INCEPT

Align architectural education with the paramount energy and climate goals of the green transition in Europe

Co-funded by the European Union

EDITURA UNIVERSITARĂ ION MINCU

ONLINE TRAINING COURSE
ON SUSTAINABLE ARCHITECTURE

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"Ion Mincu" University of Architecture and Urbanism, Bucharest

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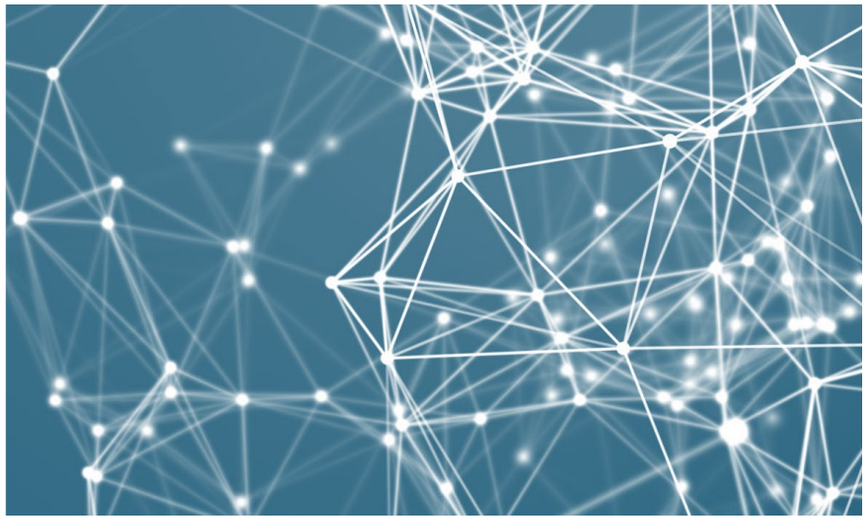


I. Introduction

I.1. Context of the Online Training Course on Sustainable Architecture

The Online training course on sustainable architecture, as part of the INCEPT Work Package 2, establishes a foundational understanding of sustainable architecture, focusing on its meaning, approaches, and objectives as essential tools for achieving climate neutrality in building stock and maximizing resource efficiency throughout a building's life cycle. Additionally, this work package sets the groundwork necessary to fulfil the project's main goal: to develop, implement, and validate a SUSTAINABLE ARCHITECTURE CURRICULUM within Master of Architecture programs at participating universities. This curriculum aims to equip students with insights into contemporary challenges facing the architectural profession, specifically in responding to climate change and the crucial role of buildings in the transition to low or zero carbon emissions. Moreover, the sustainable architecture curriculum developed by INCEPT seeks to enhance the quality of architectural education at the participating universities by introducing innovative content, fostering the development of new skills, and applying progressive teaching methods. It also aims to promote interconnectivity among educational systems, supporting contextual improvements and novel approaches tailored to each university's unique environment.

The educational curriculum on SUSTAINABLE ARCHITECTURE developed by our project within the Master of Architecture programmes is composed of: 1) Lecture course on sustainable architecture for architecture students, 2) Climate Neutral Building Design Atelier for architecture students, 3) Online course on sustainable architecture for the wider professional community.

Lecture Course related to Climate Neutral Design Atelier Interdisciplinary "Living Lab" UAUIM, April, 2024

I.2. Goals and objectives of the Online Training Course on Sustainable Architecture

The Online Training Course on Sustainable Architecture is one of the main intellectual products of INCEPT Project achieving the multiplier effect of the new educational curriculum and the maximum expansion of the project target groups.

The course is therefore designed and developed to meet the needs of the wider target groups of students and professionals and thus, multiplying the impact of the project findings and results and extending the beneficiaries of the project.

The participating universities have worked together to implement and evaluate the Online training course which use the digital university platform MOODLE open-source learning management system created at NBU for the purposes of the INCEPT Project.

Excerpt from the online course presentation by University of Zagreb,, May, 2025

II.1. Module 1

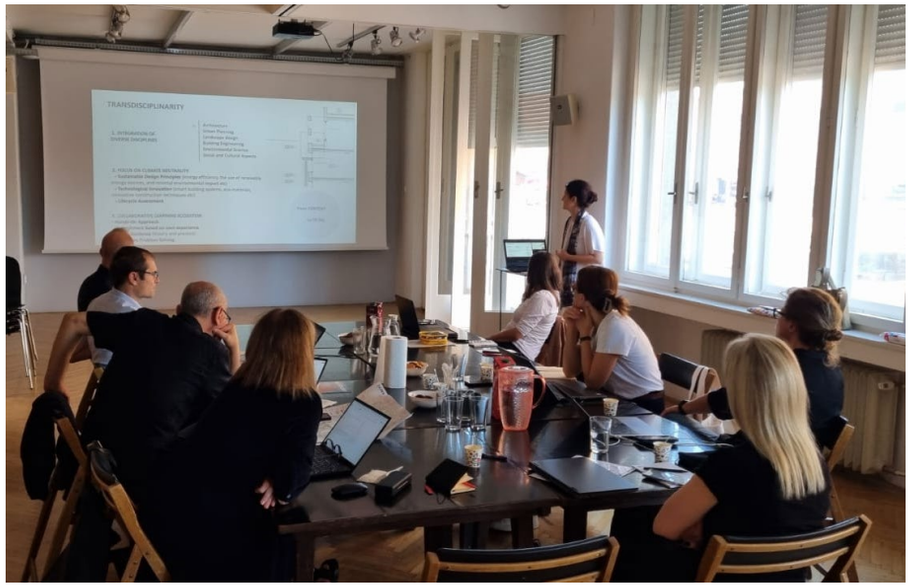
Implementing zero emission building strategies in architectural education

delivered by University of Zagreb, Faculty of Architecture (Croatia)

OVERVIEW

The lecture, part of the INCEPT project (an Erasmus+ initiative), presented how climate goals and cultural transformation are reshaping architectural education to support Europe's green transition. It emphasized aligning pedagogy with frameworks such as the European Green Deal, the New European Bauhaus, and the UN Sustainable Development Goals, aiming to embed sustainability as a core design principle rather than a supplemental topic.

A central focus was the integration of zero-emission strategies into architectural curricula to combat climate change through design. Focusing on systemic thinking and interdisciplinary collaboration, the lecture introduced the pedagogical aims of INCEPT, particularly its pilot design studios, which addressed sustainability across architectural, urban, and technical scales.



Project Meeting in Zagreb, preparing the course, September, 2024

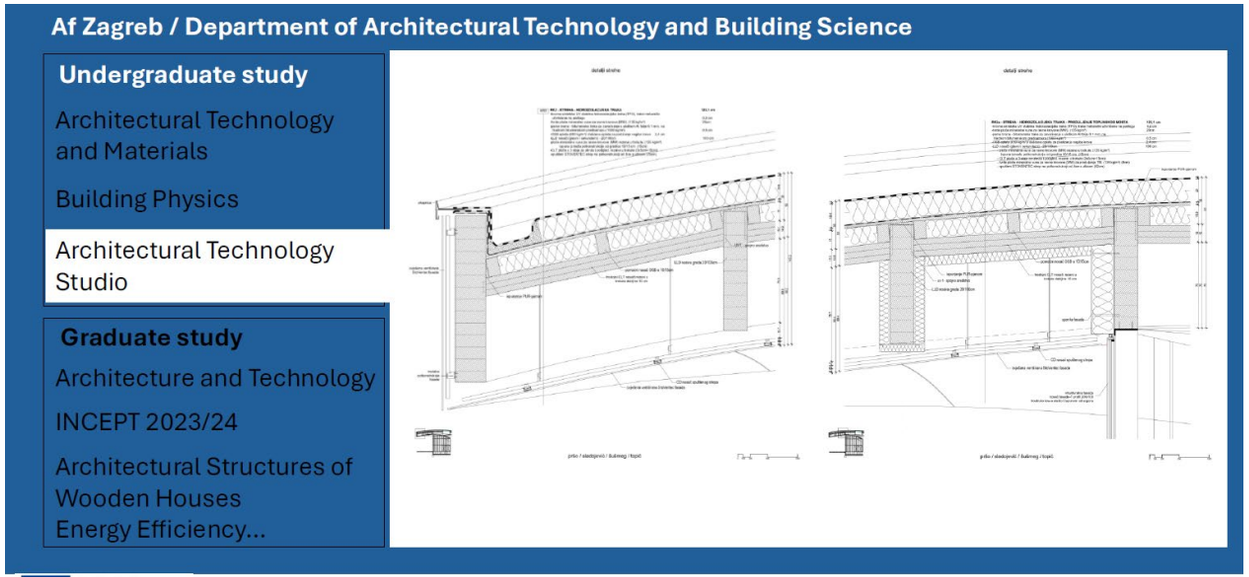
These studios challenged students with real-world tasks—such as urban regeneration and brownfield site reuse—while promoting circular design, low-carbon materials, and social inclusion as well as allowing for a holistic, site-specific design approach.
Interdisciplinary collaboration was a key element, with students working in groups, alongside experts in urbanism, environmental science, and sociology. The curriculum encouraged the application of passive design strategies, energy-efficient detailing, low-carbon materials and circular principles, equipping students with both theoretical knowledge and practical tools for creating climate-neutral, inclusive environments.

The lecture also focused on greenhouse gas emissions from buildings. It highlighted the distinction between operational and embodied carbon—emissions resulting from building use versus those from materials, transport, and construction. It emphasized strategies to minimize both types of emissions through optimized material use, efficient building envelopes, and on-site renewable energy generation. The environmental impact of materials such as cement, aluminum, and polystyrene insulation was discussed, alongside the benefits of carbon-sequestering materials like wood and renewable systems like solar power and heat pumps.

