BIMEPD

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# ADAPTED SENIOR TRAINING PROGRAM ON BIM METHODOLOGIES FOR THE INTEGRATION OF EPD IN SUSTAINABLE CONSTRUCTION STRATEGIES

2020-1-ES01-KA204-083128

## Module 04

## BIM object modelling at development level 600 (LOD600) for the integration of environmental impact data

COAMU Colegio Oficial de Arquitectos Región de Murcia

iED institute of Entrepreneurship Development

Centro Tecnológico del mármol, piedra y materiales

Warsaw University of Technology

Bulgarian Green Building Council

cype

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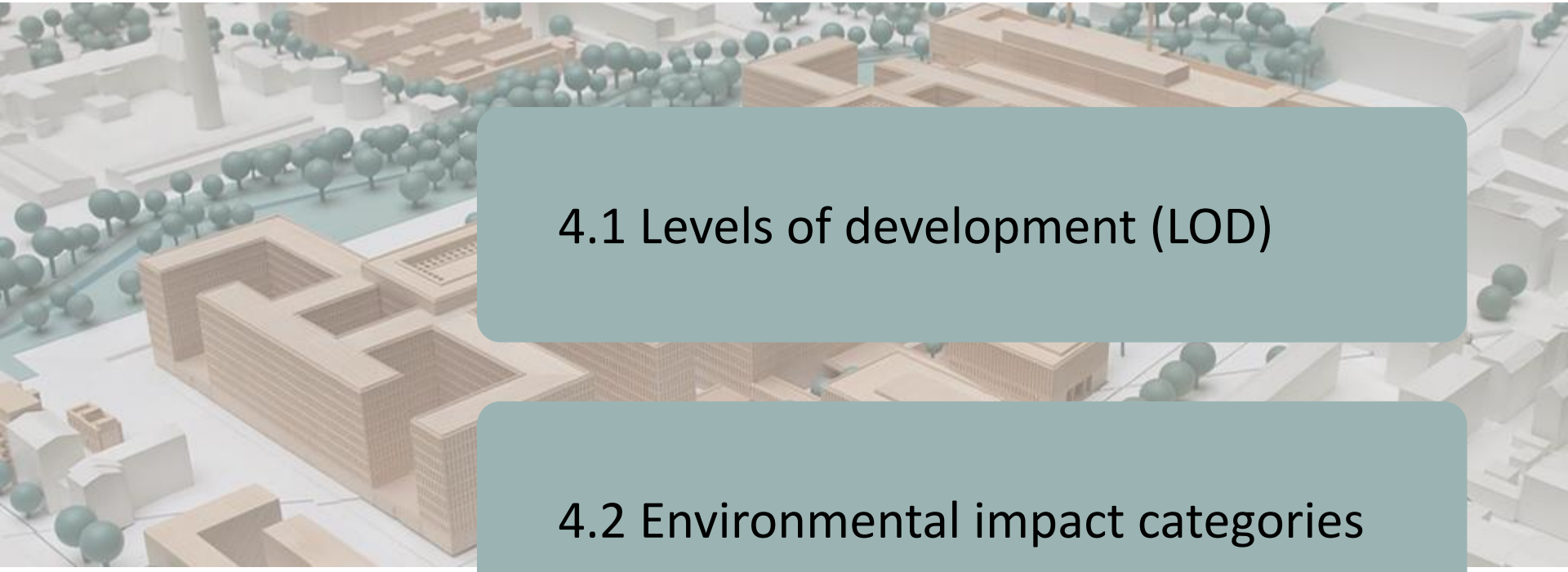

4.1 Levels of development (LOD)

4.2 Environmental impact categories

4.3 LOD600

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# 4.1 Levels of development (LOD)

BASIC CONCEPTS

BIM DIMENSIONS

LEVELS OF DEVELOPMENT (LOD)

LEVELS OF INFORMATION (LOI)

LEVELS OF DETAIL/DEFINITION (LoD)

LEVEL OF DETAIL/MODEL DEFINITION (LOMD)

TYPES OF DEVELOPMENT LEVELS

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# BASIC CONCEPTS

Expectations and understanding of what BIM is vary greatly. While there is obviously a common consensus for those immersed in the BIM methodology, most of the construction industry is still struggling to understand what they will produce, issue and receive when working with BIM.

In the example of an air conditioning system, an engineer might be expecting to receive dimensionally accurate duct layouts to ensure structural openings are properly sized, an architect may only need a zoning approximation to improve their circulation and space designs, while the reality is that the installer is only working on 2D schematics that are alien to the expectations of others.

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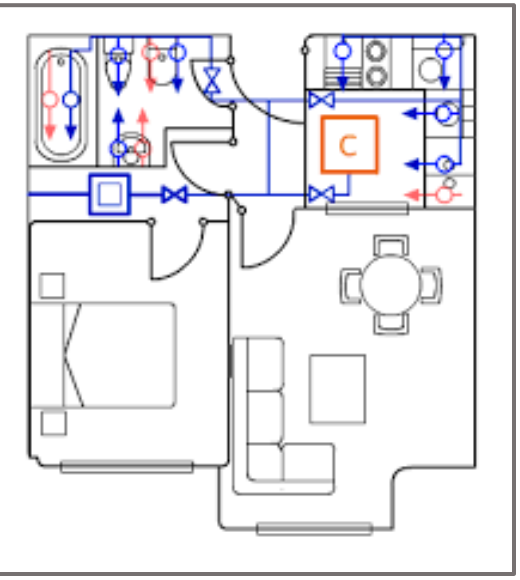
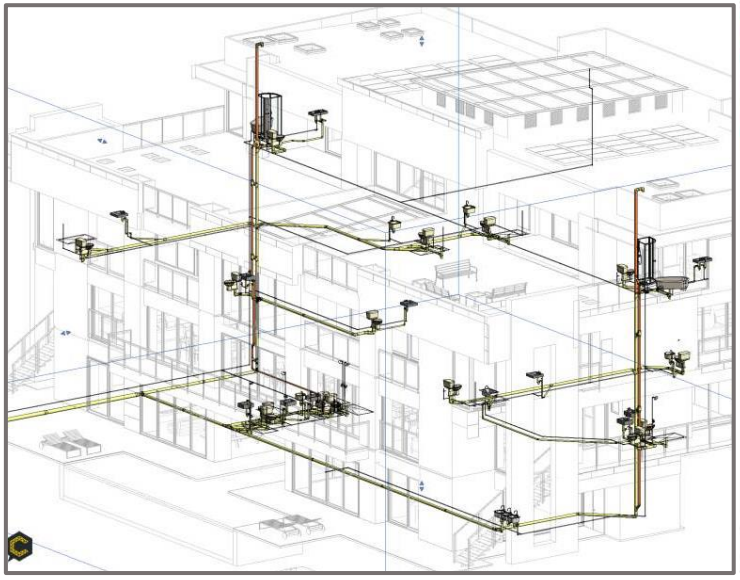
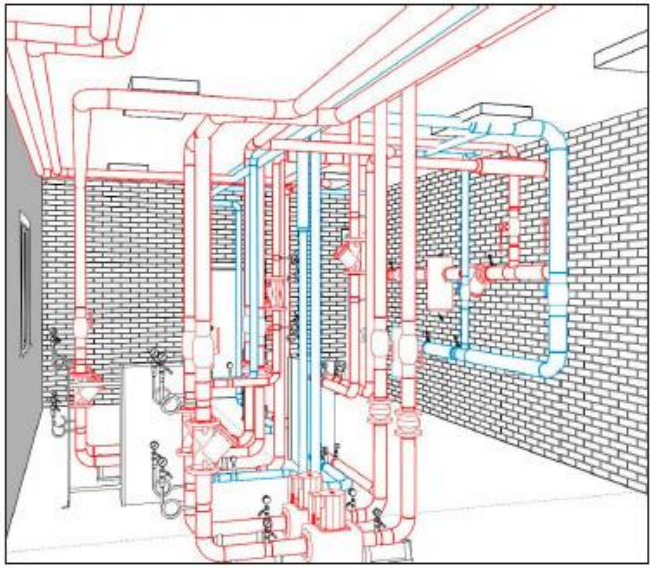
# BASIC CONCEPTS

This lack of communication and common perspective leads to delays, friction and in many cases errors.

Therefore, it is of crucial importance to properly define the degree of development, both graphically and in terms of the amount of information contained, of models and the BIM objects that make up the model in a project.







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# BASIC CONCEPTS

## BIM OBJECTS vs FAMILIES

BIM Objects are geometric models made with parametric software in a way that allows their attributes to be modified.

- When we talk about BIM objects, we always refer to open formats.
- However, in the case of the term Families, we refer to BIM Objects that we create with a specific tool: Autodesk Revit.

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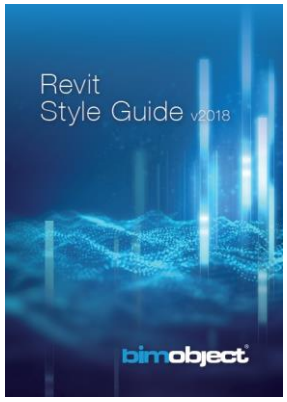
# BASIC CONCEPTS

## BIM OBJECT STANDARDS

We can find different types of standards depending on whether they are Family standards or BIM Object standards. Family standards are intended to establish a creation protocol so that people know how to create new BIM Objects for a given software, Revit in this case. Program configurations and modelling recommendations, such as the Revit Style Guide developed by BimObject.

In contrast, BIM object standards advocate open formats and focus on the information they should contain in order to be usable throughout their lifecycle. Examples are: the NBS BIM Object Standard developed by the National BIM Society (UK), OBOS: Open BIM Object Standard developed by Natspec (AU) and Masterpec (NZ) as well as the eCOB: BIM Object Creation Standard (NZ) and the eCOB: Open BIM Object Standard (UK).

Covers of Revit Style Guide v2018, NBS BIM Object Standard and OBOS (Open BIM Object Standard).



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# BASIC CONCEPTS

## BIM OBJECT STANDARDS

With regard to eCOB, produced by the ITeC (Institute of Construction Technology), it is based on the IFC scheme, extending it with a certain number of additional attributes and information. It is a standard that can be used both internationally and locally because it is adapted to the Technical Building Code (CTE), the Catalogue of Construction Elements (CEC) and the regulations applicable to construction products.

Cover of the eCOB developed by ITeC.

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# BASIC CONCEPTS

## BIM OBJECT STANDARDS

The key to a standard is to be able to synchronise data in an easy way and that the structure of the information coincides at the same time as the terms of the same.

The GDO-BIM Standard has as its aim the idea of guaranteeing the traceability of information throughout the development of a project, for which it has sought to facilitate understanding and workflows between construction agents working in BIM. We can see that, in this process, the manufacturer plays a fundamental role in achieving this goal.

Cover of BIM Object Development Guide. GDO-BIM Standard.

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# BASIC CONCEPTS

## PROTOCOLOS BIM CIC

Regarding the stage of development of these BIM objects, the BIM CIC protocols in the UK detail a 'Model Production and Delivery Table', more commonly known as a 'Responsibility Matrix', to clarify what information will be produced at any given stage and by whom. In short, it assigns a LoD (level of detail) code to each building component or system at each progressive stage of the project so that the whole team knows what to expect.

The basic codes differ between the US and UK conventions, which only serves to confuse the issue further.

For this reason, it is vitally important to differentiate properly between the following concepts.

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# BASIC CONCEPTS

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EXPLANATORY NOTE

BIM CIC Protocol (Construction Industry Council)

A supplementary legal agreement that is designed to be used by the parties involved in a construction project. It incorporates professional services engagements and construction contracts - a modification of the standard terms, creating additional rights and obligations for the builder and the contracted party to facilitate collaborative working, while safeguarding intellectual property and differentiating responsibilities between those involved.

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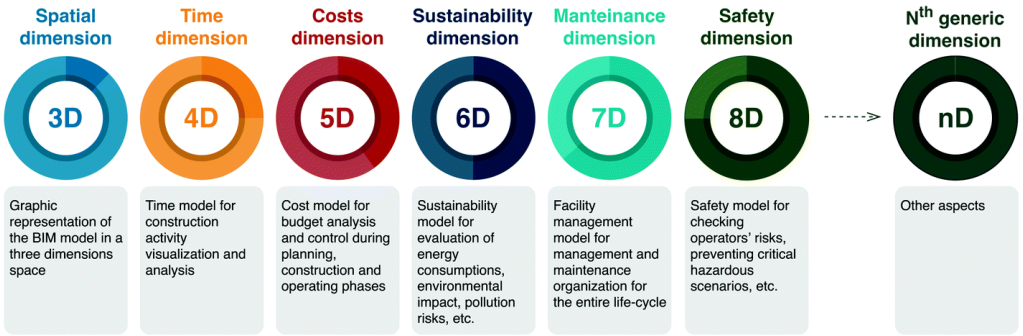
# BASIC CONCEPTS

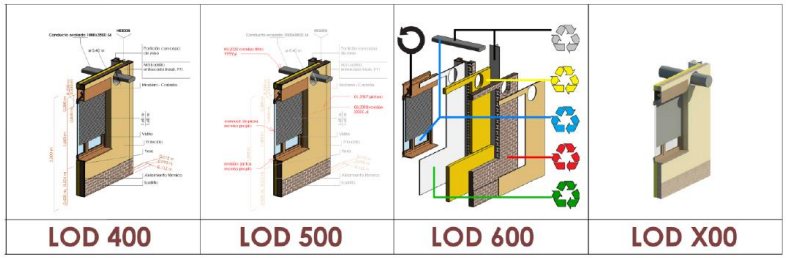
## IT IS IMPORTANT TO DIFFERENTIATE BETWEEN:

### BIM DIMENSIONS



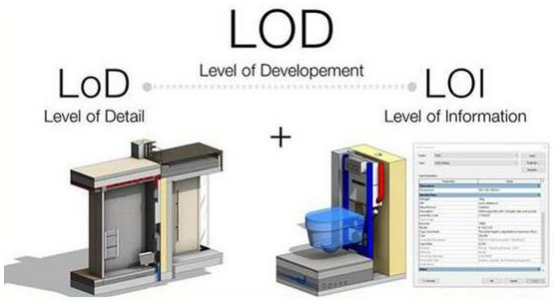

### LEVELS OF DEVELOPMENT (LOD)

American standard. Only referred to BIM objects. No time factor.



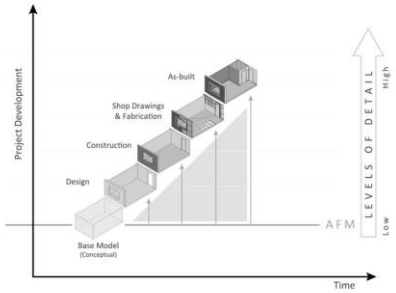

### LEVELS OF INFORMATION (LOI)

### LEVELS OF DETAIL (LOD)




British Standard

### LEVEL OF MODEL DEFINITION (LOMD)



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# BASIC CONCEPTS

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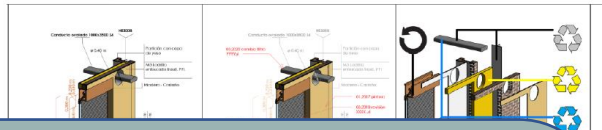

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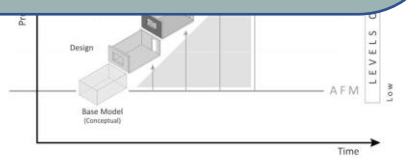
EXPLANATORY NOTE

These concepts often lead to confusion. The terms LOI and LoD come from British standard definitions enforced to the definition of BIM objects, where LOMD is the combination of both applied to the model scale (i.e. the project to be executed), while LOD comes from the American standard.

In this course we differentiate LoD (Level of Detail) and LOD (Level of Development) by means of a lowercase "o" in the case of the former, but in reality, both acronyms are professionally used with the same acronym (LOD), although they are different standards, hence their confusion, among other characteristics that differentiate them.

