Advanced Digital Design course ON modern buildings developing SKILLS for young engineers

Number of the Project 2020-1-PL01- KA226-HE-095244

Syllabus of e-learning: modules of online and face-to-face weeks.				
Module: Modern, low energy buildings with application of environmentally-friendly solutions; HVAC systems and renewable energy sources.				
Forms and number of hours of tuition:				
Virtual learning	*Hours of lectures*	*Hours of practical work*	*Hours of consultations*	*Hours of individual work*
12	*1*	*7*	*2*	*6*

Short Course Description	Changes in buildings over the years. Modern materials, their environmentally-friendly aspect. Heat losses/gains in buildings and main energy factors. Selection of the optimal HVAC system in different types of buildings. Skills to design the heating system for a residential building taking into account ecological heat sources. Construction, principle of operation, characteristic parameters of wind turbines and solar collectors. Biological sewage treatment plants.
Teaching methods	Lectures, workshops, computer labs, laboratories, design of a heating system using the available software lectures, team work on a case study, study visits in companies, virtual labs
Module programme	1. Changes in buildings over the years - lecture and workshop
	2. Modern materials, their environmentally-friendly aspect - lecture
	3. E-labs - renewable energy sources
	4. Presentation of different types of HVAC systems and discussion about parameters influencing their selection.
	5. Overview of the basic functions of the Audytor SET EN computer program.
	6. Entering basic data regarding the designed central heating system.
	7. Presentation of the structure of a typical underfloor radiator.
	8. Designing a default type of underfloor radiator.
	9. Determining the position of the heat source and distributors.
	10. Designing the distribution of pipes and the location of underfloor radiators.
	11. Adding labels of individual elements of the installation.
	12. Performing hydraulic calculations.
	13. Discussion of the calculation results.
	14. Presentation of the principle of operation of a solar collector, determination of the characteristic parameters of solar collectors.
	15. Presentation of types of wind farms. Overview of the principle of operation of a wind farm.
	16. Determination of characteristic parameters of a solar collector.
	17. Determination of the characteristics of wind turbines.

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	18. Worksop and a study visit in a model low energy house.
	19. Worksop and a study visit in a construction company.
	20. Preparation of final reports.
Assessment methods	Reports of practical and laboratory work, project, final test.
Learning outcomes	***Knowledge: knows and understands***
	1. Student knows and understands the construction, principles of operation of modern devices used in heating, ventilation and air conditioning systems.
	2. Student knows and understands selected issues in the field of detailed knowledge - necessary to understand the thermal, flow, cooling, ventilation and air conditioning processes occurring in environmental engineering.
	3. Student knows and has an in-depth understanding of the latest development trends and technologies in environmental engineering.
	Skills: is able to
	1. Student is able to properly plan research, perform it, interpret its results and draw correct conclusions on this basis
	2. Student is able to use acquired knowledge for critical analysis, synthesis, creative interpretation and presentation of issues in the field of environmental engineering and modern construction
	Social competence: is ready to
	1. Student is ready to analyze the content obtained from various sources, as well as to critically evaluate it and use it in professional work
Student workload	Participation in classes, working on projects, participation in student-teacher sessions related to the project.
Basic references	1. ASHRAE Handbook - HVAC Systems and Equipment (ASHRAE Handbook of Heating, Ventilating and Air-Conditioning Systems and Equipment SI). Ashrae, 2020.
	2. Roger Haines, Michael Myers. HVAC Systems Design Handbook. McGraw Hill; 5th edition, 2009.
	3. Carter Grayson. Basic hydronic heating components and their role in a system: Central heating structures possess a larger heating ability than a house heater. They switch the warmth the usage of water or air. Independently published, 2021.
	4. Sathyajith M., Wind Energy Fundamentals, Resource Analysis and Economics, Springer-Verlag Berlin Heidelberg, 2006.
	5. Francis de Winter, Solar Collectors, Energy Storage, and Materials, The MIT Press, 1990.
Supplementary references	6. Roy Treloar. Master Basic Plumbing And Central Heating. Teach Yourself Books, 2017.

