. To unlock the benefits of DfD/A, it is crucial that the approach to building design evolves together with improved documentation practices.

The aim of this research is to facilitate the reuse of building components at the end of their lifecycle by developing documentation strategies that incorporate the principles of DfD/A, ensuring that information is relevant, well-organised, and up-to-date. To address this challenge, we pose the following research question: How can documentation strategies including the principles of Design for Disassembly and Adaptability enhance and enable the future reuse of building components?

The lack of relevant, structured, and up-to-date information on building components creates a dual challenge for circular economy implementation in the construction sector: a) Improving the future building component reuse relies on developing the appropriate documentation strategies that integrates the data needed to reinforce, support and encourage DfD/A. b) The effectiveness of the chosen documentation strategies relies on aligning them with the specific needs of the stakeholders.

To address these challenges, we adopt a hybrid methodological approach grounded in Design Science Research. Recognising the importance of stakeholder involvement, our research employs qualitative methods throughout various stages. Interviews and case studies provide insights during the problem awareness and suggestion phases, while action research is used to improve both the practicality and adoption during the development phase. The evaluation/validation method remains to be defined, as its final form is yet to be determined.

Supervisors: Aurélie De Boissieu

FACTORIES, MEMORIES, AND TRANSFORMATION: BELGIUM AS A CASE STUDY FOR UNDERSTANDING THE ADAPTIVE REUSE OF INDUSTRIAL HERITAGE

Fiona HAMILTON
UAntwerpen

This research investigates the socio-cultural dimensions of adaptive reuse within Belgium's industrial heritage, with a specific focus on former urban manufacturing spaces in Flanders ad Brussels. It explores how narratives of industrialization and deindustrialization are preserved, transformed, or erased in the redevelopment of these sites. Drawing on theories from industrial heritage, deindustrial studies, and memory politics, the study examines how labor histories, governance structures, and community identities are influences by reuse strategies.

The project is grounded in a comparative case study methodology, supported by discourse analysis and archival research, and structured around a three-phase framework: industrialization, deindustrialization, and adaptive reuse. Through this framework the research categorizes models of how industrial sites once functioned, how they were abandoned or transformed, and how they are reinterpreted today. Case studies will be selected from cities such as Ghent, Aalst, Kortrijk, Brussels and Antwerp, where urban manufacturing significantly influenced spatial development and where recent reuse efforts are underway. Focusing on Flanders and Brussels allows the study to examine a diversity of manufacturing typologies distinct from extractive industries in Wallonia, while also offering a manageable and contextually rich governance environment for comparative analysis.

The research analyses patterns in governance, labor dynamics, and social infrastructure that have shaped industrial and post-industrial landscapes. It then investigates how these histories are engaged within current reuse projects through spatial practices, interpretive strategies, and programming decisions.

This approach reveals which narratives are emphasized, which are omitted, and what these choices signal about broader cultural, economic and political priorities. By developing a socio-cultural evaluation framework, the research contributes to a more inclusive and historically grounded approach to adaptive reuse. It aims to contribute to a greater scholarly understanding of how industrial memory is negotiated within contemporary reuse practices. It advances academic discourse on the relationship between spatial transformation, cultural narratives, and heritage interpretation, offering a critical tool for analysing the ways in which post-industrial sites are reimagined and recontextualized.

Supervisors: Yonca Erkan

LOWERING THE CARBON FOOTPRINT OF SINGLE-FAMILY HOUSES IN FLANDERS: GUIDELINES FOR PRACTITIONERS

Maud HAVERBEKE
UGent

Reducing the carbon footprint of buildings has become increasingly urgent, given the substantial contribution of the construction sector to rising CO2 emissions. However, building professionals – such as building contractors and architects – often lack practical insights into which building components have the highest environmental impact or how to reduce a building's environmental impact.

