



Software for Architecture,  
Engineering and Construction



# Open BIM Quantities

## User's Manual

*Application for obtaining the quantities and generating the cost estimations of BIM models in IFC format.*

Open BIM Quantities - Single-family detached house.qto

Project database: Import Export Add work section Add item Add quantity details line Copy Delete Cut Displace upwards Displace downwards Search Filter Filter Environmental data Tags %BIM Waste Reports Update the Block

Ut	Summary	A	B	C	D	Quantity	Rate	Amount
	Substructure							41,237.27
	Foundations							41,237.27
010	m³					177.06	232.90	41,237.27
	Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concr...							
	Superstructure							59,284.33
	Structural concrete works							50,381.44
	Flat slabs							37,658.80
1	EH1010	m²				494.21	76.20	37,658.80
	Reinforced concrete flat slab, horizontal, with free floor height up to 3m, 25cm total depth, ...							
2	EH010	m²				102.50	86.61	8,877.53
	Stairs							
3	EH5010	m³				8.61	444.86	3,830.24
	Reinforced concrete rectangular or square column, 30x30cm average section, made with RC...							
4	EH1010	m³				0.04	371.70	14.87
	Beams							
	Dropped beam, straight, reinforced concrete, 40x60cm, made with RC25/30 (XC1(P) D12; S3...							
m	Waste							
	Ut	Summary				Quantity	Rate	Amount
	Ud	Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, poured with on-site mixer...				177.06	232.90	41,237.27
020a	kg	Approved rebar spacer for foundations.				5,000	0.15	0.75
10g	kg	BS 4449 Grade B500B raw steel in bars, supplied in situ in a variety of diameters.				86,700	1.22	105.77
50	kg	Galvanised tie wire, diameter 1.30mm.				0.425	1.10	0.47
10sa	m³	Ready-mixed						
20	h	3m vibrator						
010	h	On-site concrete						
	h	Skilled steel						
	h	Steel fixer and						
	h	Skilled structural						
	h	Structural co						
	%	Other direct						

Detailed priced bills of quantities

2. SUBSTRUCTURE

2.1. Foundations

Code	Ut	Description	Quantity	Rate 0	Amount 0
C25/30	m³	Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, poured with on-site mixer, and BS EN 10080:2005 steel, with an approximate amount of 85kg per square metre, smooth surface finish using vibratory wet screed. Includes reinforcements for lift pits, folds, intersections, column starts, stairs and ramps, tying wire and spacers.	177.06	232.90	41,237.27

	A	B
Concrete/screed	1,00	35,16
Concrete/screed	1,00	25,57



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# 1 Introduction

This document aims to facilitate the introductory approach to the program. It explains the features and functionality of the **Open BIM Quantities** tool, developed to automatically obtain the quantities and generate the cost estimations of BIM models defined using the IFC standard, in an Open BIM workflow.

## 1.1 Main functions of the program

***Open BIM Quantities** is a tool whose main aim is to obtain the quantities and generate the cost estimations from BIM models in IFC format. To do this, the application will read the properties and quantities contained in each one of the entities that make up the digital model, with the sole condition that it adapts to the IFC format.*

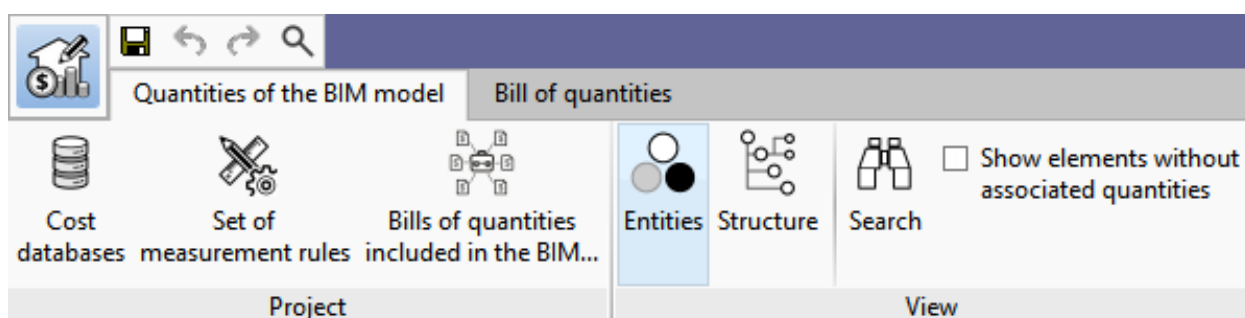
Since quantities and cost estimations are obtained automatically, almost instantaneously, and synchronised with the updated models included in the project, **Open BIM Quantities** aspires to become not only a final tool for obtaining the bill of quantities once the modelling process has been completed, but also a true **design tool** that helps with decision-making during the definition process itself. If, as is often the case, the economic factor is another conditioning factor of the project, being able to obtain quantities and cost estimations automatically will help at any time during the development of the construction adventure.

This application is integrated into the **Open BIM workflow**, allowing its users to import models from a project hosted on the **BIMserver.center** platform and be a part of the collaborative, multidisciplinary and multi-user workflow provided by Open BIM technology.