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	7. John Sands. Underfloor Heating Systems: An Assessment Standard for Installations Paperback. BSRIA Ltd, 2001.
	8. Krawczyk D. (red.), Buildings 2020+. Energy sources. Białystok, Oficyna Wydawnicza Politechniki Białostockiej, 274 s., ISBN 978-83-65596-72-7, 2019. DOI:10.24427/978-83-65596-73-4
	9. Markiewicz-Zahorski Przemysław, "Building construction, solution & details for professionals", Polygraphy Department of the Cracow University of Technology, 2019.

Module: Building Information Modelling (BIM) fundamentals, concepts of modelling

Forms and number of hours of tuition:

Virtual learning	*Hours of lectures*	*Hours of practical work*	*Hours of consultations*	*Hours of individual work*
12	*1*	*7*	*2*	*6*

Short Course Description	To introduce the basic principles of building information model (BIM) and its management requirements, using computer aided design systems. After completing this course will be able to read and understand building construction drawings. To present general engineering and computer graphics fundamentals necessary in civil engineering design. To provide with knowledge how engineering graphics methods are applied in building information modelling (BIM) design.
Teaching methods	Lectures, Workshops, Educational litterature analysis, case study, problematic issues, reflection, blended learning, systematization. Practical work, Design of a heating system using the available software lectures, individual and group work, counselling.
Course Programme	The course will be developed as follows:
	1. An introduction to BIM. Understanding the principles of BIM. Exploring the UI and organizing projects. The basics of the toolbox. Configuring templates and standards. BIM execution plan.
	2. Collaboration with lecturer and teamwork. Tool compatibility and work with different tools. BIM project management with selected work tools. Advanced BIM modelling and massing. Architectural conceptual design. Create Visualization.
	3. Collaboration with lecturer and teamwork. Tool compatibility and work with different tools. BIM project management with selected work tools. Advanced BIM modelling and massing. Architectural conceptual design.
	4. Massing, plan and functional BIM system. Coordinate system. The axes of the network. BIM and CAD Classifications and standards. Static elements and levels. Referring to the building

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	of the elements agreed. Draw a plan of the building. The axes of the building, the walls and the partition mapping
	5. Documenting and annotating your design. Graphics preparation for explanatory note. Presentation of the project. Design Analysis.
Assessment methods	Reports of practical (and laboratory) work, problematic issues, application of the theory in practice, computerized assessment tasks, Project, presentation and discussion.
Learning outcomes	***Knowledge: knows and understands***
	1. Student knows and understands standards, rules and guidelines for the design of building structures and their elements.
	2. Student knows and understands construction, principles of operation and exploitation of modern devices used in refrigeration, heating, ventilation, air conditioning and lighting.
	3. Student knows and understands the latest development trends and technologies in engineering.
	4. Student knows and understands legal, economic and institutional conditions for the functioning of entities related to environmental engineering
	5. Student knows and understands the object, parametric modelling techniques, BIM standards and how to apply rational workflow design in 2D and 3D objects using IT systems.
	6. Student knows and understands legal, economic and institutional conditions for the functioning of entities related to environmental engineering.
	7. Student knows and understands modern solutions and construction materials used in energy-efficient buildings.
	8. Student knows and understands solutions, standards and systems used in smart buildings.
	Skills: is able to
	1. Student is able to properly plan research, perform it, interpret its results and draw correct conclusions on this basis.
	2. Student is able to properly use up-to-date information on innovations in environmental engineering/construction/ architecture/ lighting/ IoT technology.
	3. Student is able to properly select and use learned methods and tools, including advanced information and communication techniques (ICT) when solving complex problems occurring in engineering and propose their improvement or alternative solutions.
	4. Student is able to properly select data for the design of networks, systems and technologies in buildings.

	5. Student will be able to analyse BIM information of object and parametric modelling, apply standards, solve problems of 2D and 3D parametric modelling, manage digital documentation.
	6. Student is able to analyse the content obtained from various sources, as well as to critically evaluate it and use it in professional work.
Student workload	Participation in classes, working on projects, participation in student-teacher sessions related to the project.
Basic references	1. Hollowell, Martha. 2017. Autodesk Revit 2018 Structure Fundamentals. ASCENT, 640 p.
	2. Danner, Rob. 2014. The BIM house 2014. Lexington, KY, 2 t.
	3. Nawari, Nawari O.; Kuenstle, Michael. 2015. 1958- Building information modelling: framework for structural design. Boca Raton, FL: CRC Press/Taylor & Francis Group, xi, 272 p.
	4. Barnes, Peter. 2015. BIM in principle and in practice / Peter Barnes and Nigel Davies. London: ICE Publishing, 136 p.
	5. Danner, Rob. 2014. The BIM house 2014. Lexington, KY, 2 t.
Supplementary references	1. Kensek, Karen M.; Noble, Douglas. 2014. 1962 - Building information modelling: BIM in current and future practice. NJ: Wiley, xxxii, 397 p.
	2. Stine, Daniel John. 2014. Design integration using Autodesk Revit 2015.: architecture, structure and mep. Mission, KS: Schroff Development Corporporation, 658 p.

