THE ECOB STANDARD FOR CREATING BIM OBJECTS. THE PERSPECTIVE FROM THE CERAMIC INDUSTRY.

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1. ABSTRACT

The international uptake of BIM technology and processes in the construction sector is a phenomenon whose impact is constantly growing. In Spain there are a significant number of public-private initiatives working towards implementing BIM in the coming years, and the number of projects being carried out in the BIM field is beginning to go beyond what we could call a pilot phase.

BIM modelling requires object libraries to be available, in which the information is rigorously and precisely ordered. However, while BIM enables collaborative, international work, it is necessary to be aware that construction projects are realized in a specific country which applies a particular set of regulations.

It is therefore necessary for objects to be available that comply with national regulations, with the aim of producing BIM models of outstanding quality.

ITeC has designed a standard for the creation of BIM objects called **eCOB** which responds to Spanish regulations, based on an international vision. It can be used to structure information from different modelling platforms, while being built on the concept of Open BIM, using the IFC[1] format.

eCOB is an open, public standard, and allows both generic and branded objects to be created. It guarantees that information is always structured and reliable.

From the ceramic industry's perspective, the standard contains the information necessary for product manufacturers to correctly manage the creation of objects or materials libraries, which are their main entry points to BIM.

2. INTRODUCTION

The construction sector is currently undergoing a period of change in its traditional ways of working. It is generally agreed that this is a sector in which there are a very diverse range of stakeholders working in a very compartmentalized way, often with conflicting interests, and that the sector has not gone through such a profound process of digitization as others in the economy.

The operational transformation which is beginning to take place has two main vectors: digitization and collaboration, which are mutually reinforcing.

Digitization aims to carry out a transformation that allows processes to become more efficient, establishing workflows whose essential objective is the correct management of data and information in the distinct phases of an asset's life cycle. These data are intended to achieve traceability, transparency and reliability.

Collaboration should be understood in terms of creating understanding among the various stakeholders involved in construction about the importance of aligning their interests, and working together towards a common goal. This should result in greater value being given to their work and to the final product delivered.

"BIM" is a term which has come to be associated with part or all of this transformation. The term has achieved great notoriety and is used, sometimes arbitrarily, to refer to various phenomena.

From a technological point of view, BIM allows us to carry out a digital process of virtual construction. This facilitates the setting of criteria, the creation of solutions, and the analysis of diverse aspects using a virtual scale model, prior to the actual construction of a building or element of infrastructure.

Another conception of BIM relates it to the processes by which the sector operates. Creating the virtual scale model is a gateway to an open, collaborative way of working with all the stakeholders involved, in which the aim is for each of them to share their knowledge in the earliest possible phase. It is a way to lay out the multiple requirements a project has to deal with, for all to see. This creates a balanced response which can produce an asset with greater added value, thereby optimizing the investment.

In any case, the virtual scale model, commonly known as "the model", is simply a database of graphic and non-graphic objects, which becomes a meeting point for the

two visions of BIM. It is therefore essential to focus on the quality of the "model" if we are to ensure the success of this transformation.

3. FROM BIM MODEL QUALITY TO BIM OBJECT QUALITY

The creation of a BIM model is a process in which the sector's various stakeholders take part, each contributing different aspects of the information needed to develop a project. The process of creating the model is driven by the needs or requirements of the promoter (EIR - *Employers' Information Requirements*), which is followed by production of a document establishing the guidelines which the stakeholders involved will work with (BEP - *BIM Execution Plan*) to provide a satisfactory response to the requirements set.

The quality of the BIM model is rooted in these documents. They establish and order how work will be done: the standards to use, the work flow, communication between stakeholders, the phases and the level of detail and information at each phase... among other details.

Object-focused design is the basis for developing a BIM model, which leads us to underline that the quality of a BIM model is inseparable from the quality of the BIM objects. It is not possible to have a quality model if the objects of which it is made are not also of good quality.

The need to exact quality from the objects which represent specific construction products is therefore clear. It is no longer sufficient to have a good-quality construction product, it is also necessary for the digital object that represents it to be of good quality, given that it will participate in a virtual construction process with these expectations. The virtual scale model will be the means of putting the product to the test. How well its attributes meet the project's needs will be analysed, and on this basis a decision will be made on whether this is the suitable product.

A product manufacturer must therefore understand how to ensure the quality of a BIM object, given that it will ultimately represent their product in the digital world.

A BIM object is, like the BIM model, the sum of graphic and non-graphic data. The graphic data are those which enable the object's visualization as a three-dimensional item in modelling software. The non-graphic data are included to enable users to search for various types of properties (physical, environmental, certification, costs...)

