Co-funded by the European Union

Funded by: Erasmus+ KA2 - VET
Project Agreement Number: 2023-1-EL01-KA220-VET-000158810

R3.1

BIM4D pedagogical manual and curriculum

BFW NRW

29.01.2025

ΠΕΔΜΕΔΕ 1934 ΠΑΝΕΛΛΗΝΙΑ ΕΝΩΣΗ ΔΙΠΛΩΜΑΤΟΥΧΩΝ ΜΗΧΑΝΙΚΩΝ ΕΡΓΟΛΗΠΤΩΝ ΔΗΜΟΣΙΩΝ ΕΡΓΩΝ
PANHELLENIC ASSOCIATION OF ENGINEERS CONTRACTORS OF PUBLIC WORKS
Gospodarska zbornica Slovenije Chamber of Commerce and Industry of Slovenia
BAU INDUSTRIE Nordrhein-Westfalen
CENTRE IFAPME Liège-Huy-Verviers
SCUOLA COSTRUZIONI VICENZA Andrea Palladio
IIPLE Istituto Professionale Edile di Bologna

Contents

Introduction

In an increasingly globalized world, the importance of education that is accessible across geographical and cultural boundaries is crucial. The present curriculum for "BIM4D" was developed to meet the requirements of an international learning environment and is now being implemented as part of online learning. This online platform enables learners worldwide to continue their education flexibly and efficiently, regardless of their location.

The advantages of online learning are manifold. It offers a flexible learning environment that allows learners to learn at pace and their own on schedule their own. This is particularly important at a time when traditional educational models are being redefined by technological advances and global challenges. As Donna J. Abernathy aptly states: "Online learning is not the next big thing, it is the now big thing" [*1]*

This international focus ensures that students not only acquire specialist knowledge but also develop the intercultural skills that are essential in a globalized working world.

The implementation of this curriculum via an online platform offers numerous advantages:

- **Flexibility**: Learners can access the content from anywhere in the world and learn at their own pace.
- **Interactive learning methods:** The use of online quizzes makes learning active and engaging.
- **Self-assessment**: Learners have the opportunity to regularly review and reflect on their progress through self-assessments.

In summary, this curriculum for "BIM use in End-of-Life practices" not only aims to impart specialist knowledge, but also to prepare learners for the challenges of a globalized world. The use of modern online learning methods and the integration of international standards ensure a high-quality and accessible education.

Source:1: eLearning Industry. (2021). 23 Inspirational eLearning Quotes For eLearning Professionals. Retrieved from eLearning Industry

General educational goals

1. **Promotion of self-directed learning**:
    - Learners should be able to work independently on learning content and assess their own progress.
    - **Self-assessment**: Regular self-assessment of your own learning progress using quizzes online and reflection questions.
2. **Development of critical thinking**:
    - Learners should be able to critically analyze information and make well-founded decisions.
3. **Promotion of digital competence**:
    - Learners should be able to achieve their learning objectives and use digital tools and platforms
    - **Virtual exercises**: Application of digital tools in a digital learning environment.

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Curriculum in BIM use in End-of-Life practices

Introduction

This manual is intended to serve as a guide for the development of training on how BIM can be used in the Demolition/ deconstruction sector. It contains detailed instructions, methods and resources to achieve the learning objectives and promote EQF competences. The curriculum consists of six structured modules, each focusing on a specific aspect of BIM in end-of-life-phases.

The learning outcomes have been shaped using the principles of **Bloom's taxonomy**, which supports a step-by-step progression from basic knowledge to advanced problem-solving. At the beginning, learners are introduced to the key ideas of deconstruction and circular construction, ensuring they can understand essential concepts. As the modules advance, learners gradually begin to apply this knowledge in practical contexts, such as regulations, digital tools, or considering strategies for material reuse. The curriculum then moves towards more complex tasks, encouraging learners to analyze real case studies, identify challenges, and evaluate different approaches. By the final stages, participants are not only able to reflect critically on what they have learned but also to create their own solutions—designing deconstruction plans, developing innovative reuse strategies, and applying BIM methods to improve sustainability in practice.

More specifically, the curriculum consists of six interconnected modules, each focusing on a specific aspect of BIM in end-of-life phases. Learning outcomes are structured to:

- **Understanding** core concepts of deconstruction and circular construction.
- **Applying** knowledge in practice through standards, regulations, and digital tools.
- **Analyzing** real projects and identifying challenges.
- **Evaluating** sustainability impacts, legal frameworks, and innovative methods.