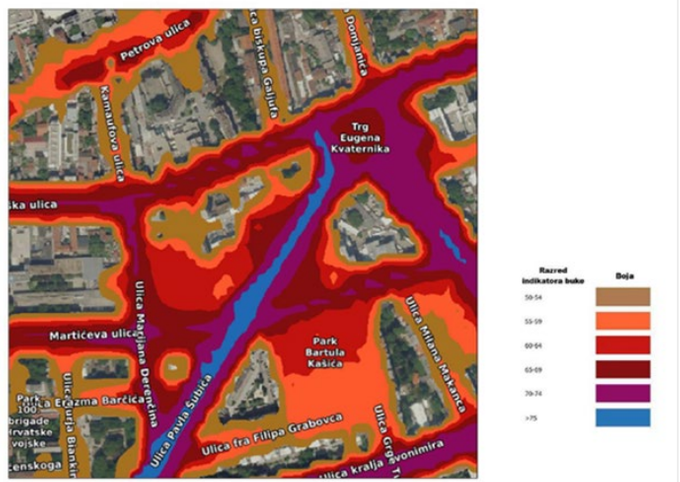
The lecture also introduced carbon lifecycle assessments, showing total emissions from construction to demolition, and stressing the importance of early design decisions in reducing a building's environmental footprint.
By embedding climate neutrality, circularity, and social inclusion into the foundation of architectural education, the lecture called for a cultural and institutional shift. It concluded with a clear message: sustainability-focused models should become the new standard for educating future architects across Europe.

SPECIFIC OBJECTIVES

1. Build student knowledge about energy efficiency, circularity, and low-carbon construction across the building lifecycle.
2. Develop studio-based curricula that integrate sustainability into real design tasks, not as an add-on, but as a core design challenge.
3. Encourage interdisciplinary teaching, bringing together experts in architecture, engineering, urbanism, sociology, and environmental science.
4. Validate and implement a new studio model across partner institutions.
5. Share resources and results, creating open access materials and a digital platform for inter-university exchange.



Excerpt from the course presentation by University of Zagreb, arch. Marin Binički, May, 2025



Output of students from University of Zagreb during the Climate Neutral Design Atelier Interdisciplinary "Living Lab"- green infrastructure and noise maps

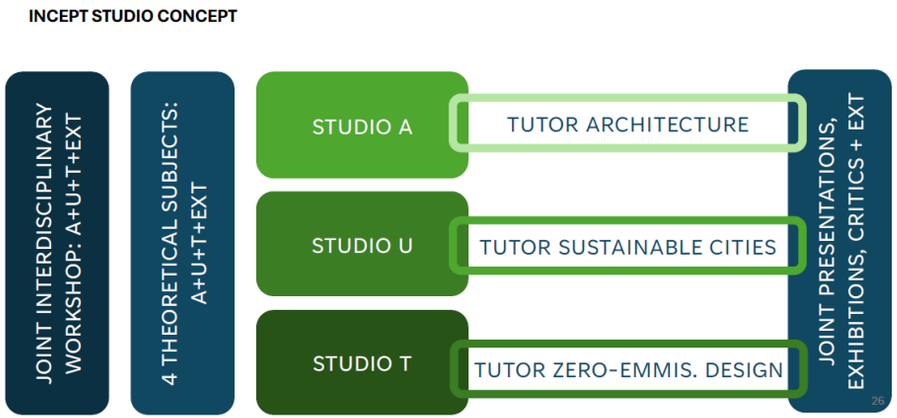
STRUCTURE OF THE MODULE

1. **Introduction.The new landscape of Architectural Education**
   - The role of the European Green Deal, the New European Bauhaus, and the UN Sustainable Development Goals.
   - Shifting from sustainability as a supplemental topic to a core design principle.
2. **Zero Emission Buildings (ZEB) in Europe**
   - Defining the ZEB standard and its goals for energy performance and carbon footprint reduction.
   - Key implementation milestones for ZEB standards by 2027 and 2030.
   - Addressing the Global Warming Potential (GWP) and embodied carbon across a building's lifecycle.
3. **Carbon in Building Design**
   - Distinguishing between operational and embodied carbon emissions.
   - Strategies for minimizing emissions:
     - Optimized material use (e.g., carbon-sequestering materials like wood).
     - Efficient building envelopes and on-site renewable energy systems (e.g., solar power, heat pumps).
   - The importance of early design decisions and carbon lifecycle assessments.
4. **Pedagogical Approach: The INCEPT Model**
   - Focus on systemic thinking and interdisciplinary collaboration.
   - Applying the principles in pilot design studios with real-world tasks (e.g., urban regeneration, brownfield site reuse).
   - Promoting circular design and social inclusion as key design principles.
5. **Conclusion**
   - Calling for a shift toward sustainability as the new standard for architectural education.
   - The future of architecture and the role of professionals in combating climate change through design.

ACQUIRED SKILLS

- The ability to integrate sustainability across architectural, urban, and technical scales.
- The capacity to interdisciplinary work with experts from diverse fields, such as urbanism, environmental science, and sociology.
- The knowledge to choose materials based on their embodied carbon and environmental impact.
- Skill to understand a basic carbon lifecycle assessments to inform design decisions and reduce a building's environmental footprint.
- Capacity to understand how to apply high-level policy frameworks and standards, such as ZEB, to practical design projects.

Lecture Course of external experts invited to Climate Neutral Design Atelier, 2024



Excerpt from Concept presentation of Climate Neutral Design Atelier, by Mia Roth Čerina, 2024

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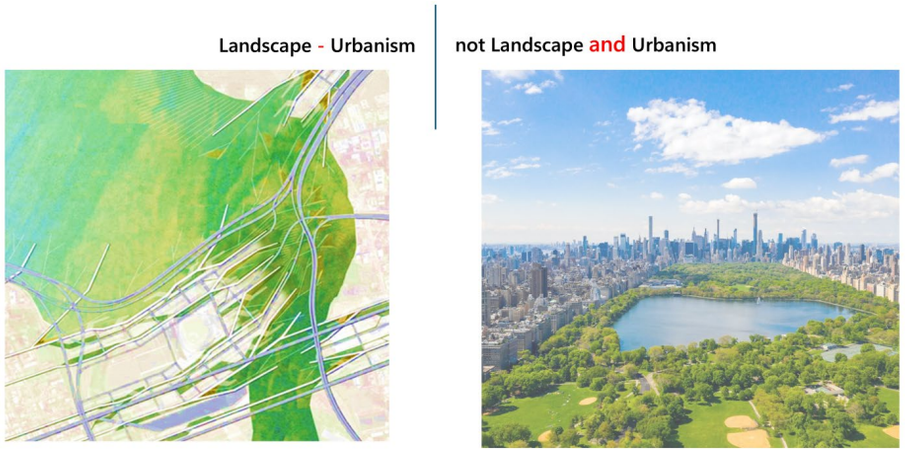


Excerpt from Module 2 online course presentation, by Angelica Stan (UAUIM). Left: https://scenariojournal.com/strategy/aqueous-ecologies/ Project: Aqueous Ecologies Designer: Michael Ezban (2013), Harvard University Graduate School of Design. Right: Central Park NY, https://world-schools.com/best-boarding-schools-in-new-york/

II.2. Module 2

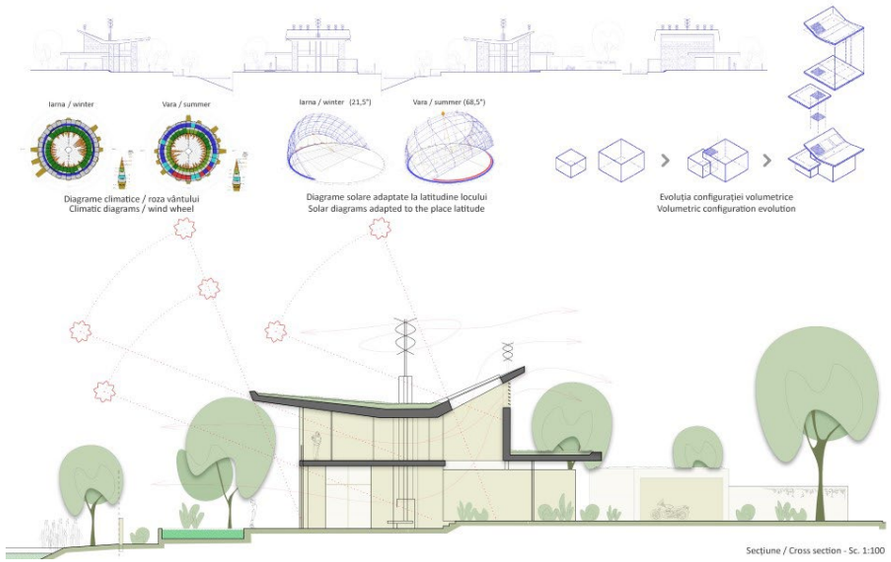
Bioclimatic design and landscape urbanism

delivered by "Ion Mincu" University of Architecture and Urban Planning -Bucharest

OVERVIEW

Bioclimatic design and landscape urbanism are progressive approaches to architecture and urban development, focused on creating buildings that respond to local climates and on integrating these structures into broader ecological landscapes. Bioclimatic design focuses on the architecture of buildings, ensuring they harmonize with natural elements like sunlight, wind, soil, water and vegetation to reduce energy demands and enhance indoor comfort. By optimizing features such as site orientation, building form, thermal mass, and passive ventilation, bioclimatic design minimizes the need for artificial heating, cooling, and lighting. This approach yields energy-efficient structures with lower emissions and operational costs, while also supporting occupants' comfort in diverse climate zones.

