Module 7

BIM Uses in Construction

Digitalisation in Construction

24 partners 12 countries

Date of Event

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BIM uses in construction | Summary

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To equip the learner with the relevant knowledge required to understand how a BIM model data can carry out costings, verify materials and quantity and coordinate the construction work.

BIM uses in construction | Objectives

1. Outline how the separate disciplines or models can be brought together or "federated" in a BIM Viewer
2. Demonstrate how to navigate import/export data and save NWC files
3. Outline how to create a federated model, navigate viewpoint, review and select functions and importance of clash detection
4. Demonstrate how to create a federated model and navigate the viewpoint, review, select and clash detection functions
5. Outline and understand the importance of the functions time-liner and qualification
6. Demonstrate simply how to navigate the time-liner and quantification functions using demonstration model
7. Outline the use of BIM objects for each phase of the construction process (preconstruction, construction and post construction).
8. Outline BIM model uses for coordination, design review, clash detection, specification, costing, quantification and energy analysis.

BIM uses in construction | Content

Topic 1 – BIM objects

Topic 2 – Maturity levels

Topic 3 – Use of BIM in each phase

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1. BIM Objects

Advantages of using BIM versus traditional models

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Working with BIM models means working with parametric construction entities that provide precision, productivity and agility in changes, integrating different layers of information in a single container.

↓

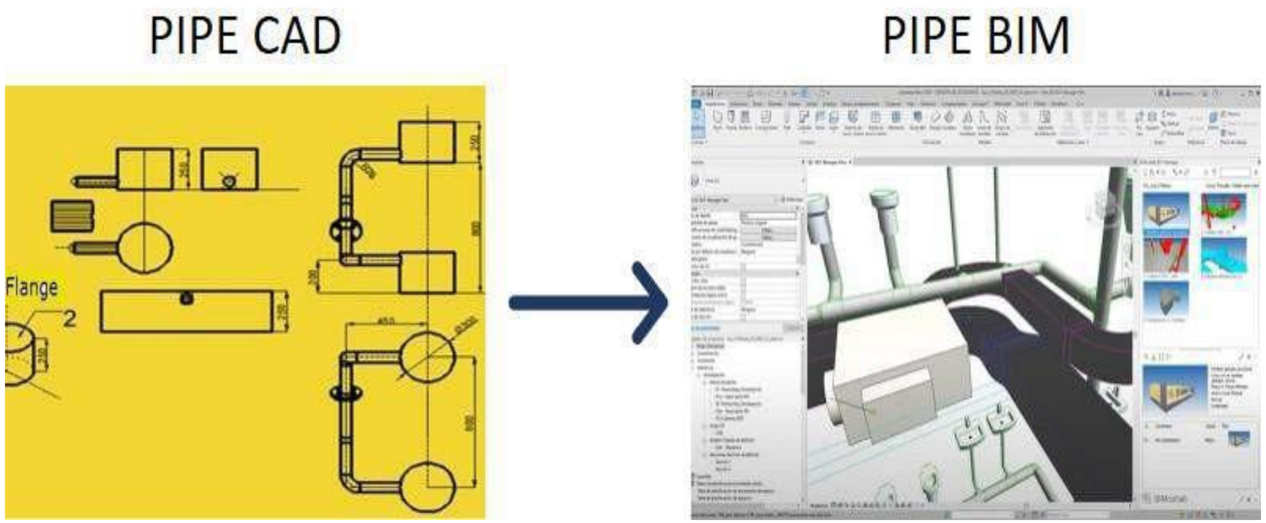
BIM MODEL

A CONSISTENT MODEL WITH SUFFICIENT INFORMATION TO GENERATE ANY DOCUMENTS NEEDED FOR DESIGN, CONSTRUCTION AND MAINTENANCE OF THE ASSET.

Advantages of using BIM over traditional models

BIM Applications

- They imitate the real construction process and use real construction elements (walls, floors, columns, windows) that have parametric properties. → a change in the design causes automatic changes in the affected elements.
- Elements of BIM and the model are intelligent → they have built-in parametric information → accurate and detailed information to obtain different information (budget, revisions and maintenance).