British Standard



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# BIM DIMENSIONS

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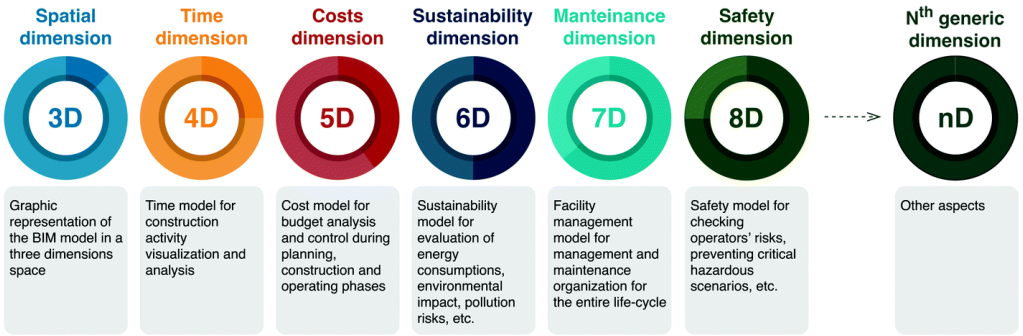
### BIM DIMENSIONS




### LEVELS OF DEVELOPMENT (LOD)

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### LEVELS OF INFORMATION (LOI)

### LEVELS OF DETAIL (LOD)




British Standard

### LEVEL OF MODEL DEFINITION (LOMD)

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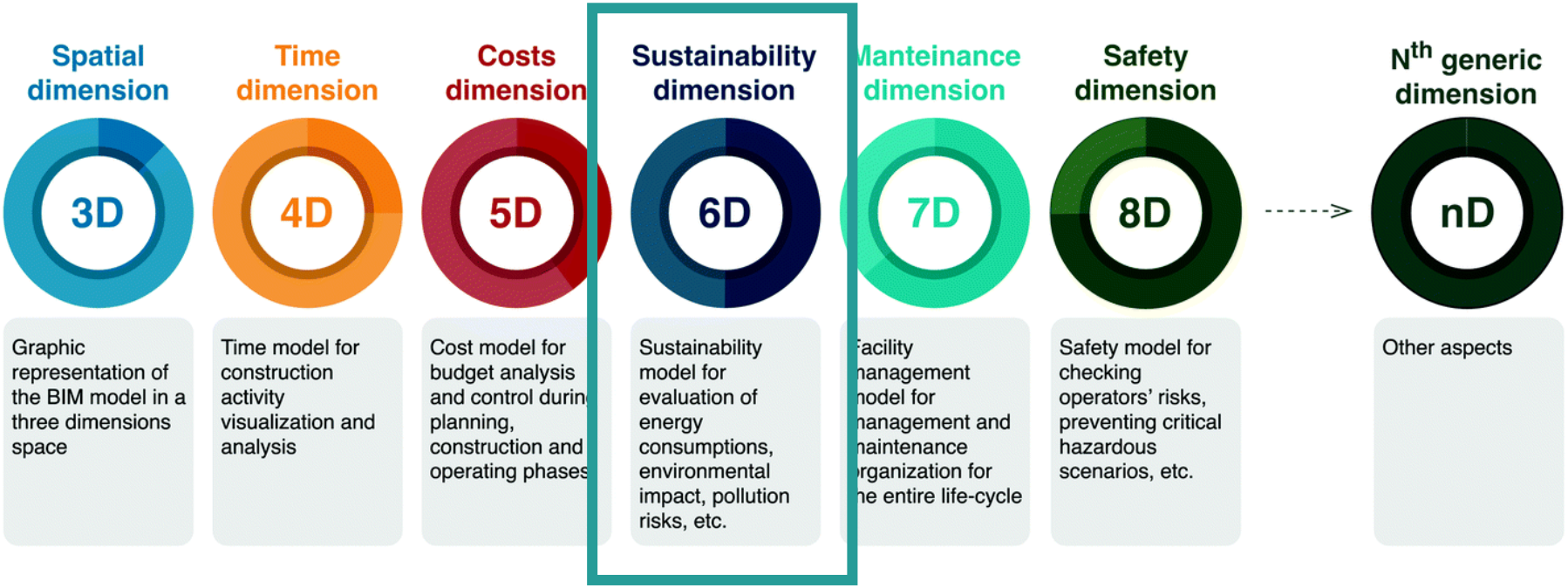
# BIM DIMENSIONS

BIM is the evolution of traditional plan-based design systems, as it incorporates geometric (3D), time (4D), cost (5D), environmental (6D), maintenance (7D), health and safety (8D), etc.



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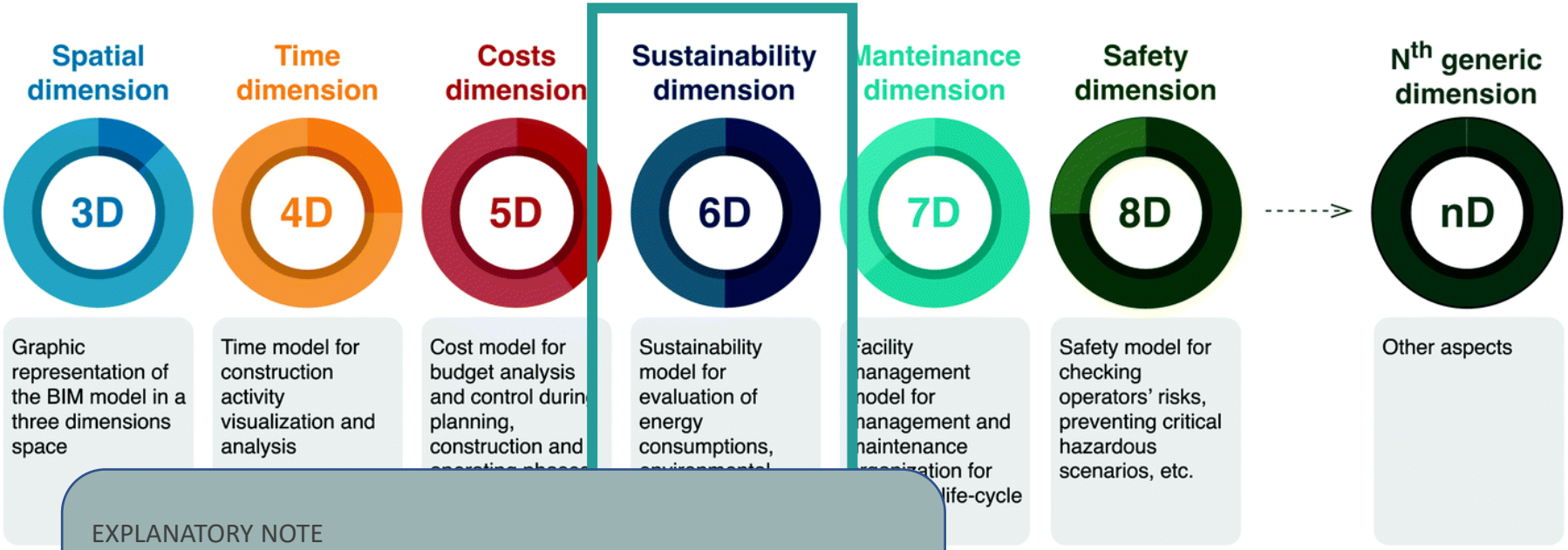


EXPLANATORY NOTE

The use of BIM goes beyond the design phases, encompassing the execution of the project and extending throughout the life cycle of the building, enabling the management of the building and reducing the economic and environmental costs of operation.

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# BIM DIMENSIONS

**The BIM dimensions consist of sectorising each descriptive phase of the building's life cycle**, being integrated in a virtual graphic model considered as dynamic, since all this information can be changed according to the current state of the construction (design, execution, use and end of its useful life). The building reality is always supported by a virtual graphic model that adapts to it.

Consequently, a very important fact to bear in mind is that during the entire life cycle of the project, from the idea to its demolition/deconstruction - and recycling - there is a continuous process of feedback. In other words, the BIM model is continually being modified -evolving-, so that at any given moment reality and model are identical.

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# BIM DIMENSIONS

**1D = The idea:**

We start from an idea - a house for example - and define the initial conditions, the location; we make some initial estimates - surface area, volumetry and costs; we establish the execution plan, etc.

**2D = The sketch:**

We prepare the software for modelling; we project the first lines, etc.

**3D = Information model of the building:**

From all the information gathered, we generate the 3D model that will serve as the basis for the rest of the project's life cycle. It is more than a graphic representation of the idea. The 3D model is not only visual but incorporates all the information that will be needed for the following BIM phases -dimensions-.

**4D = Time:**

To what could so far be considered static, the dimension of time is added. So we can define the phases of the project, establish its time planning; as well as simulate time parameters - life cycle, sun, wind, energy, etc. - and we can also simulate the time parameters - life cycle, sun, wind, energy, etc. -.

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# BIM DIMENSIONS

**5D = Cost:**

This is the cost control and cost estimation of the project. The main objective of this dimension is to improve the profitability of the project.

**6D = Sustainability or Simulation:**

Sometimes called Green BIM or Green BIM, it consists of simulating the possible alternatives of the project to finally arrive at the optimal alternative. And all this before 'laying the first brick'.

**7D = Operation and Maintenance or Instruction Manual:**

This could be said to be the manual to be followed during the life of the project, once built, for the use and maintenance of the project -inspections, repairs, maintenance, etc.-.

**8D = Health and Safety:**

The use of BIM and Lean together not only produces an increase in the productivity of construction projects, but also means an improvement in the quality of the preventive measures that can be adopted in the construction phase. All this results in an increase in the quality of Health and Safety at work, better controlling risks and creating a better workplace for workers.

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# LEVELS OF DEVELOPMENT (LOD)

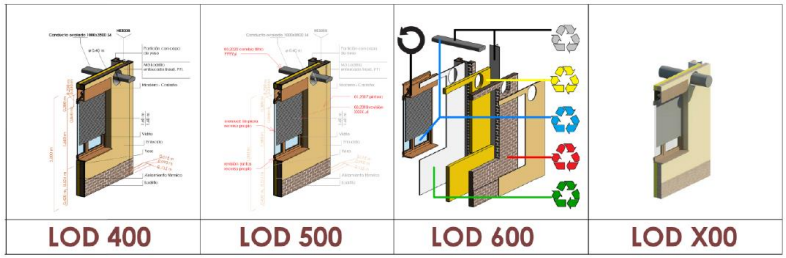
## IT IS IMPORTANT TO DIFFERENTIATE BETWEEN:

### BIM DIMENSIONS

| Spatial dimension | Time dimension | Costs dimension | Sustainability dimension | Manteinance dimension | Safety dimension | Nth generic dimension |
|---|---|---|---|---|---|---|
| 3D | 4D | 5D | 6D | 7D | 8D | nD |
| Graphic representation of the BIM model in a three dimensions space | Time model for construction activity visualization and analysis | Cost model for budget analysis and control during planning, construction and operating phases | Sustainability model for evaluation of energy consumptions, environmental impact, pollution risks, etc. | Facility management model for management and maintenance organization for the entire life-cycle | Safety model for checking operators' risks, preventing critical hazardous scenarios, etc. | Other aspects |

### LEVELS OF DEVELOPMENT (LOD)

American standard. Only referred to BIM objects. No time factor.




### LEVELS OF INFORMATION (LOI)

### LEVELS OF DETAIL (LOD)

### LEVEL OF MODEL DEFINITION (LOMD)




British Standard

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# LEVELS OF DEVELOPMENT (LOD)

The LOD as Level of Development defines the level of development or information maturity that **an element of the model** possesses, and this is the part of a component, construction system or building assembly.

It should be clarified that the LOD does not refer to the entire project and is not linked to the development or construction phase.

*Source: https://muralit.es/lod-nivel-de-desarrollo/*

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# LEVELS OF DEVELOPMENT (LOD)

It is a classification scale of the level of detail that BIM objects will have according to the moment of development of the project. According to the international standards of the AIA (American Institute of Architects) the LOD levels range from LOD 100 to LOD 500.

A LOD 100 would correspond to the most initial design moment, a LOD 300 would be a level of graphic detail corresponding to that of an execution project and a LOD 500 would correspond to an "as built", which would be used for the management of the building already in use.

However, as we will see below, the British have their own standards, defined as Levels of Detail (rather than Levels of Development) which, being more focused on graphical aspects, range from LoD 1 to 7 and are called: LoD 1 brief (concise), LoD 2 concept, LoD 3 design development, LoD 4 Production, LoD 5 Installation (describes the construction), LoD 6 As built and LoD 7 Asset Information Model (asset information).

AIA LOD 100 would correspond to UK LOD 2 and LOD 500 would correspond to UK LOD 6.

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# LEVELS OF INFORMATION (LOI)

## IT IS IMPORTANT TO DIFFERENTIATE BETWEEN:

### BIM DIMENSIONS



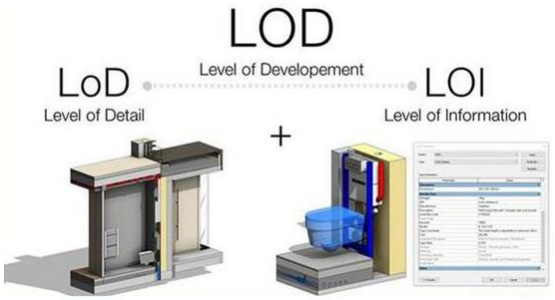

### LEVELS OF DEVELOPMENT (LOD)

American standard. Only referred to BIM objects. No time factor.




**LEVELS OF INFORMATION (LOI)**

**LEVELS OF DETAIL (LOD)**




British Standard

### LEVEL OF MODEL DEFINITION (LOMD)

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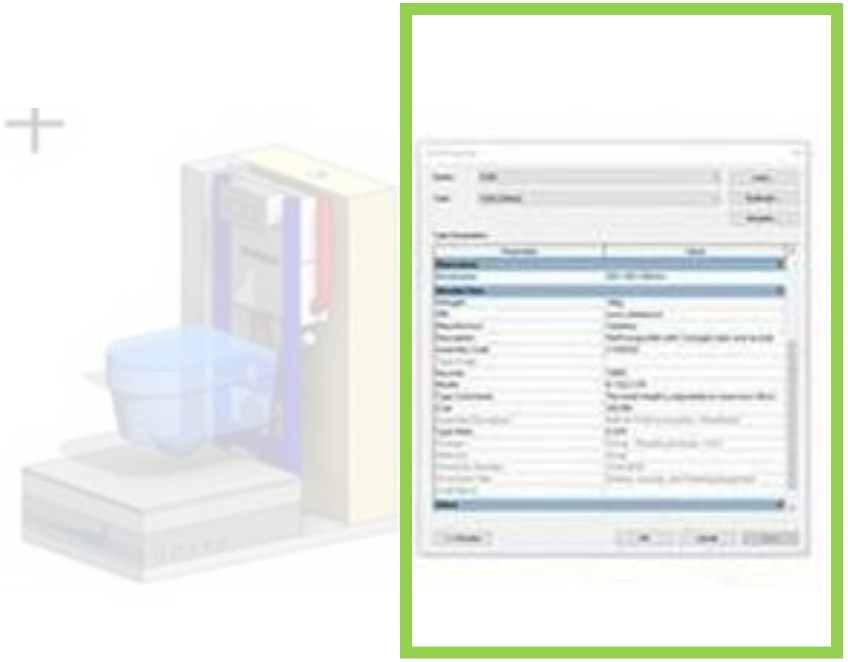
# LEVELS OF INFORMATION (LOI)

This is the amount of non-modelled information that a BIM object has. For example, a family has its types and within these types it can have a huge number of parameters that can range from something as simple as height and width to as complex as a mathematical formula that changes the spacing of the elements depending on the occupancy of the room, they are in.

LOI can be tables, specifications and parametric information.



Source: https://sktalleres.com/bim-lod-100-200-y-300/

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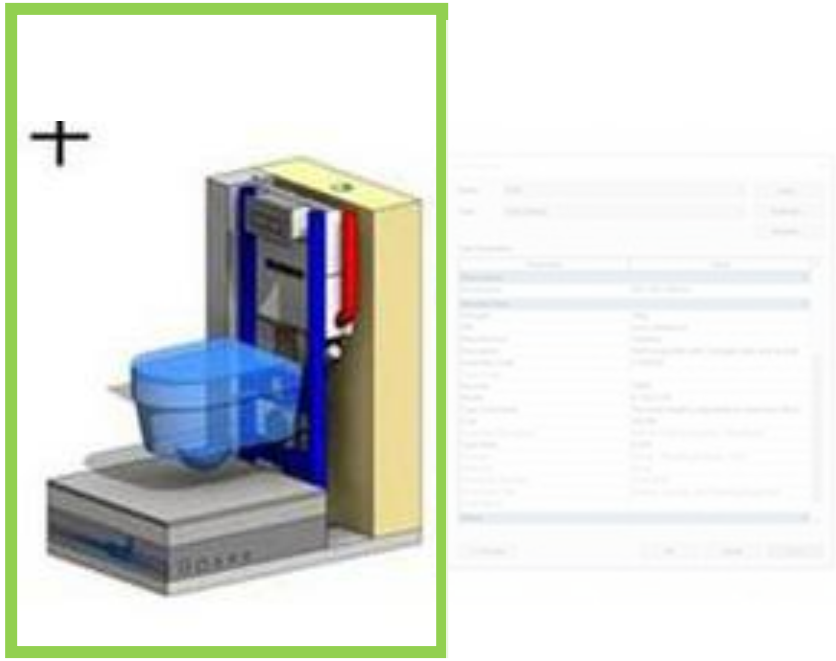
# LEVELS OF INFORMATION (LOI)

The levels of detail are defined in the British standard and mainly focus only on graphical aspects referring to the model and its level of definition, sometimes both to the model and to the BIM objects that compose it.



Source: https://sktalleres.com/bim-lod-100-200-y-300/

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# LEVELS OF DETAIL (LoD)

- The levels of detail are determined by letters (A, B, C...) or letters and numbers (G0, G1, G2...) depending on the country of origin in the definition to be taken into account.
- The English standards and publications PAS 1192-2/3/4 and BS 8541:2011 define these levels (A.78:Schematic, Conceptual and Defined):
  - G0 Symbolic. No scale, simply a "suggestion" of where the object will exist. For example, in the case of doors, this could simply be a black rectangle on a 2D wall.
  - G1 Placeholder. Although it may be to scale, the object may not represent the appearance of the final component. For example, in the case of doors, this would be a simple, plain object without frames, vision panels or hardware.
  - G2 Suitable for construction. This is where the representative geometry of the final component would be provided. It may not yet include hardware (as this would normally be specified separately) but could be an object downloaded by manufacturers.
  - G3 High resolution, fully detailed object. Normally only used for visualisation or, indeed, for manufacturing.

