Education for zero energy buildings using Building Information Modelling

O7.4 BIMzeED Toolkits

Draft edition

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1. Executive Summary

This report is a useful toolkit of information for educators and students on the BIMzeED training course. The toolkit for educators is a short, summarised set of instructions for HEIs on how to best use the BIMzeED project resources and the training platform. Moodle could be used to enhance undergraduate, post-graduate and VET Programmes.

The toolkit for students is a short report and instructions for students on how to use the training platform and maximise the benefits of the course.

Summary of why we chose topics for trainings, how and what is created, piloting delivery techniques and how these are useful for trainer/educators and students/SMEs (BIM Toolkits)

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2. Introduction to BIMzeED

Brief summary of WP2, summary of WP3 and summary of Moodle comparative study, listing useful tools in Moodle

2.1   Project Summary & background

The BIMzeED project focuses on the training needs for the current and future construction industry with the main purpose to encourage **1) better employability 2) low-carbon growth, 3) digital and NZEB skills 4) increase in youth employment**. The challenge of the BIMzeED project is to overcome skills mismatching and improve employability in the current European construction market by improving and extending the existing skills of trainers, architects, SMEs, site managers, craftworkers and other experienced operatives.

The construction industry across Europe is facing major challenges in achieving energy efficiency targets, for Near Zero Energy Buildings (NZEB), but they are also experiencing a digital revolution, with Building Information Modelling (BIM) and other digital construction and management tools. The BIMzeED project intends to improve the human-capital basis of the construction sector, identified as a strategic initiative by the European Commission, acting on HEIs and VET systems in Europe. The BIMzeED project supports the construction industry, through education and training to upskill on technical innovation and digitalization.

The objectives of the BIMzeED project are to:
- Identify the knowledge and skills gap in BIM and NZEB within the HEI and construction sector for each partner country, i.e., Croatia, Hungary, Ireland and Spain.
- Update the knowledge and skills of Educators and Trainers, Students and SMEs in the field of BIM and NZEB through provision of specific innovative active educational materials and delivery.

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- Stimulate development of new training and education programmes at Higher Education Institute, HEI or Vocational Educational Training, VET in the fields of BIM/NZEB by grouping the micro-learning units together to create new programmes or update existing programmes by integrating them into the programmes and finally use the micro-learnings as independent learning tools for HEI/VET and the construction industry.
  - o Transfer knowledge of BIM and NZEB to and from other countries.
  - o Strengthen links between lecturers, industry and SMEs with innovative technologies and installations creating connected learning communities (viewing case studies, on-site site visits, industry demonstrations)
  - o Strengthen employability in teaching and SMEs, known as business development cooperation.

2.2   Development of the Learning Units LUs

NZEB

It has become clear that better management of the information during the whole life cycle of the NZEB is absolutely necessary in order to avoid mistakes and have trustful information at any time / when an intervention is necessary. This can be achieved by using BIM approach.

BIM

In the surveys that was distributed to educators and construction stakeholders respondent needed to assess their skills and knowledge and skills and knowledge provided by educations provided. The scale was the same as in NZEB field:
1. Fundamental Awareness (basic knowledge)
2. Novice (limited experience/Basic Level of Competency)
3. Intermediate (practical application/Proficient)
4. Advanced (applied theory)
5. Expert (recognised authority)

2.3   Learning Units

1) Collaborative BIM to achieve NZEB

2) BIM and NZEB for Workers

3) NZEB Realization and commissioning: Building Envelope and Air Tightness

4) NZEB Realization and commissioning: Building Services and Smart Technologies

5) NZEB Realization and commissioning: Quality Assurance

6) BIM Model Uses during construction

7) BIM Model Uses for specification and quantification

8) BIM Model Standardization for NZEB Design

9) Building Energy Modelling (BEM) Design and Export

10) Energy Simulation with BIM Tools

11) Nearly Zero Energy Building Facility Management

12) BIM in Facility Management Software (CMMS)

The following section elaborates on each learning unit.

ALL LUs can be found and accessed through our project website: www.bimzeed.eu

2.4   Descriptors and learning outcomes of each developed Learning Unit

LU1: Collaborative BIM to achieve NZEB (add icons or present in blocks)

Descriptor

The following learning unit aims to give all tools and knowledge necessary to all project team

members for BIM workflow generation and application. For this purpose, roles and

responsibilities of the different construction team members will be taught, as well as the necessary documents and regulations to consider for BIM methodology application. BEP, BIM Management Plan, statement of requirements or statement of work are some of the topics we will deal in an innovative way.

Learning Outcomes

- Create a collaborative workflow between all construction team members using BIM.
- Identify the role and responsibilities of each construction team members.
- Identify the building regulations applicable and generate all documents to achieve NZEB design.