What is the BIM object?

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Virtual elements are needed in the construction of the virtual model → BIM objects and geometric entities

Each element will be identified and classified with respect to certain parameters → non-graphical information contained in a BIM object. The term *attribute* is also used.

Attribute → contains the information (graphical and non-graphical) that allows the BIM object to identify, define its traceability, filter, measure, quantify, qualify, etc., the different data:

- Locate the object within the model (e.g., 1st floor, basement -2).
- Know what function the object fulfils within a system (e.g., whether it is a beam or a bronchial beam).
- Know what type of element it is.
- Identify what materials it is made of.
- Any other information relevant to the work to be done.

2. BIM maturity levels

BIM maturity levels

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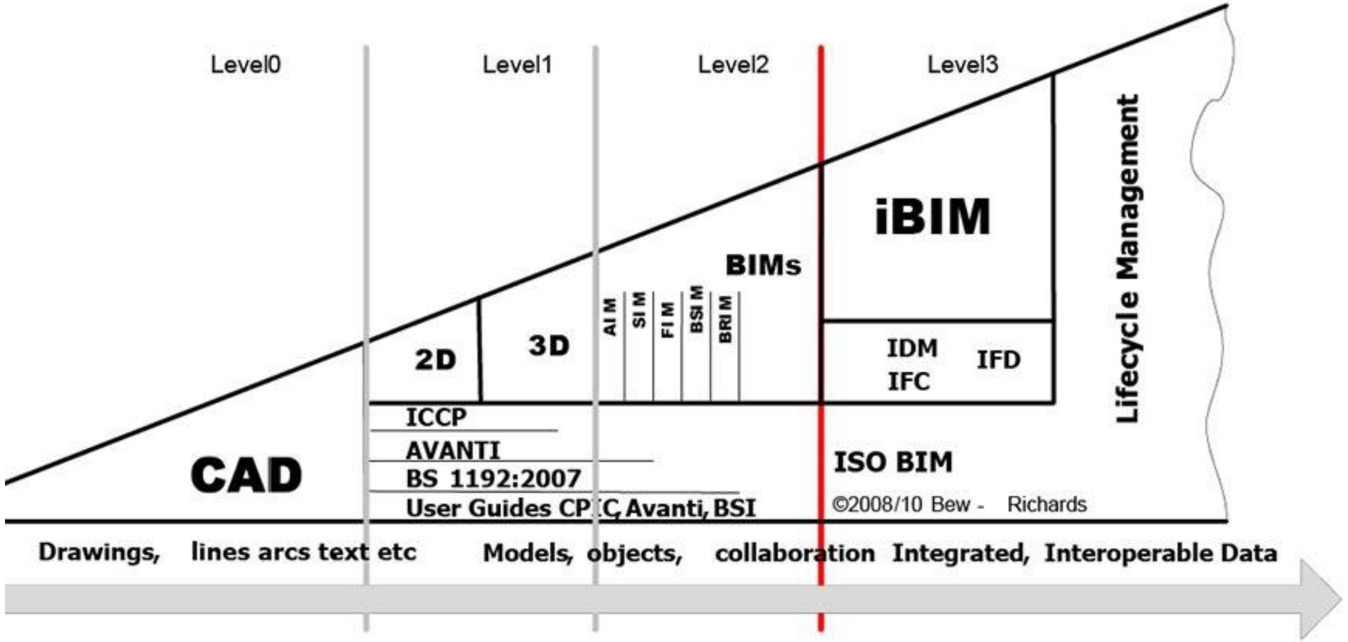
The UK maturity model - also known as the iBIM model (the name of its highest level) or the BIM Wedge (due to its famous shape) - was developed by Mark Bew and Mervyn Richards in 2008.