*Open BIM Quantities allows users to establish the **sets of measurement rules** they deem appropriate, in order **to transform the data of the elements** or components of the model **into items**.*

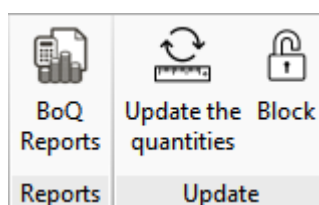
The criteria will consist of **sets of rules** that allow, on the one hand, the filtering of elements according to their features and, on the other hand, to indicate which of their quantities will be used in the measurement of the items to be generated. Ultimately, these rules will define which elements' quantities will be defined and how as well as how and which cost estimations will be carried out.

The relationships between model elements (*components or type instances*) and elements from quantities (*quantity lines belonging to items*) will not always be bidirectional, it is possible that some elements of the model will not need to be measured while others will need to generate quantity lines included in several items; therefore, **the definition of rules will be flexible and customisable** to each unique need. Operating with rules and having the possibility of saving these rules (*set of measurement rules*) for subsequent operations will, in conclusion, automate the processes. Being able to use existing definitions in subsequent jobs saves effort and time in new projects.



Considering that the program establishes a connection between model components and quantity lines related to items, cost databases containing all the necessary information to define quantities and cost estimations need to be managed. The application allows the databases to be created from scratch (*work section structure, items, breakdowns, etc.*), however, it is more interesting to import databases (*or individual concepts*) from bills of quantities developed according to the standard Spanish exchange format **FIEBDC-3** (.bc3). Open BIM Quantities uses this format and allows both the import and export of the generated bills of quantities.

As well as the aforementioned .bc3 standard, Open BIM Quantities allows specifications for construction to be extracted from the quantities and cost estimations by means of a series of reports that can be exported in the following formats: HTML, DOCX, PDF, RFT and TXT.



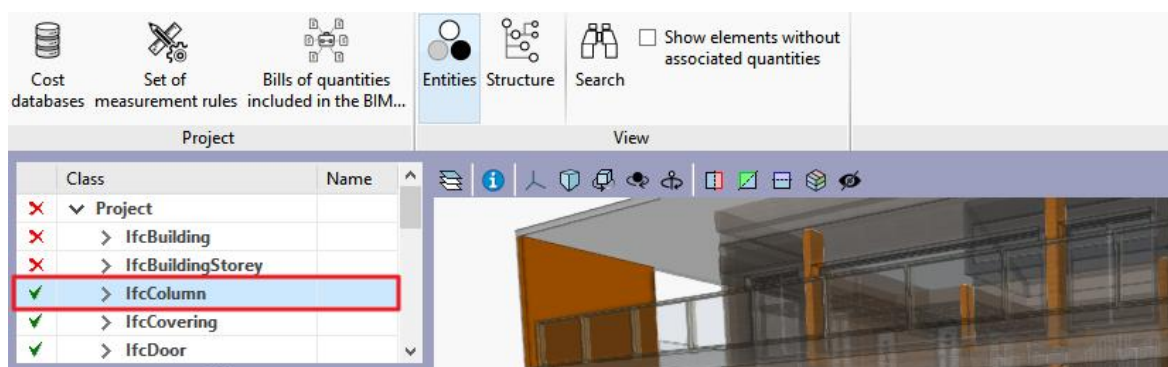
## 1.2 Previous information

As mentioned in the previous section, the main objective of Open BIM Quantities is to obtain the quantities and generate the cost estimations from BIM models adapted to the standard IFC format. To ensure the correct Reading of properties and quantities contained in the reference model and to allow an efficient workflow, some basic concepts related to the nature and organisation of data in this format should be mastered.

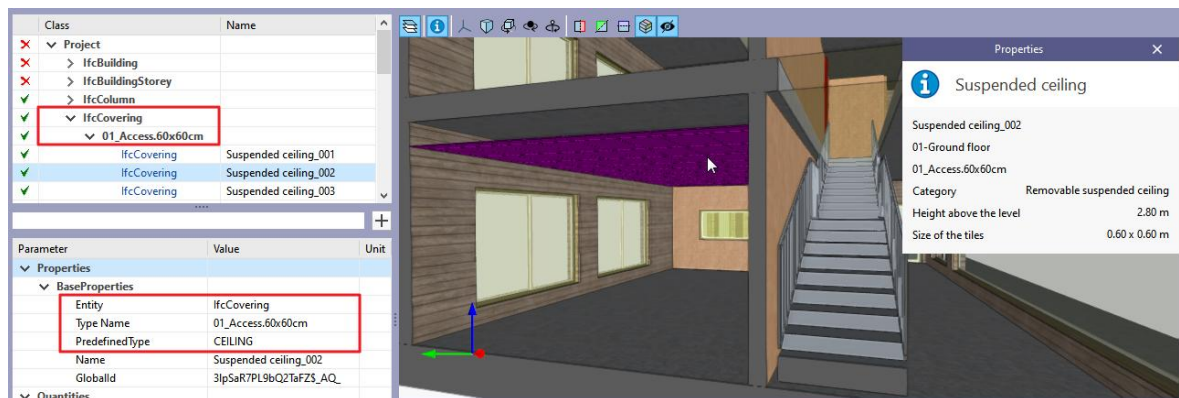
### 1.2.1 *IFC: the origin of the quantity amounts*