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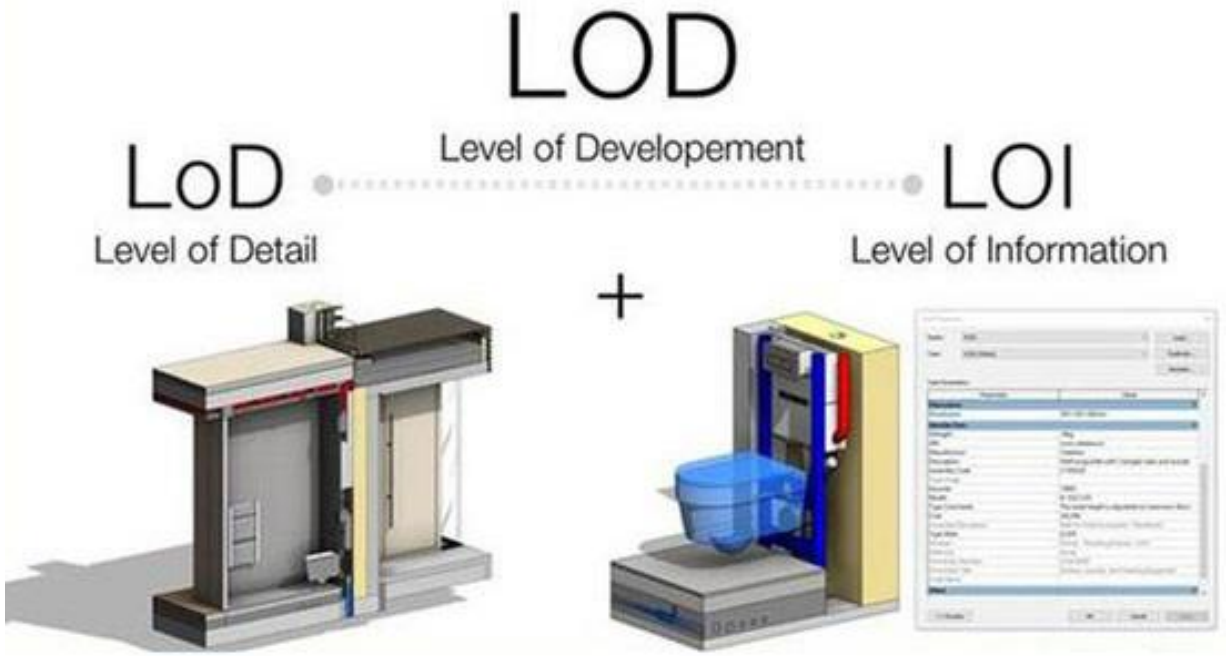
# LEVELS OF DETAIL (LoD)

- The term LOD (Level of Development) is sometimes misinterpreted as Level of Detail (LoD). The Level of Detail (LoD) essentially refers to the amount of graphical detail included in the model element. However, the LOD is a measure of the amount of information and the quality of the information.
- Roughly speaking, we could say that the LOD for the American standard is the sum of LOI and LoD of the British standard.




Source: https://sktalleres.com/bim-lod-100-200-y-300/

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# LEVEL OF MODEL DEFINITION (LOMD)

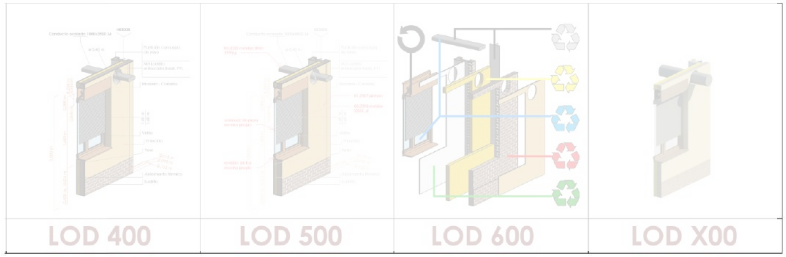
## IT IS IMPORTANT TO DIFFERENTIATE BETWEEN:

### BIM DIMENSIONS




### LEVELS OF DEVELOPMENT (LOD)

American standard. Only referred to BIM objects. No time factor.




### LEVELS OF INFORMATION (LOI)

### LEVELS OF DETAIL (LOD)




British Standard

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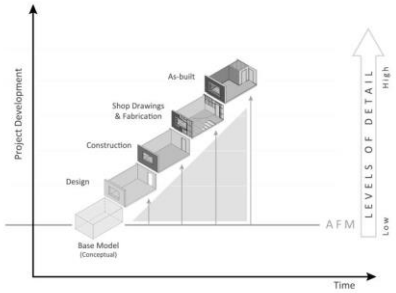
### LEVEL OF MODEL DEFINITION (LOMD)



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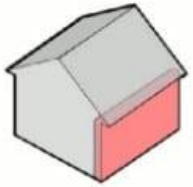
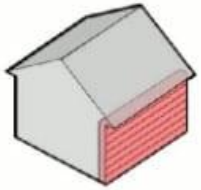
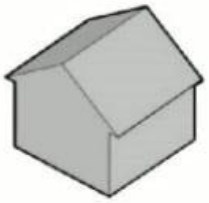
# LEVEL OF MODEL DEFINITION (LOMD)

Sometimes the term LoD (Level of Detail) is used to refer to the model, and not to the elements that make it up. But this leads to confusion and other authors use the term LOMD when referring to the model (the project to be executed) instead of the elements that make it up (the BIM objects that make up the project graphically).

| LOMD1<br>PREPARATION & BRIEF | LOMD2<br>CONCEPT DESIGN | LOMD4<br>DEVELOPED DESIGN | LOMD4<br>TECHNICAL DESIGN | LOMD5<br>CONSTRUCTION | LOMD6<br>HANDOVER |
|---|---|---|---|---|---|
| | |  |  | |  |
| • A model communicating the performance requirements and site constraints | • A conceptual or massing model intended for whole building studies including basic areas & volumes, orientation, cost | • Generalized systems with approximate quantities, size, shape, location and orientation. | • Production, or pre-construction, "design intent" model representing the end of the design stages.<br>• Modelled elements are accurate and coordinated, suitable for cost estimation and regulatory compliance checks. | • an accurate model of the construction requirements and specific building components, including specialist sub-contract geometry and data. | • An "as built" model showing the project as it has been constructed. The model and associated data is suitable for maintenance and operations of the facility. |

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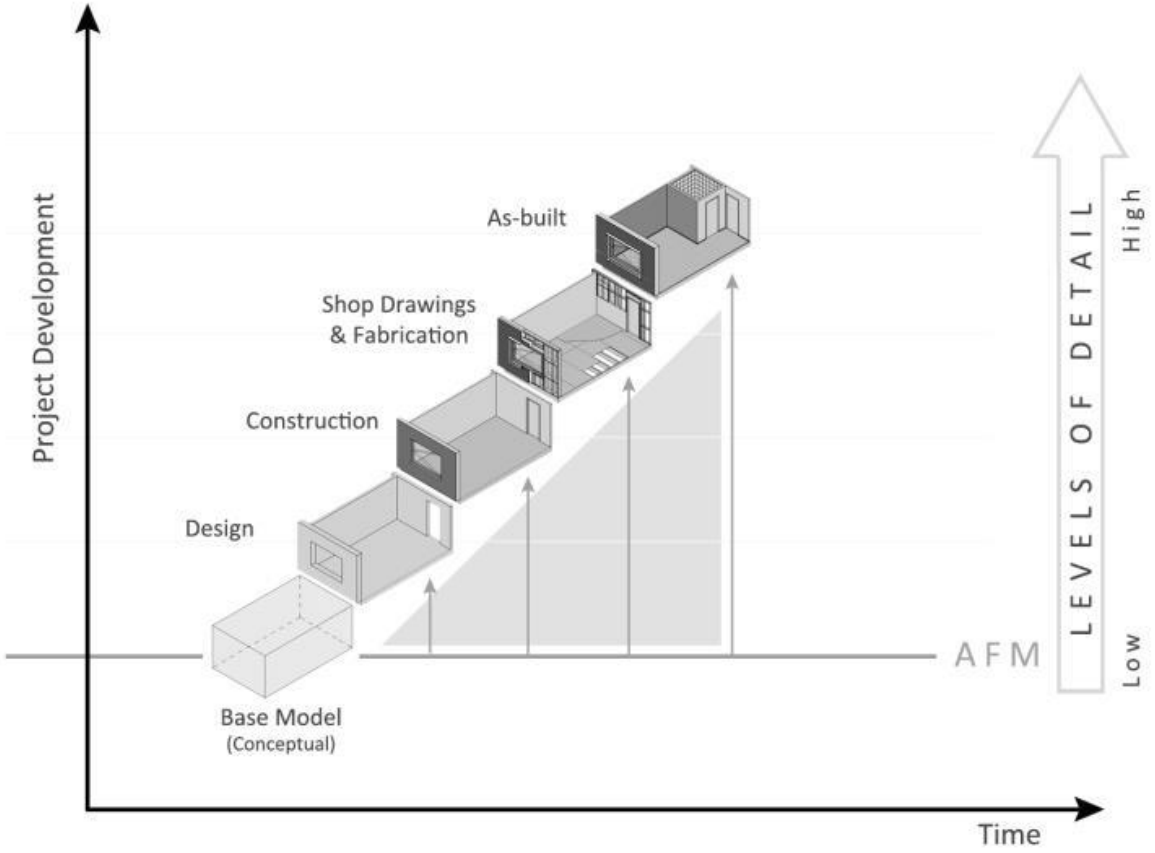
# LEVEL OF MODEL DEFINITION (LOMD)

The Definition Level corresponds to the linear evolution of quantity and richness of information of a construction process; **it always increases over time and refers to the project model**, costs/budgets and time planning.



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# TYPES OF DEVELOPMENT LEVELS

From the classifications explained above, it is worth highlighting the equivalences between the British model (LoD, Level of Detail) and the American model (LOD, Level of Development), and we will now explain the types of LOD according to the American standard.

| UK convention | US convention |
|---|---|
| LOD 1 | |
| LOD 2 | LOD 100 |
| LOD 3 | LOD 200 |
| LOD 4 | LOD 300 |
| LOD 5 | LOD 400 |
| LOD 6 | LOD 500 |
| LOD 7 | |

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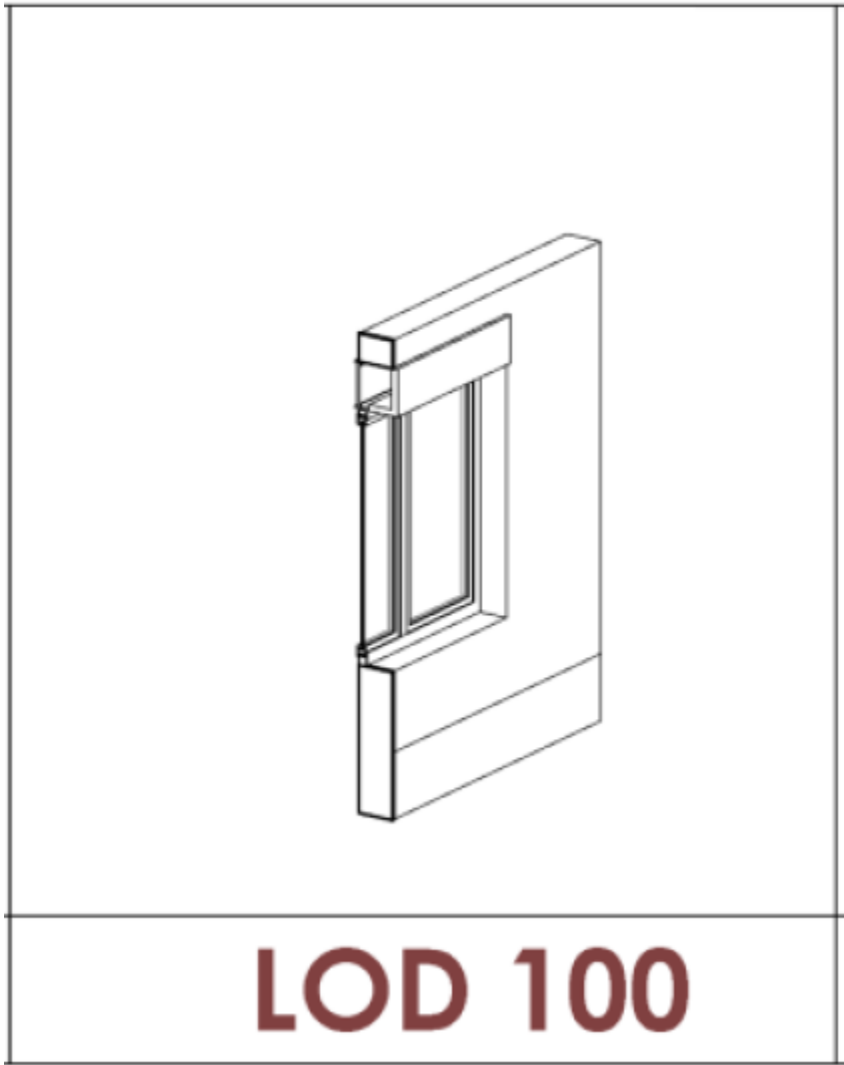
# TYPES OF DEVELOPMENT LEVELS

- **LOD 100: Pre-design stage.**
  - Contains basic element information such as area, height, volume, location and orientation. This information should be considered as approximate.
  - The element may be represented graphically in the model with a symbol or other generic representation.
  - For example, in the case of a partition wall, we would have the dimensions of the partition wall.

*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*



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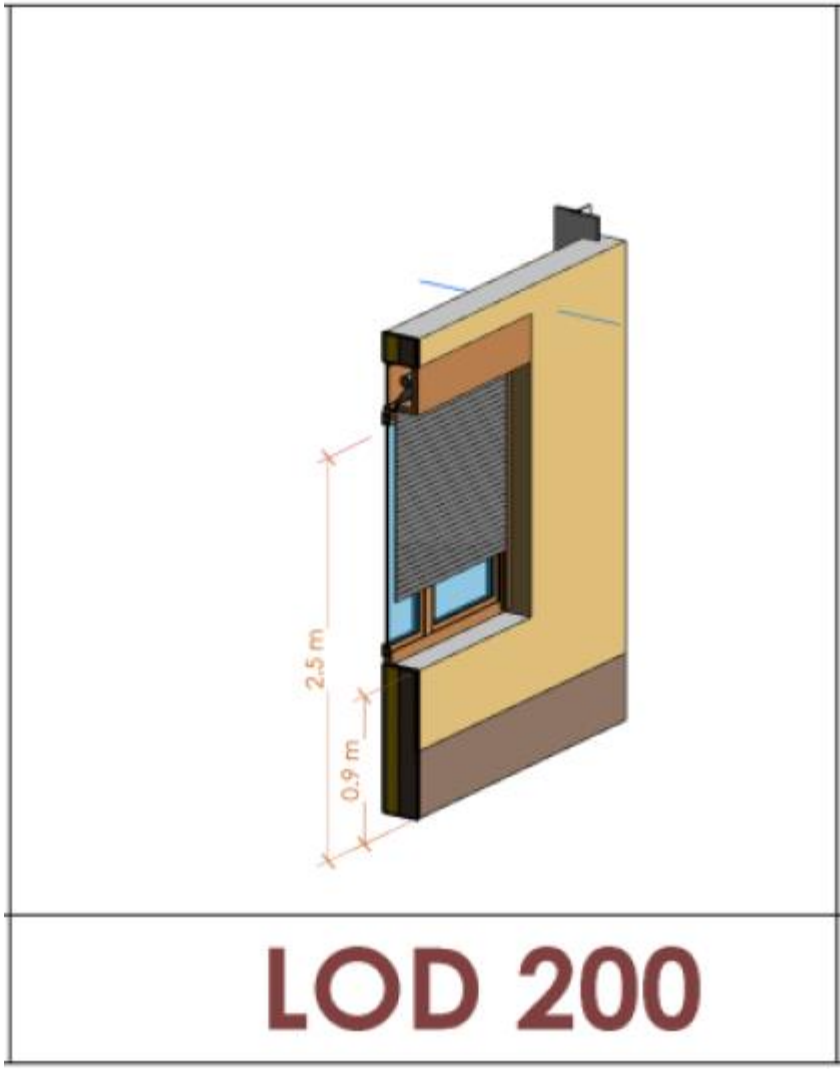
# TYPES OF DEVELOPMENT LEVELS

- **LOD 200: Schematic design.**
  - General model in which elements are modelled with approximate quantities, size, shape, location and orientation.
  - We can also attach non-geometric information to the elements of the model.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509* págs. 40-58

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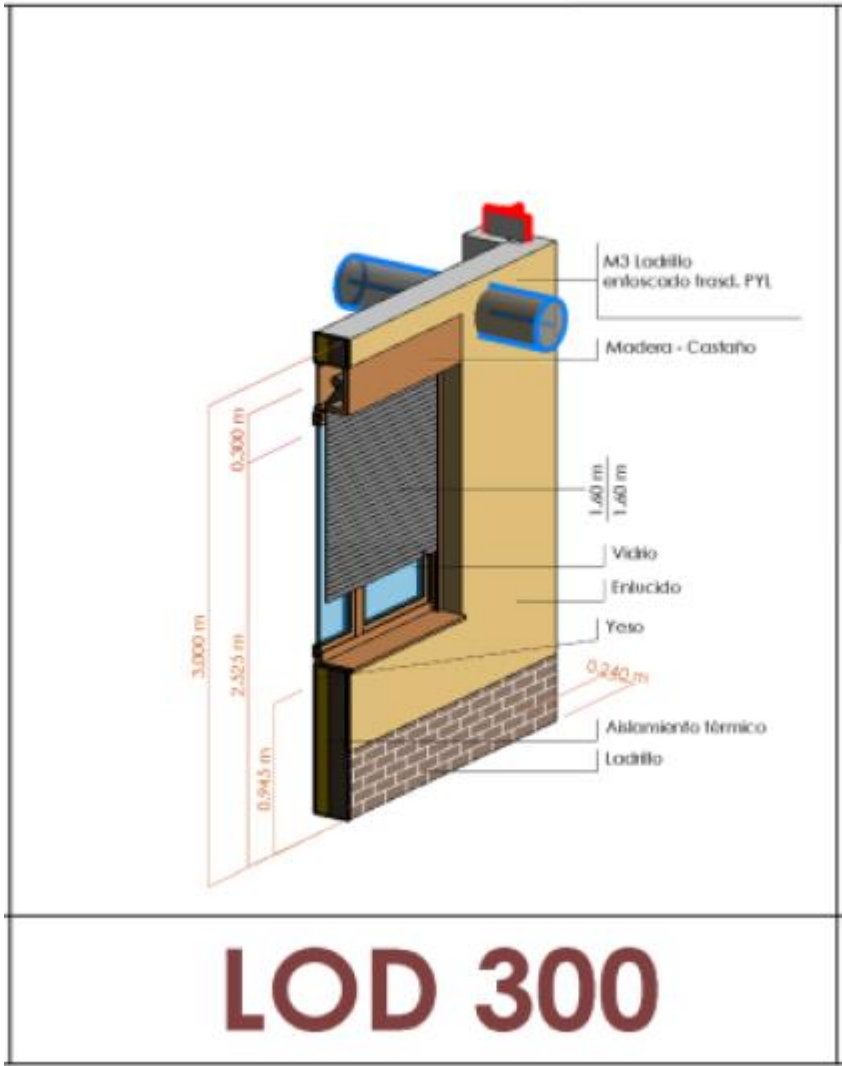
# TYPES OF DEVELOPMENT LEVELS