Level 0 BIM

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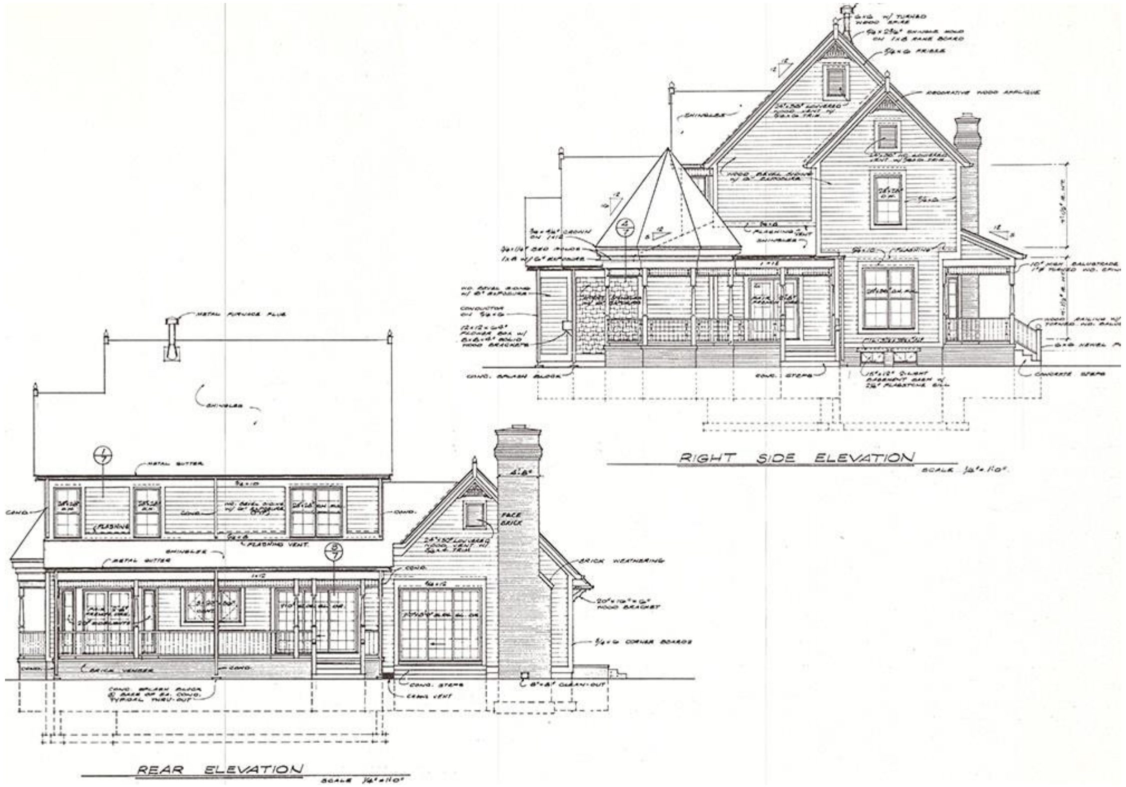
The range of levels that this form of modelling can take are described as 'maturity levels' and are described bon next slides:

Level 0 BIM

Unmanaged computer aided design (CAD) including 2D drawings, and text with the paper-based or electronic exchange of information but without common standards and processes. Essentially this is a digital drawing board.



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- **Level 1 BIM**

2D and 3D models. A Common Data Environment (CDE) is used in this case.

A CDE is an online shared repository where all the data of the project are collected and managed.

BIM level 1 focuses on the transition from CAD information to 2D and 3D one.