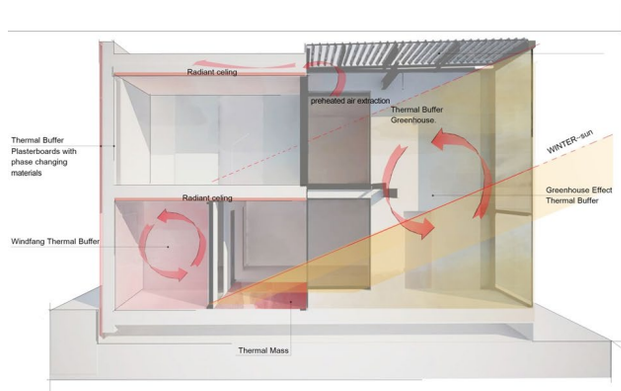
Landscape urbanism, complementing bioclimatic architecture, shifts the focus to urban planning that integrates buildings within ecologically driven landscapes.



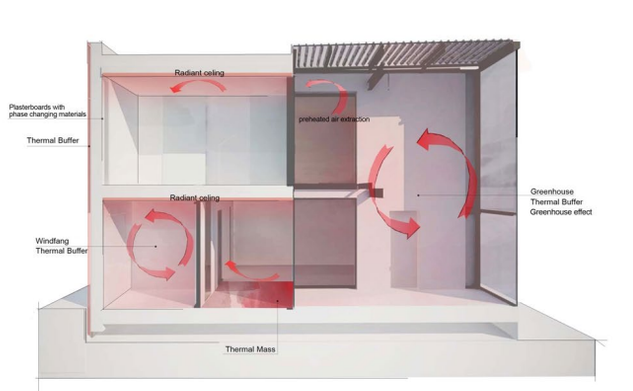
Excerpt from Module 2 online course presentation, by Daniel Armenciu (UAUIM)

Rather than viewing green spaces as purely aesthetic or recreational, landscape urbanism treats them as vital frameworks that manage urban growth, mitigate climate impacts, and enhance resilience in the face of urban sprawl. With an emphasis on green infrastructure, biodiversity, and ecosystem services, this approach ensures that built environments remain interconnected with natural systems, promoting healthier, more sustainable cities.

Recent research supports the combined use of these strategies in urban resilience efforts. For instance, Wong et al. (2023) illustrate how bioclimatic principles applied in building design can significantly reduce urban heat, while Amati et al. (2022) highlight landscape urbanism's role in enhancing air quality and thermal comfort through green infrastructure. Hossain et al. (2021) show how bioclimatic design in high-density cities not only saves energy but also improves overall liability.



Bioclimatic strategy – winter scenario, day time



Bioclimatic strategy – winter scenario, night time

EFdeN Project / authors: Asociația Solar Decathlon România

Excerpt from the concept-model of students work, The Landscape Design and Planning dep., Faculty of Urbanism, UAUIM. coordinated by prof. Angelica Stan

SPECIFIC OBJECTIVES

1. Explaining the principles of bioclimatic design and how they can be applied to create energy-efficient buildings that respond to local climates.
2. Providing strategies for using bioclimatic design to optimize building features (site orientation, form, thermal mass) to minimize energy consumption.
3. Explaining the principles, strategies and methods of landscape urbanism to manage urban growth, mitigate climate impacts, and enhance urban resilience.
4. Detailing how landscape urbanism integrates buildings into ecologically driven landscapes, emphasizing the importance of green infrastructure and natural systems in urban planning.
5. Demonstrating how the combined application of bioclimatic design and landscape urbanism can lead to healthier, more sustainable, liveable cities.

A restored naturalized stream runs through Bishan-Ang Mo Kio Park in Singapore's City. Image: National Parks Board.

STRUCTURE OF THE MODULE 2

A. Landscape Urbanism as Paradigm

(delivered by prof. PhD Arch. Angelica Stan)

- An introduction to the concept of Landscape-Urbanism as an integration of landscape and urban- architectural principles, including ecological and environmental principles.
- Why is it necessary? An operational redefinition correlated with the logistical and economic support from the European Community
- How it works?
  - Ecosystem thinking
  - Spatial heterogeneity and dynamic processes
  - Integration of human and natural processes
  - Prioritizing sustainability and multifunctionality in design
  - Connectivity, a sense of place, community engagement, and visual quality
  - Key concepts and tools like Green Infrastructure (GI) and Nature-Based Solutions (NbS).

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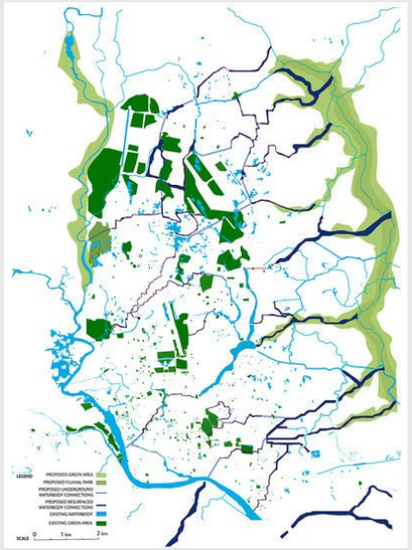


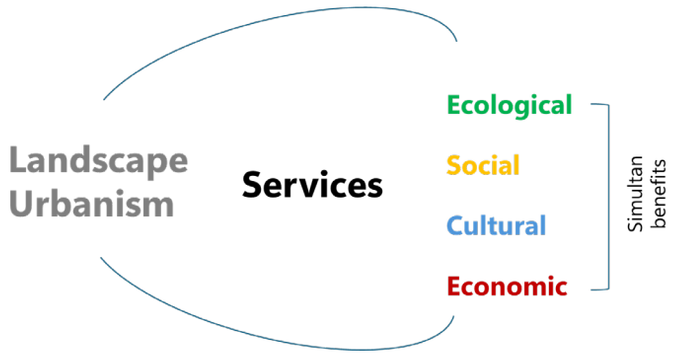
https://www.mdpi.com/2073-445X/8/9/138

Excerpt from Module 2 online course presentation, UAUIM- Angelica Stan, May 2025

B. Landscape Urbanism Services and Benefits

- Simultaneous Benefits
- Ecosystem Services

  Examples: Stormwater management using landscape features like swales and permeable surfaces, food production (e.g., community gardens) and energy production (e.g., biomass).
- Economic Services/ increased property values, reduced infrastructure costs, and job creation.
- Which are the big "enemies" of Landscape-Urbanism?



Joel Sternfeld's most iconic shot of the High Line, looking east along 30th St. A railroad artifact, May 2001., https://www.thehighline.org/

A DECALOG
for a good approaching the Landscape Urbanism

1. to see the real potential of a place, no matter how minor, dirty, abandoned, peripheral it may be
2. to see the value of urban heritage, sometimes hidden in banal places
3. to educate the sense of observation, the ability to plan and foresee
4. to realy involve interdisciplinarity
5. to see beyond the limits imposed by the systems and biurocracy
6. to train specialists and the wider public (public competitions, debates, courses)
7. to create communities around places + ideas
8. to give voice to people to express their needs
9. to develop with enthusiasm, with openess and dialog
10. to trust people

Students outputs of the Climate Neutral Design Atelier Interdisciplinary "Living Lab" , UAUIM, March- June, 2024

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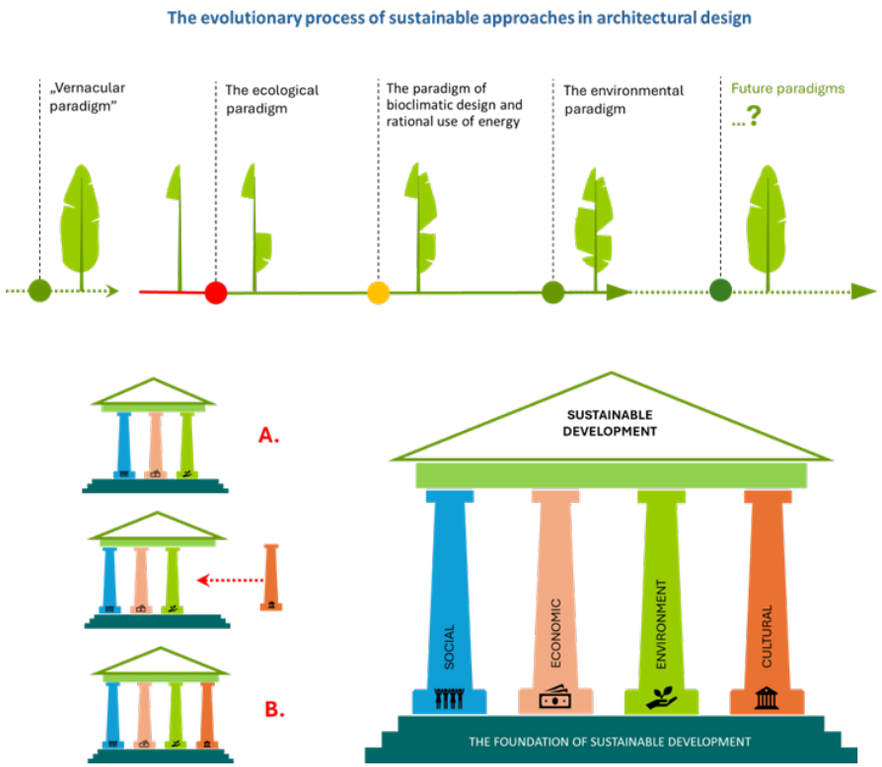