- **LOD 300: Detailed design.**
  - Precise and geometrically defined modeling in detail, as well as its position, belonging to a specific construction system, use and assembly in terms of quantities, dimensions, shape, location and orientation.
  - Non-graphical information may also be included to the element.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509* págs. 40-58

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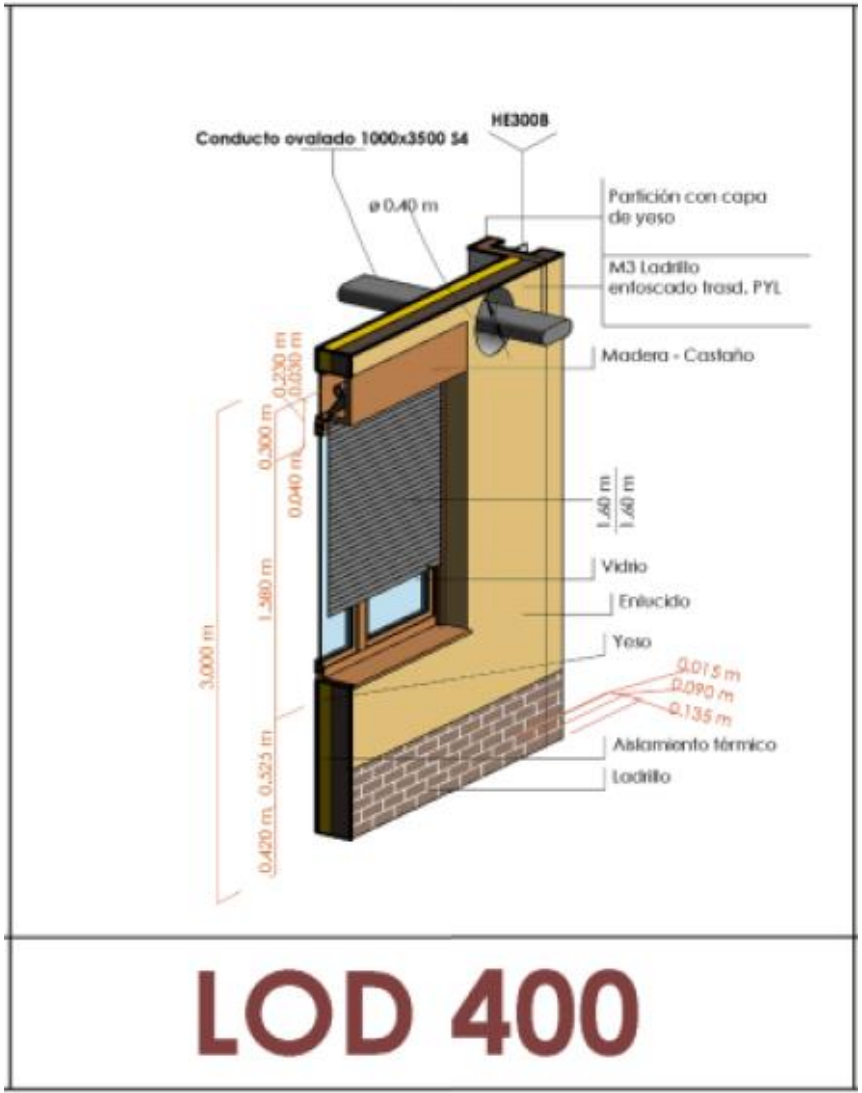
# TYPES OF DEVELOPMENT LEVELS

- **LOD 400: Manufacture and assembly.**
  - The object is defined in detail geometrically, as well as its position, belonging to a specific construction system, use and assembly in terms of quantities, dimensions, shape, location and orientation.
  - It includes specific information for design, commissioning/assembly and installation.
  - Non-graphical information may also be included for the element.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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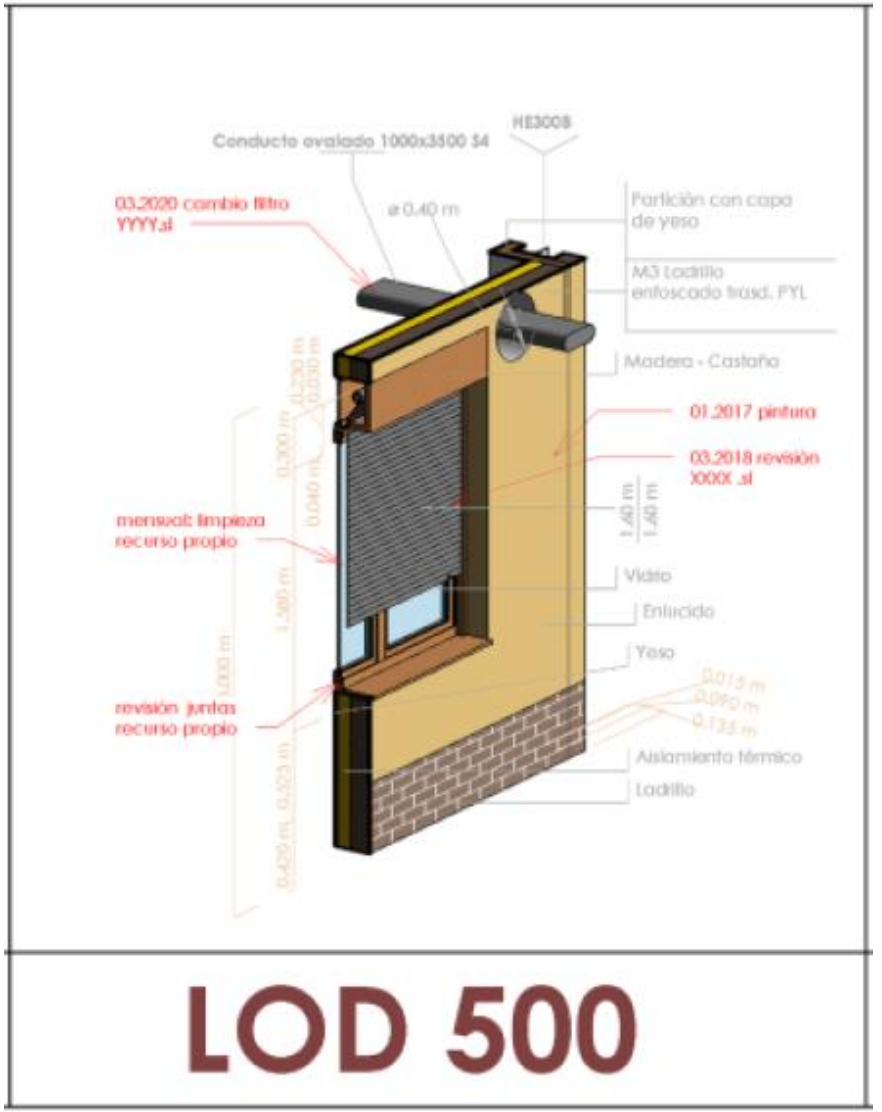
# TYPES OF DEVELOPMENT LEVELS

- **LOD 500 (I).**
  - Elements are modelled as assemblies built for maintenance and operations.
  - In addition to the actual and accurate information on size, shape, location, quantity and orientation, non-geometric information is attached to the modelled elements.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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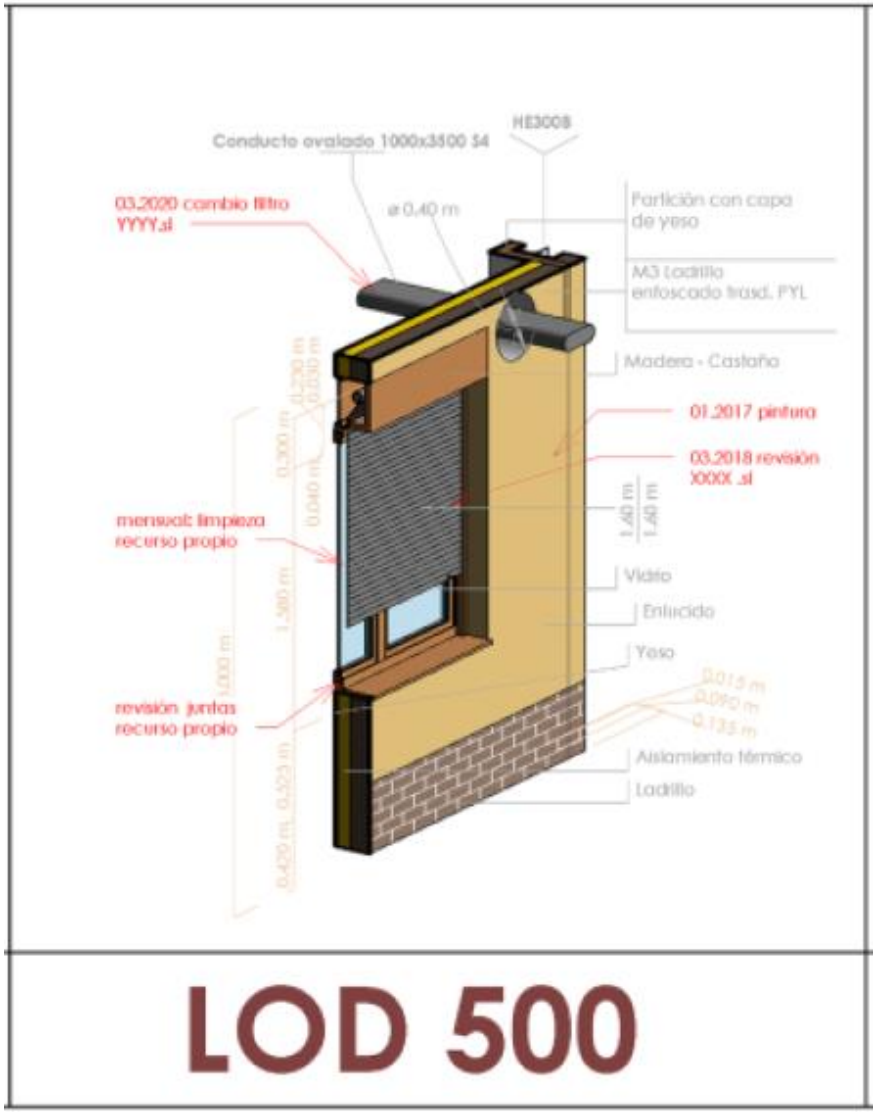
# TYPES OF DEVELOPMENT LEVELS

- **LOD 500 (II).**
  - Information at this level is verified in relation to the "as built" construction process and is not applicable to all elements of the project.
  - Its use is linked to the future and may include: determination of current status, product specifications and approvals, direct or indirect use and maintenance, management and operation, as well as renovations and modifications.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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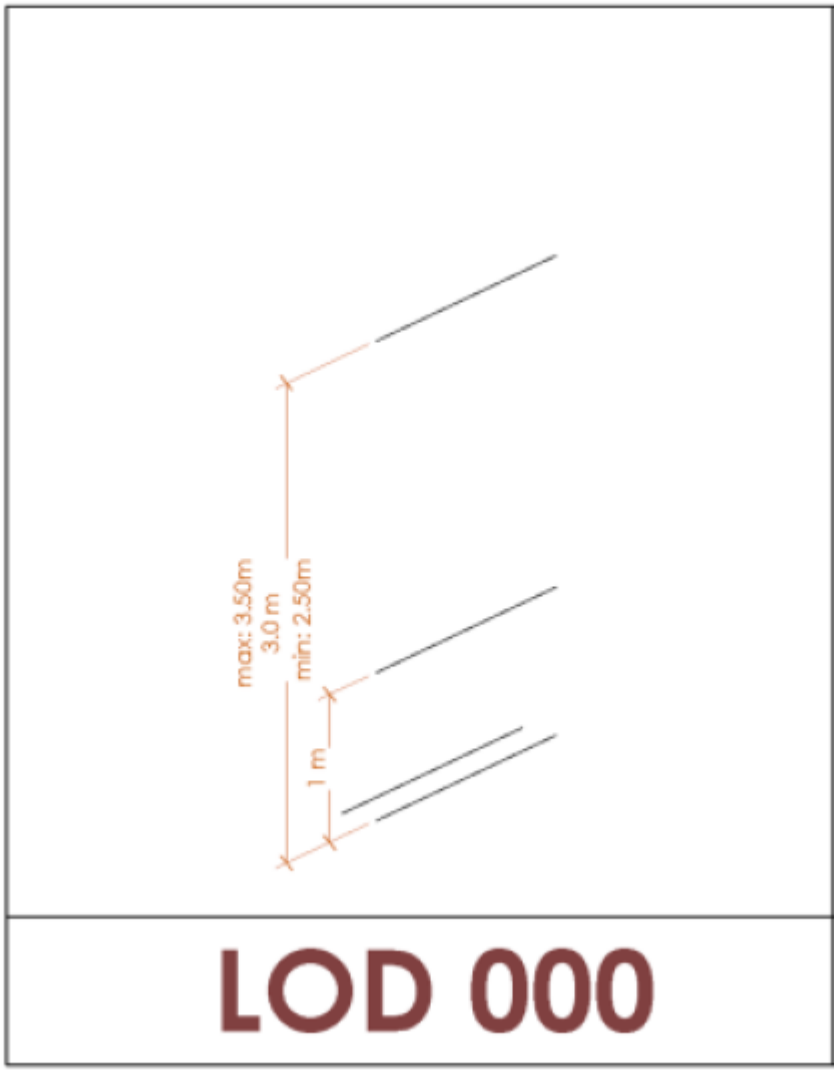
# TYPES OF DEVELOPMENT LEVELS

- **LOD 000 *(autor: Alonso Madrid)*.**
  - It includes the characteristics of the land (position, height, topography, geotechnical, state, etc.), those of the surroundings (climate, connections, sunlight, distances to reference points, local needs, etc.) and those of the plot (cadastral reference, surface area, divisions, owner(s), endowments, etc.).




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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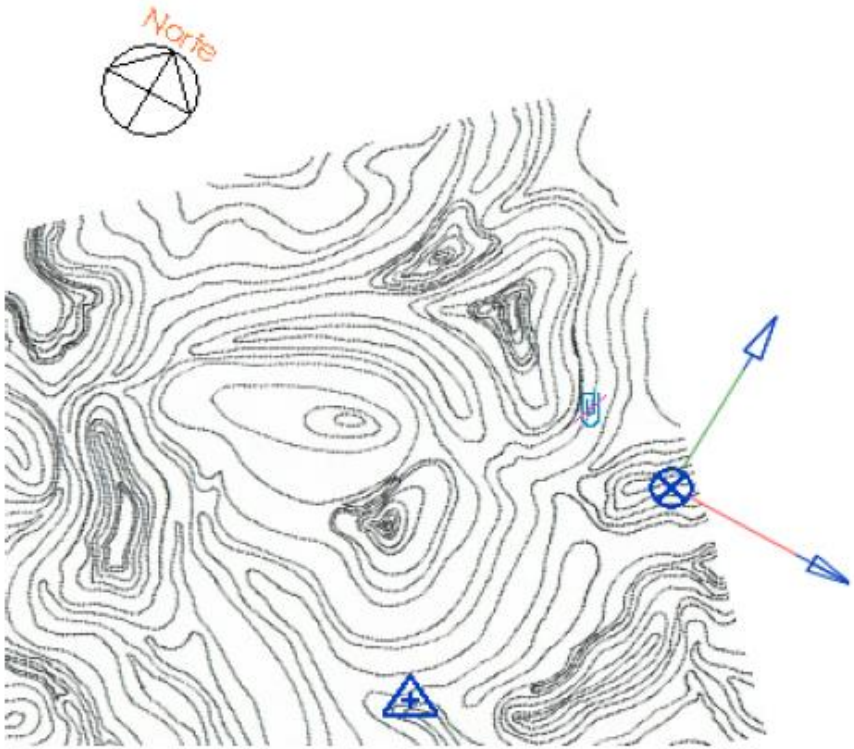
# TYPES OF DEVELOPMENT LEVELS

- **LOD 000 *(autor: Alonso Madrid)*.**
  - The target element is not geometrically defined, but its basic dimensions, position, location and orientation with respect to the whole site and its surroundings are defined.
  - It is mainly based on non-graphical information linked to the element.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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# TYPES OF DEVELOPMENT LEVELS

- **LOD X00 *(autor: Alonso Madrid)*.**
  - Included in this level of development is an activity that has already begun, such as the 3D scanning of existing buildings that are to be permanently demolished, or moved from their original site, remaining with the corresponding development permanently or temporarily in a virtual world with a specific degree of definition and likely to be the subject of further reproduction or development.