The origin of the quantity data comes from **the information contained in the IFC files** of a project hosted on the BIMserver.center platform. The IFC format should be seen as a standard exchange format for BIM models. Although it is not necessary to have an advanced knowledge of the IFC scheme, it is worth understanding and managing the following concepts:

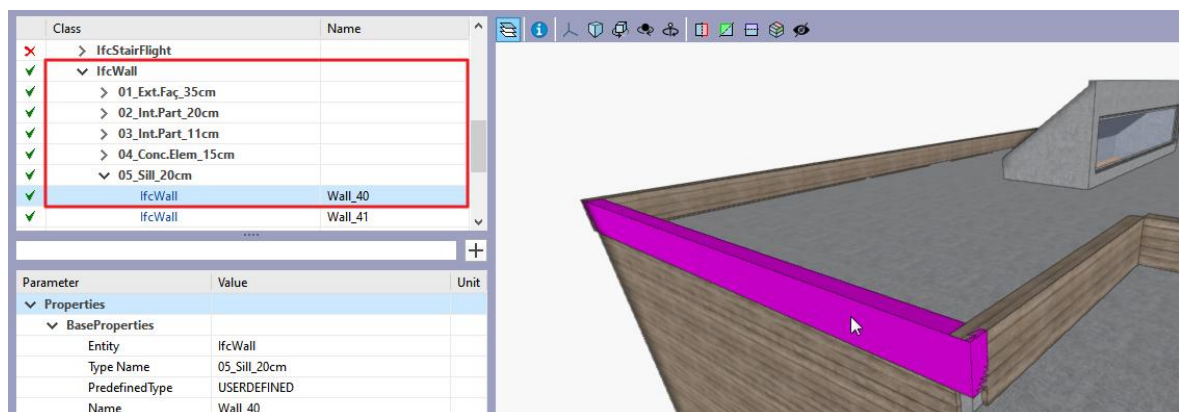
- **Entity.** Similar to the concept of “*class*” in the context of object-oriented programming. For the purposes of using an IFC file, it should be considered as an information class defined by common attributes. There are hundreds of entities in the IFC schema such as *IfcActor* for defining human agents involved in the process, or *IfcProcess* for defining events or activities that are ordered in time. However, for the use of Open BIM Quantities, it will be of users’ interest to recognise and manage entities related to “tangible and measurable” objects such as *IfcColumn*, *IfcWall* or *IfcFlowSegment*. These entities will be defined by common attributes that allow information to be managed and filtered.



- **Predefined Type** and type of object/element. The Predefined type is an attribute predefined by the IFC schema that adds a classification level to the entity, e.g., for the case of coverings (*IfcCovering*), predefined finishings for ceilings and finishings for flooring, etc., are available.



On the other hand, the type of object/element corresponds to a classification that is not predefined in the IFC schema and is determined by the source application; normally for each type of construction element (e.g., a wall) different typologies are defined to which the elements used in the model will belong; belonging to this typology defines a series of common features for these elements, among others, naturally, the type name. This name is transferred to the schema (*IfcWallType*, in the case of a wall) and will be readable from Open BIM Quantities as a value of the *Type Name* parameter.

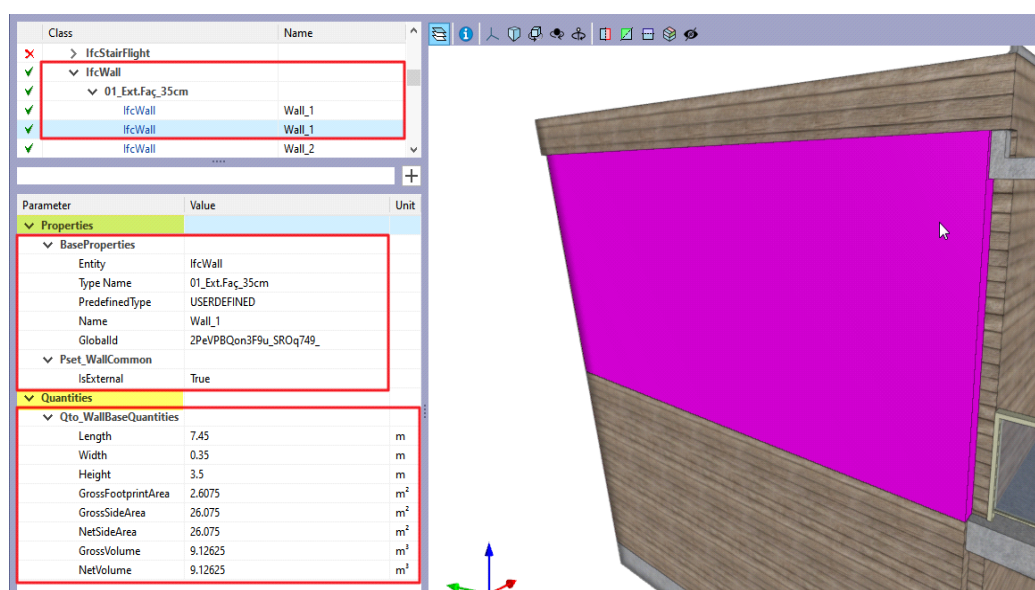


In both cases, it is possible to filter by predefined type and/or type name to facilitate the creation of rules of measurement.