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Level 2 BIM

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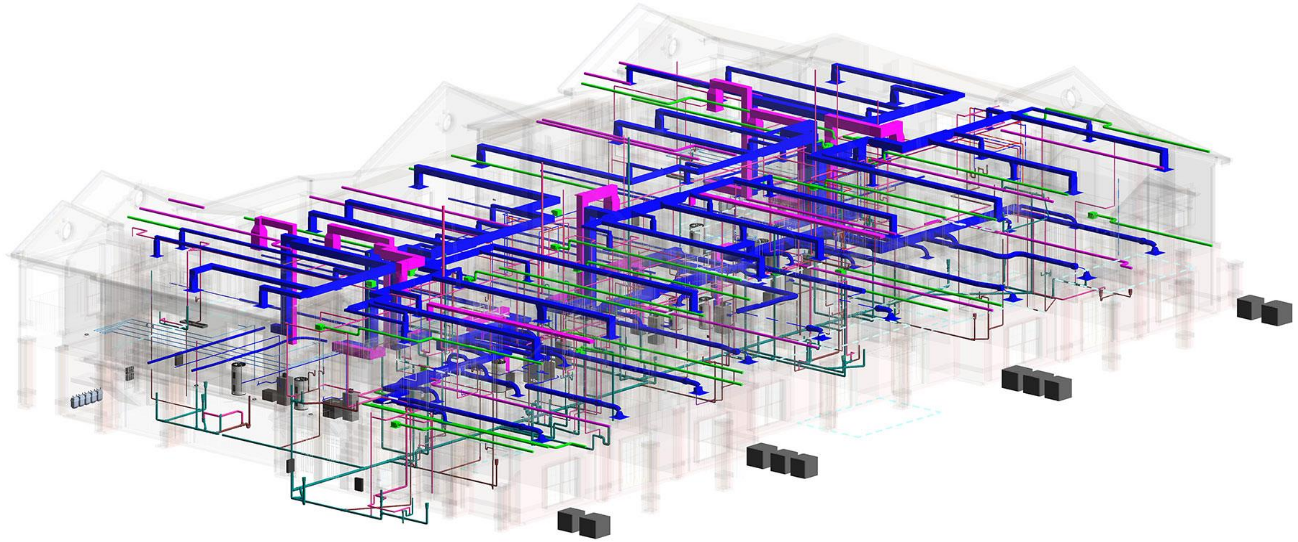
Managed 3D environment with data attached, but created in separate discipline-based models. These separate models are assembled to form a federated model but do not lose their identity or integrity. Data may include construction sequencing (4D) and cost (5D) information.



Level 3 BIM

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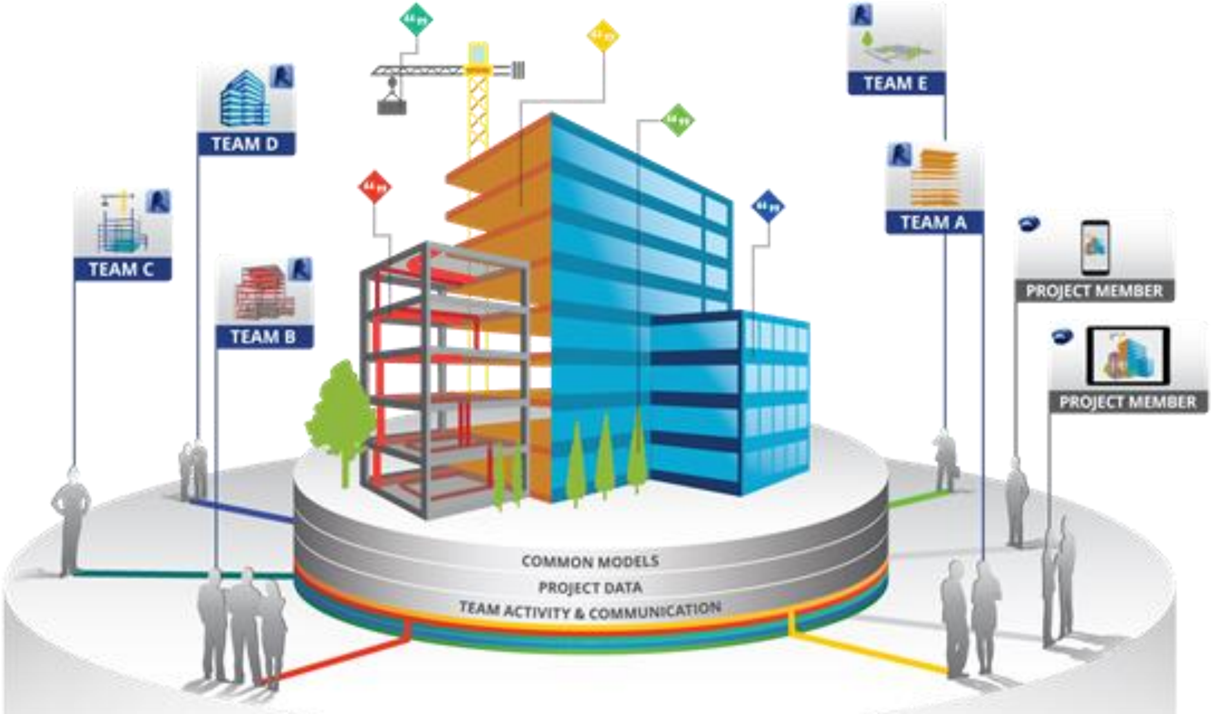
Enotni spletni model projekta, ki omogoča sodelovanje, z zaporedjem gradnje (4D), stroški (5D) in informacijami o življenjskem ciklu projekta (6D). To se včasih imenuje "iBIM" (integrated BIM) in je namenjeno doseganju boljših poslovnih rezultatov.