4. GENERIC AND BRANDED OBJECTS

A project always has several stages, through which it progressively develops and defines all its characteristics more precisely (conceptual, basic, detailed, as built). The point at which a brand and model are assigned to a specific component of the project varies in time. Nowadays, for example, a public construction project's detailed design may not contain specific brands. Nor is it very common for a designer to include product brands in the initial, definition phases of a project. It therefore makes sense that there will be generic objects for use in initial project phases, and branded objects for the later phases.

Generic objects dictate or specify properties, while branded objects ensure provision of the features that respond to the initial project requirements. It is important for all these objects, whether generic or branded, to be structured in a uniform way.

5. THE NEED FOR STANDARDIZATION

There is therefore a clear need to require the BIM objects which represent construction products to be produced according to a set "style guide" that can efficiently organize all information on the object, as well as its visual expression. We will consider this style guide a standard which will become a benchmark for the creation of objects.

The existence of such a standard is beneficial for all:

- For manufacturers of construction products, giving them the certainty that objects will be correctly generated to rigorous technical standards, thereby optimising the value of the investments they make.
- For creators of BIM objects, allowing them to offer a product based on guidelines established by an independent organization, which specializes in the field of standardization and certification.
- For object users (specifications writers, designers, construction professionals), enabling them to realize standardized comparative analyses, and produce BIM models in which including objects from different origins does not produce the kind of unnecessary background noise which could decrease quality.

To date there is no universal, internationally-recognised standard. Various standards exist, but none of them are obligatory. There is much discussion of BIM's capacity to enable international-level work, but each project is also designed for a particular site and this makes it necessary to comply with the specific regulations of a certain country. When following any standard for producing objects, we should consider which regulations they are responding to.

6. THE ECOB STANDARD

As a result of the considerations summarised above, ITeC has developed the Standard for Creating BIM Objects (Estándar de Creación de Objetos BIM) - eCOB. This is an open, evolving standard:

- Open, so as to provide a solution for creating objects not only to object creation businesses, but also to the sector's professionals: the product manufacturers, organizations and associations representing subsectors of construction products, which need to create objects independently.
- Evolving, because it is able to meet the requirements of each type of product as well as the need for information throughout the life-cycle.

The eCOB standard aims to facilitate interoperability, and has been developed by taking an international perspective and grounding it in a local reality. For this reason, it makes as much use as possible of the IFC format - the most common open format - to which the properties considered necessary for our normal operating environment have been added. Compliance with Spanish regulations is therefore prioritized, although the way in which information is structured allows the specific regulations of other countries to be adopted.

The standard covers the creation of both generic and branded objects, and applies to object creation on any modelling platform.

The standard has two parts. The first part explains key concepts, to facilitate understanding of the aspects involved in the creation of objects that will form part of BIM models. The second part sets out the exact specifications to be applied in the generation of objects, their structure, the way of expressing technical information, and visual representation.

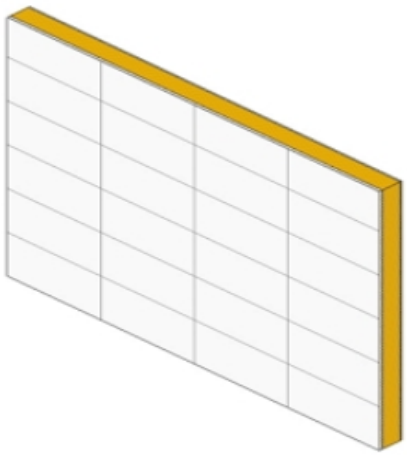
7. PROPERTIES OF BIM ITEMS

The eCOB standard structures the information on "*Property Sets*" (Psets), which are attributed to BIM items. Some of the sets originate in the IFC schema, while others have been developed to order information on the products, on the basis of what are known as "BIM Dimensions".