Module: Internet of Things (IoT) and its application in modern buildings

Forms and number of hours of tuition:

Virtual learning	*Hours of lectures*	*Hours of practical work*	*Hours of consultations*	*Hours of individual work*
12	*1*	*7*	*2*	*6*

Short Course Description	Introduction to programming with C++. Theoretical aspects of programming. Basics of programming in Arduino environment. Work with Wokwi simulator. Monitoring the temperature and gas changes with IoT technology. Circuito.io: A platform for idea development. Real-time visualization of sensor data using the Power BI. Smart house IoT equipment project.
Teaching methods	Lectures, workshops, computer labs, design of an IoT system using online simulators, data visual representation using online platform, team work on a case study.
Module programme	1. Introduction to programming with C++: Variables, Datatypes, Operators – lecture, practical tasks with online C++ compiler.
	2. Introduction to programming with C++: Control Structures – lecture, practical tasks with online C++ compiler.

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	3. Basics of programming in Arduino environment - lecture, knowledge.
	4. Wokwi simulator: simulation of Arduino circuit board – tutorial of simulator basics.
	5. Work with Wokwi simulator: modelling simulation of Arduino temperature data.
	6. Monitoring gas and temperature data with TinkerCad online simulator – practical lab.
	7. CIRCUITO.IO: A Platform for idea Development: instructions and practical lab for creating own electrical IoT circuit.
	8. Theoretical aspects of programming: presentation.
	9. Introduction to IoT: presentation and workshop.
	10. Real-time visualization of sensor data using the Power BI - practical lab.
	11. Group work: smart house IoT equipment project.
	12. Preparation of final reports.
Assessment methods	Reports of practical and laboratory work, project, final test.
Learning outcomes	***Knowledge: knows and understands***
	1. Student knows and understands the main principles of programming in C++ language.
	2. Student knows and understands selected issues of Arduino programming for IoT implementation purpose.
	3. Student knows and understands the latest development trends and technologies in IoT implementation in modern buildings.
	Skills: is able to
	1. Student is able to simulate IoT based solutions using online simulation software.
	2. Student is able to make visual data representation using PowerBI data analysis platform.
	Social competence: is ready to
	1. Student is ready to analyze the content obtained from various sources, as well as to critically evaluate it and use it in professional work.
Student workload	Participation in classes, working on projects, participation in student-teacher sessions related to the project.
Basic references	1. Deitel Paul, Deitel Harvey (2013). C++ How to programm. Ningth Edition. Pearson Publishing.
	2. Lea Perry (2018). Architecting Internet of Things. Packt Publishing: Birmingham, Mumbai.
	3. McEwen Adrian, Cassimally Hakim (2014). Designing the Internet of Things. John Wiley and sons: Chichester, West Sussex.
	4. https://wokwi.com

	5. https://www.circuito.io
Supplementary references	1. From Internet of Things to Smart Cities (2018). Edited by Hongjian Sun, Chao Wang, Bashar I. Ahmad. CRC Press: London, New York.
	2. Rayes Ammar, Salam Samer (2019). Internet of Things From Hype to Reality. The Road to Digitization. Second Edition. Springer: Cham, Switzerland.
	3. Gantz J., Reinsel D. The Digital Universe in 2020: Big Data, Bigger Digital Shadows, and Biggest Growth in the Far East. –URL: https://www.emc.com/collateral/analyst-reports/idc-digital-universe-united-states.pdf
	4. https://powerbi.microsoft.com