Excerpt from Module 2 online course presentation, by Daniel Armenciu (UAUIM)

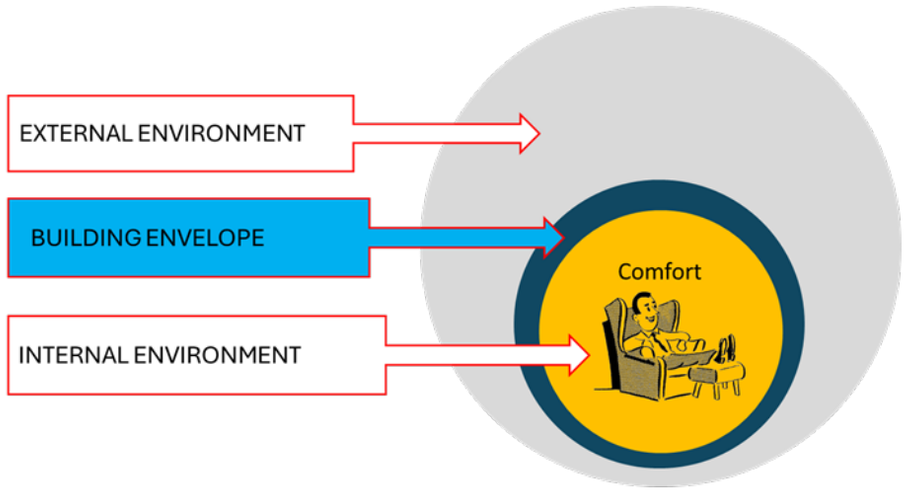
C. Bioclimatic Design

(delivered by lect. PhD Arch. Daniel Armenciu)

- What is it?: This part of the lecture defines bioclimatic design as a set of solutions that create comfortable conditions in a building by adapting it to the site's climatic conditions, using minimal conventional energy. It is an evolution of design paradigms, from the ecological to the environmental, aiming for future paradigms.
- How it works?: The presentation outlines a logical process for bioclimatic design:
  - Site Analysis: Analyzing the external environment (local climate, solar radiation, etc.) and the internal environment (human needs and activities).
  - Strategy: Developing a design strategy based on the site analysis.
  - Spatial Configuration: Implementing the strategy through specific building designs.
- Design Examples: The lecture presents design strategies for different climatic zones, such as shading for hot-humid climates and a well-insulated envelope for cold climates.

D. Case Studies

- EFdeN 4C Project: This case study demonstrates bioclimatic strategies for both winter and summer scenarios, utilizing elements like thermal buffers and natural ventilation.
- Casa bioclimatică Alumil: This project illustrates the application of bioclimatic diagrams and the evolution of volumetric configuration based on solar diagrams for local latitude.
- Other Examples: The Commerzbank Tower in Frankfurt and various skyscrapers by architect Ken Yeang are also presented as examples of bioclimatic architecture.



_ early design theories, initiated by Victor Olgyay's

_ bioclimatology

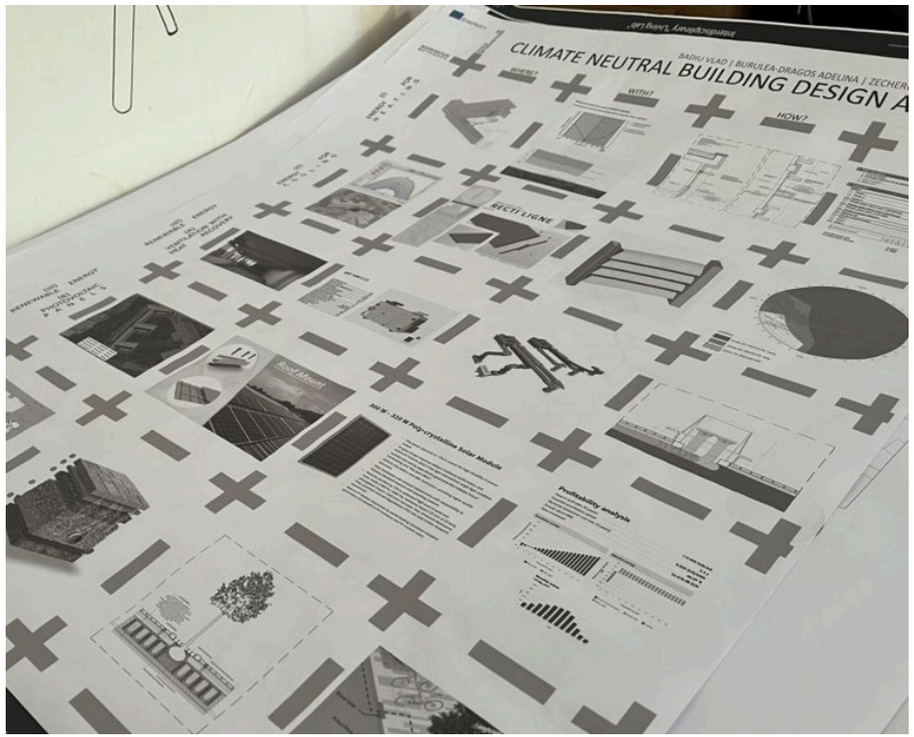
_ regionalism in architecture

The essential feature of bioclimatic design is to 'build with the climate'.

Excerpt from Module 2 online course presentation, by Daniel Armenciu (UAUIM)

ACQUIRED SKILLS

- Ability to integrate the principles of bioclimatic design and landscape urbanism in architectural projects to create energy-efficient and climate-responsive buildings. This includes optimizing site orientation, building form, and passive ventilation to minimize energy consumption.
- Capacity to critically approach urban planning by viewing buildings and green spaces as interconnected, ecologically driven systems, rather than as separate entities.
- Ability to conduct site-specific analysis of both the external environment (e.g., climate, solar radiation, soil, and wind) and the internal environment (e.g., human needs and activities) to inform a design strategy.
- Understanding and ability to work with principles, strategies, and methods from various fields, such as ecology, urban planning, and environmental science, to produce more sustainable and holistic solutions.
- Ability to apply theoretical concepts like Green Infrastructure and Nature-Based Solutions to practical design problems, such as stormwater management, to create healthier and more livable cities.



Students outputs of the Climate Neutral Design Atelier Interdisciplinary "Living Lab" UAUIM, March- June, 2024

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Application of building integrated Renewable Energy Systems (BIRES)

Excerpt from Module 3 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU

II.3. Module 3

Renewable energy sources

delivered by New Bulgarian University (Sofia)

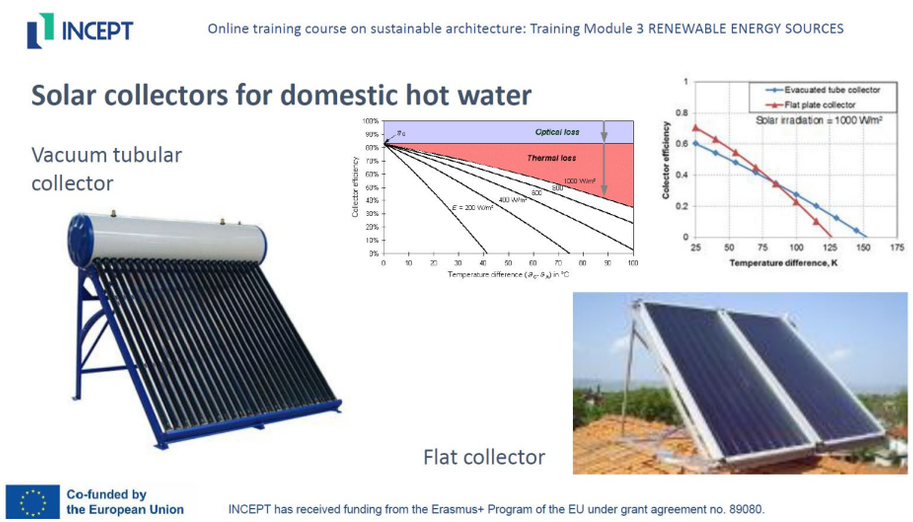
OVERVIEW

The term "energy from renewable sources" and its definition according to the European directive will be presented and how energy from wind, solar (solar thermal and solar photovoltaic) and geothermal energy, osmotic energy, ambient energy, biomass, landfill gas, sewage treatment plant gas, and biogas can be used in buildings will be discussed. Renewable energy for buildings can be produced on-site (systems using RE from grid, building integrated elements or system on additional construction) or nearby and hence contribute to carbon neutrality of the building sector. The requirement for nearly zero energy buildings includes requirements for both energy efficient building and use of renewable energy to cover building needs.

The main issues related to renewable sources as their fluctuation (especially for solar energy and wind) and hence the need of improved control and in most cases needs of storage will be discussed. This also reflects the operation of energy grids. One of the solutions is the application of demand-side management (to adjust dynamic energy loads) and hence to alleviate the challenges in the energy infrastructure (frequency and voltage regulation, peak load limitation and others) caused by the unstable operation.

Factors to consider when integrating renewable energy systems into architectural designs will be presented as site analysis and potential of renewable energy, energy needs and consumption, building orientation and design, integration with architectural elements, cost-benefit analysis, regulatory and environmental considerations.