https://thebimhub.com/



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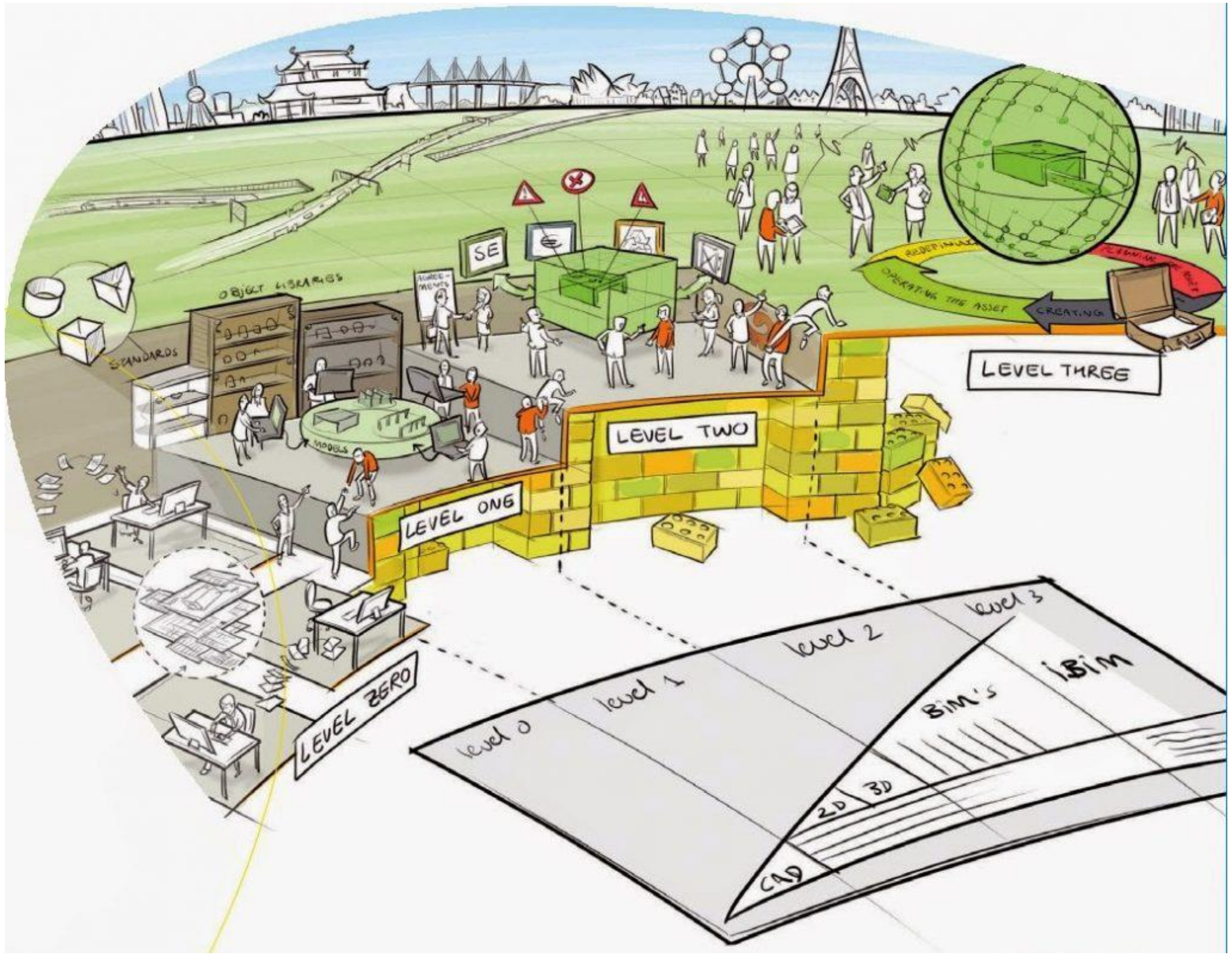