Module: Sustainability in buildings: what is sustainability, sustainable design process, technological solutions for sustainable buildings external envelope, practical workshop.				
Forms and number of hours of tuition:				
Virtual learning	*Hours of lectures*	*Hours of practical work*	*Hours of consultations*	*Hours of individual work*
12	*1*	*7*	*2*	*6*

Short Course Description	The course starts outlying the main concepts related firstly to sustainability and then to sustainability in constructions detailing the sustainable integrated design process and the construction site analysis. Then the design of school sustainable buildings is analysed in detail considering every distinguishing typological factors. Finally different kind of technological solutions for the external walls are addressed: rainscreen façades, external insulated walls and glazing façades detailing all components and characteristics. A workshop during face-to-face lectures is addressed to practice the main concepts addressed during online lectures.
Teaching methods	Lectures, individual practical activities, face-to-face workshop (design of a case study).
Module programme	The course will be developed as follows:
	1. The concept of sustainability: energy consumption and GHG emissions in Europe, history of sustainability, sustainability in buildings – lecture and individual test (questionary).
	2. Construction site analysis: sustainable integrated design, site analysis, solar radiation, wind and vegetation – lecture and individual test (practical exercise).
	3. Sustainable school buildings: qualitative and quantitative guidelines to design a sustainable school, cost optimal method and advices/observations to redevelop an existing school building - lecture and individual test (game: crossword).

	4. General information on vertical closures: functions, requirements and performance, functional model and functional layers – lecture and individual test (practical exercise).
	5. External insulated walls: the ETICS: functional model, vêture, ETICS system, technological details – lecture and individual test (practical exercise).
	6. Rainscreen façades: functional model, different type of technological solutions (system components, details, examples) – lecture and individual test (practical exercise).
	7. Glazing and glass façade: functional model, technical alternatives, main components, glass characteristics, glazing configuration, details and examples – lecture and individual test (practical exercise).
	8. Sustainable building design: construction site analysis in different climate zone, functional organization of the internal layout for a school or house, verification of the different building typological factors, design of façade ad solar shading system, choice of technological solution for external wall and glazing and calculation of the environmental impact of the technological solution chosen for the external wall – workshop: students work in group from different HEI.
	9. Preparation of final reports and presentations.
Assessment methods	Final individual test (questionary, game or practical exercise) for each lecture, final presentation of the building designed by working in group during workshop.
Learning outcomes	***Knowledge: knows and understands***
	4. Student knows and understands contemporary trends in construction technologies and their impact on the architectural form of buildings.
	5. Student knows and understands influence of climatic conditions on the technical conditions of shaping the architecture of the building.
	6. Student knows and understands modern solutions and construction materials used in energy-efficient buildings.
	7. Student knows and understands selected aspects of energy-efficient buildings design.
	Skills: is able to
	1. Student is able to use acquired knowledge for critical analysis, synthesis, creative interpretation and presentation of issues in the field of environmental engineering and modern construction.

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	2. Student is able to act in an entrepreneurial way through training and improving professional competences, and initiate activities aimed at using their knowledge and skills.
	3. Student is able to be creative and entrepreneurial, cooperate and work in a group, assuming different roles in it.
	Social competence: is ready to
	1. Student is ready to analyze the content obtained from various sources, as well as to critically evaluate it and use it in professional work.
	2. Student is ready to apply and adhere to the principles of professional ethics and conduct themselves in a professional manner while performing job duties and to enforce such behavior on others.
Student workload	Participation in classes, working on practical project, participation in student-teacher sessions related to the project.
Basic references	1. EN 15978 (2011): Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method
	2. ISO 21931(2010): Sustainability in building construction - Framework for methods of assessment of the environmental performance of construction works Buildings.
	3. European Assessment Document EAD 040083-00-0404 External thermal insulation composite systems (ETICS) with renderings.
	4. EN 13119:2016 - Curtain Wall - Terminology
	5. F. Bazzocchi, C. Ciacci, V. Di Naso, Qualitative and quantitative guidelines for carbon-neutral kindergarten design in Italy, in Journal of Green Buildings, fall issue, vol. 16, 2021. ISSN: 1552-6100
	6. F. Bazzocchi, C. Ciacci, V. Di Naso, Evaluation of Environmental and Economic Sustainability for the Building Envelope of Low-Carbon Schools, in Sustainability, vol. 13, 2021. ISSN: 2071-1050
Supplementary references	1. ISO 21931(2010): Sustainability in building construction - Framework for methods of assessment of the environmental performance of construction works Buildings.
	2. https://www.baubook.info/Download/e2s/OI3_Berechnungsleitfaden_V3_en.pdf?20210322172819
	3. https://calumenlive.com/it/configure
	4. https://www.agc-yourglass.com/configurator/app/login
	5. https://www.baubook.at/eco2soft/?SW=27&lng=2
Module: Green buildings and management of energy consumption	
Forms and number of hours of tuition:	