To address this, this study analyses a sample of 108 newly built Flemish Single-Family Houses (SFHs). These SFHs differ in typology (terraced, semi-detached, or detached), size (small, medium, or large), construction method (solid or timber), environmental impact of building elements (low, medium, or high), and roof type (flat or pitched). This sample is used to assess the buildings' embodied impact, identify the building elements with the highest contribution, and investigate the influence of building parameters and material choices on their embodied impact. In the second part, the reduction potential for three selected SFHs is assessed by applying conventional materials with a low embodied impact and alternative solutions, such as bio-based and reused materials. The analysis is conducted through Life Cycle Assessment (LCA).

The results show that, within current construction practices, the slab on grade, internal floors, roofs and external walls contribute most to the embodied impact. Furthermore, the study concludes that, in addition to typology and building size, the material choice has a significant influence on the overall embodied impact of the SFHs. Depending on the material choice, the embodied impact ranges from -37% and 32% for detached and semi-detached SFHs, and -37% and 29% for terraced SFHs, relative to the medium-impact scenario at the element level. Moreover, by incorporating alternative solutions, a reduction potential of 54-56% is achieved for the three selected SFHs.

Supervisors: Marijke Steeman

AN ASSESSMENT FRAMEWORK FOR INTEGRATING CIRCULAR MATERIAL AND ENERGY FLOWS IN NEIGHBORHOOD-SCALE RENOVATIONS

Rachel Qiuxian LI
KULeuven

To decarbonize the built environment, the EU has launched the Renovation Wave initiative, aiming to double the annual energy renovation rate by 2030. Renovations at the neighbourhood scale offer cost-effective solutions and facilitate integration with energy and circularity goals, as highlighted in the revised Energy Performance of Buildings Directive. Furthermore, the new Circular Economy Action Plan of EU promotes aligning the Renovation Wave initiative with circular principles. Given these frameworks, there is a need to integrate circular strategies in neighbourhood renovations.

However, integrating circular material flows (e.g., reuse and recycling of materials) and circular energy flows (e.g., on-site renewable energy production and energy sharing within the neighbourhood) at the neighbourhood scale presents new challenges, particularly due to the lack of a standardized method for assessing circularity at this scale, which hinders the implementation. The recently published ISO 59004:2024 defines circularity assessment as the evaluation and interpretation of results and impacts derived from a circularity measurement. Therefore, it requires a comprehensive approach to capture multiple aspects of circularity.

This PhD project aims to develop a holistic circularity assessment framework for neighbourhood renovations, focusing on the integration of circular material and energy flows. The proposed circularity assessment framework will comprise a comprehensive set of indicators developed to evaluate both the physical aspects of circular strategies (e.g., the degree of circularity in terms of materials and energy use) and their associated environmental and economic impacts at the neighbourhood level. Given the complexity of multi-criteria decision-making, the framework will apply a weighting-based system to support informed decisions in selecting the optimal alternative at the early design stage of neighbourhood renovation projects.

Supervisors: Chiara Piccardo, Dirk Saelens

A LOW-TECH THERMAL COMFORT STRATEGY

Loïc LIEUTENANT
UCLouvain

In the context of a significant climate crisis, reducing energy consumption related to buildings is crucial. The solution often proposed is improving the thermal efficiency of buildings, but such an approach has budgetary, material, and labor limitations.

Therefore, developing energy sobriety or sufficiency is an interesting but underexplored avenue. The Low-tech approach, which advocates for addressing only the strictly necessary fundamental needs, shares similarities with the concept of energy sufficiency. Thus, using the Low-tech approach provides technological selection criteria, and developing the strategy enables us to explore new Low-tech systems.

This is why the objective of this thesis is to propose a Low-tech thermal comfort strategy. In the spirit of the Low-tech approach, this involves quantifying the temperature needs within the building. To achieve this, a state-of-the-art review across different fields (building, comfort, health, etc.) will be conducted through an interdisciplinary literature analysis.

Regarding the specific needs of buildings, a numerical simulation will be carried out to examine the impact of temperature on relative humidity and its consequences on the building's salubrity.

Personal Comfort Systems (PCS) are heating systems that deliver energy directly to the user. Literature has demonstrated their great effectiveness because they are in direct contact with users. They will be tested in a laboratory setting with volunteers to evaluate the comfort and acceptability they provide.