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3. Use of BIM in each phase

BIM application in the early stages of project phases oriented towards pre-construction modelling that seeks the virtual construction of a project in order to simulate and foresee those errors that could arise in the real construction.

A distinction is made:

- BIM itself → the model.
- Virtual design and construction process that will be supported by BIM *Virtual Design and Construction* (VDC)

WE DO NOT TALK ABOUT VDC WITHOUT BIM

Principles of pre-construction modelling

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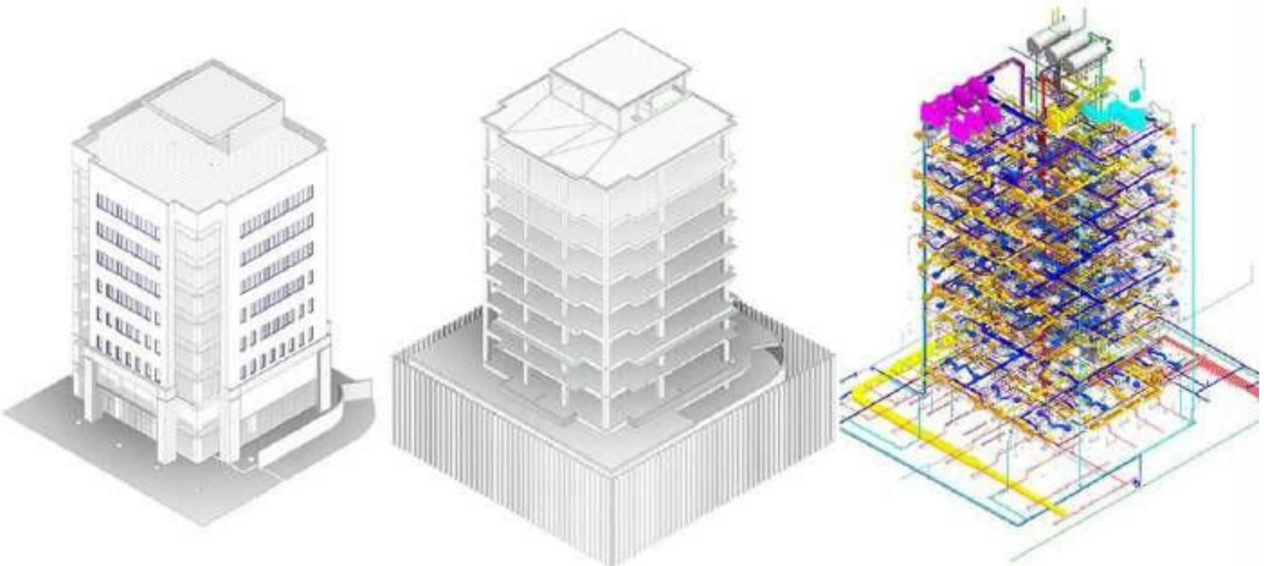
It is oriented towards generating one (or several) BIM models that serve as a basis for the subsequent construction and maintenance of a specific asset. It is about generating a digital model oriented towards obtaining the necessary documentation to develop a construction project for execution.