This approach ensures that learners not only acquire technical knowledge but also develop critical thinking, problem-solving, and creativity, preparing them for active roles in sustainable construction and demolition practices across Europe.

Module 1: Introduction to deconstruction and circular construction

This module supports becoming familiar with the basic principles of deconstruction and circular construction. Learners will explore why these practices matter, how they have evolved, and what role they play in sustainability and resource efficiency today.

Objectives

- Develop a basic understanding of the definition and objectives of deconstruction
- Learn about construction and its benefits for sustainability
- Learning about the principles of circular construction
- Gain an overview of the history and development of deconstruction and circular construction

Learning Outcomes

1. **Understanding deconstruction**:
    - Learners can explain clearly and precisely the term of deconstruction
    - Learners should be able to Identify and describe the key principles, methods, and benefits of deconstruction.

2. **Knowledge of circular construction**:
    - Learners can explain the principles of construction and its benefits for sustainability and resource conservation and circular construction
    - Learners should be able to explain the principles of construction and its advantages of circular construction

3. **History and development**:

    - Learners can describe the historical development of construction and assess their significance for modern construction practice of deconstruction and circular construction

EQF competences

- **Knowledge:** Basic understanding of the definition aims and importance of deconstruction and the principles of circular construction.
- **Skills:** Ability to the benefits of explain construction for sustainability, resource conservation and circular construction
- **Competences:** Ability the historical development of to describe construction and to evaluate their significance of deconstruction

Contents

- **Introduction to deconstruction**:
    - Definition: What is deconstruction?
    - Goals: Why is deconstruction important?
    - Significance: What are the benefits of deconstruction for the environment and society?
- **Principles of Circular Construction:**
    - Sustainability: How does circular construction contribute to sustainability?

- Conserving resources: What resources can be saved through circular construction?
- Environmental benefits: What positive effects does circular construction have on the environment?

- **History and development:**
  - Evolution of deconstruction: How has deconstruction developed over time?
  - Milestones: Important events and developments in the history of Circular Construction.

Evaluation

- Self-assessment: Online quiz to check your understanding of deconstruction.
- Reflection questions: Self-assessment of knowledge about circular construction.
- Virtual case studies: Analyzing historical developments and their significance.

Module 2: Standards and regulations

This module builds on the introductory knowledge by connecting deconstruction and circular construction practices with the legal and regulatory frameworks that govern them. Learners will examine how standards, EU directives, and certifications shape professional practice and ensure quality.

Objectives

- Get an overview of national and European standards and guidelines.
- Understand the legal framework of the EU and its member states.
- Learn about the importance and requirements of certifications and labels.

EQF competences

Knowledge: Overview of national and European standards and directives as well as the legal framework of the EU and its member states.

Skills: Ability to explain the meaning and requirements of certifications and labels.

Competences: Ability to apply relevant standards and regulations in practice and assess their impact on deconstruction projects

Learning outcomes

1. **Overview of standards and guidelines**:
    - Learners should be able to acknowledge relevant national and European standards and guidelines explain their application in practice.
2. **Understanding of the legal framework**:
    - Learners should be able to understand the legal framework of the EU and its member states and its impact on assess deconstruction projects
3. **Knowledge of certifications and labels**:
    - Learners should be able to explain the significance and requirements of certifications and labels and their role in quality assurance.

Contents

- **National and European standards**:
    - Overview of relevant standards: Which standards are important for deconstruction and circular construction
    - Guidelines: Which guidelines must be observed?
- **Legal framework conditions**:
    - EU laws: Which EU laws affect deconstruction and circular construction?
    - National regulations: What national regulations exist in the member states?

- **Certifications and labels**:
    - Importance of certifications: Why are certifications important?
    - Requirements: What requirements must be met for certification?

Evaluation

- Self-assessment: online quiz on standards and guidelines.
- Reflection questions: Self-assessment of knowledge of the legal framework.

Module 3: Reuse of materials

This module shifts the focus to the practical reuse of materials. Learners will examine techniques and strategies that enable resources to be preserved and reducing environmental impact. By analyzing real examples and best practices, they will understand how reuse contributes to sustainability and learn to develop their own approaches for application in future projects.