*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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# TYPES OF DEVELOPMENT LEVELS

- **LOD X00 (author: Alonso Madrid).**
  - The object element will be fully geometrically defined and will add new concepts such as distance from which it is visible and different degrees of geometric definition according to distances, for example.
  - The texture shall be derived from the characteristics of its surface materials. It is possible to add other non-graphical information linked to the element.

*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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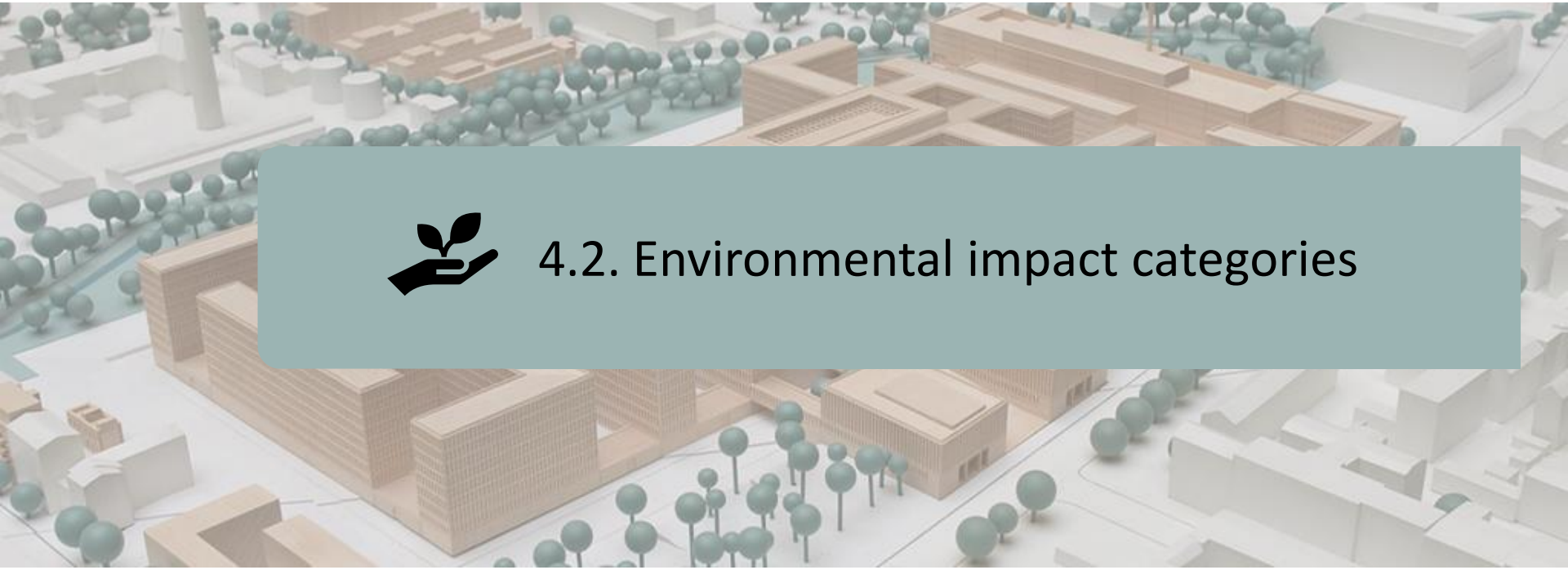

# 4.2. Environmental impact categories

DEFINITION OF ENVIRONMENTAL IMPACT CATEGORIES

FUNCTIONAL UNIT

DECLARED UNIT

TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

LIFE CYCLE STAGES

EXAMPLE OF AN EPD (ENVIRONMENTAL PRODUCT DECLARATION)

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# DEFINITION OF ENVIRONMENTAL IMPACT CATEGORIES

- The environmental impact categories represent the environmental impacts of interest to which the Life Cycle Impact Assessment (LCIA) results will be assigned. In other words, they are the environmental impacts for which results are desired.
- There are a multitude of environmental impact categories and the selection of one or the other will depend on the objective of the study, the target audience and the level of accuracy of the results required.
- In some cases, a substance contributes to several impact categories and should therefore be considered in all impact categories

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# FUNCTIONAL UNIT

- **FUNCTIONAL UNIT**: Quantified performance of a product system for use as a unit of reference *(Definition according to EN ISO 14040:2006).*

The functional unit defines how the identified functions or performance characteristics of the product are quantified. The main purpose of the functional unit is to obtain a reference that allows the standardisation of LCA results related to material flows (input and output data) of the construction product and any other information, in order to produce data expressed on a common basis *(UNE-EN 15804, article 6.3.1).*

In principle, the comparison of products based on their EPBD is defined by the contribution they make to the environmental performance of the building. Therefore, the comparison of the environmental performance of construction products using EPBD information should be based on the use of the product and its impacts on the building and should consider the whole life cycle (all information modules) *(UNE-EN 15804, article 5.3).*

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# FUNCTIONAL UNIT

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In principle, the comparison of products based on their EPBD is defined by the contribution they make to the environmental performance of the building. Therefore, the comparison of the environmental performance of construction products using EPBD info uilding and *15804, arti*

EXPLANATORY NOTE

Information module: Data collection used as the basis for the type III environmental declaration, covering a unitary process or a combination of unitary processes that are part of the life cycle of a product.

Definition according to EN ISO 14025:2010.

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# DECLARED UNIT

- **DECLARED UNIT**: Quantity of a construction product to be used as a reference unit in a EPD for an environmental declaration based on one or more reporting modules *(Definition according to UNE-EN 15804).*

The declared unit is used instead of the functional unit when the exact function of the product or the scenarios at building level are not established or unknown. The declared unit is to be applied when a EPD covers one or more life cycle stages by means of information modules, i.e. in the case of a 'cradle to door' EPD and a 'cradle to door with options' EPD, and when the EPD is not based on a full 'cradle to grave' LCA.

It provides the reference allowing to combine the material flows attributed to the construction product and to combine the environmental impacts for selected stages of an incomplete life cycle of the construction product, referring to typical product applications.

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# DECLARED UNIT

EXAMPLES (*UNE-EN 15804*).

- An element or set of elements, for example a brick, a window, etc. Therefore, defined as a unit of product where the dimensions must be specified;
- Mass (kg), e.g., 1 kg of cement;
- Length (m), e.g., 1 m of pipe, 1 m of beam (where dimensions are to be specified);
- Area ($m^2$), e.g., 1 $m^2$ of wall element, 1 $m^2$ of roof element (dimensions to be specified);
- Volume ($m^3$), e.g., 1 $m^3$ of timber, 1 $m^3$ of ready-mixed concrete;

EXAMPLE: If an EPD for an insulation material has been declared in units of thermal resistance RD ($m^2K/W$) in the building, then a conversion factor is required, e.g., for one kg of material.

In transport and disposal scenarios, a conversion factor is also required if the declared unit is mass.

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## GLOBAL WARMING POTENTIAL (GWP)

- A phenomenon observed in temperature measurements that shows on average an increase in the temperature of the Earth's atmosphere and oceans in recent decades.
- Reference unit: Kg CO2 eq.

*Source: [www.dec.media](www.dec.media)*

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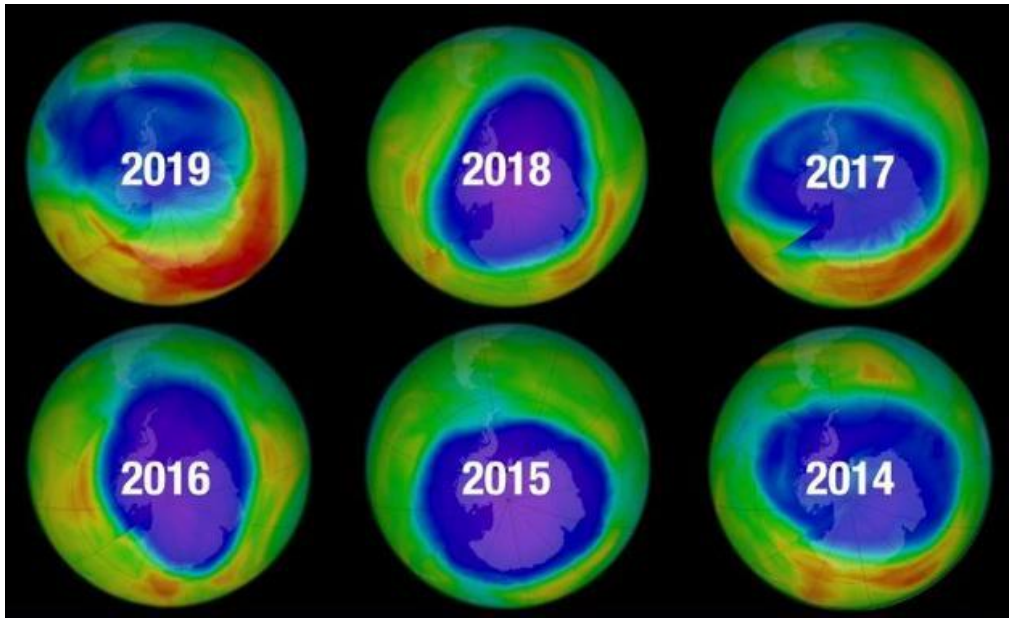
# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## STRATOSPHERIC OZONE DEPLETION POTENTIAL (ODP)

- Negative effects on the solar ultraviolet radiation protection capacity of the atmospheric ozone layer.
- Reference unit: Kg CFC-11 Eq.




*Source: [www.leonoticias.com](http://www.leonoticias.com)*

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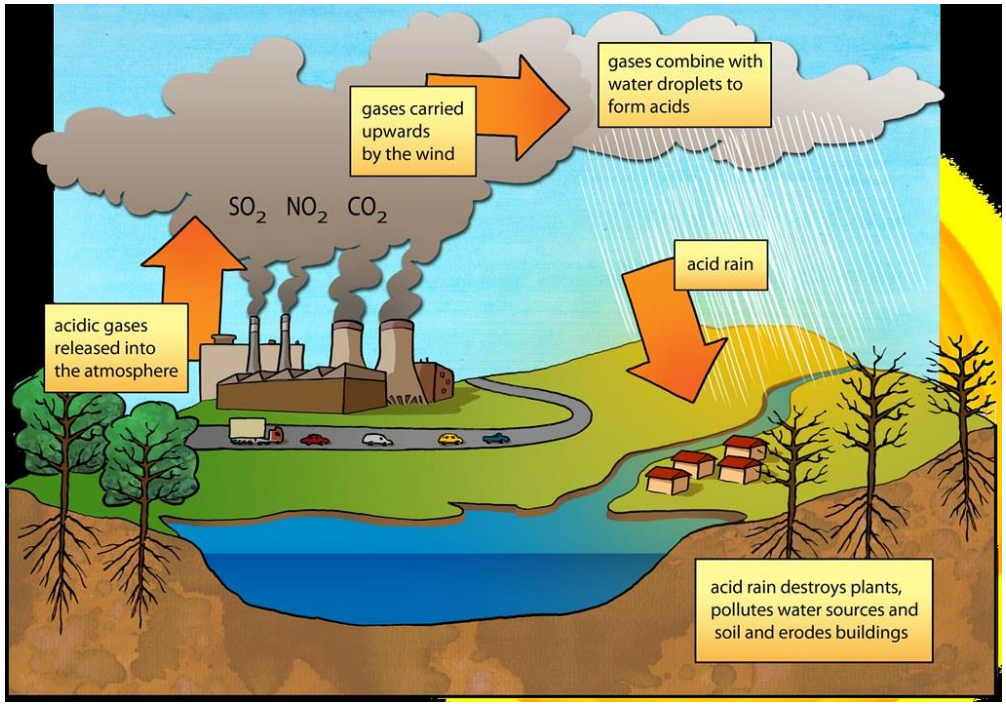
# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## ACIDIFICATION POTENTIAL (AP)

- Loss of the neutralising capacity of soil and water, as a consequence of the return of sulphur and nitrogen oxides discharged into the atmosphere to the earth's surface in the form of acids.
- Reference unit: Kg SO2 Eq.




*Source: [www.Flickr.com](www.Flickr.com)*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## EUTROPHICATION POTENTIAL (EP)

- Excessive growth of the algae population caused by the artificial enrichment of river and reservoir waters because of the massive use of fertilisers and detergents leading to a high consumption of oxygen in the water.
- Reference unit: Kg (PO4)3- eq.

*Source: iAgua*

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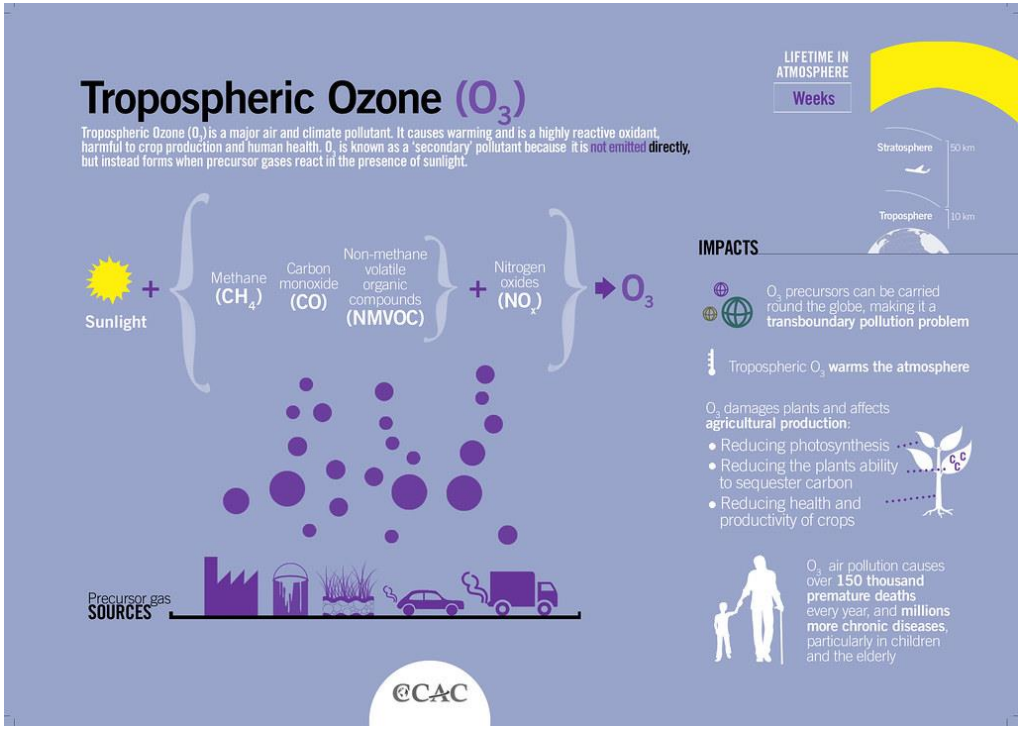
# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## TROPOSPHERIC OZONE FORMATION POTENTIAL (POCP)

- Formation of molecules composed of three oxygen atoms (O3) in the layer closest to the earth's surface, because of complex photochemical reactions in intense sunlight between nitrogen oxides and volatile organic compounds.
- Reference unit: Kg ethylene eq.




*Source: https://www.flickr.com/*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## ABIOTIC RESOURCE DEPLETION POTENTIAL FOR NON-FOSSIL RESOURCES (ADPE)

- Depletion of those resources that surround living beings and, together with them, make up the ecosystem. These abiotic resources are part of nature, including all "non-living" resources that can be exploited by humans, including energy resources.
- Reference unit: Kg Sb eq.

*Source: [www.revistapetmi.com](http://www.revistapetmi.com)*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## ABIOTIC RESOURCE DEPLETION POTENTIAL FOR FOSSIL RESOURCES (ADPF)

- Depletion of those resources that surround living beings and, together with them, make up the ecosystem. It is related to the use of fossil fuels, either as fuel or raw material.
- Reference unit: MJ.

*Source: [www.tietarteve.com](www.tietarteve.com)*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## FRESHWATER ECOTOXICITY (SW-ECOTOX)

- It is linked to emissions of metals into water bodies, producing toxic effects on aquatic species. It is an estimate of the share of potentially affected species per unit mass of the emitted substance.
- Reference unit: Kg DCB eq.

*Source: www.aguasresiduales.info*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## HUMAN TOXICITY (H-TOX)

- Identification of impacts on human health caused by different environmental stressors, with the aim of quantifying changes in mortality and morbidity associated with goods and services in an integrated way.
- Reference unit: Kg DCB eq.

*Source: www.ecourbano.es*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## MARINE ECOTOXICITY (M-ECOTOX)

- Affecting the most vulnerable marine ecosystems, causing changes in species composition, loss of habitats, etc.
- Reference unit: Kg DCB eq.

*Source: www.puntoqpack.com*

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## TERRESTRIAL ECOTOXICITY (T-ECOTOX)

- Affecting the most vulnerable terrestrial ecosystems, causing changes in species composition, loss of habitats, changes in floods and droughts, sudden changes in temperature, etc.
- Reference unit: Kg DCB eq.

*Source: www.lavanguardia.com*

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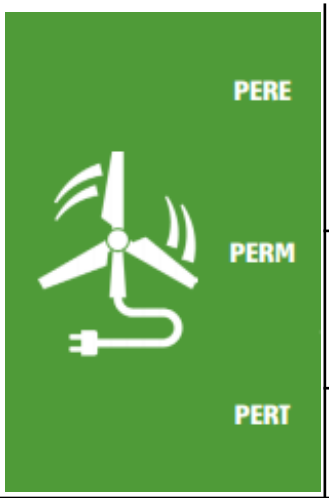
# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

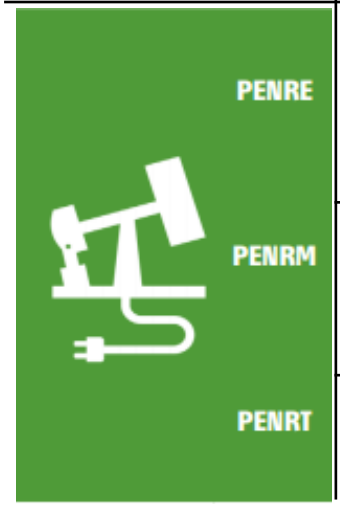
## OTHER IMPACT CATEGORIES INCLUDED IN A DAP




**PERE: Primary renewable energy use excluding primary renewable energy resources used as raw material (MJ).**

PERM: Use of renewable primary energy used as feedstock (MJ).