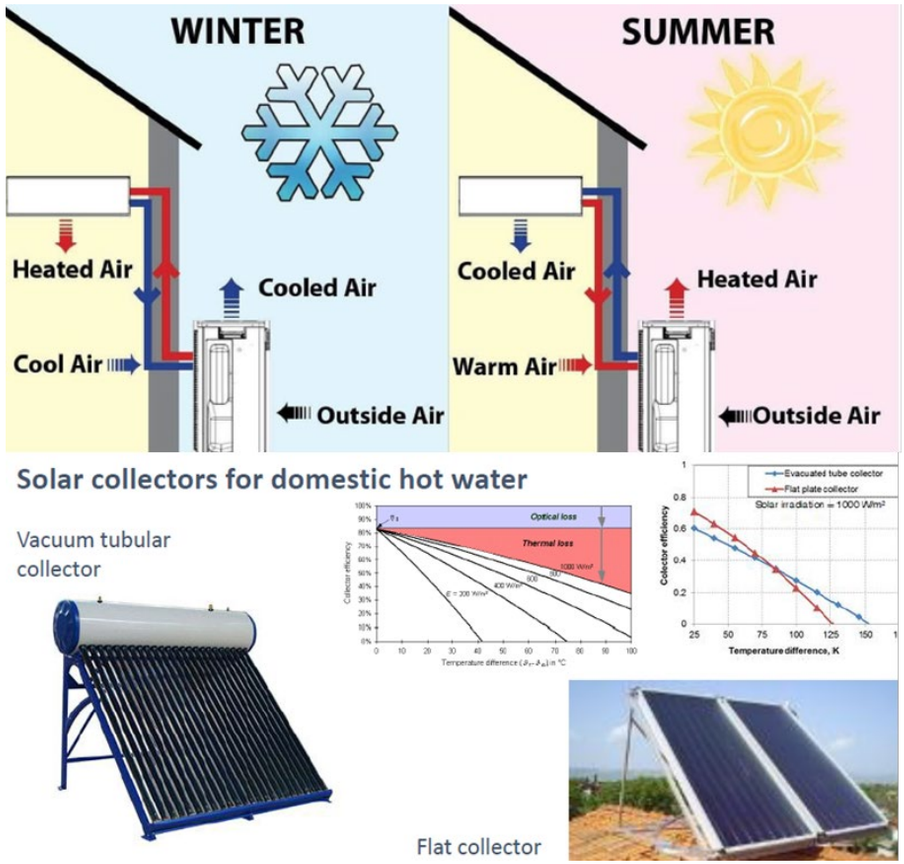
Case studies of successful integration of renewable energy systems in architectural designs serve as inspiring examples of how sustainable practices can be seamlessly incorporated into the built environment. Examples will be presented and discussed.



Excerpt form Module 3 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU

SPECIFIC OBJECTIVES

1. Defining "energy from renewable sources" according to the European directive and identify various types of renewable energy applicable to buildings.
2. Distinguishing between on-site and nearby production of renewable energy and explain its contribution to the carbon neutrality of the building sector.
3. Analyzing the challenges associated with the fluctuation of renewable sources, such as solar and wind energy, and evaluate the role of energy storage and demand-side management in mitigating these issues.
4. Evaluating key factors for integrating renewable energy systems into architectural design, including site analysis, energy needs, and cost-benefit analysis.
5. Recognizing examples of successfully integrated renewable energy systems in architectural case studies and propose similar sustainable design practices.



Excerpt from Module 3 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU

STRUCTURE OF THE MODULE 3

Lecturers: Georgi Georgiev, Zdravko Georgiev, NBU

1. Introduction to Renewable Energy Sources

- Definition of renewable energy and its sources (e.g., wind, solar, geothermal).
- The European directive's definition of "renewable energy sources".
- Reasons for adopting renewable energy: fossil fuel depletion, climate change, and the European Green Plan.

2. Building-Integrated Renewable Energy Systems (BIRES)

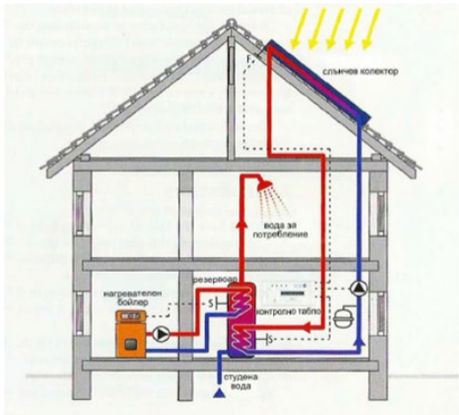
- Definition and purpose of BIRES.
- Key characteristics: integration into the building's physical structure and on-site resource utilization.
- How BIRES transforms buildings from passive consumers into active producers.
- The holistic approach to BIRES integration: from site analysis to design phase.

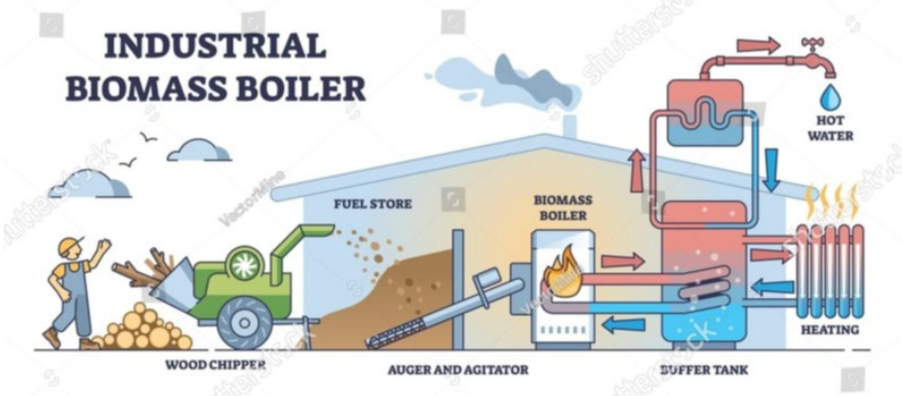
3. Types of BIRES

- Photovoltaic (PV) Systems: How they produce electricity, their efficiency, and installation options on roofs and facades.
- Solar Collectors: Types (plate and vacuum), their use for hot water and heating, and factors affecting their performance.
- Heat Pumps: Types (air-source, water-source, ground-source), how they work, and factors to consider for selection, including efficiency (COP, EER) and noise issues.
- Biomass Systems: Use of wood biomass, pellets, and other materials; suitability for different areas; and maintenance considerations.

Building integrated solar collectors for domestic hot water

- Optimal fixed slope of collectors: for year-round use, the local latitude is assumed
- Specific solar yield of final energy for DHW : 300-700kWh/m2year (Bulgaria)
- Overall efficiency of solar DHW systems : 40-60%





3. Challenges and Opportunities of BIRES

- Challenges: High upfront costs, technical complexity, regular maintenance needs, and compliance with regulations.
- Opportunities: Long-term energy savings, revenue generation (e.g., feed-in tariffs), increased market value, and government incentives.
- Demand-Side Management: A solution to the challenges of fluctuating energy sources.

4. Case Studies

- Examples of successful BIRES integration in architectural designs.
- Discussion of how these examples demonstrate sustainable practices in the built environment.

https://www.globetoday.net/

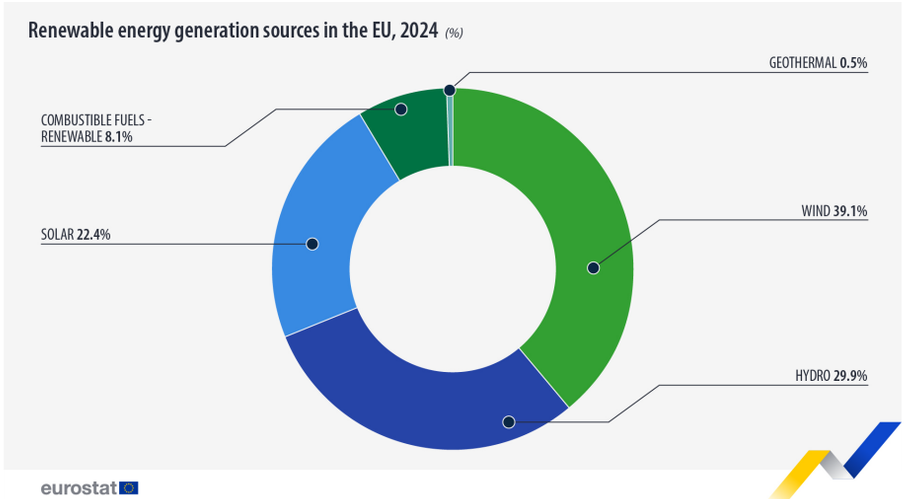
ACQUIRED SKILLS

a) Ability to apply the European definition of renewable energy to building design scenarios.

b) Critical Thinking to address the technical challenges of renewable energy systems, such as energy fluctuation and grid instability, through solutions like demand-side management.

c) Skills in considering practical factors—like building orientation, energy consumption, and regulatory requirements—when incorporating renewable energy into architectural projects.

d) Students will learn to analyze real-world examples to inform their own sustainable design solutions.