Using a thermal manikin, it will also be possible to determine the thermal resistance of technical clothing to propose effective and discreet clothing solutions.

Performing an energy renovation of a single room could reduce renovation costs while giving each building the opportunity to have a thermally efficient space. The relevance of this solution will be verified through numerical simulation.

All these solutions will be implemented in real-world conditions in office buildings within the Franco-Belgian cross-border area

Supervisors: Geoffrey van Moeseke

SUSTAINABLE SCENOGRAPHY: APPLYING CIRCULAR DESIGN STRATEGIES TO TEMPORARY EXHIBITIONS

Ilse LINDENBERGH
UAntwerpen

In the search for sustainable development, museums have recently shown a great willingness to adapt and improve their policies and institutional workings. However, of growing concern is the huge waste pile that stems from their practices. The Culture, Climate and Environmental Responsibility Annual Report by Julie's Bicycle, a non-profit organisation for climate action in England, highlights that "energy" constitutes the most significant source of emissions, accounting for 54% of the total environmental impact, followed by "waste" at 28% (Julie's Bicycle, 2024). Addressing waste management in museums presents a complex challenge. A significant proportion is believed to arise from temporary exhibitions due to their short life cycle. Although the concept of circularity is an interesting direction to limit the negative environmental impact of exhibitions, it is scarcely researched. The proposed research question is: "How can museums apply circular design strategies to the scenography of temporary exhibitions, focusing on limiting their waste production?".

Promising insights were found during a literature review and analysis of the international scene. Regarding current research concerning sustainable exhibition design, three directions can be characterised: Life Cycle Assessments (LCA) and waste audits, exchanging scenography on sharing and second-hand platforms, or reusable scenography by design. Firstly, LCA evaluates the environmental impact of exhibitions. While it does not eliminate emissions, it increases transparency and enables better understanding. Secondly, external organisations provide a service to rent and share scenography and other exhibition materials or sell them second-hand at a reduced price. Although the initiative is post-use and proves to be challenging, this practice is seen more frequently. Lastly, a more fundamental approach is integrating circularity in exhibition design, such as designing modular scenography fitted for adaptation or reusing internal structures with updated finishing layers.

In the second and ongoing phase of the research, an online survey will be sent out to selected museums in Belgium and the Netherlands to gain more insight into the perception of sustainable exhibition design and policies. This will be the baseline for qualitative, practice-oriented research, closely working with the three actors mentioned. Engaging them in case studies during data analysis and validating the findings increases their motivation to participate and knowledge of the topic. This PhD aspires to advise museum professionals in implementing circular design strategies in producing exhibitions, thus supporting their sustainable transition.

Supervisors: Nathalie Vallet & Hélène Verreyke

ADVANCING URBAN BUILDING ENERGY MODELLING FOR EVALUATION OF INDOOR OVERHEATING RISKS

Richard Dean MORALES
UAntwerpen

City dwellers face a higher risk of indoor overheating due to the combined impacts of global warming and the urban heat island effect. Climate-resilient buildings help protect occupants from rising temperatures. Urban building energy modelling (UBEM) offers insights into urban energy systems, facilitating urban energy plans and policy interventions. However, current UBEM approaches lack suitability for assessing indoor conditions under extreme climate, revealing a knowledge gap for developing urban adaptation and mitigation strategies.

This research presents a proof-of-concept toolchain for UBEM from Geographic Information System (GIS) data, through the lens of indoor thermal comfort only, distinct from broader public health impacts like mortality. The study performs building simulations and sensitivity analyses to identify impactful factors in thermal comfort. Novel methods are developed to generate detailed multi-zone building simulation models, investigating the impact of building internal organisation (such as single-family vs. multi-apartment buildings) and varying thermal zone resolutions. Influencing external elements affecting heat balances, such as trees and longwave radiation, are also modelled to quantify their influence on overheating. Based on these analyses, the toolchain integrates the identified critical factors for simulating indoor comfort conditions. This toolchain is employed in developing and assessing climate mitigation and adaptation strategies for a district in Antwerp, considering current and future climate change scenarios. The types of strategies evaluated include passive measures like solar shading and natural ventilation, insulation upgrades, nature-based solutions, and active cooling systems. Aligning with the core objectives of 'Sustainability Research in the Built Environment,' this research develops a novel modelling framework to critically evaluate urban climate resilience, specifically focusing on indoor thermal comfort and enabling the assessment of sustainable adaptation measures at the city level