PERT: Total Primary Renewable Energy Use (MJ).




PENRE: Primary non-renewable energy use, excluding primary non-renewable energy resources used as feedstock (MJ).

PENRM: Use of non-renewable primary energy used as feedstock (MJ).

PENRT: Total Non-Renewable Primary Energy Use (MJ).

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## OTHER IMPACT CATEGORIES INCLUDED IN A DAP

| | |
|---|---|
| | **SM: Use of secondary materials (MJ).** |
| | RSF: Use of renewable secondary fuels (MJ).<br><br>**NRSF: Use of non-renewable secondary fuels (MJ).** |
| | **FW: Net use of flowing water resources ($m^3$).** |

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## OTHER IMPACT CATEGORIES INCLUDED IN A DAP

| | |
|---|---|
| | **HWD: Hazardous waste disposed (kg).** |
| | NHWD: Non-hazardous waste disposed(kg). |
| | **RWD: Radioactive waste disposed (kg).** |
| | **CRU: Components for re-use (kg).** |
| | **MRF: Materials for recycling (kg).** |
| | **MER: Materials for energy recovery (kg).** |

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# TYPES OF ENVIRONMENTAL IMPACT CATEGORIES

## OTHER IMPACT CATEGORIES INCLUDED IN A DAP

EE: Energy exported (kg).

TEE: Thermal energy exported (kg).

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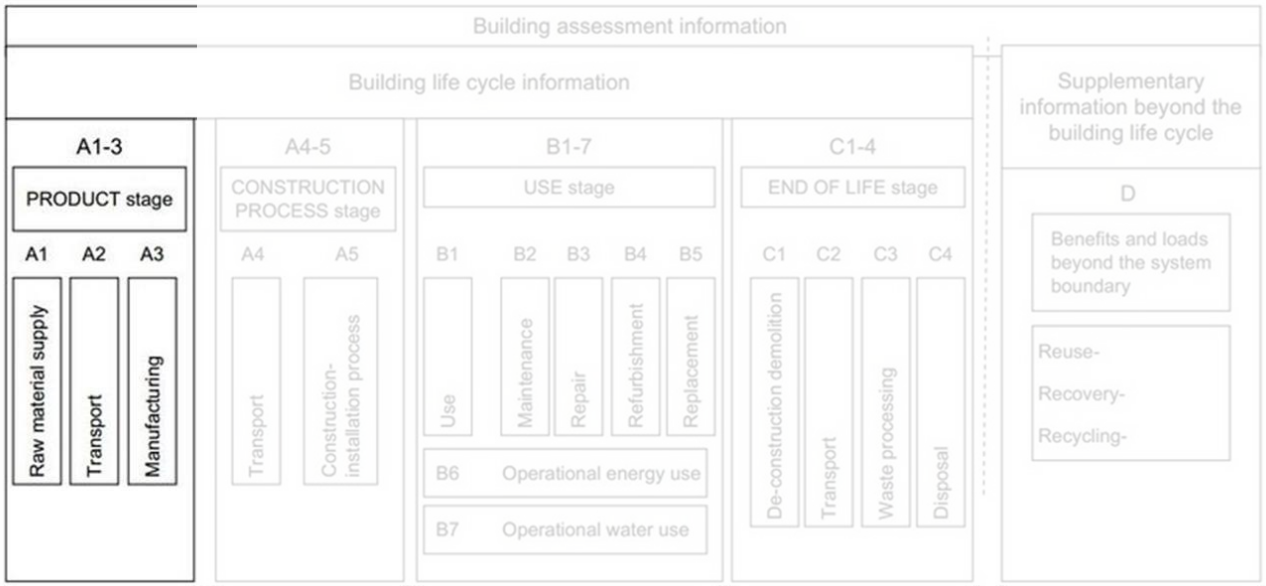
# STAGES OF THE LIFE CYCLE

## ➢ Product A1 - A3

- Supply of raw materials (A1). Extraction and processing of raw materials, processing of inputs that constitute secondary materials (e.g., recycling processes).
- Transport to factory (A2)-
- Manufacturing (A3)-

Including the supply of all materials, products and energy, as well as the treatment of waste to the end-of-waste state or the elimination of the final waste during the product stage.



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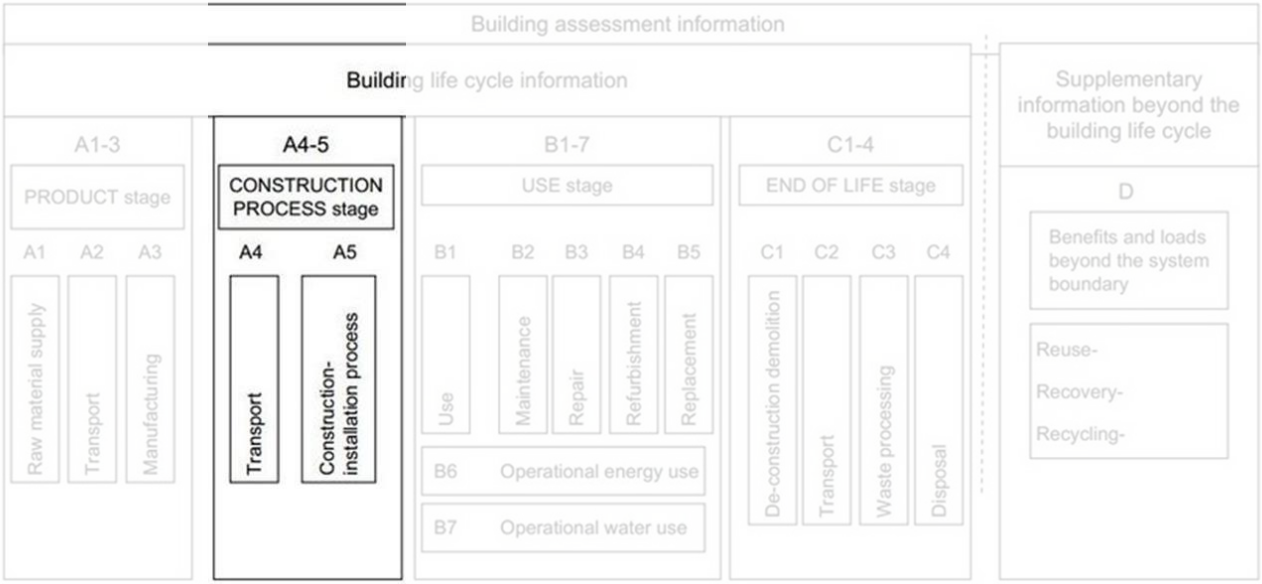
# STAGES OF THE LIFE CYCLE

## ➢ Construction A4 - A5

- Transport to site (A4).
- Installation in the building (A5).

Including the supply of all materials, products and energy, as well as the treatment of waste to the end-of-waste state or disposal of the final waste during the construction process stage. These reporting modules also include all impacts and aspects related to losses in this stage of the building process (i.e., production, waste transport and disposal of the lost products and materials)..



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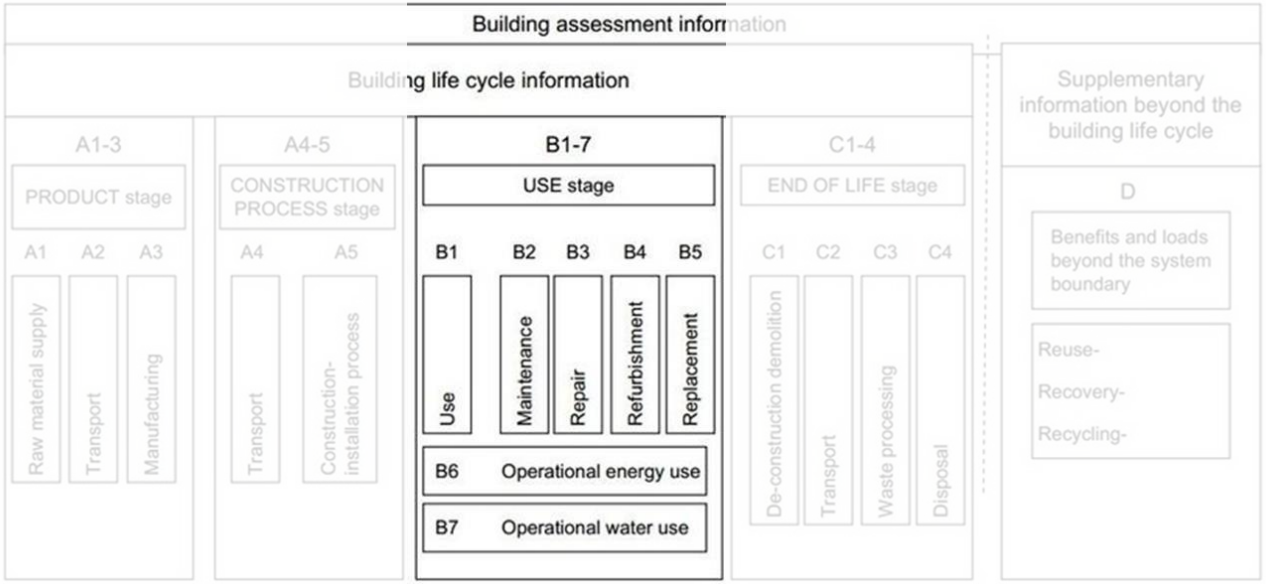
# STAGES OF THE LIFE CYCLE

➢ **Use B1 - B7**

- Use (B1).
- Maintenance (B2).
- Repair (B3).
- Replacement (B4).
- Rehabilitation (B5).

Including the supply and transport of all materials and products and the use of energy and water, as well as the treatment of waste up to the end-of-waste state or disposal of the final waste during the use stage. These reporting modules also include all impacts and aspects related to losses at this stage of the construction process (i.e., production, transport and treatment of waste and disposal of lost products and materials).



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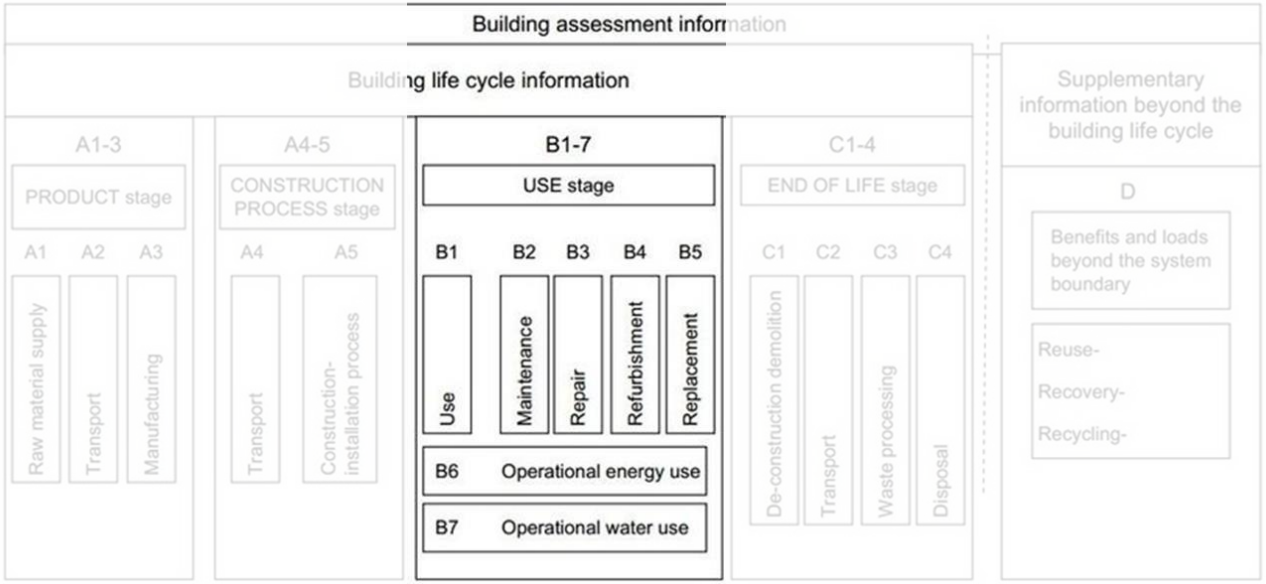
# STAGES OF THE LIFE CYCLE

## ➢ Uso B1 - B7

- Operational energy use (B6).
- Operational water use (B7).

These information modules include the supply and transport of all materials and products and the supply of energy and water, as well as the treatment of waste up to the end-of-waste state or the disposal of the final waste during the use stage..



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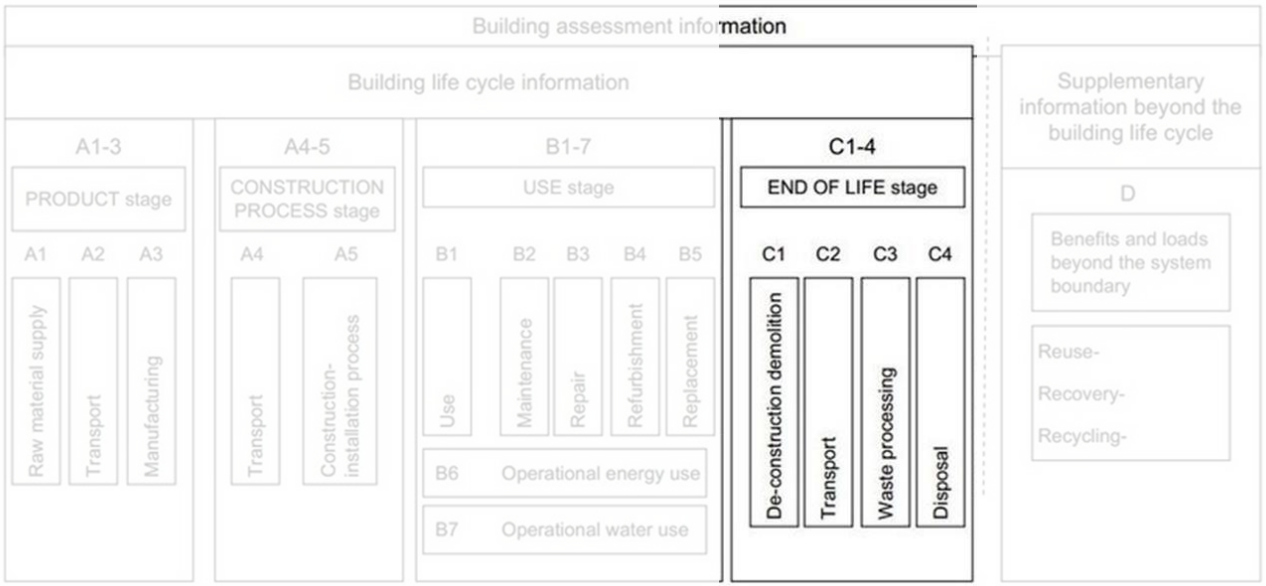
# STAGES OF THE LIFE CYCLE

## ➢ End of life C1 - C4

- Deconstruction and demolition (C1).
- Transport (C2).
- Waste management for reuse, recovery and recycling (C3).
- Transport (C4).

Including the supply and transport of all materials and products, and associated energy and water use.



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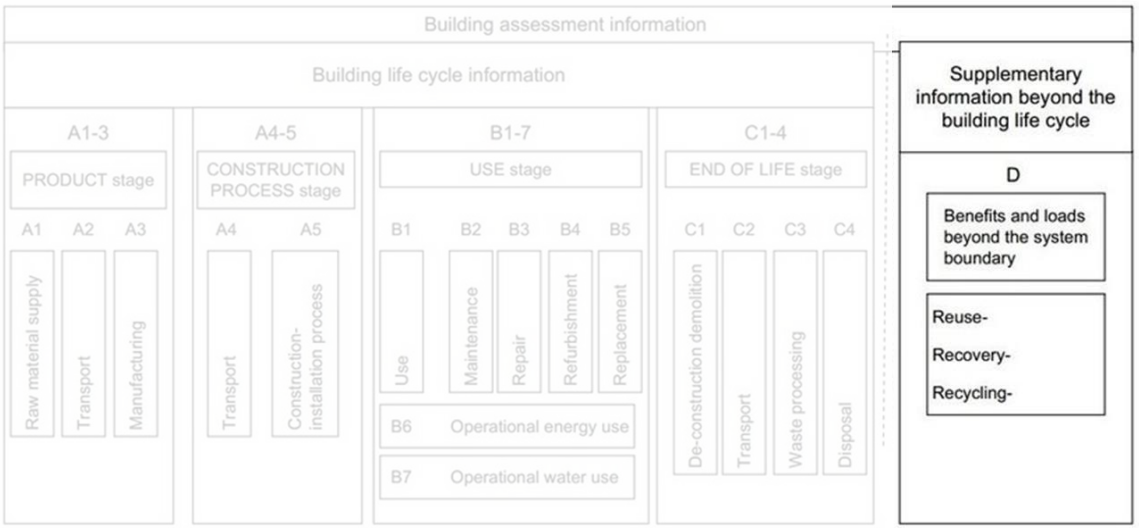
# STAGES OF THE LIFE CYCLE

➢ **Reuse, recovery and recycling potential (D), expressed as net benefits and burdens.**

Benefits and burdens beyond system boundaries: Reporting module D seeks transparency of environmental benefits or burdens generated by reusable products, recyclable materials and/or useful energy carriers coming from the product system, e.g., in the form of secondary materials or fuels.
Therefore, all declared net benefits and burdens obtained from net flows leaving the product system that have not been allocated between co-products and that have reached end-of-waste status should be included in module D (system expansion). Avoided impacts allocated to co-products should not be included in module D.