- Instance.** Generally, it refers to the quantities of elements or components (*each wall, column or duct span existing in the model*). The components or instances are the individual spatial manifestations or “occurrences” of the different entities. On the other hand, these elements are organised into types (e.g., for *IfcColumn*, there is the *IfcColumnType* entity) with common information and features (*material information, profile, etc.*). The common properties are defined for the specific entity and type, the elements or occurrences can generate quantity lines associated to the individual values that the properties take for each of them.



- **Property Sets** (*IfcPropertySet*). These define a set of standard and common properties for each of the object types present in the model. They depend on the entity and are shared between all instances of the same object type. For example, in the case of walls (*IfcWall*), the *Pset\_WallCommon* is available and provides information on whether the wall is external or internal, among other things, thanks to the *IsExternal* parameter. These sets of properties may contain alphanumeric attributes, which does not guarantee their validity for use as a numeric field in the quantities but does ensure their validity for filtering components.
- **Quantity sets** (*IfcQuantitySet*). For each of the entities mentioned above, they define the parameters (dimensions) necessary to be able to obtain the quantities of the components: Length, Width, Height, Area, Volume, Weight, etc. They ensure that their attributes can be used as a numeric field for the quantities. For example, in the case of walls (*IfcWall*), the *Qto\_WallBaseQuantities* may be available, which will provide information on length, width, gross area (GrossSideArea) or net area (NetSideArea), among others.



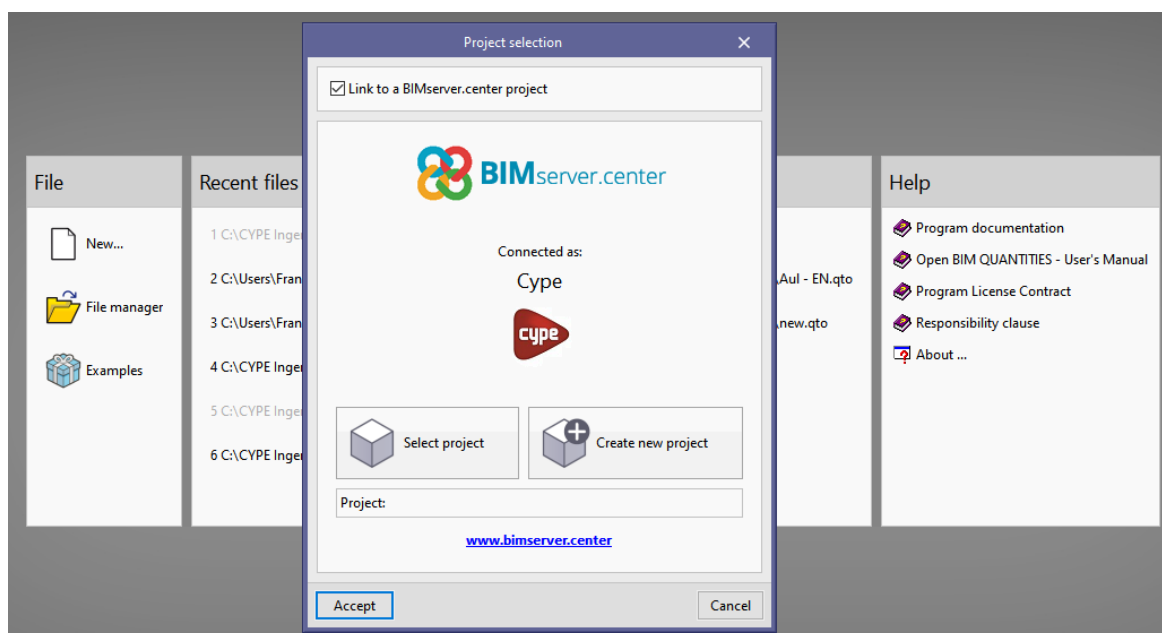
***The components in the model must be correctly assigned to the proper entity as, depending on this entity, specific quantities will be assigned (and displayed), thus allowing appropriate sets of measurement rules to be established.***

## 2 Start guide: First steps

### 2.1 Creating a new Open BIM Quantities job and linking it to a project

**Project should not be confused with job or file.** When using an application integrated in BIMserver.center, users can create a new job (*file*) integrated in a **BIMserver.center** project.