Supervisors: Amaryllis Audenaert and Stijn Verbeke

STRUCTURAL DESIGN USING UPCYCLED FORMWORK WOOD: ASSESSING THE REMAINING MECHANICAL PROPERTIES

Gabrielle NICOLAS
VUB

In Belgium, as well as in numerous countries globally, standard-quality wood serves as a building material in a plethora of applications. From permanent structures to temporary solutions, it finds its use in auxiliary constructions such as scaffolding and formwork. Formwork wood is abundantly used during construction, representing one-third of the total on-site waste. However, it has a limited lifespan due to the on-site solicitations. Typically, it's employed only one to four times before its surface begins to deteriorate, causing imperfections that affect the quality of concrete curing. The wood surface may not respond to formwork requirements but still has qualitative structural properties and great potential for reuse.

This research studies and explores the reuse possibilities of formwork wood materials in structural applications. To begin with, the different types of formwork wood are considered (beams, boards, fibre and multiplex wood). The first step was to learn more about the uses and the waste management of formwork wood in Belgium by contacting different wood associations, construction companies, and the associations upcycling and reusing construction materials. In parallel, the formwork wood material was collected on several construction sites and prefabrication centres and tested to determine its new and variable mechanical properties. The tests included bending, traction and compressive strength testing and non-destructive tests. Subsequently, a database will be created to catalogue the gathered waste wood along with its properties. A spatial structure will be then designed based on the studied properties of the formwork wood.

Supervisors: Didier Snoeck, Lars De Laet

COMPLEXITY, CONTRADICTION AND SUFFICIENCY IN THE BUILDING SECTOR: CRITERIA AND INDICATORS FOR INTEGRATIVE ARCHITECTURAL ENERGY DESIGN

Camilo PAEZ PEREZ
ULB

A concept with ancient and varied filiations, sufficiency has gained significant attention in the past few years in several research and policy domains as a key sustainability strategy. Such demand-side approaches, with human and socioeconomic emphasis, are understood as complementary, necessary or, in some cases, alternative to efficiency-oriented technological strategies that have led so far sustainability efforts. Within this active context, after an overview and characterisation of the "energy design" indicators conventionally used, this contribution addresses a frame of reference beacons, identifying definitions and potentially contradictory sufficiency approaches useful for our integrative architectural energy design analyses.

As in agriculture, transport, or industry, sufficiency policies have a potential share of benefits in the building sector. We find these building sector actions and benefits considered within broad economy papers or as the subject of recent sector-specific studies or detailed research topics, which we review here, assessing the estimated potentials and the implications of embracing such strategies and indicators for buildings' energy and architectural design – also going beyond the usual focus on housing.

As for efficiency, conceptualisation, modelling, and regulation have prioritised the "energy" aspects of Sufficiency, which, for building, translates mostly into the operation phase of energy use – design estimations and role of behaviour. We embrace a lifecycle and embodied energy scope with an integrative design perspective, contraposing it to the operative energy one. This broadened view allows for checking potential reinforcement or conflict of sufficiency measures in these areas, and we also assess the dialogue on these measures with efficiency and consistency.

Supervisors: Samia Ben Rajeb

MOISTURE-RESILIENT BIO-BASED WALLS: INNOVATION OR ILLUSION?

Ruben VAN DEN BOSSCHE
UGent

Bio-based materials show a promising potential for the CO2 transition in the current construction industry from a linear to a circular economy. They are renewable, locally available, fast-growing, valorise rest streams of well-established industries and sequester CO2 resulting in low embodied energy. Despite an increasing use as sustainable building methods, their exact hygrothermal response in vapour-open walls is still under research. Degradation, upscaling, material variability, legislation, lack of standards, poor perception and absence in confidence lead too often to applications primarily limited to low-rise buildings and committed (self-)builders.

