INTELLECTUAL OUTPUT 1
TASK O1-A4
RecoverIND Course Curriculum based on ecological challenges and new technologies

Consortium members: Universitatea Transilvania din Brasov (UNITBv), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Universidad de Sevilla (USE), Asociatia Romania Green Building Council (RoGBC), Poznan University of Technology (PUT), Fundatia pentru Formare Profesionala si Invatamant Preuniversitar Viitor (FPIP) and Zespol Szkol Budownictwa Nr 1 (ZSB1)

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ECOLOGICAL AND INNOVATIVE TECHNOLOGIES FOR RECOVERING INDUSTRIAL AREAS FROM LCA AND ENERGY EFFICIENCY POINT OF VIEW

2020-1-RO01-KA203-080223

O1-A4. RecoverIND COURSE CURRICULUM BASED ON ECOLOGICAL CHALLENGES AND NEW TECHNOLOGIES

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CONTENTS

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ECOLOGICAL AND INNOVATIVE TECHNOLOGIES FOR RECOVERING INDUSTRIAL AREAS FROM LCA AND ENERGY EFFICIENCY POINT OF VIEW

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1. Course data

Name	RESTORATION OF INDUSTRIAL ZONES AND NEW TECHNOLOGIES
Module	*
Qualification in which it is taught	*
Other qualifications that could be offered *	Civil Engineering Architecture Building Engineering Environmental Engineering Master's programs related to Industrial restoration
Centre	*
Character	OPTIONAL
Course	*
Language	Official Language*
Theory class schedule	*
Classroom	*
Practice class schedule	*
Place	*

(*) All the fields marked with an asterisk are subject to completion with the specific information for each educational centre.

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2. Teacher's data

Teacher responsible	*
Department	*
Area of knowledge	*
Teacher's office location	*
Phone	*
E-mail	*
URL / WEB	*
Tutorial timetables	*
Tutorial location	*
Teaching and research profile	*

(*) All the fields marked with an asterisk are subject to completion with the specific information for each educational centre.

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3. Description of the course

3.1. Short description of the contents

- LCA - Life Cycle Assessment for building materials.

- Use of ICT tools in construction.

- Information modelling methods for industrial buildings.

3.2. General description of the subject

The use of new technologies in the construction sector is revolutionizing project planning both in the new construction and in the restoration plans of existing buildings. This new methodology of action means great progress in controlling all parameters and criteria that affect new developments.

The use of digital technologies, such as the BIM methodology, will be a step forward in both the planning and the efficiency of the resources used. The technology used for industrial rehabilitation (drones, scanners, data measurement) training of both students and professionals becomes essential to take advantage of the interoperability offered by ICT (equipment and software) to assess the energy efficiency of buildings and product life cycle from industrial areas.

3.3. Material resources

Minimum list of material resources (equipment, tools and instruments, models, raw materials and materials, technical, economic, legal documentation, etc.), necessary to obtain the learning outcomes:

• Multimedia facilities,

• Training tutorials on using applications,

• Computer, video projector, computer applications.

3.4. Recommendations to the course

(*) Completion subject to the criteria of the educational centre.

3.5. Special measures provided

(*) Specific regulations of the educational centre with respect to the establishment of special adaptation in the methodology and the development of teaching for students who suffer from some type of disability or limitation.

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4. Learning outcomes

4.1. Knowledge

1. Life cycle assessment for materials

Comprehensive, specialized, factual and theoretical knowledge about:

- Energy efficiency of buildings.

- Current research on climate change issues, the role of installations in maintaining high quality indoor air, paying particular attention to appropriate CO_2 levels.

- Connection with green buildings, environmentally friendly building materials and sustainability in relation to technical regulations in construction national and international.

2. Information modeling methods for industrial buildings

Specialized factual and theoretical knowledge on:

- Planning and monitoring the activities of a project.
- Design with the help of nationally / internationally recognized software tools.
- Specialized software for BIM design and planning.
- The possibilities for data exchange between planning and design software tools.

3. Use of ICT tools in construction

Comprehensive, specialized, factual and theoretical knowledge about:

• New IT technologies for building design and monitoring.
- Photogrammetry, stereophotogrammetry.
- 3D scan.
- Thermography.