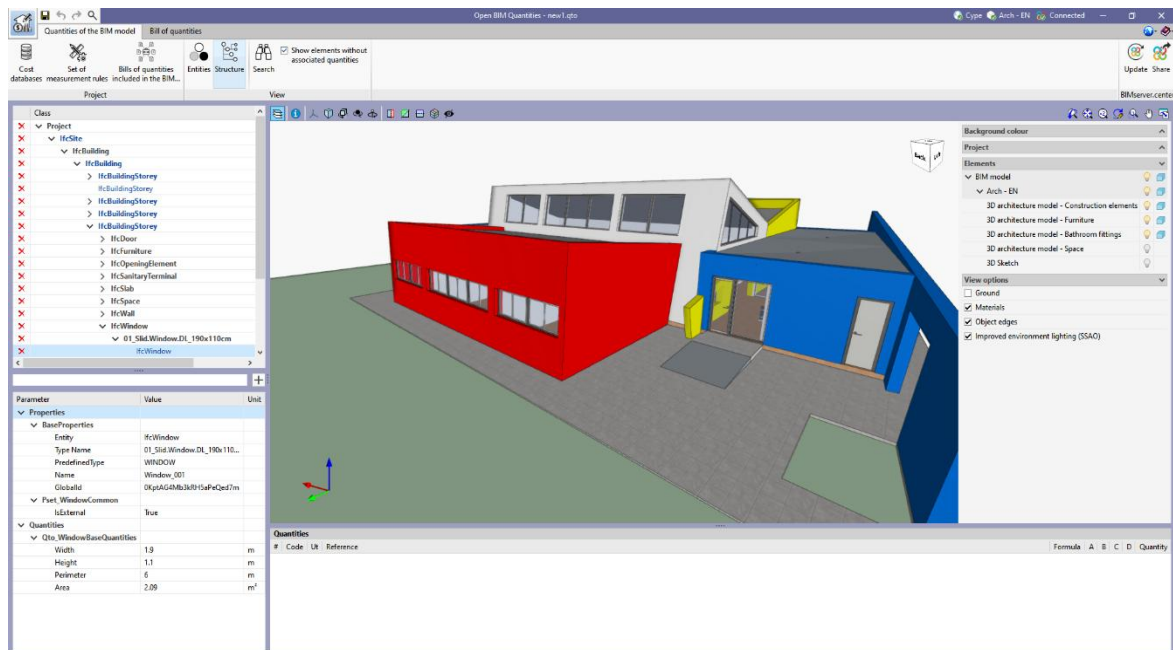
Open BIM Quantities is no exception. When the application is started and by clicking on **New**, it offers the possibility to create a *New job* and then integrate it into an existing project in BIMserver.center. It also has the *Create new project* option, and in this case, the project created will be visible from BIMserver.center from that moment onwards.



Since Open BIM Quantities is an application for obtaining quantities from existing IFC models, the most common situation is to link to a project that already contains at least one model; in this case, the application offers users the possibility to include any of the existing **models** in that project, **which will be visible, and their quantities able to be calculated in Open BIM Quantities.**

Once the new job has been created, the interface is accessed where the graphic window showing the imported model(s) is displayed.

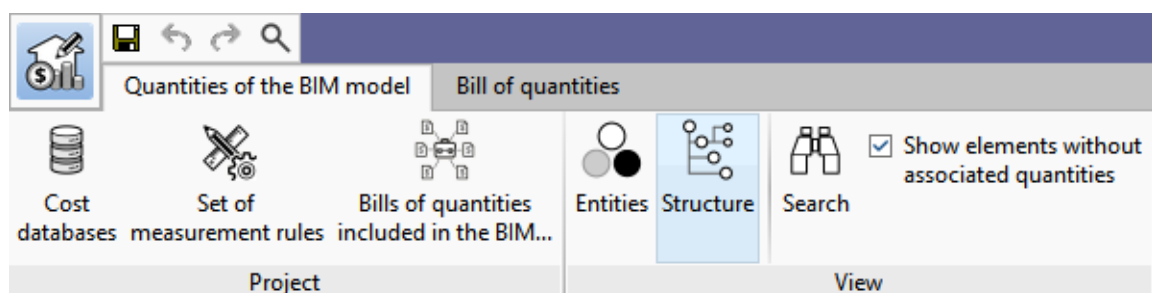




## 2.2 Quantities of the BIM model tab

This is the tab activated by default when starting a new job. It shows a fairly simple upper toolbar, a graphic window that occupies the majority of the interface (*in which it is possible to show and hide the different models incorporated in the job*) and a couple of panels located on the left side of the screen (*similar to those found in any IFC viewer*). The upper panel is a navigation panel, a tree structure displaying the different components or objects contained in the model referred to as the "Tree structure". At the bottom, there is a properties panel that shows the properties of the marked element, either in the tree or in the graphical window. The interface also includes a fourth panel below the graphical window; this is the quantities panel, which shows the quantities associated with each selected element. This panel remains empty as long as quantities are taken from the model and its components.

A number of tools appear in the top toolbar:



- **Cost databases.** Allows databases (cost databases) to be added to the project. The application allows users to create new ones or import them from files in standard FIEBDC-3 (.bc3) format. The mapping or linking process between components in the model and quantity lines is based on rules that refer to the items contained in these cost databases.

The **Add** button allows users to create (this will be explained below) or import cost databases in FIEBDC-3 format.