Objectives

- Acquire basic knowledge of techniques and strategies for reusing materials.
- Understand the environmental and economic benefits of material reuse.
- Learn about examples of successful projects and best practices.

EQF competences

Knowledge: Basic knowledge of techniques and strategies for reusing materials as well as the ecological and economic benefits of material reuse.

Skills: Ability to analyze successful projects and best practices for reusing materials.

Competences: Ability to develop own concepts for material reuse and to promote them practical application.

Learning outcomes

1. Techniques and strategies for reuse:

- Learners should be able to describe techniques and strategies for reusing materials and promote their practical application.

2. Advantages of material reuse:

   - Learners can explain the ecological and economic benefits of material reuse and assess its contribution to sustainability.

3. Examples of successful projects:

- Learners should be able to analyze successful projects for the reuse of materials.

Contents

- **Techniques and strategies**:
  - Methods for reuse: What techniques are available for reusing materials?
  - Strategies: How can materials be reused effectively?
- **Advantages of material reuse**:
  - Ecological aspects: How does the reuse of materials contribute to environmental protection?
  - Economic aspects: What are the economic advantages of material reuse?
- **Examples of successful projects**:
  - Best practices: What successful projects are there for the reuse of materials?
  - Case studies: Detailed analysis of best practices.

Evaluation

- Self-assessment: online quiz on techniques and strategies.
- Reflection questions: Self-assessment of knowledge about the benefits of material reuse.

- Analyzing best practices.

Module 4: BIM in deconstruction: digital tools for material mapping/waste tracking

This module introduces digital tools and BIM (Building Information Modeling) to support better planning and management in deconstruction. Learners will explore digital twins, which are virtual models of buildings that show the materials inside and how they can be reused or recycled. The module also presents practical methods for mapping materials and tracking waste, helping learners understand how to monitor and manage resources effectively.

Objectives

- Develop a basic understanding of digital twins in demolition.
- Acquire knowledge of digital tools and techniques for material acquisition.
- Build knowledge of waste tracking and management systems.

EQF competences

Knowledge: Basic understanding of digital twins in demolition as well as digital tools and techniques for material acquisition.

Skills: Ability to explain and apply systems for tracking and managing waste.

Competences: Ability to use digital tools and techniques in practice and to evaluate their efficiency.

Learning outcomes

1. Understanding the digital twins:

   - Learners should be able to explain the basics and advantages of digital twins and outline and recognize their possible applications.

2. Knowledge of digital tools:

   - Learners should be able to describe digital tools and techniques for material acquisition and optimize their use in practice.

3. Tracking and management of waste:

   - Learners can explain waste tracking and management systems and evaluate their efficiency and accuracy.

Contents

- **Introduction to digital twins**:
  - Basics: What are digital twins?
  - Advantages: What advantages do digital twins offer in demolition?
- **Material Mapping**:
  - Digital tools: What digital tools are available for recording materials?
  - Techniques: How are these tools used?
- **Waste Tracking**:
  - Tracking systems: What systems are there for tracking waste?
  - Waste management: How is waste managed effectively?

Evaluation

- Self-assessment: Online quiz on digital twins.
- Reflection questions: Self-assessment of knowledge about waste tracking.

Module 5: Case studies

This module focuses on learning from real-world examples of deconstruction and circular construction. By examining successful projects, learners gain practical insight into how circular principles are applied in practice and how challenges are addressed. The module highlights key lessons learned, helping learners understand what works, what can be improved, and how innovative approaches and technologies are shaping the future of the construction industry. Learners will analyze project implementation, explore problem-solving strategies, and assess the potential of new methods and technologies. By the end of this module, learners will be able to analyze construction and deconstruction projects, identify challenges and solutions.

Objectives

- Examine real-world construction projects that successfully implement deconstruction and circular construction principles.
- Analyze key challenges, solutions, and lessons learned from case studies to enhance practical understanding and problem-solving skills.
- Explore innovative techniques and emerging trends in deconstruction and circular construction, identifying their potential impact on future projects

EQF competences

Knowledge: Knowledge of successful deconstruction and circular construction projects such as well as their challenges and learning points.

Skills: Ability to analyze innovative approaches and new methods and evaluate their potential.

Competences: Ability to transfer findings from case studies to own projects and develop innovative solutions.