4.2. Skills

1. Life cycle assessment for materials

Cognitive and practical skills required:

- To describe the materials that ensure the energy efficiency of an industrial / residential building.

- To identify those features ecology, climate and environment in developing a project.

- To understand and explain the environmental impact of building materials, including recycling and reuse.

- Understanding the principles of sustainability (social, economic and environmental).

2. Information modeling methods for industrial buildings

Cognitive and practical skills for:

- Apply software tools specialized in the design, monitoring of buildings, in the management of existing databases related to buildings including suggestions for improvements

- Practical skills in applying multicriteria assessments.

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3. Use of ICT tools in construction

Necessary cognitive and practical skills:

- Understands how to work with drones.

- To identify those building characteristics by using photogrammetry in developing a project.

- To understand and explain the process of thermography, photogrammetry, stereophotogrammetry.

- To use the GIS system in the process of designing, monitoring buildings.

4.3. Attitudes

1. Life cycle assessment for materials

- Reviewing and developing personal and others' performance and responsibility for evaluating and improving work.

- Make judgments and make decisions about specific solutions, based on the coordination of one's own activity with other responsible persons, e.g., for the choice of materials, information management.

2. Information modeling methods for industrial buildings

- Responsibility of the parties specialized in the design and planning of the R project with the application of nationally recognized software tools.

- Read and process project documents responsibly and autonomously

- Responsibility for monitoring:

- Project status.

- Technical condition of the building.

- Energy.

3. Use of ICT tools in construction

- Reviewing and developing personal and others' performance and responsibility for evaluating and improving work.

- Self-management and / or supervision within the work guidelines related to the use of IT applications in the design and monitoring of buildings.

4.4. Learning contents

1. Life cycle assessment for materials

1.1 Elements of energy efficiency

• Building envelope, Thermal insulation, Thermal bridges, etc.

• Thermal and ventilation installations, electrical installations specific to industrial constructions.

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1.2 Principles of the circular economy

The concept of recycling / reuse of water, construction materials, electrical and electronic:

- Waste (from construction, electrical and electronic installations).

- Waste recycling.

- Reuse of waste.

- Materials.

- Degradation.

- Recycling.

• Material life cycle

- Modern methods for determining the life cycle of materials, carbon footprint; use of IT tools (ecochain.com, https://sphera.com/corporate-sustainability-software/).

2. Information modeling methods for industrial buildings

2.1 Planning and design tools

- BIM-technical tool for design and planning in the restoration of buildings and industrial parks.

- Evaluation of the life cycle of buildings.

- Working areas-BIM models: industrial buildings-renovation, new industrial constructions

- Software application tools: Agisoft Metashape, SketchUp, Revit, Archicad - 3D modelling.

3. Use of ICT tools in construction

3.1 Elements of innovation-IT

• Drones - their use in constructions and installations.

- Photogrammetry: fields of use, terrestrial photogrammetry.

- Identifying the pipeline routes.

- Information collection - maps, construction sites.

- Topographic survey.

• Stereophotogrammetry-working principles, tools used

• 3D scanning

- Work equipment, practical applications.

    - Cloud points.

• Thermography in construction-equipment, working methods, practical applications.

5. Contents

5.1. Theory programme (sessions and issues)

THEMATIC AREA I: LIFE CYCLE ASSESSMENT FOR MATERIALS

UNIT 1. Life Cycle Assessment (LCA).

1.1 Introduction. Basic concepts.

1.2 LCA in constructions sector.

1.3 Methodology.

1.4 Normative frame of reference for LCA.

1.5 LCA examples.

1.6 LCA conclusions.

UNIT 2. Building Energy Efficiency.

2.1 Introduction. Basic concepts.

2.2 Building energy assessment in BIM.

2.3 Estimating energy efficiency.

UNIT 3. Energy Certification of buildings.

3.1 Definition and scope.

3.2 Energy Performance of Existing Buildings.

3.3 Examples of Energy Certification.

THEMATIC AREA II: INFORMATION MODELING METHODS FOR INDUSTRIAL BUILDINGS.

UNIT 4. BIM technologies.