Architectural modelling (I)

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Any BIM-based project (building or infrastructure) starts with an architectural reference model — model that serves as the basis for the rest of the partial (or specialised) models that will be fundamental for most of the analysis and simulations.

Each structural element that is part of the model must be created, not just drawn — use of specific tools for such creation that allow any programme integrated in the openBIM flow to recognise the element, regardless of the software with which it was created.

Each structural element modelled shall have:

- A 3D design.
- Parametric information → database associated with different types of information (material with which it is going to be built, unit price of such material, manufacturer's data, date of construction, etc.).

Architectural modelling (II)

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A BIM modeller must have a wide catalogue of elements to be able to carry out the virtual construction process with guarantees.

Some parametric characteristics of the objects will be common to all BIM objects regardless of the modeller (software tool) with which they have been created — will be reflected in the different openBIM protocols or will be specific to each of the modellers.

(More information on specific tools: Unit 2B-Architectural Modelling: Tools)

MEP Modelling (I)

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Systems modelling involves the definition of other elements beyond the architectural model: materials, layouts, sections, manufacturers and the relationship of each element to the rest of the building (systems).
The same principles apply for MEP modelling as for architectural modelling.

MEP installations → different systems or sub-disciplines → *Mechanical, Electrical & Plumbing* = air conditioning, electricity and plumbing.

MEP modelling functions:

- Move from a schematic model design to a complete definition of the different elements of the model.
- Better coordination between disciplines.
- Powerful analysis and simulation tool to improve facility design and optimise energy consumption throughout the asset's life cycle.
- High value for asset users and facility maintenance.

MEP Modelling (II)

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Requirements for working with facilities to be included in the BIM model:

- Applicable regulations.
- Quality demands of the client/developer.
- Manufacturers' specifications of the different elements of the building and/or infrastructure.

2 strategies for information input into the BIM model:

- Directly using specialised MEP modelling software.
- Indirect, with links that relate elements of the model to external documents containing information on the requirements in a biunivocal way.

Separate MEP models can be designed for each of the installations while maintaining consistency between all of them.

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MEP Modelling (III)

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Real objects are used that correspond to real elements of the installation (pipes, terminals, ducts, machinery, etc.).
They are used:

- Generic elements in early design phase.
- Specific commercial elements in the implementation, construction and maintenance phase.

The use of real objects does not oblige to do it always in 1:1 scale → the designer will define the level of detail according to the specific use of the model.

The modelling of the planimetric information is done in a separate design from the facility design – the drawings will show coordinated information between:

- Different installation sub-disciplines (mechanical, plumbing) - Major disciplines: architecture, structures and installations.
- Spatial definition for the implementation of the project – can be done in early design phases to avoid errors, improving results and avoiding cost overruns associated with the execution and maintenance phase.

MEP modelling: tools

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- Modellers as tools capable of being integrated in a collaborative workflow that allow the precise definition of the elements that make up the installations.

- Factors affecting the choice of software:

- Interoperability – tools that allow seamless data exchange with other disciplines (using open standards such as IFC with specific plugins.

- Capacity – it is desirable to use a modeller that covers all MEP disciplines with quality and the same level of complexity.
- Localisation – to have a programme with information adapted to local regulations.

(More information on specific tools: Unit 2B-Installation Specific Modelling: Tools)

Structural model

Different demands and requirements depending on the phase of the project:

- Pre-project phase — Starting from the architectural design, the suitability of solutions will be analysed for economic (costs) and technical (constructive viability) evaluation.

- Basic project phase → development of the structural model elements to assess their compatibility with the facility systems and solutions defined by the design team.

- Project implementation phase — includes detailed structural elements (position, dimension, sections and materials) and other requirements (e.g., fire stability).

Integration of structural models allows the virtual construction of a building that reflects its built equivalent.
→ increased control over the decisions to be taken during project design and the smooth exchange of information between decision-makers (technicians, developers and builders).