Learning Outcomes

1.Analysing successful projects:

- Learners should successfully be able to analyze construction, deconstruction and circular construction projects

2.Findings from case studies:

- Learners should be able to describe challenges and learning points from the case studies and improve their application in future projects.

3. Innovative approaches and methods:

- Learners should be able to explain innovative approaches and new methods and assess their potential for the further development of the industry.

Contents

- **Analysing real projects**:
  - Successful projects: What successful deconstruction and circular construction projects are there?
  - Detailed analysis: How were these projects implemented?
- **Learning points and challenges**:
  - Findings: What insights can be gained from the case studies?
  - Challenges: What challenges were there and how were they overcome?
- **Innovative approaches**:
  - New methods: What new methods are there in deconstruction and circular construction?
  - Technologies: Which innovative technologies are used?

Evaluation

- Virtual case studies: detailed examination and discussion.
- Reflection questions: Self-assessment of findings from case studies.

Module 6: The practice of deconstruction

This module introduces the practical methods, tools, and techniques needed to carry out deconstruction projects effectively. It also highlights success factors and best practices that help make projects safe, efficient, and high quality. Learners will explore how to plan, carry out, and monitor deconstruction projects from start to finish. The focus is on understanding what works in real projects and how to apply these methods in practice.
By the end of the module, learners will be able to use practical tools, explain what makes projects successful.

Objectives

- Acquire basic knowledge of practical methods, tools and techniques for deconstruction
- Develop an understanding of success factors and best practices

Build knowledge about the planning, implementation and monitoring of deconstruction projects

EQF competences

Knowledge: Basic knowledge of practical methods, tools and techniques for deconstruction as well as success factors and best practices.

Skills: Ability to the planning, implementation and monitoring of explain deconstruction projects.

Competences: Ability to successfully plan, execute and monitor deconstruction projects

Learning outcomes

1. Knowledge of practical methods and techniques:

- Learners will be able to use practical methods, tools and techniques for describing and ensuring their effective application of deconstruction

2. Understanding the success factors:

- Learners are able to explain success factors and best practices and their significance for the quality and efficiency of deconstruction projects.

3. Planning and realisation of projects:

- Learners can explain the planning, implementation and monitoring of and ensure their successful realization of deconstruction projects.

Contents

- **Practical methods**:
    - Tools: Which tools are used in deconstruction?
    - Techniques: Which techniques are important in practice?
- **Best Practices**:
    - Success factors: What factors contribute to the success of deconstruction projects?
    - Proven procedures: What are the best practices?
- **Project management**:
    - Planning: How are deconstruction projects planned?
    - Implementation: How are these projects implemented?
    - Monitoring: How is progress monitored and evaluated?

Methodology

- Online learning tool, self-study

Evaluation

- Virtual exercises: Application of methods and techniques.
- Reflection questions: Self-assessment of knowledge about success factors.
- Online project work: Planning of a deconstruction project.

Education plan: BIM in deconstruction

Duration: 540 minutes Workload

Target group: People with completed vocational training, EQF level 4-5

Overall structure

Module 1: Introduction to Deconstruction and Circular Construction

Module 2: Standards and Regulations

Module 3: Reuse of Materials

Module 4: BIM in Deconstruction: Digital Tools for Material Mapping/Waste Tracking

Module 5: Case Studies

Module 6: The Practice of Deconstruction

Module 1: Introduction to Deconstruction and Circular Construction

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **Introduction to deconstruction**:
    - Definition, objectives and significance.
    - **Learning methods**: Online lectures, discussion forums (optional).
    - **Assessment**: Online quiz, self-assessment.
- **Principles of Circular Construction**:

- Sustainability, resource conservation, environmental benefits.
- **Learning methods**: Online lectures, discussion forums (optional).
- **Assessment**: Online quiz, self-assessment.

- **History and development**:
  - Evolution of deconstruction, milestones.
  - **Learning methods**: Virtual case studies (optional), discussion forums (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Module 2: Standards and Regulations

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **National and European standards**:
  - Relevant standards and directives.
  - **Learning methods**: Online lectures, webinars with experts (optional).
  - **Assessment**: Online quiz, self-assessment.
- **Legal framework conditions**:

- EU laws, national regulations.
- **Learning methods**: Online lectures, webinars with experts (optional).
- **Assessment**: Online quiz, self-assessment.