4.1 BIM definitions.

4.2 BIM basics applied to LCA

4.3 Levels of development (LOD).

4.4 Environmental impact categories.

4.5 LOD600.

UNIT 5. Use of 2D documentation for the 3D inventory of building.

5.1 Scanning of drawing documentation.

5.2 Photographs.

5.3 Graphic correction.

5.4 Import of scans as trace reference.

5.5 Using the trace reference.

UNIT 6. Structural modelling of buildings.

6.1 General characteristics.

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6.2 Models and tools.

6.3 Structural modelling in the building restoration.

6.4 Application examples.

UNIT 7. Geographical Information System (GIS).

7.1 Introduction. GIS definitions.

7.2 The use of GIS in the building restoration.

7.3 GIS examples.

7.4 GIS conclusions.

THEMATIC AREA III: USE OF ICT TOOLS IN CONSTRUCTION

UNIT 8. Drones.

8.1 Introduction.

8.2 Drone legislation.

8.3 Use of drones.

8.4 Drone flight applications.

8.5 Practical application.

UNIT 9. Thermography.

9.1 Thermal imaging cameras.

9.2 Faults and precautions in use.

9.3 Areas of use.

9.4 Practical applications of the thermal imaging camera.

9.5 Thermography applied to electric power lines.

UNIT 10. 3D laser scanner.

10.1 Laser scanning of building.

10.2 Outputs of scanning.

10.3 Point cloud editing.

10.4 Import point cloud to BIM software.

10.5 Use the point cloud for 3D modelling.

10.6 IFC export.

UNIT 11. Photogrammetry.

11.1 Basic concepts.

11.2 Use of photographs and videos.

11.3. 3D model generation.

11.4 Import the model to BIM.

11.5 Practical application of stereophotogrammetry.

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UNIT 12. 3D-printed construction technologies.

12.1 Introduction.

12.2 Advantages of 3D printed.

12.5 Technologies and equipment.

12.4 Programming and optimization.

12.5 On-site applications of 3D-printed construction technologies.

12.6 Factory applications of 3D-printed construction technologies.

5.2. Practices programme

Realisation of practical cases of each covered tool.

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6. Teaching methodology

6.1. Teaching methodology per each Unit			
Activity	**Teaching techniques**	**Student's work**	**Hours**
Theoretical classes	Expositive classes of the theoretical contents, using the method of lesson dialogue. Resolution of doubts raised by students.	On-site:	**12**
		Non-on-site:	0
Solution of problems and practical cases	Resolution of practical cases. Problems are proposed to students for their resolution in the classroom at a certain time. They are solved using blackboard and / or projector. Proposition of exercises for resolution at home.	On-site:	**3**
		Non-on-site:	2
Practices in computer classroom	Search for information, management of databases and use of tools for calculating and estimating emissions.	On-site:	0
		Non-on-site:	4
Cooperative work activities	Resolution of practical cases. Working groups will be set up in the classroom to carry out practices, monitoring the participation of the group's members.	On-site:	**3**
		Non-on-site:	2
Tutorials	Resolution of doubts about theory, problems, practices and seminars.	On-site:	0
		Non-on-site:	3
Seminars and visits to companies and facilities	In the seminars, specific topics of the theoretical syllabus will be expanded. Depending on availability, a visit will be made, or the assistance of an environmental management professional will be scheduled.	On-site:	**3**
		Non-on-site:	0
Work / Individual study	Study of the subject.	On-site:	0
		Non-on-site:	25
Works / Informs	Realisation of works and reports of practices to be delivered by the student.	On-site:	0
		Non-on-site:	10
Formative evaluation activities	Follow-up and development of works, practices and reports.	On-site:	0
		Non-on-site:	4
Official exams	Preparation, correction and review of written tests.	On-site:	**2**
		Non-on-site:	0
Exhibition of Works	Evaluation and correction of the expositions corresponding to the different works to be carried out by the student.	On-site:	**2**
		Non-on-site:	0
			75