Structural model: tools

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Priority in the choice of tools → seek maximum interoperability between the various tools used by the different actors in the project. → use of open standards for information exchange (IFC or other openBIM open standards)

Some architectural modellers allow the design of structural elements, but specific structural modelling tools can also be used to facilitate the generation:

- Calculation models.
- Complex structural solutions.
- Documentation required for the construction phase (usually in the form of drawings).

(More information on specific tools: Unit 2B-Specific Modelling of Structures: Tools)

Energy design (I)

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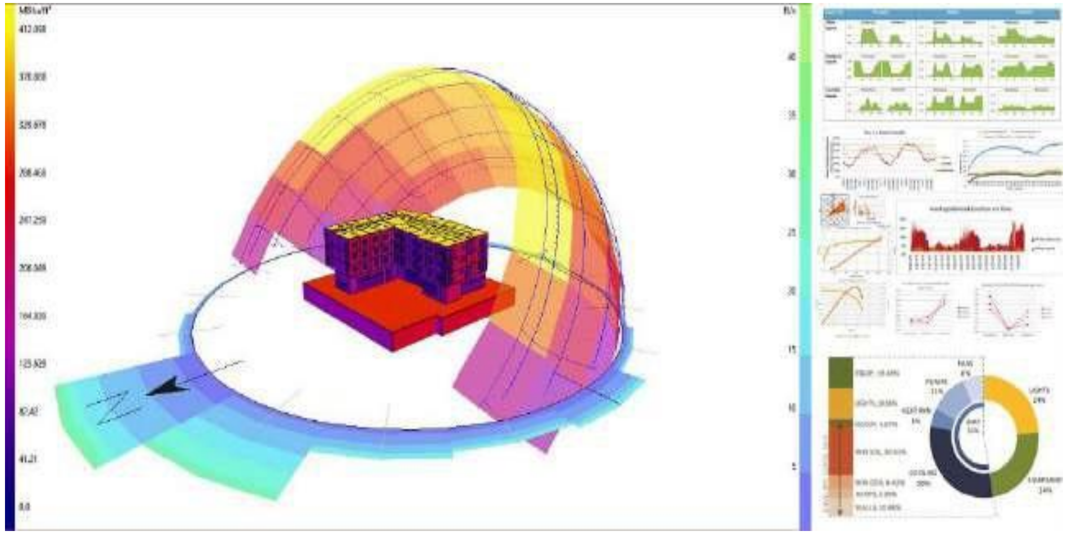
It is possible to perform energy analysis of a building or spaces or structures from early design phases with the pre-construction of virtual models based on real building data.

Energy analysis as a transversal design tool — parametric information accompanying the model, which allows for immediate changes to improve the outcome and optimal use of resources.



Energy design (II)

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Analysis in the different phases:

Conceptual design — basic simulations are carried out with initial comfort and energy requirements based on the minimum architectural model.

Schematic design — with the different architectural models (including MEP), alternatives can be analysed in order to choose the optimal solution.

Final design — Once the final solution has been chosen, energy analysis tools provide a quantification of the energy that the building will consume (=energy label) and the impact of the use of the facilities during the operational phase.

Construction phase → evaluation of different options, specific design modifications and variations in the equipment to be installed.

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Energy design: tools

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Tool requirements:

- File exchange — it is recommended to use tools that are integrated in the openBIM workflow (with files in IFC import format).

- Ability to perform dynamic calculations — consider factors such as thermal inertia, covering a whole year with hourly intervals, internal thermal loads and times of use of spaces and facilities.

- Starting data — as indicated by the tools of other disciplines, which makes it necessary to control the architectural-structural model of facilities.

(More information on specific tools: Unit 2B-Modelling for Energy Design: Tools)

Assessment

QUIZ!

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Thank You

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CNC Confederación Nacional de la Construcción

EBC CONSTRUCTION SMEs EUROPE

FFB FEDERATION FRANÇAISE DU BATIMENT

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