- **Certifications and labels**:
  - Meaning, requirements.
  - **Learning methods**: Virtual group work (optional), webinars with experts (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Module 3: Reuse of Materials

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **Techniques and strategies**:
  - Methods for reuse, strategies.
  - **Learning methods**: Virtual workshops (optional), online lectures.
  - **Assessment**: Online quiz, self-assessment.
- **Advantages of material reuse**:
  - Ecological and economic aspects.

- **Learning methods**: Online lectures, discussion forums (optional).
- **Assessment**: Online quiz, self-assessment.

- **Examples of successful projects**:
  - Best practices, case studies.
  - **Learning methods**: Virtual case studies (optional), discussion forums (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Module 4: BIM in Deconstruction: Digital Tools for Material Mapping/Waste Tracking

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **Introduction to digital twins**:
  - Basics, advantages.
  - **Learning methods**: Online demonstrations, webinars with experts (optional).
  - **Assessment**: Online quiz, self-assessment.
- **Material Mapping**:
  - Digital tools, techniques.

- **Learning methods**: Virtual exercises (optional), online demonstrations.
- **Assessment**: Online quiz, self-assessment.

- **Waste Tracking**:
  - Systems for tracking and managing waste.
  - **Learning methods**: Online demonstrations, webinars with experts (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Module 5: Case Studies

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **Analysing real projects**:
  - Successful projects, detailed investigation.
  - **Learning methods**: Virtual case studies (optional), discussion forums (optional).
  - **Assessment**: Online quiz, self-assessment.
- **Learning points and challenges**:
  - Insights, challenges.

- **Learning methods**: Virtual case studies (optional), discussion forums (optional).
- **Assessment**: Online quiz, self-assessment.

- **Innovative approaches**:
  - New methods, technologies.
  - **Learning methods**: online group work (optional), discussion forums (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Module 6: The Practice of Deconstruction

Time volume: 90 minutes

PowerPoint slides: Maximum 60

Contents

- **Practical methods**:
  - Tools, techniques.
  - **Learning methods**: Virtual exercises (optional), online lectures.
  - **Assessment**: Online quiz, self-assessment.
- **Best Practices**:
  - Success factors, best practices.
  - **Learning methods**: Online lectures, discussion forums (optional).

- **Assessment**: Online quiz, self-assessment.

- **Project management**:
  - Planning, implementation, monitoring.
  - **Learning methods**: online project work (optional), mentoring (optional).
  - **Assessment**: Online quiz, self-assessment.

Online teaching session (optional)

- **Time-out sessions**: Tasks are worked on during a virtual meeting to actively accompany the transfer of knowledge.

Certificate

Certificate: BIM in deconstruction (EQF Level 4-5)

Evaluation criteria and scoring system

To obtain the certificate, learners must achieve a minimum score of 70%. The total score is made up of the following components:

Certification example for the module: Deconstruction and Circular Construction

Certification examination

Total score: 100 points

Pass mark: 70 points (70%)

Exam structure

1. **Multiple-choice questions** (40 points)
    - 20 questions, 2 points each
    - Example:
        - Question: Which of the following statements best describes the principles of circular construction?
            - A) Maximization of resource consumption
            - B) Minimizing waste and promoting reuse
            - C) Use of non-renewable resources
            - D) None of the above
        - Correct answer: B

2. **Short answer questions** (30 points)
    - 6 questions, 5 points each
    - Example:
        - Question: Explain the importance of digital twins in demolition and their advantages.
        - Answer: Digital twins are virtual models of physical objects or systems. In demolition, they offer advantages such as accurate material recording, efficient planning and waste tracking.
3. **Self-assessment** (10 points)
    - Reflection questions for self-assessment, 10 points
    - Example:
        - Question: What new knowledge and skills have you acquired through this module? How will you apply them in your professional practice?

Evaluation criteria

- **Multiple-choice questions**: 2 points are awarded for each correct answer.
- **Short answer questions**: Answers are assessed for completeness, accuracy and clarity**. (Optional)**

- **Case study analysis**: evaluation based on the depth of the analysis, identification of success factors and challenges
- **Self-assessment**: Reflection questions are assessed for honesty and depth of self-reflection.

Result

- **Passed**: 70-100 points
- **Failed**: 0-69 points