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# ENVIRONMENTAL PRODUCT DECLARATIONS (EPDs)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Water use (WDP) | m^(3) Welt-Äq. entzogen | 4.89 | 0.0178 | 0.161 | 0.00151 | 0.00404 | 0.242 | 0.0565 | -0.0355 | -0.012 |
| Eutrophication potential terrestrial (EP-terrestrial) | mol N-Äq. | 1 | 0.0145 | -0.00265 | 0.00904 | 0.00329 | 0.073 | 0.011 | -0.0192 | -0.004 |
| Global Warming Potential total (GWP-total) | kg CO (2)-Äq. | 146 | 4.15 | 0.824 | 0.352 | 0.942 | -10.1 | 0.5 | -1.46 | -1.06 |
| Global Warming Potential fossil fuels (GWP-fossil) | kg CO (2)-Äq. | 145.6 | 4.13 | 0.83 | 0.366 | 0.938 | 1.44 | 0.541 | -1.45 | -1.05 |
| Abiotic depletion potential for fossil resources (ADPF) | MJ | 1.58E+3 | 54.8 | -14.9 | 4.66 | 12.5 | 27.1 | 6.9 | -19.1 | -15.1 |
| Abiotic depletion potential for non fossil resources (ADPE) | kg Sb-Äq. | 0.0000162 | 3.43E-7 | -2.25E-7 | 2.92E-8 | 7.79E-8 | 0.00000158 | 4.88E-8 | -3.14E-7 | -2.28E-7 |
| Global Warming Potential luluc (GWP-luluc) | kg CO (2)-Äq. | 0.0795 | 0.0173 | -0.00132 | 0.00147 | 0.00392 | 0.00529 | 0.00156 | -0.00484 | -0.00135 |

EXAMPLE OF ENVIRONMENTAL IMPACT ASSESSMENT INDICATORS IN EPD.

Source: www.eco-platform.org

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# ENVIRONMENTAL PRODUCT DECLARATIONS (EPDs)

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EXAMPLE OF ENVIRONMENTAL IMPACT ASSESSMENT INDICATORS IN EPD.

Source: www.eco-platform.org

**EXPLANATORY NOTE**

**As we will see in section 4.3 below, in a LOD 600 Development Level it would be possible to include information on the environmental impact categories of a model element, both the total sum of all stages and each individual stage:**

**Output A1 - A3**

**- Supply of raw materials (A1)**

**- Transport to factory (A2)**

**- Manufacture (A3)**

**Construction A4 - A5**

**- Transport to site (A4)**

**- Installation in building (A5)**

**Use B1 - B7**

**- Use (B1)**

**- Maintenance (B2)**

**- Repair (B3)**

**- Replacement (B4)**

**- Rehabilitation (B5)**

**- Operational energy use (B6)**

**- Operational water use (B7)**

**End of life C1 - C4**

**- Deconstruction and demolition (C1)**

**- Transport (C2)**

**- Waste management for reuse, recovery and recycling (C3)**

**- Transport (C4)**

**Reuse, recovery and recycling potential (D)**

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# 4.3. LOD600

BIM OBJECT PLATFORMS

LOD IN BIM PLATFORMS

LOD600 LEVEL DEFINITION

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# BIM OBJECT PLATFORMS

Nowadays it is possible to find several websites where you can download free resources for BIM software: libraries of BIM objects of different LOD levels, families or components, materials, plug-ins, manuals, etc.

bimtool

BIM&CO

bimobject

SYNCRONIA
ARCHITECTURE VICTIMS

Bimetica
BIM a tu lado

ARCAT

BIM Community

bimstore

*Source: https://www.espaciobim.com/recursos-bim-revit-gratis*

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bimtool

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SYNCRONIA
ARCHITECTURE VICTIMS

Bimetica
BIM a tu lado

ARCAT

EXPLANATORY NOTE

Remember that BIM objects are geometric models made with parametric software in a way that allows their attributes to be modified. When we talk about BIM objects, we always refer to open formats. When we talk about Families, we refer to BIM Objects that we create with a specific tool: Autodesk Revit.

*Source: https://www.espaciobim.com/recursos-bim-revit-gratis*

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# BIM OBJECT PLATFORMS

bimtool is an intelligent BIM platform for the industry. It has a complete catalogue of products in BIM standard, allowing buyers to download and work with them on their projects, where it brings together the entire AEC construction community: material suppliers and manufacturers, architectural, design, engineering and construction professionals...

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# BIM OBJECT PLATFORMS

BIM&CO is very present in the world of construction digitalisation, offering all the agents involved in construction and manufacturers solutions to manage and share their BIM objects.

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# BIM OBJECT PLATFORMS

bimobject is one of the most powerful websites for free downloads of BIM objects. Once registered, it is possible to download all available objects (objects for Revit, BIM components for ArchiCAD, Allplan, Rhinoceros, Sketchup, etc.). It is also possible to install its plug-in for various BIM software and have access to its catalogue from the software.

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# BIM OBJECT PLATFORMS

Syncronia.com is a totally free professional services web platform, offering BIM models, catalogues, technical information and product presentations, and consultancy for technical offices of companies. Syncronia is also a space to find new clients, interact with other professionals and manufacturers, or publish new projects.
Syncronia selects brands of excellence for different product categories, with the possibility of downloading BIM models developed by manufacturers in collaboration with Autodesk, its technological partner, completely free of charge. That is why the BIM models are mainly developed for Autodesk Revit.

SYNCRONIA
ARCHITECTURE VICTIMS

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# BIM OBJECT PLATFORMS

Bimetica is a social platform that offers specialised knowledge and information on technologies, methodologies and products related to the construction sector and especially BIM. It is not only possible to download BIM objects - Revit, Archicad, IFC, AECOsim, etc. families, as well as other files and 3D blocks, datasheets, etc. - but also to order them if they are not in the BIM library. Completely free of charge.

Bimetica
BIM a tu lado

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# BIM OBJECT PLATFORMS

In essence, it is a BIM library. In addition to BIM objects, it is possible to download technical specifications of construction products. They even have their own mobile app. BIM components are Revit objects and families as well as DWG files.

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# BIM OBJECT PLATFORMS

Its aim is to be the international reference portal in Spanish in the BIM world. The main resource that can be found on this website is information in the BIM environment: software, mobile applications, guides, BIM servers, books, BIM components, etc. And of course, links to the main websites that offer all these resources.

BIM Community

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# BIM OBJECT PLATFORMS

bimstore.com.uk básicamente es una librería BIM para Revit, además de una fábrica de objetos BIM. Como curiosidad, Bimstore Eye, su visor de realidad aumentada, permite ver en 3D los componentes BIM de los fabricantes.

bimstore

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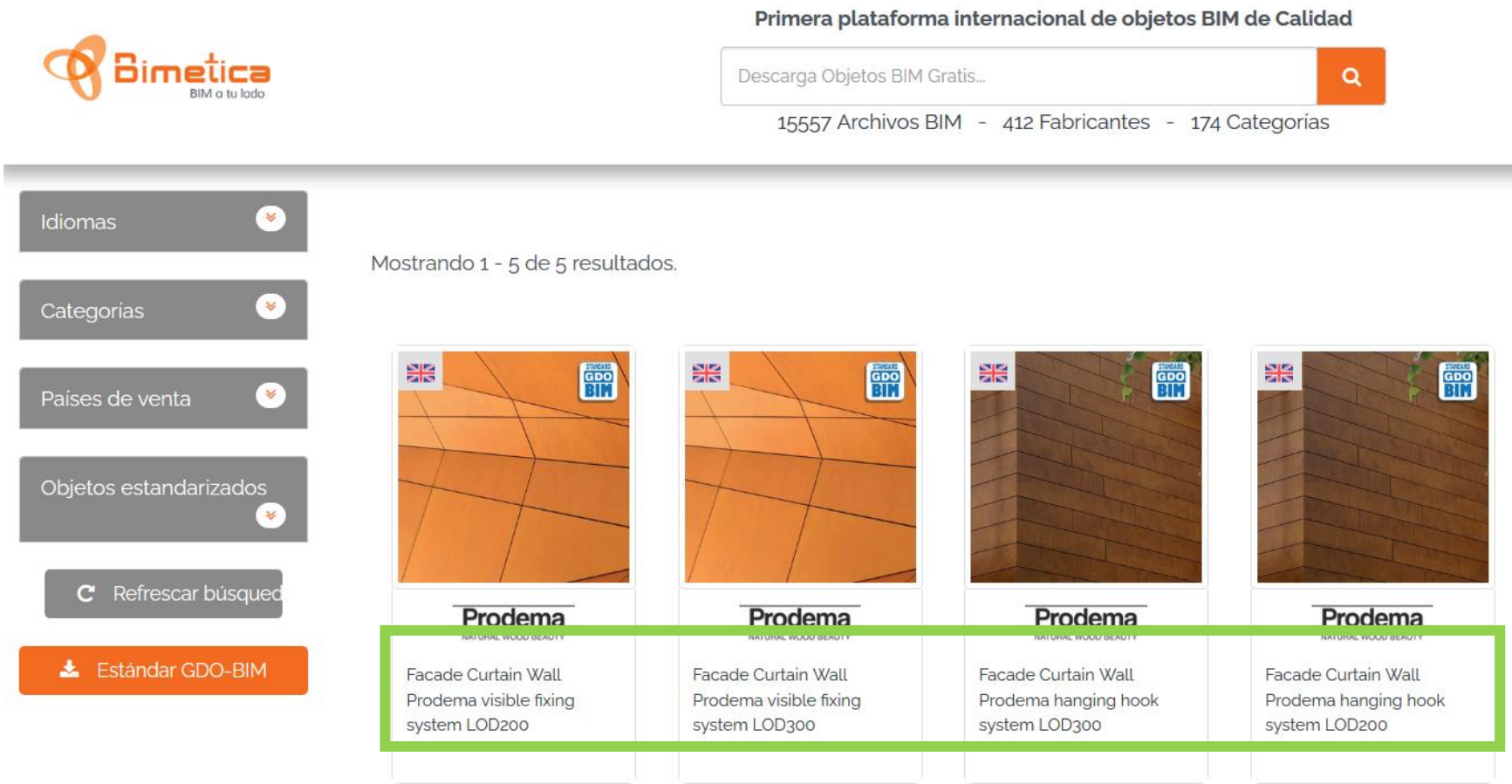
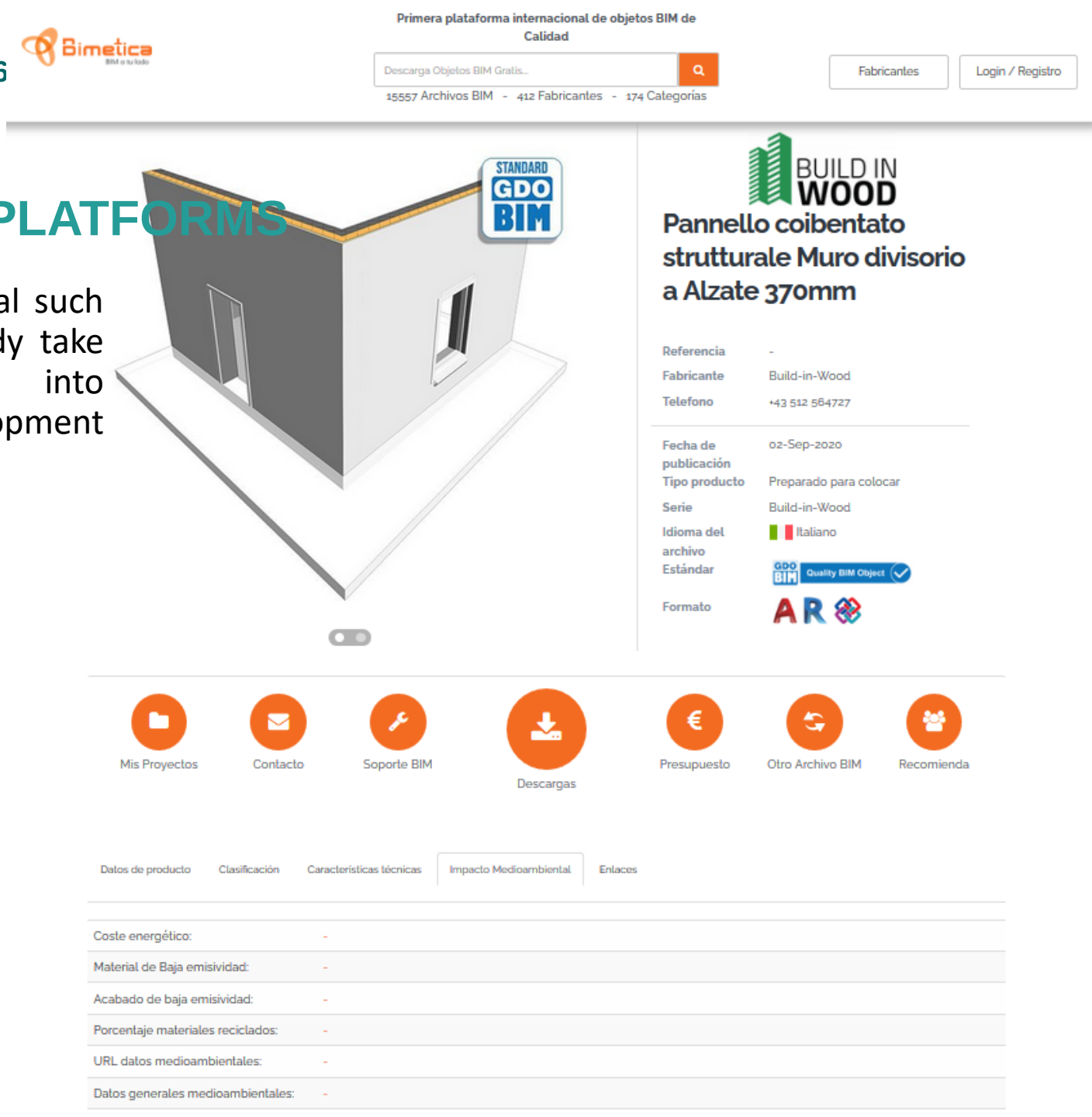
# LOD ON BIM PLATFORMS

Regarding the above-mentioned platforms, many of them take into account facilitating the LOD level of the uploaded BIM objects for the users.

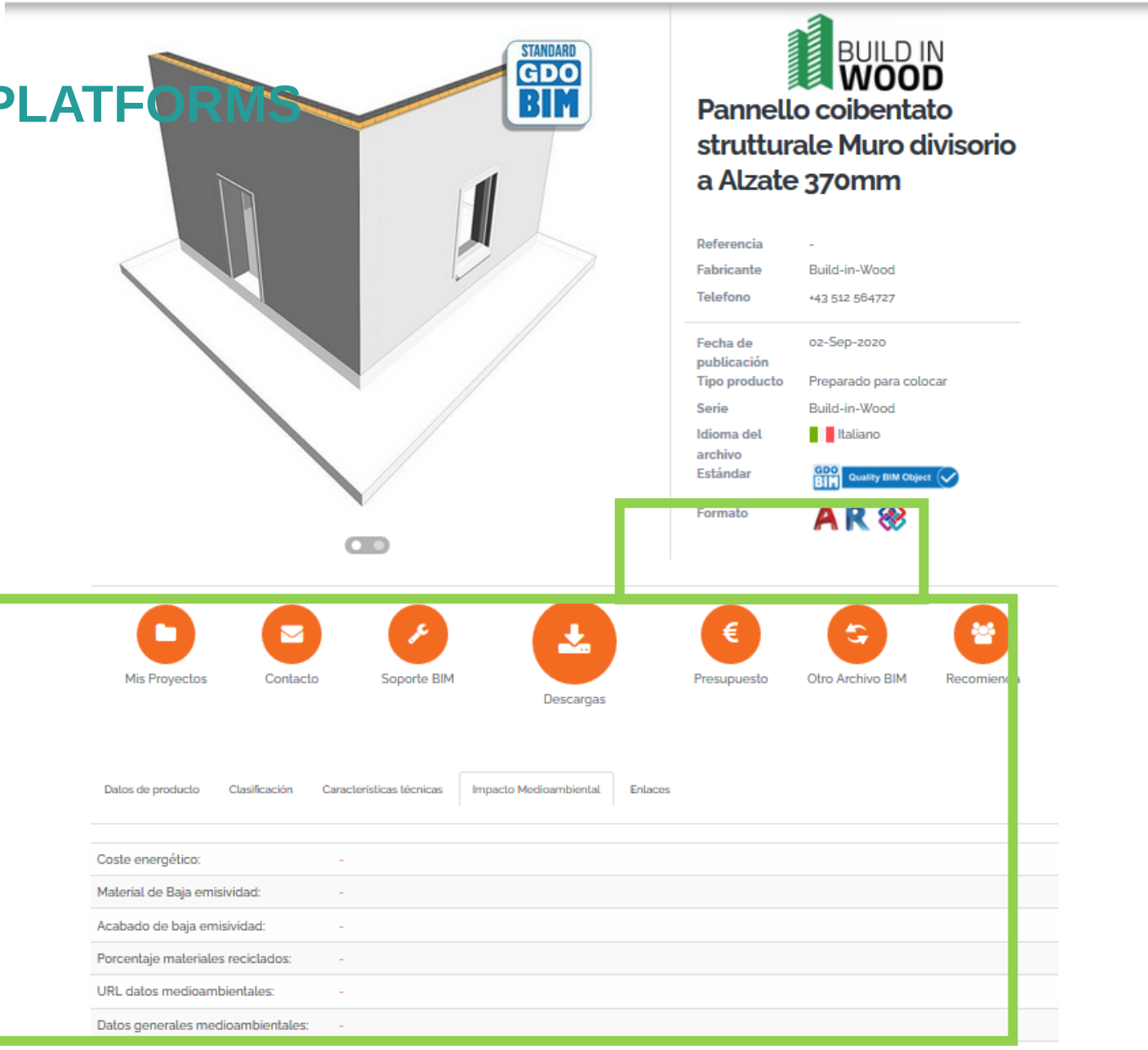


# LOD ON BIM PLATFORMS

There are also several such platforms that already take environmental data into account in the development of BIM objects.