LU2: BIM and NZEB for Workers

Descriptor

The following learning unit is intended to inform workers of the BIM methodology that has been used during project design, in this way, not only is the process speeded up, but there is an awareness to prevent and anticipate solutions. For this reason, digital communication using BIM tools on site between the design team and the construction team is essential. Knowledge of NZEB will help you recognise the parameters which you should pay more attention to and execute effectively.

Learning Outcomes

- Carry out communication between design and construction teams.
- Use the BIM methodology on site to apply problem solving workflow.
- Evaluate the situation and apply the necessary prior actions to prevent setbacks using BIM methodology.
- Understand and apply the NZEB principles on site.

LU3: NZEB Realization and commissioning: Building Envelope and Air Tightness

Descriptor

The following learning unit is aimed at the creation of BIM objects suitable for NZEB design and their correct use within the BIM model. Therefore, principles and parameters affecting building envelope and air tightness, quality controls to guarantee NZEB values as well as best practices will be studied. All this with an active and innovative methodology, thanks to the digital tools that provide greater ease in the application of solutions in the design.

Learning Outcomes

- Use tools for BIM object creation (foundations, walls, roofs...)
- Understand the principles that affect an element to be suitable in an NZEB building design.
- Guarantee a correct NZEB design through the application of a quality control of the construction model.
- Base NZEB building design on suitable BIM objects.

LU4: NZEB Realization and commissioning: Building Services and Smart Technologies

Descriptor

The following learning unit is aimed at the creation of BIM objects suitable for NZEB design and their correct use within the BIM model. Therefore, principles and parameters affecting building services and smart technologies, quality controls to guarantee NZEB values as well as best practices in the field will be studied. All this with an active and innovative methodology, thanks to the digital tools that provide greater ease in the application of solutions in the design.

- Learning Outcomes
- Use tools for BIM object creation (energy systems, mechanical ventilation...).
- Identify the principles that affect an element to be suitable in an NZEB building design.
- Guarantee a correct NZEB design through the application of a quality control of the construction model.

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- Base NZEB building design on suitable BIM objects.

- Perform analyse energy demand calculations for building services design.

- Compare and contrast different technologies to facilitate selection of an appropriate solution or solutions.

LU5: NZEB Realization and commissioning: Quality Assurance

Descriptor

The following learning unit focuses on quality assurance of the elements granting a NZEB qualification to the building, like energy production systems and constructive elements, using BIM methodology as a communication tool.

Learning Outcomes

- Guarantee energy saving systems and sustainable materials quality.

- Determine different quality controls and verify their good implementation.

- Coordinate the project team to ensure the quality control in the construction site.

LU6: BIM Model Uses during construction

Descriptor

The following learning unit focuses on the uses that BIM models provide for optimization during construction and a digital twin design. In an innovative way, solutions for clashes between different disciplines and engineering calculations via a BIM model, will be explained. Likewise, special emphasis will be placed on an active work methodology aimed at anticipating and solving problems.

Learning Outcomes

- Implement and design a digital twin of the building.

- Optimize the BIM model and create models with zero clashes.

- Implement an active working methodology in the use of BIM for constructive design.

- Generate structure and systems calculations from the BIM model.
- Audit the BIM model project provided by the client (Clash detection, technical issues, LOD)

LU7: BIM Model Uses for specification and quantification

Descriptor

The following learning unit is intended for the model data exploitation through cost extraction, site planning and material listing. Furthermore, you will acquire knowledge in the design of a construction model considering time (4D) (construction planning, tasks management…), cost (5D) (budgeting, cost efficiency…) and environmental aspects (6D) (bill of materials, LCA...).

Learning Outcomes

- Design construction models based on the effectiveness and efficiency provided by the BIM methodology.
- Analyse model data to minimize costs, time and clashes in site planning.
- Conceptualize and apply the BIM dimensions (4D, 5D and 6D).

LU8: BIM Model Standardization for NZEB Design

Descriptor

The following learning unit is based on standardizing the structure of the BIM model based on European regulations and national requirements to achieve an NZEB design. Also, the necessary documentation to validate NZEB will be studied and thus optimize the workflow.

Learning Outcomes

- Standardize the BIM model data structure to accomplish NZEB goals based on European directives and national requirements.
- Generate the required documentation for NZEB validation.
- Optimize the design workflow based on the standardized BIM model.

LU9: Building Energy Modelling (BEM) Design and Export

Descriptor

The following learning unit will teach you how to develop a Building Energy Model (BEM) and how it affects the design of NZEB buildings. BEM grants advantages to thermomechanical and energy performance fields. Export properties and functionalities will be explained to deliver a BEM to an energy simulation tool. Considering the knowledge acquired in this training you will speed up your work, be able to prevent future needs and provide a preventive solution.

Learning Outcomes

- Generate a Building Energy Model (BEM) and evaluate its positive impact on the workflow of NZEB design.
- Design and export a Building Energy Model (BEM) considering NZEB requirements and parameters.
- Generate a Building Energy Model (BEM) of existing buildings to rehab them into NZEB buildings.