Excerpt form Module 3 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU

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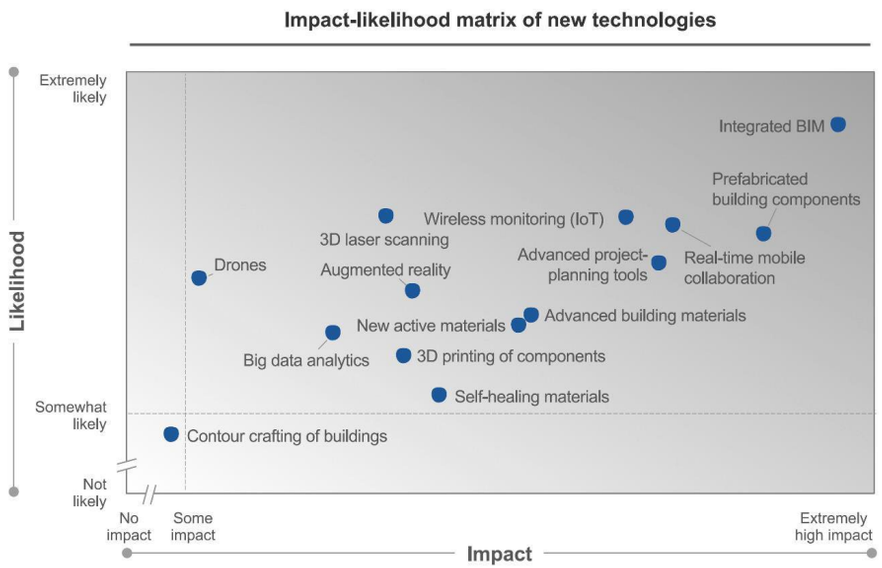


Excerpt from Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU. Source: Shaping the Future of Construction

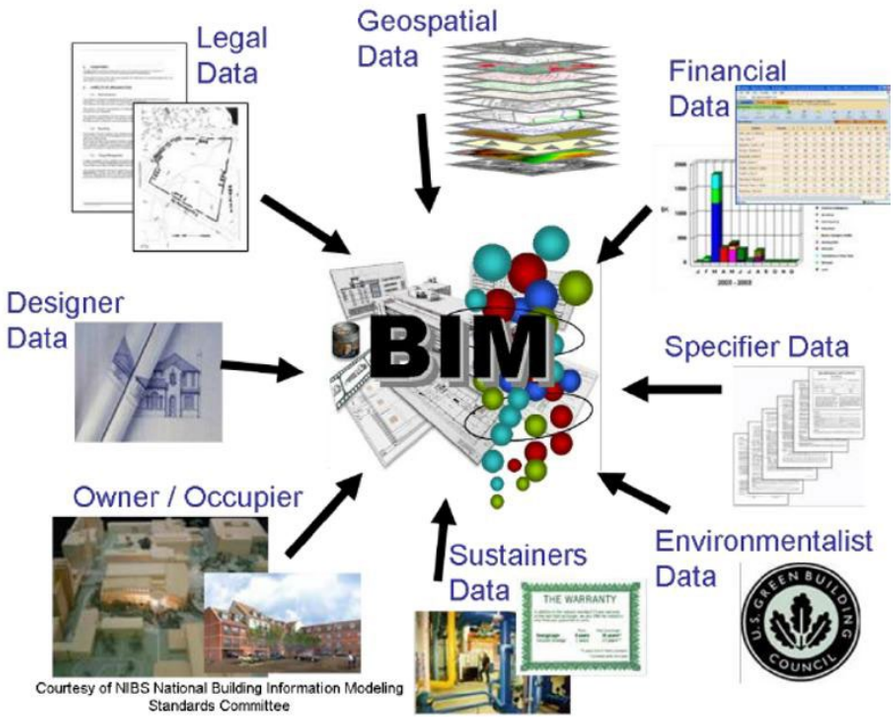
II.4. Module 4

Digitalization

delivered by New Bulgarian University (Sofia)

OVERVIEW

The introduction to the lecture will stress on the importance of the building management for ensuring a smooth and effective operation of buildings over their lifespan. From one side building management becomes a more complex service, including different tasks, from the other – the needs for sustainability require applying responsible models that ensure traceability using digital tools and instruments. In the last decades, we are facing a fast and comprehensive shift toward digitization of building maintenance and operations. This process is driven by the digitalization of all sectors (construction, occupational health and safety, energy, security, etc.). The development of smart city concept also requires integration of building management into processes of smart governance at all levels – from decision-making to everyday activities.

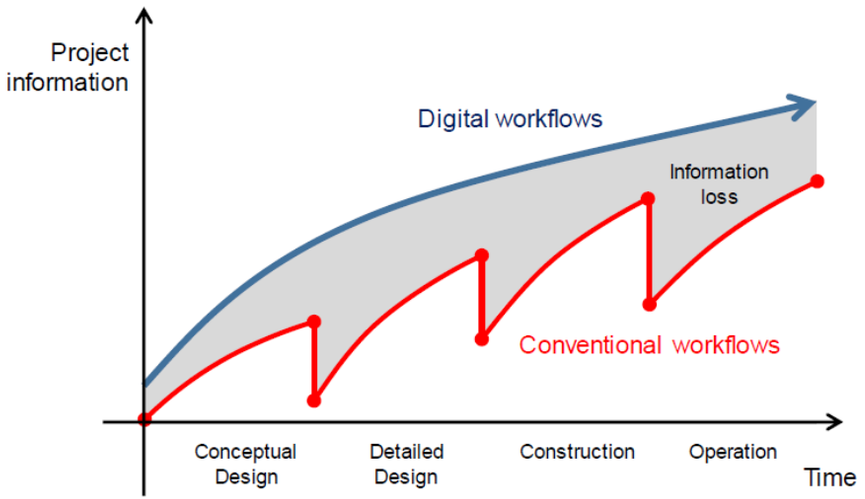


Excerpt from Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU. Source> Communication, Collaboration and Visualisation with BIM model (NIBS, 2008)

The new concept for construction of buildings includes not only building codes and other legislative requirements but also facility management is included in the plan. For example, designers and contractors are using Building Information Modelling (BIM) software to visualize the project more effectively. Furthermore, BIM provides multiple layers of data necessary to manage building maintenance and operations efficiently.

The fast development of digital technologies has the potential to reduce costs and overcome barriers to energy efficiency in building operation through dynamic control and operation of energy systems in buildings. The developed instruments and means includes:

- Data collection and mining, including artificial intelligence and comprehensive assessments and predictive management;
- The Internet of Things (IoT), make easier access on the status and activity of equipment building environment;
- Sharing economy platforms, including new business models for connecting demand and supply of energy-efficiency software services.



Eastman, C., Teicholz, P., Sacks, R. & Liston, K. (2008). BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.

SPECIFIC OBJECTIVES

1. Analyze the role of Building Information Modeling (BIM) and Digital Twin technologies in achieving sustainable and energy-efficient architecture.
2. Evaluate the different dimensions of BIM and how they extend beyond a simple 3D model to include time, cost, operation, sustainability, and safety.
3. Explain how digital twins can be created and used to optimize building management and predict future situations in real-time.
4. Assess the key functionalities of the Smart Readiness Indicator (SRI) in a building, including optimizing energy efficiency and adapting to occupant and grid needs.
5. Identify and discuss the challenges and opportunities associated with implementing these technologies, such as data integration and the high upfront costs versus long-term savings.

POPULAR BIM SOFTWARE

CYPE

Autodesk

Revit

Navisworks

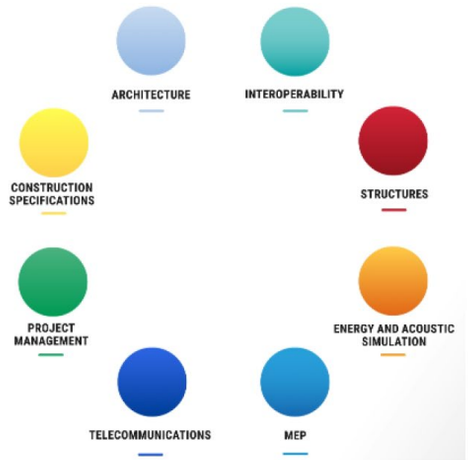
ArchiCAD

Bentley Systems

Tekla Structures

Others: BIMCRONE

DIALUX https://www.dalux.com/



Excerpt form Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU.

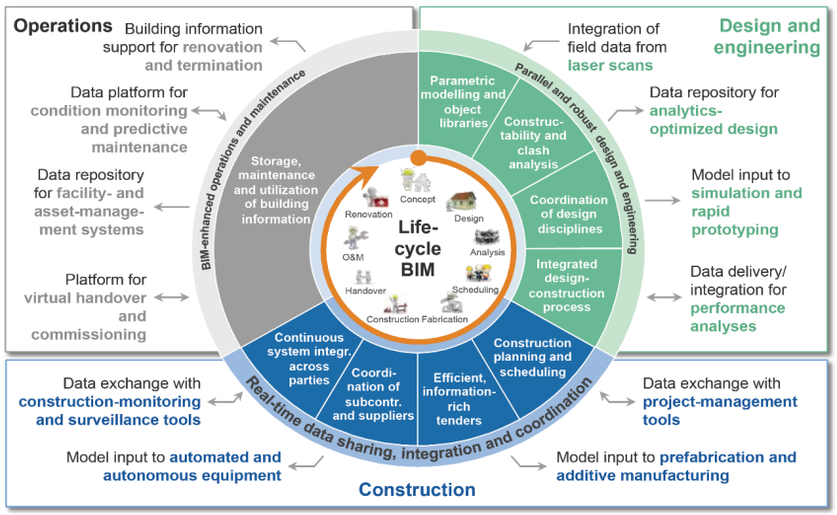
STRUCTURE

Introduction to Digitalization in Architecture

- An overview of key digital technologies shaping the building industry.
- Introduction to Building Information Modeling (BIM) as a foundational tool for the design and construction phases.
- Introduction to Digital Twins as the next step in digitalization, providing real-time digital replicas for facility management and long-term efficiency.

Building Information Modeling (BIM)

- Definition and Purpose: Explore the official definitions of BIM from ISO and the U.S. National Building Information Model Standard Project Committee.
- BIM Dimensions and Data: Discuss the various dimensions of BIM (3D, 4D, 5D, 6D, 7D, 8D) and the different types of data it integrates, such as legal, geospatial, financial, and designer data.
- BIM for Efficiency: Examine how BIM enhances operational efficiency through asset management, preventive maintenance, life cycle management, and more.
- Scan to BIM: Introduce the process of creating a digital model from a physical building using laser scanning.
- Standards: Highlight the key international and European standards for BIM, such as the ISO 19650 series.