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Virtual learning	*Hours of lectures*	*Hours of practical work*	*Hours of consultations*	*Hours of individual work*
12	*1*	*7*	*2*	*6*

Short Course Description	This module is divided into 4 different topics: first an introduction to the design of renewable energy systems for suppling energy (thermal and electrical) to buildings. The standard methods used for this purpose are explained with a short theoretical introduction and applied to a practical case by the teacher. Student will apply posteriorly this knowledge to supply RE to the building of the team project. Second the analysis of the energy resources and inputs of a general-purpose building. The first block of this topic starts with the analysis of energy procurement markets at European level. After analysing the types of installations and control systems in a typical building, the parameters for improving energy efficiency, reducing costs, and improving the use of resources are studied. Finally, a workshop is proposed to design a system for the use and integration of renewable energy resources integrated in the traditional energy pool of any installation. Third the course will focus on the basic methodologies to design “Green and Blue roof”. Firstly, an overview “Green and Blue roof” will be explained, as well as the most important advantages to use this kind of technology nowadays. Moreover, the main guides and constructive methodologies will be described. Together with the technical information, the current status of the principal projects at the national and European level will be provided along with the most recent research results. This session will not only facilitate students the key knowledge to tackle the practical session, but also provide a complete summary of “Green and Blue roofs” that will show them new possibilities in the labor market. Finally the last topic concerns the Indoor Air Quality and the requirements of ventilation in buildings. Review of the European Standard EN 16798-1 (2019) Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings.
Teaching methods	Introductory lectures, Workshops, Practical work, Short lessons with a voice explanation.
Course Programme	The module will be developed as follows:
	1. Solar Collector for Hot water, photovoltaic system and other RE (optional).
	2. European Energy Markets, installations in buildings, efficiency factors, sources for electricity.
	3. Historical development of green roofs, Concept and strategies for water efficiency, green roof typologies and design considerations, benefits and Economic value of green roofs,

	legislation status of green roof, industrial sector and current global projects.
	4. Indoor Air Quality and ventilation, ventilation demand, regulations and recommendations, perfect mixed ventilation model.
Assessment methods	Evaluation of the student design of a RE installation, project, presentation and discussion, reports of practical work.
Learning outcomes	***Knowledge: knows and understands***
	1. Student knows and understands modern solutions and construction materials used in energy-efficient buildings.
	2. Student knows and understands selected aspects of energy-efficient buildings design.
	3. Student knows and understands legal, economic and institutional conditions for the functioning of entities related to environmental engineering.
	4. Student knows and understands solutions, standards and systems used in smart buildings.
	5. Student knows and understands IoT tools allowing to improve functionality of buildings and to increase energy savings.
	6. Student knows and understands the latest development trends and technologies in engineering.
	7. Student knows and understands contemporary trends in construction technologies and their impact on the architectural form of buildings.
	8. Student knows and understands construction, principles of operation and exploitation of modern devices used in refrigeration, heating, ventilation, air conditioning and lighting.
	9. Student knows and understands selected issues in the field of detailed knowledge - necessary to understand the thermal, flow, cooling, ventilation and air conditioning processes occurring in environmental engineering.
	Skills: is able to
	1. Student is able to make an economic evaluation of the proposed technical, technological and system solutions in buildings.
	2. Student is able to properly plan research, perform it, interpret its results and draw correct conclusions on this basis.
	3. Student is able to properly use up-to-date information on innovations in environmental engineering/construction/ architecture/ lighting/ IoT technology.
	4. Student is able to use scientific, popular science and industry literature, subject standards, legal acts, internet databases in