The purpose of this research is to integrate bio-based materials in futureproof vapour-open wall construction systems. There will be focused on different building methods, e.g. monolithic walls, masonry walls with interior retrofit and classic wood framing. Thus, the research is applicable to both new and renovated buildings.

The research will be done by a laboratory characterisation and in situ monitoring campaign representative for the Flemish building context, complemented by simulations. The hygrothermal analyses will be carried out for existing and new robust wall systems suitable for wider application and upscaling. Heat, Air and Moisture (HAM) simulations will be carried out to study the hygrothermal behaviour of the wall systems, investigate variants and define key parameters. The experimental work will function both as input and validation for the simulations, because bio-based materials are scarcely represented in simulation databases. The most promising wall systems will then be built and investigated by lab testing.

The research methodology aims to be reproducible for future-emerging bio-based materials and lower the threshold for bio-based building systems.

Supervisors: Nathan Van Den Bossche, Marijke Steeman

SYNERGISTIC EFFECTS OF NATURE-BASED SOLUTIONS (NBS) ON URBAN HEAT ISLANDS IN BRUSSELS

Tianyi WANG
ULiège

Urban Heat Islands (UHI) are a major sustainability challenge in densely built environments, increasing energy demand, health risks, and urban vulnerability to climate change. In Brussels, where urban temperatures can exceed surrounding areas by up to 8°C, the integration of Nature-Based Solutions (NBS)—such as green roofs, urban forests, and water bodies—offers promising mitigation potential. While existing studies have explored individual NBS effects, little attention has been given to their combined impact across multiple urban scales.

This research introduces a GIS-based multi-scale framework coupled with ENVI-met microclimate simulations to assess the synergistic cooling effects of integrated NBS strategies in Brussels. The methodology enables cross-scale analysis—at building, neighbourhood, and city levels—supporting both spatial precision and system-wide insights. The study also considers the feasibility and scalability of these interventions in real-world urban planning contexts.

Expected outcomes suggest that coordinated multi-scale NBS interventions can deliver greater cooling performance than isolated actions, contributing to more cost-effective and resilient urban design strategies. The findings aim to inform sustainable planning practices in Brussels and provide a transferable model for cities facing similar climatic and spatial challenges.

Supervisors: Shady Attia

INTEGRATING THERMAL COMFORT AND HEAT HEALTH RISK ASSESSMENT: TOWARDS ADAPTIVE STRATEGIES FOR MITIGATING FUTURE HEAT WAVE IMPACTS

Dyna Chourouk ZITOUNI
ULiège

With rising urban heat exposure, assessing and mitigating heat-health risks has become a critical priority particularly in Mediterranean and African cities where climatic extremes and dense urban morphology amplify thermal stress. The IPCC (Intergovernmental Panel on Climate Change) developed the Heat Health Risk Indicator (HHRI) by integrating hazard (frequency and intensity of heat), exposure (population and land use), and vulnerability (socio-economic and health-related factors). Yet, this indicator has never been applied in Mediterranean or African contexts. This study introduces a novel approach by coupling HHRI with the Universal Thermal Climate Index (UTCI), which quantifies physiological heat stress, to provide a comprehensive assessment of heat-related health risks.

To capture urban thermal disparities, a Local Climate Zone (LCZ)-based framework was employed, classifying urban and natural areas by morphology and land cover. Drawing on satellite imagery, meteorological data, and census records from the summers of 2001–2023, spatial heat-health risk maps were generated, revealing pronounced differences across LCZs. This research also contributes to the development of a GIS-based Early Warning Tool that integrates real-time meteorological data, geospatial analysis, and automated alerting to support timely decision-making for urban planners and public health officials. Preliminary findings identify persistent urban hotspots, underscoring the urgency for localized, adaptive mitigation strategies. By bridging thermal comfort science with spatial risk analytics, this work advances climate resilience planning in heat-vulnerable urban environments.

Supervisors: Shady Attia

DS²BE Book of Abstract

35 pp.

22 May 2025
UCLouvain – KULeuven

Editors: G. van Moeseke, K. Allacker, E.Gobbo