- **Set of measurement rules.** A set of measurement rules is a collection of rules that allows users to filter components and define the necessary operations to associate them to items as well as ensure their correct quantities. As it is clearly connected to the cost databases, it has a similar work section structure

The **Add** button allows users to create (this will be explained below) detailed sets of rules. On the other hand, the graphical interface itself allows “*quick rules*” to be created from the direct selection of objects and properties. These quick rules will be incorporated into the activate set of measurement rules.

- **Bills of quantities included in the BIM project.** Allows partial cost estimations included in models imported from the BIMserver.center project to be incorporated into the job.
- **Viewing tools.** Includes some tools for managing the tree structure of components; it allows users to switch between a spatial or entity-based hierarchy, to search for components by terms included in their type or name, and to enable or disable the visibility of elements without quantities in order to facilitate orderly quantity processes.

## 2.3 Using the graphical window

The graphical window in Open BIM Quantities takes up the majority of the graphical interface if its limits are not readjusted. In this window, the interaction with the model and the selection of components to be measured is carried out.

Using it is intuitive and similar to using any other three-dimensional modelling or design program. A three-button mouse with a central wheel enables specific tools to be used; spinning the wheel allows users to zoom in on the model; pressing the central button and moving the mouse allows the scene to be centred; and lastly, the previous action together with the simultaneous pressing of the **SHIFT** key allows the scene to be orbited.

Pressing the left button allows objects to be selected; they will be immediately highlighted in the tree structure (when in the Quantities tab) or in the Bill of quantities

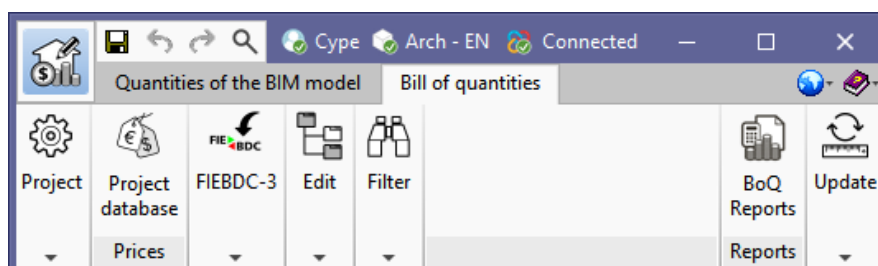
tab (when in the Bill of quantities tab and there are quantities associated to the selected components).



The top part of the graphic window includes a toolbar common to almost all tools in the BIMserver.center ecosystem. Clicking on the first of these **Elements** opens a window that allows users to manage the view of the different grouped elements (by models, floors, typologies, etc.). The rest allow orbiting, selecting the type of perspective, sectioning, etc.

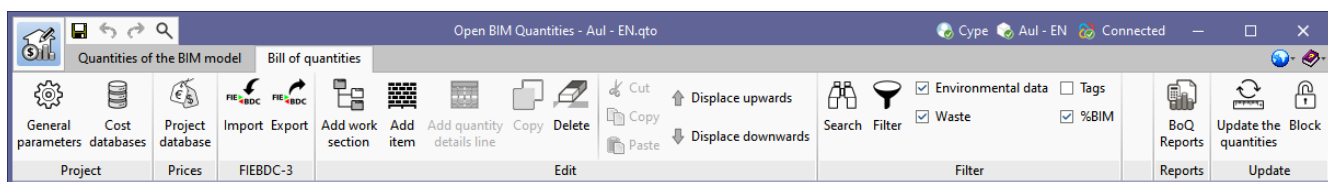
## 2.4 Bill of quantities tab

Once the automatic quantities processes have been defined using the Quantities of the BIM model tab, the actual Bill of quantities itself can be obtained and managed using the Bill of quantities tab. The tools in this tab are similar to those in a conventional tool for generating bills of quantities. The only tool that is not included in the above generalisation is **Update the quantities**. Activating this tool automatically generates the bill of quantities based on the chosen set of measurement rules after the cost database has been selected.

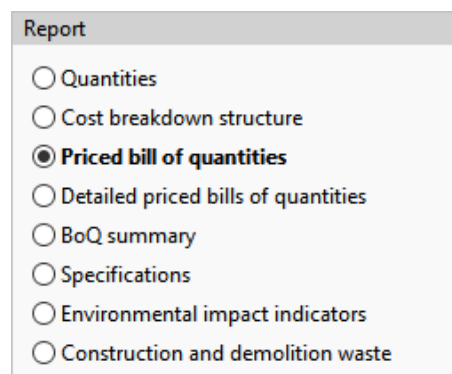


In the same way as with the graphic environment associated with the quantities tab, the one associated with the Bill of quantities tab contains a graphic window which is used in the same way. Additionally, given that this tab will display the Bill of quantities itself, a couple of panels showing the actual structure of the Bill of quantities are included. In the main window, the hierarchy of work sections, items and quantity lines is displayed; below the main one, a secondary panel is displayed that provides detailed information about the line selected in the main one (such as the breakdown or details of the quantity lines).

The upper part of the graphic environment includes a bar with tools for managing the bill of quantities; the editing tools allow it to be edited manually (add, delete, edit, or copy work sections, items or quantity detail lines). Naturally, there are also tools for generating reports, and exporting or importing bills of quantities adapted to the FIEBDC-3 standard (.bc3).