As a result, the following "Psets" have been established

Pset name	Content	Origin
ifcExport	Properties with information to facilitate alignment ("mapping") or exporting to IFC	IFC
Pset_BuildingElements	Determined by IFC for each type of item (Pset_ColumnCommon, Pset_WallCommon, etc.).	IFC
Qto_BuildingElements	Determined by IFC for quantification	IFC
Ecob_Pset_General	Properties to contain general information on the BIM model (author, date, version, model name, classification, etc.)	eCOB
Ecob_Pset_BuildingElements	Properties based on the expected use of the construction item	eCOB
Ecob_Pset_BuildingTopology	Properties defined to contain information on the location of the items within the BIM models	eCOB
Ecob_Pset_Products	Properties defined to contain information on the item's construction products (manufacturer or the product's commercial name, CE mark, DdP, etc.).	eCOB
Ecob_Pset_4D	Properties defined to contain information on the temporal conditions of construction.	eCOB
Ecob_Pset_5D	Properties defined to contain information related to quantity take-offs and the budget of the construction project (materials orders, description, etc.).	eCOB
Ecob_Pset_6D	Properties defined to contain information on sustainability-related aspects.	eCOB
Ecob_Pset_7D	Properties defined to contain information on operations and maintenance of the construction project	eCOB

The most strictly technical Psets include properties which are necessary for each construction product. While properties such as thermal conductivity may be included for a thermal insulation product, for flooring products the friction coefficient may be included to measure slipperiness, or the resistance to impact, which would also be applicable to ceramic cladding.



The following images show the content of some Psets that are related to a generic object, developed by ITeC, corresponding to a partition wall, of 145mm thickness, having a ceramic masonry structure with wall tiling on one side and gypsum plastering with painted finish on the other.

This and other generic objects can be found at:

http://metabase.itec.cat/bim/es/

Itec_Pset_General

Author	ITeC	*Author of BIM object.*
COBieCategory	21-03 10 10 10 Interior Fixed Partitions	*COBie category.*
OmniclassCode	21-03 10	*Omniclass code as per table 21.*
UniclassCode	EF_25_10	*Uniclass code as per tables of elements or systems.*
Uniformat2010code.	C10	*Uniformat 2010 code.*
OmniclassDescription	Cerramientos interiores	*Omniclass description as per table 21.*
UniclassDescription2115	Walls	*Uniclass description as per tables of elements and systems.*
UniformatDescription2010	Cerramientos interiores	*Uniformat 2010 description.*
ObjectStandard	ECOB_v1_2017	*Reference to BIM object standard*
Emision date	12/06/2017	*Date of creation of BIM object.*
TypeBimITeC	ITeC_Divisorias145mm_Alic+FabCer+Enl	*ITeC BIM type name.*
ITeC BIM type	http://metabase.itec.cat/empresa/es/1639958/bim/1519	*Url of ITeC BIM Type.*
Version	RVT_2015 / AC_19	*Version of BIM object.*

Figure. *Example of a Pset_General for a partition wall that is tiled on one side*

Pset_WallCommon

Combustible	No	*Checking fire behaviour properties must be done using the documentary accreditation that accompanies product components of the BIM element.*
ElementoExterior	No	*It indicates whether the element is designed for exterior use or no.t*
Estado	SP	*State of the element in the project phase defined as New, Pre-existing, For Demolition, Temporary (such as a fixing background structure).*
ExtenderAEstructura	SP	*Value as per project.*
IndiceGlobalRedAcustica	42 dBA	*NR global noise reduction index weighted A*
Portante	No	*Load-bearing function of the element.*
ReaccionAlFuego	A1	*Classification according to UNE-EN 13501-1. At least C-s2, d0, value required in table 4.1 of the BD FS of the Building Technical Code for wall cladding in occupiable areas. Checking fire behaviour properties must be done using the documentary accreditation that accompanies product components of the BIM element.*
Referencia	ITeC_Divisorias145mm_Alic+FabCer+Enl	*Element type identifier.*
ResistenciaFuego	SP	*At least EI 60, value required in table 1.2 of the BD FS of the of the Building Technical Code for walls that define fire sectors. At least R 30, value required in table C.2 of the BD FS of the of the Building Technical Code for fixing backgrounds and walls. Checking fire behaviour properties must be done using the documentary accreditation that accompanies product components of the BIM element.*
SectorizacionFuego	SP	*Value as per project.*
TransmitanciaTermica	1,932 W/(m2*K)	*Value calculated for the set of layers that make up the BIM element from the characteristics of its BIM materials.*

Figure. *Example of a Pset_WallCommon for a partition wall that is tiled on one side*

Itec_PSet_WallProperties

AbsorcionAcustica	0,02	*Acoustic absorption alpha of the finish of the BIM element.*
MasaSuperficial	161 kg/m2	*Value calculated for the set of layers that make up the BIM element from the characteristics of its BIM materials.*
Orientacion	SP	*East, South, North-East,...*
ResistenciaTermica	0,518 (m2*K)/W	*Value calculated for the set of layers that make up the BIM element from the characteristics of its BIM materials.*
RiesgoDeCondensacion	0,517	*Value calculated for the set of layers that make up the BIM element from the characteristics of its BIM materials.*

Figure. *Example of a Pset_WallProperties for a partition wall that is tiled on one side*

8. THE PROPERTIES OF BIM MATERIALS

BIM items are a virtual rendering of construction items which can have one or various BIM materials associated with them. The materials comprise an abstract concept which represents the item's material as it is when incorporated into the building or facility (ceramic masonry structure instead of bricks and mortar; wall tiling instead of tiles, mortar and grout; reinforced concrete instead of steel bars and concrete; air cavity instead of air and substructure, etc.).