7. Assessment methodology

7.1. Activities and assessment criterio per each unit		
Activities	Systems and assessment criteria	Percentage Weight (%)
Written tests.	Theoretical-practical knowledge acquired by the student will be evaluated.	60
Assessment of practices cases with ICT support.	Knowledge acquired in practices with ICT support will be evaluated.	0-5
Individual and teamwork assessment works.	Development and presentations of individual and group works will be evaluated.	30
Other assessment activities.	Attendance and participation to classes of the subject will be evaluated.	5-10
Works		
Individual and teamwork works.	All aspects related to the task to be carried out will be evaluated, from the search of information to the final presentation.	40
Resolution of practical cases.	Both the proposed solution and the analysis of alternatives and the justification of the solutions that have been carried out will be evaluated.	20
Assessment of practices cases with ICT support.	Knowledge acquired in practices with ICT support will be evaluated.	0-5
Individual and teamwork assessment works.	Development and presentations of individual and group works will be evaluated	30
Other assessment activities.	Attendance and participation to classes of the subject will be evaluated.	5-10

7.2. Control and monitoring mechanism
The control and monitoring of student learning will be done through the following actions: - Participation in the issues and practical cases raised in class. - Assistance to theoretical and practical classes. - Tutorials. - Carrying out self-evaluation questionnaires. - Assessment of the individual written test, or of the research works, individual and in group.

8. Bibliography and resources

8.1. Bibliography

BCCA (2017) Consejería de Fomento y Vivienda / Vivienda y Rehabilitación / Base de Costes de la Construcción de Andalucía (BCCA).

Freire-Guerrero, A., Alba-Rodríguez, M. D. and Marrero, M. (2019) 'A budget for the ecological footprint of buildings is possible: A case study using the dwelling construction cost database of Andalusia', Sustainable Cities and Society. Elsevier, 51, p. 101737. doi: 10.1016/J.SCS.2019.101737.

Marrero, M. and Ramirez-De-Arellano, A. (2010) 'The building cost system in Andalusia: application to construction and demolition waste management', Construction Management and Economics. Routledge, 28(5), pp. 495–507. doi: 10.1080/01446191003735500.

Martínez-Rocamora, A. et al. (2016) 'LCA databases focused on construction materials: A review', Renewable and Sustainable Energy Reviews. Elsevier, 58, pp. 565–573. doi: 10.1016/j.rser.2015.12.243.

BIM Methodology. https://www.buildingsmart.es/bim/

https://www.kaizenai.com/bim/que-es-el-bim/

Dimensions of BIM. https://storage.googleapis.com/wzukusers/user-33893552/images/5b8922d869f31HaEK1lJ/Las-Dimensiones-de-BIM.png

BIM implementation. https://www.buildingsmart.es/bim/

Software BIM. https://www.bimnd.es/tipo-software-bim-en-cada-fase/

Use Autodesk® Revit in Spain. https://www.espaciobim.com/software-bim-mas-utilizado-revit

Environmental Product Declarations. Sustainable Insulation. ISOVER. https://www.isover.es/sites/isover.es/files/assets/documents/dap-oct-2015.pdf

EN 15804:2008 Sustanibility of construction Works – Environmental product declarations – Core rules for the Product Category of Construction Products. https://www.une.org/encuentra-tu-norma/busca-tu-norma/norma?c=N0052571

LCA implementation in BIM platform - Source: Márcio Minto Fabricio https://www.researchgate.net/figure/LCA-implementation-in-BIM-platform-Source-AuthorselaborationAuthorselaboration_fig1_311557520

Current situation. https://www.researchgate.net/publication/325435242_Contribuicao_da_modelagem_BIM_para_facilitar_o_processo_de_ACV_de_edificacoes_completas

Characteristics of BIM in the LCA calculation https://www.bimandco.com/es/blog/25-what-role-does-bim-play-today-in-lca

Frequently asked questions about BIM objects. https://www.msistudio.com/preguntas-frecuentes-sobre-objetos-bim/

Revit Style Guide v2018. https://www.bimobject.com/en-us/solutions/product/bim-revit-content-style-guide

NBS BIM Object Standard. https://www.nationalbimlibrary.com/en/nbs-bim-object-standard/

OBOS (Open BIM Object Standard). https://bim.natspec.org/documents/open-bim-object-standard

eCOB. BIM object creation standard. https://ecobject.com/

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BIM Object Development Guide. GDO-BIM Standard. https://bimchannel.net/es/disponible-para-descargar-guia-estandar-bim/

BIM dimensions. https://storage.googleapis.com/wzukusers/user-33893552/images/5b8922d869f31HaEK1lJ/Las-Dimensiones-de-BIM.png

The 7 dimensions of BIM. https://www.espaciobim.com/dimensiones-bim#:~:text=Te%20voy%20a%20hablar%20de,dado%20en%20denominar%20dimensiones%20BIM.