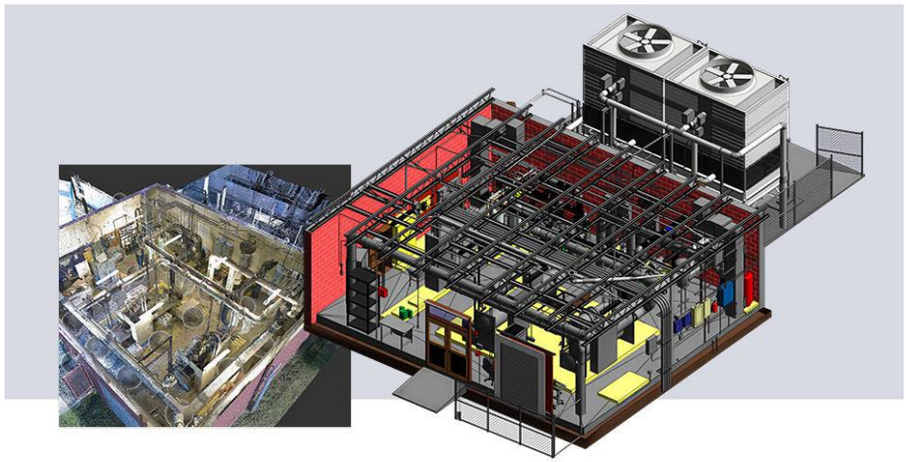
Excerpt from Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU.

Digital Twins and Smart Buildings

- Digital Twin Technology: Explain the concept of a digital twin as a real-time replica of a physical object. Discuss how it is created by connecting project, construction, and sensor data.
- Smart Cities: Discuss how digital technologies like IoT and smart metering in buildings contribute to smart city initiatives.
- Smart Readiness Indicator (SRI): Define the SRI as a metric that measures a building's ability to use smart technologies for decarbonization, comfort, and efficiency.

Case Studies and Conclusions

- Real-World Examples: Explore case studies such as the Sydney Opera House and the Norwegian 14Helse building and Tvedestrand VGS school to illustrate the benefits of BIM and Digital Twins in practice.
- Challenges and Opportunities: Discuss the main challenges, such as data collection and sharing, as well as opportunities, like optimizing building lifecycle costs.
- Summary: Conclude with the importance of integrating smart, energy-efficient technologies and the role of digitalization in creating healthier, more comfortable, and sustainable buildings.



Excerpt from Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU, source> https://www.united-bim.com/ultimate-guide-of-scan-to-bim/

ACQUIRED SKILLS

- Gainning familiarity with key terms and technologies, such as BIM, Digital Twins, and IoT, and understand their application in the architectural field.
- Integrated Design Thinking, learning to approach building design and management holistically by integrating information across a building's entire lifecycle, from design to demolition.
- Capacity to interpret and utilize data from various sources (project, construction, sensors) to perform predictive analysis and optimize building performance.
- Ability to understand a basic cost-benefit analysis for implementing BIM and other digital tools, considering both initial investment and long-term operational savings.
- Ability to identify potential design conflicts and propose data-driven solutions for maintenance and system optimization throughout a building's life.
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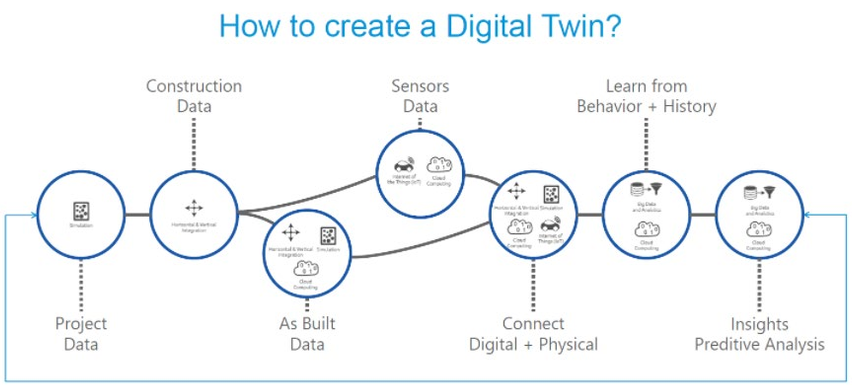

Excerpt form Module 4 online course presentation, by Georgi Georgiev and Zdravko Georgiev, NBU. Source> https://www.autodesk.com/autodesk-university/article/Forge-BIM-360-Docs-IoT-Hub-2019

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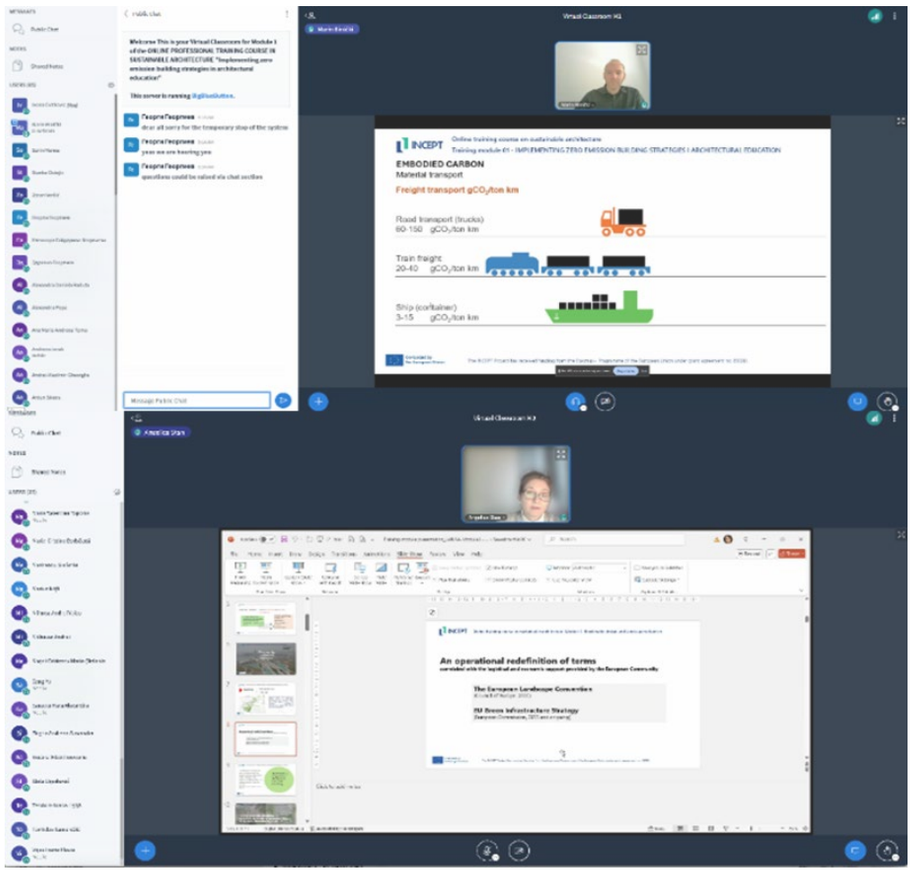
III. The Implementation of the Online training course on sustainable architecture

The Online training course was implemented in collaboration of all three participating universities, and included the university lecturers from the teams of the project partners, along with the preparation of the content and of the promotion toward the audience.
The course targets students from various disciplines relevant to green architecture, sustainable urban development, and landscape planning and design, but also targets larger audience groups from connected disciplines such as sociology, environmental science, construction etc.

The implementation of activities in the fourth work package of INCEPT Project targets specialists from the wider professional communities in the participating countries and in particular professionals in the field of sustainable development and energy efficiency of the building stock (landscape architects, civil and structural engineers, energy efficiency experts, urban sociologists, environmentalists, biodiversity specialists, social workers, etc.).

The Online training course involved more than 250 participants, from various categories, as follows:

- Academics/teachers
- Civil servants/public officers
- Professionals in architecture and urban planning
- Professionals in related fields
- Students in architecture and urban planning
- Students in related fields
- PhD students
- Representatives of associated industries



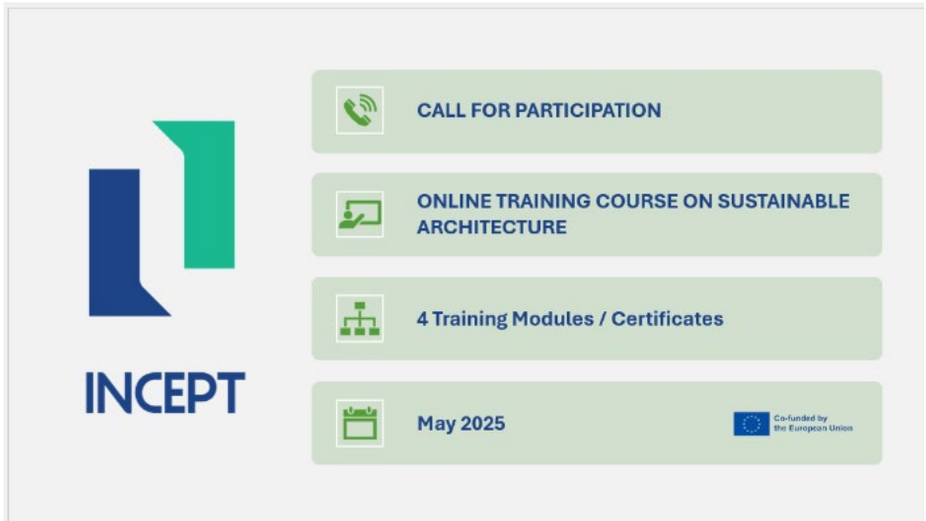
Screenshots from Module 1 and Modul 2 online course presentations, May 2025.