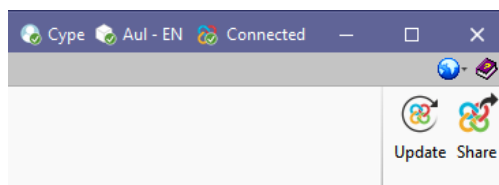


Once the bill of quantities has been generated, all the usual reports can be generated: *quantities, cost breakdown structure, detailed priced bill of quantities, specifications, BoQ summary, specifications, environmental impact indicators, and construction and demolition waste*. The reports can be exported to BIMserver.center to be used in other applications.



## 2.5 Connecting to BIMserver.center

Once a job has been started in Open BIM Quantities (*and linked to a BIMserver.center project*) there is little sense in exporting it to upload information until development has progressed, however, the **Update** button allows the project status and the different files linked to the project (*dates, changes, source applications, etc.*) to be checked at any time. Furthermore, and above all, it allows any of the files linked to the project to be imported and/or updated. The availability of external reference files allows users to advance in defining the global bill of quantities in a coordinated manner.



Considering all the previous points, the process of obtaining the quantities and generating the bill of quantities can begin. Once the process has been totally or partially completed, the bill of quantities can be shared and made available to all collaborators by simply clicking on the **Share** tool. Clicking this button triggers a series of operations beyond the user's control (*generating an IFC file and uploading this file and associated files [.bc3 and .pdf] to BIMserver.center thanks to the pre-installed BIMserver.center Sync application*) that simply add or update the bill of quantities to the project hosted in the cloud, i.e. in **BIMserver.center**.

**NOTE:** *It should be noted that the native file is protected at all times. This process does not share any native information but only a snapshot of the job in standard IFC, FIEBDC-3 and PDF formats, which is enough for the project development process to continue in other software applications.*

From left to right, the title bar shows the user, project, and connection status with the platform. Clicking on the username provides a direct link to the BIMserver.center cloud. If the user is offline, a name and password can be entered in order to log in. On the right, clicking on the name of the project displays information related to it, such as the type of project, view options, collaboration request management, and its description. Further to the right, the connection status with BIMserver.center is displayed so that, when an operation affecting the platform is being carried out, the message text changes to indicate the action, in the case of both an upload and a download of the project.

## 3 Overview of the interface

Open BIM Quantities offers a simple and intuitive interface for automatically generating quantities based on BIM models and their economic valuation thanks to their link to cost databases. It also allows users to edit the generated and imported bills of quantities. For this reason, the interface has two tabs with different work environments: *Quantities of the BIM model* and *Bill of quantities*. In any case, it is a very clear and simple graphic environment with a few buttons, several panels for information management and, dominating most of the interface area, the graphic window in which it is possible to interact with the imported models.

**NOTE:** *The limits of any of these panels can be moved as required.*

### 3.1 File

The **File** button is a common element that always appears in the top left-hand corner. Clicking it allows users to access the traditional menu with the work file management options. Below is a brief description of the commands available.

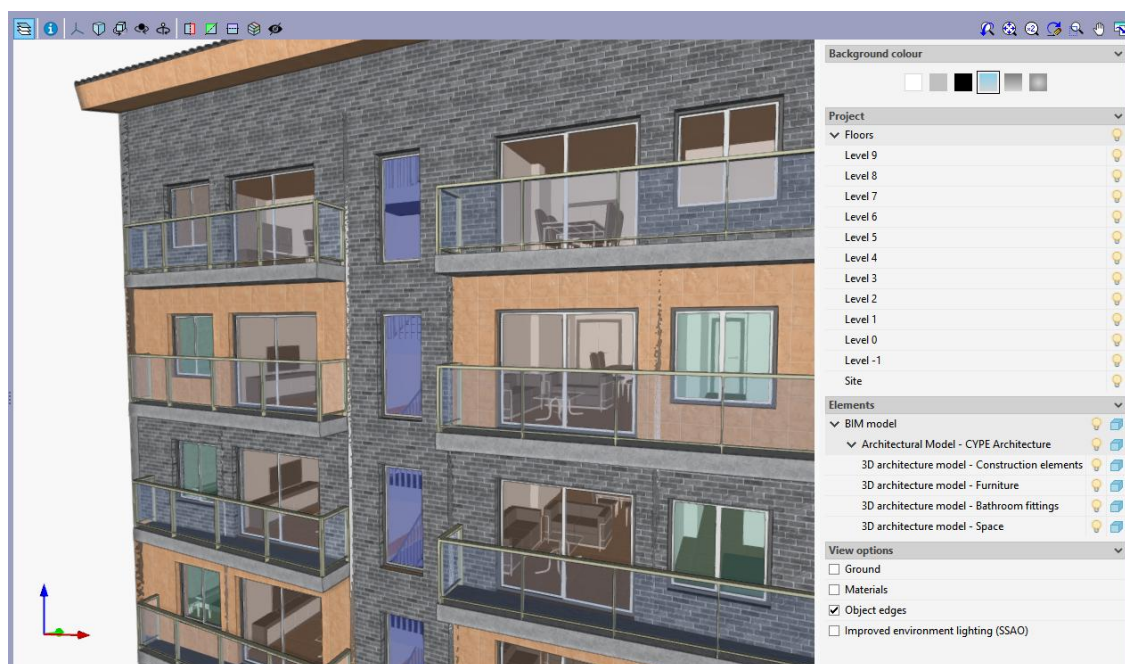
- **New.** Clicking on this option opens a dialogue box for creating a file. The name and a short description of the file must be entered. If the **Browse** button is clicked, the new file can be placed in the desired folder.
- **File.** Allows you to open a file, create a new one, copy, delete, search, compress, decompress, send, share, and select examples jobs.
- **Save / Save as.**
- **Job description.** Allows you to add a job description that will be displayed when the file is opened.
- **Recent files.** Allows users to quickly access the latest files that have been used in the program.
- **Exit.** Closes the program.