LU10: Energy Simulation with BIM Tools

Descriptor

The following learning unit focuses on the analysis and interpretation of a Building Energy Model (BEM). In order to guarantee economic viability and to provide solutions, advanced knowledge in BEM analysis is indispensable in the first steps of the construction design process. Aspects and parameters involved in a NZEB qualification will be studied and analysed to ensure NZEB values before construction. Preventing and anticipating future problems will speed up your work and all the agents involved.

Learning Outcomes

- Analyse a Building Energy Model (BEM).
- Make economic feasibility studies and apply solutions.

- Verify and evaluate the parameters needed to accomplish a NZEB building.

LU11: Nearly Zero Energy Building Facility Management

Descriptor

The following learning unit provides you with knowledge to improve efficiency during facility management. Preventing and anticipating future problems or improvements and documenting them in a digital communication system between the design team and the facility team is essential. This learning unit will give you the knowledge to understand the building parameters to consider in order to guarantee its NZEB qualification during its use, like spaces and users schedules, climate control changes, etc.

Learning Outcomes

- Diagnose and improve energy efficiency during the facility management.
- Implement tools and techniques for communication with users to collect suggestions.
- Validate and carry out preventive efficiency controls.

LU12: BIM in Facility Management Software (CMMS)

Descriptor

The following learning unit focuses on the object classification, data structure and model generation in order to create a correct BIM model for facility management systems. This unit will focus on standards like COBie and best practices documents. A facility management software (CMMS) with the support of a BIM model is essential to speed up urgent interventions and to communicate issues to other agents detailing placement and situation in the building.

Learning Outcomes

- Structure model data for a correct facility management implementation with BIM.
- Classify BIM objects, spaces and other BIM parameters to be compatible with facility management software.

- Generate a model considering maintenance parameters.

2.5 Moodle

Review O4.1 https://bimzeed.eu/reports/

- What moodle can do and provide

- Use of gamification

- Forums

- Uploading and submissions assessment etc

- Use of automated assessment grading

3. Toolkits for Educators

A short, summarised set of instructions for HEIs on how the BIMzeED project resources and the Moodle could be used to enhance undergraduate, post-graduate and VET Programmes. Discuss the tools and usefulness. Refer to trainers resources.

A short report and instructions for students on how to use the learning portal and maximise the benefits of the course.

3.1 Train the Trainer Resources

- Complete the Train the Trainers programme successfully and get the Badge as a Certified BIMzeED Trainer.

- Explain the process and tools in brief.

3.2 LU Training Resources

The following training material has been developed for all learning units to support educators when teaching the BIMzeED course in parts, or as a whole.

The material is accessible through the training centre on the project website: https://bimzeed.eu/course-information/

- Slides and presentations: PPT with comments and guidelines.

- Instructions for practical exercises.

- Theoretical Assessment – short Quizzes.

- Practical Assessment – short projects worked on during the course using BIM tools.

- A checklist table (spreadsheet) defining the different points to be evaluated and the different indicators to score.

- Instructions to facilitate grading and correction activities will be developed. Different type of files (PDF, WORD, EXCEL, etc.)

4. Toolkits for Students/Learners

4.1 LU Resources

Put under tool headings or as target groups – worker/professions or level EQF. Review and add types of tools into a table for each LU. Discuss how these tools are useful and beneficial for the LUs.

4.2 Learning portal Moodle

To login to the BIMzeED learning portal, please follow the below steps;

1. Visit www.bimzeed.eu
2. Click 'Login' on the Menu bar
3. Enter the username and password you received when you registered for the course

   There is a video on how to use moodle and how to login

4.3   Discussion Forum

A place that give all learner and trainers an opportunity to hold discussions online. The discussion is started by one member by posting a topic, other members reply and interact. This allows the group to share information and ideas.

4.4   Digital tools

- BIM for design
- Digital tool on site
- Mobile apps
- NZEB tools
- Building Performance modelling & Management tools

4.5   In Class exercises and Tasks

Demo videos, demo activities, (use of vimeo for the videos)

4.6   Self-directed resources

Reading resources and videos, URL links etc (use of YouTube for videos)

4.7   Home Study activities

Activities, submissions etc

4.8   Tips on how to gain the most out of on-line education

Some of the difficulties students encounter with on-line education include:

- Technical issues.

- Distractions and time management.

- Staying motivated.

- Understanding course expectations.

- Lack of in-person interaction

- In order to mitigate these challenges, below are some simple tips on how to gain the most out of on-line education:

- Familiarise yourself with online learning practices and expectations.

- Ensure you have reliable internet access.

- Have a dedicated study space.

- Identify your learning objectives and goals.

- Create a study plan and follow it.

- Participate in online discussions.

- Eliminate distractions.

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Conclusions and Recommendations

4.9   Contact information in case of questions

For any questions or queries you may have in relation to the course, please contact info@bimzeed.eu or the project coordinator LIT, IE.

5. References