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	English language; properly use the information obtained, as well as formulate and present opinions.
	5. Student is able to properly select the technical conditions for designing buildings in relation to climatic conditions in order to design selected building elements of the facility.
	Social competence: is ready to
	1. Student is ready to analyze the content obtained from various sources, as well as to critically evaluate it and use it in professional work.
	2. Student is ready to formulate and communicate to the public, in a commonly understood way, information and opinions concerning scientific achievements as well as other aspects of the engineer's activities, presenting different points of view.
	3. Student is ready to communicate effectively in a variety of intercultural contexts, reflect critically on stereotypical perceptions of reality, and to accept diversity and differing points of view.
Student workload	Participation in lecture and workshops, working on projects, participation in student-teacher sessions, quizzes.
Basic references	1. Jown Twidell and Tony Weir. Renewable Energy Resources (1986) Ed. Taylor & Francis. London and New York.
	2. Frand Kreith and D. Yogi Goswami. Handbook of Energy Efficiency and Renewable Energy (2007). Ed. CRC Press. Taylor & Francis. London and New York.
	3. Edited by Marco Canponigro and Azrundin Husika. Handbook on Renewable Energy Sources. Project ENER SUPPLY. South EAST Europe. Transnational Cooperation Programme.
	4. Subbiah, M. (2015). Introduction to Renewable Energy (1st ed.). LAP LAMBERT Academic Publishing. Retrieved from https://www.perlego.com/book/3429927/introduction-to-renewable-energy-pdf (Original work published 2015)
	5. European Parliament. Directive 2002/91/CE. Buildings Energy Efficiency.
	6. European Parliament. Directive 2010/31/UE. Energy performance of the buildings.
	7. European Parliament. Directive 2012/27/UE. Energy efficiency.
	8. https://doi.org/10.1016/j.landurbplan.2022.104426
	9. W Drozd 2019 *IOP Conf. Ser.: Earth Environ. Sci.* 214 012076
	10. FLL Green Roof Guidelines: Guidelines for the Planning, Constructtion and Maintenance of Green roofs
	11. Living Roofs and Walls, from policy to practise
	12. https://doi.org/10.1016/j.rser.2021.111523

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	13. World Health Organization, (2010). WHO guidelines for indoor air quality: selected pollutants, WHO Regional Office for Europe. Copenhagen, Denmark.
	14. EN 16798-1 (2019) Energy performance of buildings - Indoor Environmental Quality - Part 1: Indoor environmental input parameters for the design and assessment of energy performance of buildings.
	15. EN 16798-2 (2019) Energy performance of buildings - Ventilation for buildings - Part 2: Interpretation of the requirements in EN 16798-1 - Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics (Module M1-6).
Supplementary references	1. Spanish Technical Building Code (Royal Decree 314/2006 of 17 March 2006). English Translation in web page of UN Climate Technology Centre & Network: www.ctc-n.org
	2. EPDB, Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.
	3. Agency for the cooperation of energy regulators. Cross-regional roadmap for Day-Ahead Market Coupling. http://www.acer.europa.eu/en/electricity/regional_initiatives/cross_regional_roadmaps/pages/1.-marketcoupling.aspx
	4. European network of transmission system operators for electricity. www.entsoe.eu
	5. New World Record Achieved in Solar Cell Technology (press release, 2006-12-05), U.S. Department of Energy.
	6. World Bank open data. 7. http://data.worldbank.org/
	8. https://doi.org/10.1016/j.scitotenv.2021.148407
	9. Growing Green Guide, a guide to green roofs, walls and facades
	10. https://efb-greenroof.eu/
	11. Guía de azoteas vivas y cubiertas verdes
	12. BCN ECOLOGIA, Cobertes i murs verds a Barcelona. Estudi sobre les existents, el potencial i les estratègies d'implantació, 2010.
	13. EPDB, Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.
	14. EPDB, Mandate M/343 Mandate to CEN, CENELEC and ETSI for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and

	estimating the environmental impact, in accordance with the terms set forth in Directive 2002/91/EC; 30 January 2004.
	15. EPDB, Recast of the Directive on the energy performance of buildings (2010/31/EU) of 14th December 2010.
	16. Mandate M/480, Mandate to CEN, CENELEC and ETSI for the elaboration and adoption of standards for a methodology calculating the integrated energy performance of buildings and promoting energy efficiency of buildings, in accordance with the terms set in the recast of the Directive on the energy performance of buildings (2010/31/EU) of 14th December 2010.