¿Dónde encontrar recursos BIM? https://www.espaciobim.com/recursos-bim-revit-gratis

LOD o nivel de desarrollo. https://www.espaciobim.com/que-es-el-lod-nivel-de-detalle

Latorre-Uriz, A. et al. (2018) "Aplicación del 8D y de los principios Lean para la mejora de la seguridad y prevención de obras de edificación", Conferencia: CONTART 2018 La convención de la Edificación (Zaragoza). https://www.researchgate.net/publication/325653755_Aplicacion_del_8D_y_de_los_principios_Lean_para_la_mejora_de_la_seguridad_y_prevencion_de_obras_de_edificacion

Los 20 términos BIM clave. https://bimanagement.co/2020/03/26/los-20-terminos-bim-clave-que-usted-necesita-saber/

LOD = LOD + LOI. https://evolve-consultancy.com/lod-lod-loi/

Alonso-Madrid, J. (2015), "Nivel de desarrollo LOD. Definiciones, innovaciones y adaptación a España", Building Smart. https://www.researchgate.net/figure/Figura-24-Evolucion-de-Niveles-de-Desarrollo-Fuente-propia_fig17_283570424

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Declaraciones Ambientales de Producto. Aislamiento Sostenible. ISOVER. https://www.isover.es/sites/isover.es/files/assets/documents/dap-oct-2015.pdf

LCA implementation in BIM platform - Fuente: Márcio Minto Fabricio https://www.researchgate.net/figure/LCA-implementation-in-BIM-platform-Source-AuthorselaborationAuthorselaboration_fig1_311557520

Situación actual. https://www.researchgate.net/publication/325435242_Contribuicao_da_modelagem_BIM_para_facilitar_o_processo_de_ACV_de_edificacoes_completas

Características del BIM en el cálculo del ACV. https://www.bimandco.com/es/blog/25-what-role-does-bim-play-today-in-lca

Global EPD (2017). "Declaración Ambiental de Producto. Ladrillos y bloques cerámicos para revestir. Pieza "P" según la Norma UNE-EN 771-1." http://ceramicasampedro-9189.kxcdn.com/wp-content/uploads/2017/07/DAP_GlobalEPD_Ladrillos_y_bloques_cer%C3%A1micos_para_revestir.pdf

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8.2. Regulations

EN ISO 19650-1:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) - Information management using building information modelling - Part 1: Concepts and principles (ISO 19650-1:2018)

EN ISO 19650-2:2018 Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) - Information management using building information modelling - Part 2: Delivery phase of the assets (ISO 19650-2:2018)

EN ISO 12006-3:2016 Building construction - Organization of information about construction works - Part 3: Framework for object-oriented information (ISO 12006-3:2007)

EN ISO 29481-1:2017 Building information models - Information delivery manual - Part 1: Methodology and format (ISO 29481-1:2016)

EN ISO 29481-2:2016 Building information models - Information delivery manual - Part 2: Interaction framework (ISO 29481-2:2012)

EN ISO 16739:2016 Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries (ISO 16739:2013)

SR EN 15804 + A1: 2014. Sustainable development of construction works. Product environmental statements. Basic rules for the category of construction products.

SR EN 15942: 2012. Sustainability of construction works. Environmental product declarations. Communication format business-to-business.

Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC.

8.3. Online resources and other resources

www.allbim.net

www.bimserver.org

www.codigotecnico.org

www.csostenible.net

www.eco-circular.com

www.magrama.gob.es

www.oerco2.eu

Consortium members: Universitatea Transilvania din Brasov (UNITBv), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), Universidad de Sevilla (USE), Asociatia Romania Green Building Council (RoGBC), Poznan University of Technology (PUT), Fundatia pentru Formare Profesionala si Invatamant Preuniversitar Viitor (FPIP) and Zespol Szkol Budownictwa Nr 1 (ZSB1)

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