# LOD ON BIM PLATFORMS



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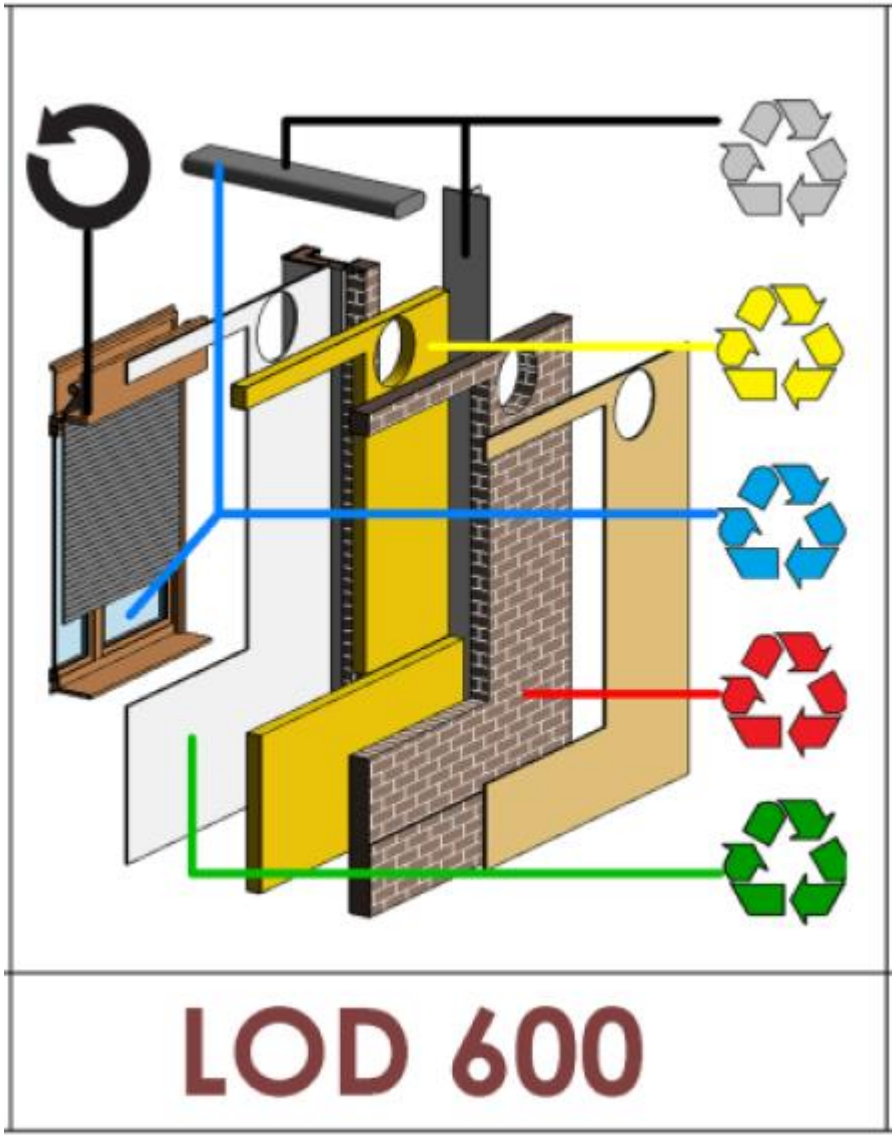
# LOD600 LEVEL DEFINITION

- **LOD 600 *(autor: Alonso Madrid)*.**
  - The object is not geometrically defined in detail, but its recycling conditions, such as own materials, toxicity, lifetime, distance to recycling points, weight and volume, ways of transport and dismantling, etc. are defined.
  - It is mainly based on non-graphical information linked to the item.




*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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# LOD600 LEVEL DEFINITION

## ➢ USES OF LOD 600:

- **Analysis**: The element should include its dismantling, demolition and recycling details. Composed mainly of non-graphical information.
- **Cost**: Estimation of costs/expenses according to the recycling needs of the element, linked to issues such as useful life, depreciation, renewal value, etc. specific to the site and the distance to other environments (recycling points, factories, urban centres, protected areas, etc.).
- **Programming**: The item shall consider its useful life, reliability in use and costs arising from recycling, as well as related fees or penalties.
- **Coordination**: The element can be used to coordinate with other elements of the project based on recycling schedules, as well as its effect on the other elements of the project during its modification (removal, decrease in efficiency, toxicity, etc.).

*Source:*
*https://www.buildingsmart.es/app/download/11134225126/sjbim1501.pdf?t=1575535509 págs. 40-58*

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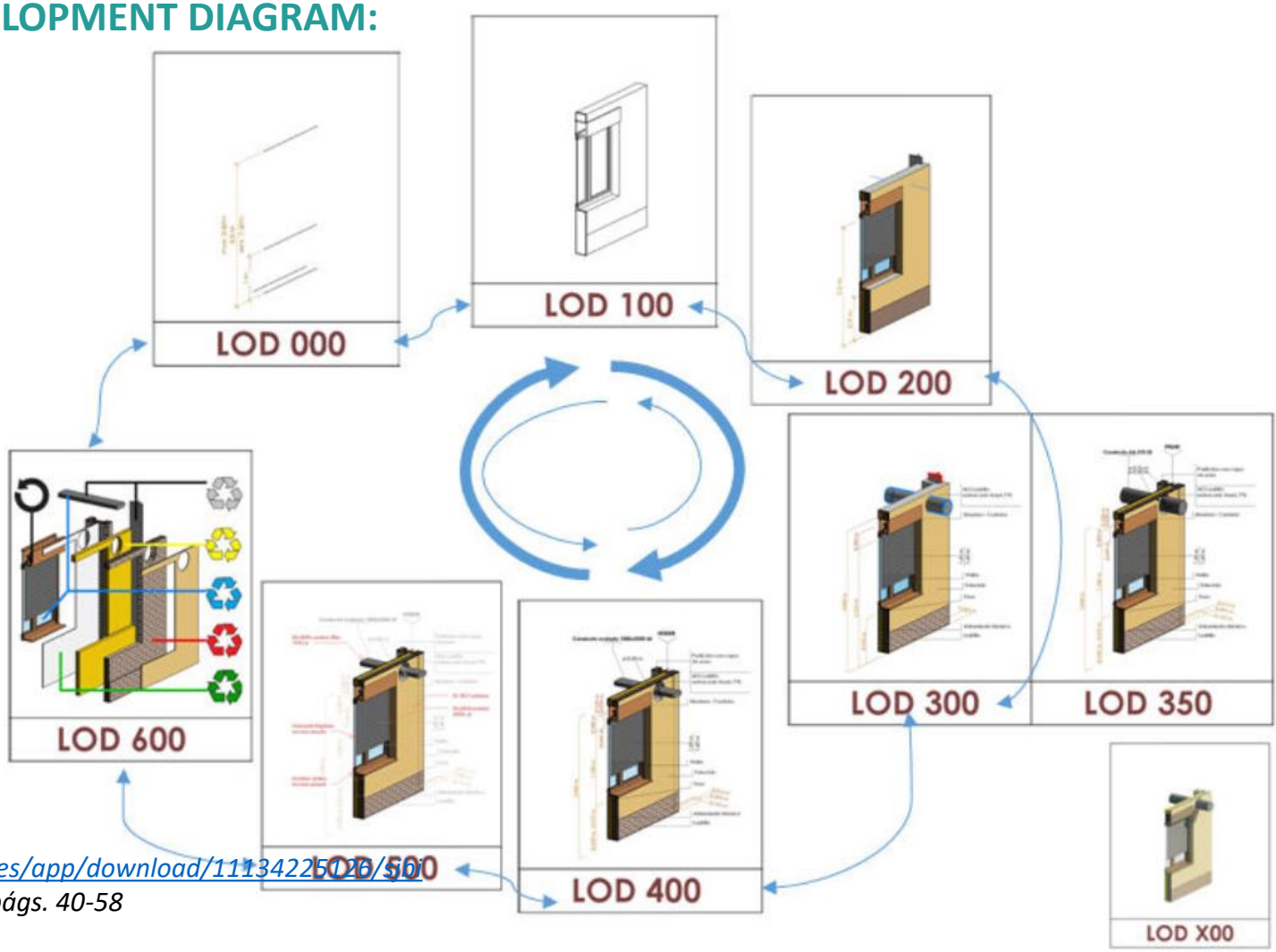
# LOD600 LEVEL DEFINITION

## ➢ BIM OBJECT DEVELOPMENT DIAGRAM:




*Source:*
*https://www.buildingsmart.es/app/download/11134225026/500m1501.pdf?t=1575535509 págs. 40-58*

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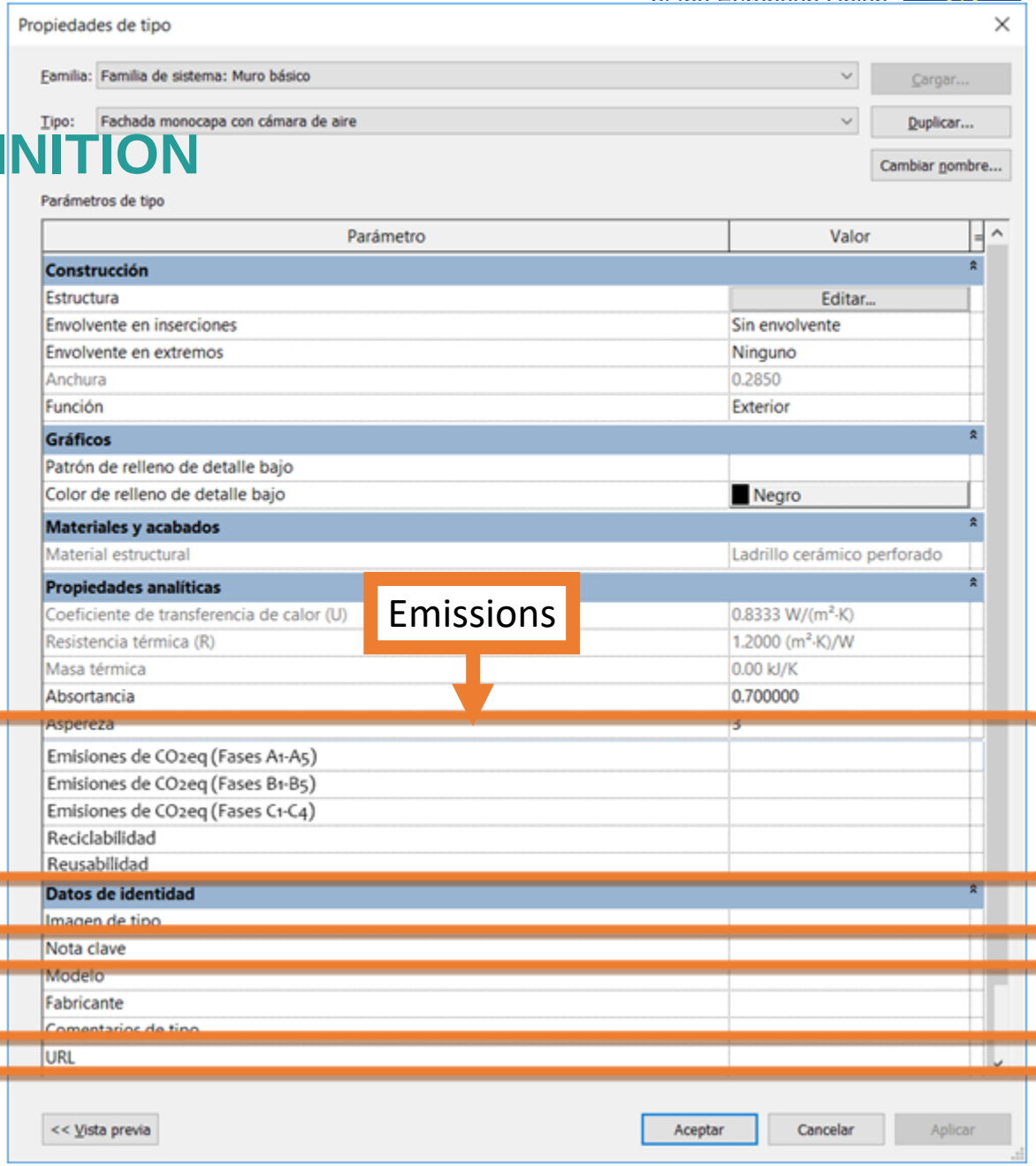
# LOD600 LEVEL DEFINITION

Consequently, under the same criteria and based on current standards, it is possible to insert environmental impact data into BIM objects, as will be developed in the following modules of this course.




Example of integration of environmental impact data into a BIM material from Autodesk Revit.
Source:
[http://repositorio.ucam.edu/bitstream/handle/10952/2436/Tesis.pdf?sequence=1&isAllowed=y](http://repositorio.ucam.edu/bitstream/handle/10952/2436/Tesis.pdf?sequence=1&isAllowed=y)

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

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BIMEPD

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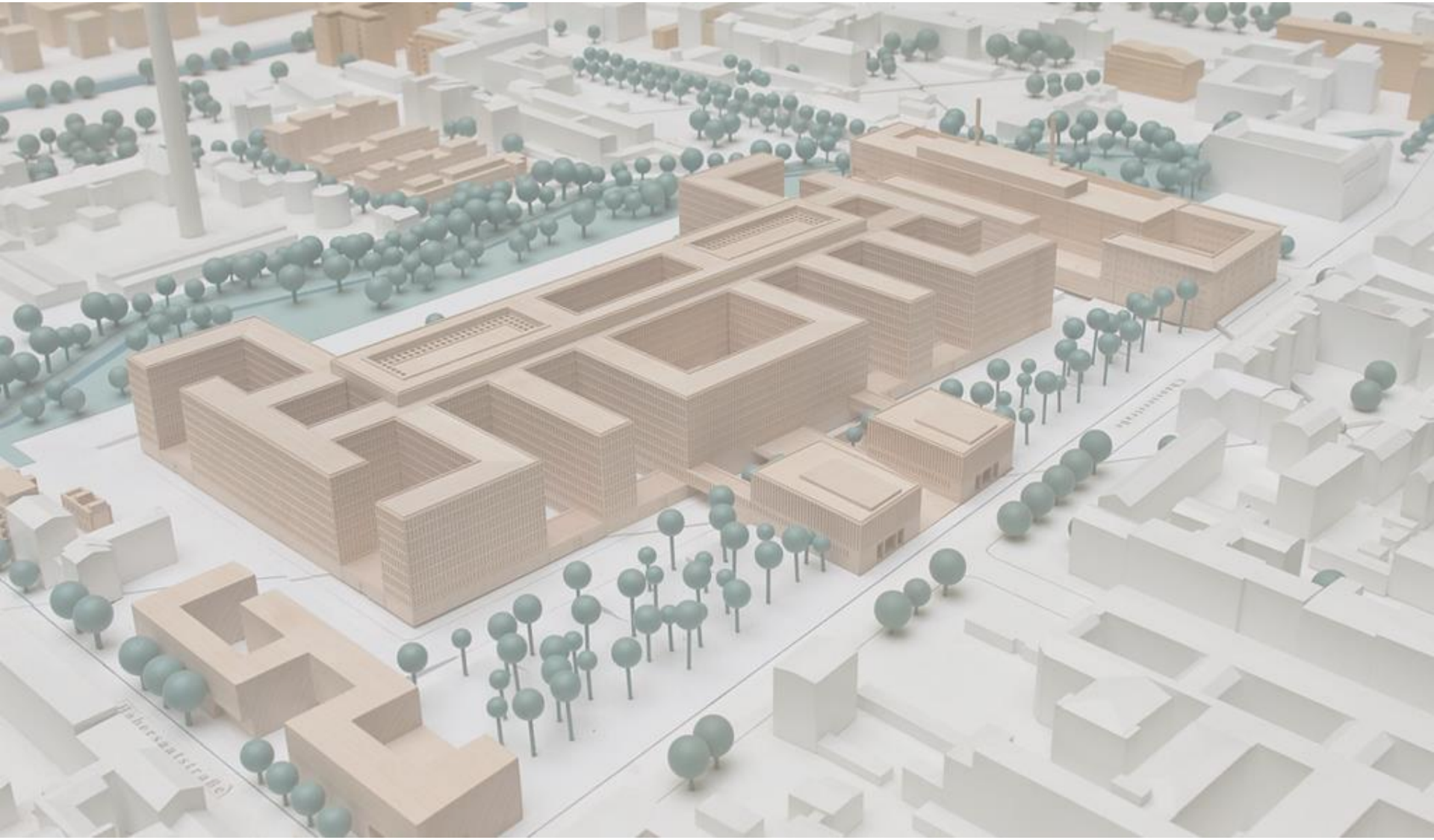

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iED institute of Entrepreneurship Development

Centro Tecnológico del mármol, piedra y materiales

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