The dominant target groups were the architecture students (from all participating universities) and students, including PhD students from various disciplines relevant to architecture, construction, urban development or landscape planning and design. Also, it targets other stakeholder groups, such as: wider academic colleagues, practitioners, government officials, local third sector representatives and the wider public, and professional and industry organisations, working groups and academic partnerships.

The IO2 Online training course on sustainable architecture was conducted on the digital educational university platform- MOODLE open-source learning management system,- created at NBU for the purposes of the INCEPT Project.

Each of course sessions took two hours (1 hour lecture followed by 1 hour of interactive discussion). Attendees' questions were welcomed via chat box during the sessions. After the lecture presentation, attendees had the opportunity to interact with the speaker(s) during the Q&A session.

IV. The Promotion and Dissemination of the Online training course

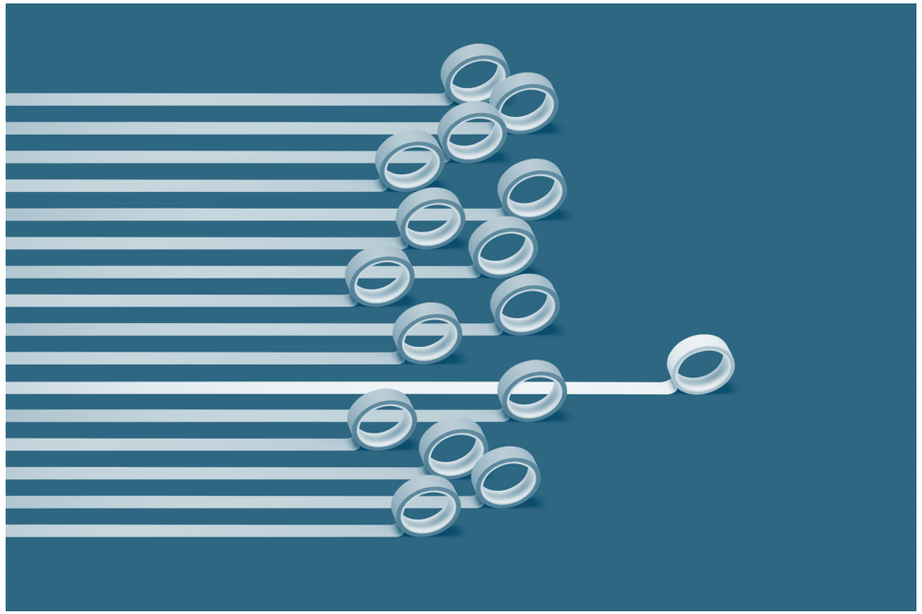


Excerpt from the course announcement on the UAUIM webpage

By promoting and disseminating the Online training course on sistainable archtecture at master level Architecture students, INCEPT successfully aligned expertise across sectors, sparking collaborative efforts that led to robust, sustainable solutions for current and future environmental challenges.

•Pre-Course Promotion
Prior to the training course, a dedicated effort was made to promote it to boost its visibility and attract the target audience. This activity involved creating a written description for each module, which covered its main points, insights, and key takeaways. Visual infographics were also created and shared on the INCEPT project's social media channels. An INCEPT newsletter was also used as an effective tool to announce the training course activities.

•Post-Course Dissemination and Impact
Following the training course, the project team recorded and archived all modules, including the Q&A and interactive segments, to ensure the content remained accessible. Follow-up emails were sent to participants, which included the presentation materials and a certificate (if applicable). By strategically disseminating the course content, a wider audience was reached, and the course's content remained relevant, thereby multiplying the INCEPT project's impact and reinforcing the expertise of the participating universities.



The promotion and dissemination of the online training course activities achieved several key goals:

•Holistic understanding of sustainability issues by bringing together experts from diverse fields, which fostered a more comprehensive understanding of complex, interconnected challenges like climate change, biodiversity loss, and resource depletion.

•Innovation through cross-disciplinary collaboration, as interdisciplinary approaches encouraged creative thinking and innovative solutions by blending perspectives and methodologies, especially during post-lecture discussions.

•Effective policy and practice implementation, as the webinars helped bridge the gap between science, industry, and government, ensuring that policies were evidence-based and aligned with community needs.

•Increased awareness and shared responsibility, as engaging participants from different disciplines (students and professionals) raised awareness of each field's role in sustainability.

•Building resilient solutions, as the interdisciplinary webinars created a platform for discussing how societies can adapt to and recover from environmental challenges.

•Education and capacity building, which was crucial for fostering a generation of professionals equipped to think and act across disciplinary boundaries.

•Strengthened networks and partnerships, as the webinars connected professionals from diverse fields, fostering collaborations that can drive long-term sustainability initiatives.

•Improved student proficiency and faculty expertise in the specific knowledge areas of the training modules.

•Insight into alumni success and career trajectories, allowing the project to gauge graduates' involvement in sustainable projects and their contributions to the field.

•Continuous improvement, as feedback mechanisms, such as student and alumni surveys, were utilized to refine the educational approach.

Feedback session on INCEPT curriculum implementation at UAUIM, 2024

IV.1. Training module questionnaire

A post-course questionnaire designed as a requirement for receiving a certificate was created to ensure participants absorbed key content and found the session valuable. This type of questionnaire also had the potential to reinforce learning, gather insights for improvements, and ensure participants met a knowledge standard before receiving a certificate. To make this process effective, the questionnaire included various types of questions, including content comprehension, feedback on experience, and open-ended responses for deeper reflection.

The questions reflected the main learning objectives of the training course, using tools such as key concept identification, practical application, true or false statements, scenario-based questions, or short answer reflection.

Each of the participating universities defined a training module questionnaire with relevant questions, so the questionnaire could gather insights into how the session was delivered and whether the format was conducive to learning. This feedback was critical for improving future webinars. The questions could target overall satisfaction, content quality, engagement level, pacing and structure and likelihood to recommend.

Training course participants were required to complete all sections to be eligible for the certificate. This approach not only validated participants' understanding but also made the webinar experience more interactive and beneficial, ensuring that the certificate represented meaningful knowledge acquisition.

IV.1.2. Training module certificate of completion

Each training module attendee was able to receive a certificate as an attest of the acquired knowledge on the specific topic. The participating universities were invited to use the certificate template in order to ensure modules' mutual compliance and clarity.

V. Conclusions

The Online Training Course on Sustainable Architecture, as a key intellectual output of the INCEPT project, served as a foundational step in aligning architectural education with the paramount energy and climate goals of the European Green Transition. By establishing a comprehensive understanding of sustainable architecture, the course successfully provided students and professionals with essential knowledge and tools to address contemporary challenges in the built environment. This initiative was not merely about delivering lectures; it was about fostering a new, future-oriented curriculum that prioritizes sustainability and energy efficiency from the very first stages of a building's design. The successful implementation, which involved over 250 participants from diverse disciplines, demonstrated a significant multiplier effect, extending the project's impact far beyond the confines of the consortium universities.

The course's four training modules provided a holistic view of sustainable architecture, from high-level frameworks to specific technical applications. The content effectively navigated complex topics, beginning with the integration of zero-emission building strategies and frameworks like the European Green Deal and the New European Bauhaus. It then delved into bioclimatic design and landscape urbanism, explaining how to create buildings that respond to local climates and integrate seamlessly with broader ecological landscapes.

The course also explored renewable energy sources and their practical application in buildings, addressing both their benefits and the challenges of their integration. Finally, the role of Building Information Modeling (BIM) and digitalization in managing and optimizing building performance throughout its life cycle was discussed.

The implementation of the course was structured to maximize learning and engagement. Each two-hour session, consisting of a lecture followed by an interactive Q&A, facilitated a collaborative environment. This approach not only enabled knowledge transfer but also fostered cross-disciplinary collaboration among participants from architecture, engineering, environmental science, and urban planning.

The post-course questionnaire served a dual purpose: it ensured participants had a demonstrable understanding of the key concepts and provided critical feedback for the continuous improvement of the educational approach. The use of the MOODLE digital platform ensured the course was accessible to a wider audience, fulfilling a core objective of the INCEPT project.

The promotion and dissemination activities of the course effectively extended its reach and impact, ensuring that the content remained accessible and relevant. By archiving the sessions and providing follow-up materials, the project reinforced its message and multiplied the course's value. The project's success in achieving a holistic understanding of sustainability issues and fostering innovation through cross-disciplinary collaboration was evident. The course helped bridge the gap between academia, industry, and government, promoting a shared responsibility for building resilient solutions. It also provided valuable insights into alumni success and career trajectories, highlighting how the course’s educational model can equip future leaders to make sustainable decisions.

A core strategy for ensuring the continuous relevance of the Online Training Course on Sustainable Architecture is its reiteration within other university faculties. To achieve this, several key strategies are essential for the future. Regular reviews and updates to the course content are necessary to incorporate the latest academic research and findings related to sustainable architecture, urban and landscape planning, and climate resilience. Maintaining strong ties with the architecture industry will ensure the course reflects current trends, technologies, and best practices. Furthermore, a continuous feedback loop from students and alumni is crucial for adapting to evolving educational needs. By consistently updating the content and methodology, the online course can continue to be a vital resource, reinforcing the expertise of the participating universities and driving long-term sustainability initiatives.

INCEPT

Align architectural education with the paramount energy and climate goals of the green transition in Europe

Co-funded by the European Union