BIM materials are not considered BIM objects because they do have a GUID to identify them, so the Psets of the items are not the same, and do not apply to them. Each modelling platform defines the materials with some "series" properties (density, conductivity, embodied energy, manufacturer, direction, etc.), but those which must be taken into consideration are the ones which are included as the minimum in IFC files:

- Material colour (not texture or an associated image)
- Material name
- Order of the layers, in multi-layer items.
- Thickness in mm, in multi-layer items.

9. THE DIGITIZATION OF CONSTRUCTION PRODUCTS: ITEMS OR MATERIALS

In Europe, construction products are regulated by the Construction Products Regulation (EU) 305/2011, by which manufacturers and distributors report on products on the basis of seven essential requirements (mechanical strength and stability, fire safety, etc.); as well as by DoPs or Declarations of Performance; and product labelling with the CE mark.

These three levels of information on a construction product are the starting point for their virtual rendering in a BIM model. As we have seen, BIM models define items or materials according to their form when incorporated into the building work, rather than their form when supplied. When considering the digitization of a construction product, users should consider what the product will be like when used in construction and what its ultimate use will be, to decide whether it should take the form of a functional item or a BIM material.

If the product is digitised as a BIM item, its specifications and attributes will be defined within the item's Psets, and it will have many properties and parameters which information can be uploaded into.

In contrast, if the product is digitised as a BIM material, only a few properties can be defined (colour, name, order of layers and thickness), but these can be expanded if its properties are added to the Pset of the item which contains this material.

10. THE CERAMIC INDUSTRY AND BIM

The entry of any construction product manufacturer into the world of BIM is inevitable when the BIM objects corresponding to the products they have on the market are available. BIM objects are much more than a visual representation, instead they offer a new way of demonstrating the technical specifications of products.

In the specific case of the ceramic sector, as discussed above, companies should have a clear idea about how their products will be included in the BIM. In some cases, they will be treated as systems, and in others as materials. Those treated as systems will be represented as objects, while those treated as materials will have access to the parameters defined for this type of element. Although, as mentioned above, BIM materials have a more limited number of properties, it is possible to consider incorporating them into a higher-level item and inputting a response into the Pset of this item. It is essential to evaluate the best option for each case.

Faced with the need for access to generic and branded objects, the ceramic industry can approach its integration into the BIM field in two complementary ways, which may be developed in parallel.

The generic objects can be produced within sectoral associations or organizations, as a common project which will benefit all companies equally. We should underline here that the information contained in generic objects has a prescriptive nature, focused on compliance with the technical regulations.

Producing branded objects will be a matter for each company, which can establish the strategy for marketing their products according to their own criteria. The information contained in the branded objects is of a performance-related nature, as it describes the declared features, in alignment with the regulatory requirements.

The preparation of both types of object can be covered by one standard, such as eCOB, to guarantee the technical rigour of these objects.

11. CONCLUSION

The definition of BIM objects and materials plays an essential part in the quality of the BIM models produced. It is therefore essential that these are developed to a satisfactory level of quality. Not only the quality of branded objects must be assured, but also the quality of those we term generic objects.

The eCOB standard (The Standard for Creating BIM Objects) aims to provide the sector with an instrument that guarantees this level of quality, and whose open and evolving nature allows it to adapt to the requirements of each specific construction subsector.

The ceramic industry’s products will be incorporated into BIM either as BIM Materials or BIM Objects, in the case of systems.

The Instituto de Tecnología Cerámica (ITC) and ITeC are currently working together to ensure that the eCOB is able to appropriately handle the information that ceramic systems will need to incorporate. The aim is to thereby make it easier for businesses which sell these systems to create their own objects, with the necessary level of quality.

The eCOB standard can be accessed on ITeC's website.

12. REFERENCES

[1] Based on standard EN ISO 16739 Industry Foundation Classes (IFC) for data sharing in the Construction and Facility Management industries.