## 3.2 Graphic window

This is the panel that allows users to interact directly with the model; on the other hand, it allows a **very visual relationship to be established between the information contained in the various analytical panels and the geometry in the BIM model.**

At the top of the window are a series of options and tools that allow users to define the orientation and type of projection, rotate or centre the scene, section the model, or zoom in and out. Despite the possibilities offered by these tools, the use of this window is intuitive and similar to that of any other 3D environment program. The use of a mouse with three buttons and a central wheel eliminates the need to use more specific tools; turning the wheel allows you to zoom in and out of the model; pressing the central button and moving the mouse allows you to control the scene; and finally, the previous action together with the simultaneous pressing of the **SHIFT** key allows you to orbit the scene (it is also possible to orbit by pressing the right or left button).



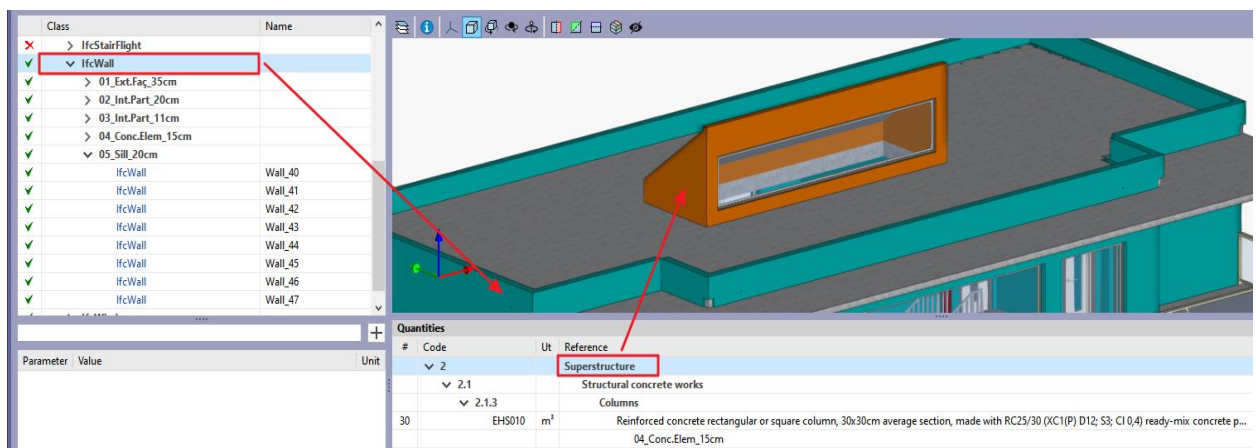
The following tools deserve special mention:

- **Consult the information of the element**  When activated, it displays a small window with information about the preselected item.
- **Elements**  This tool displays a list that allows users to manage the visibility of the scene (*background, edges, etc.*) as well as the different elements, according to spatial criteria (*model or plan*) and/or typologies.

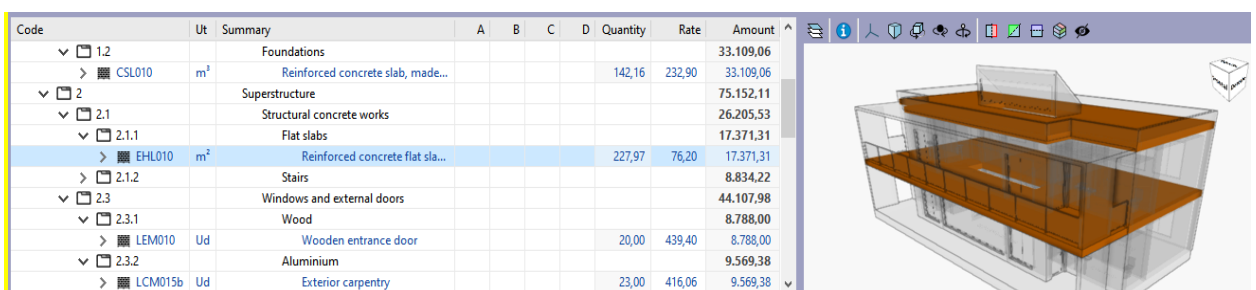
Left-clicking the mouse allows objects to be selected. These objects will be highlighted instantly in the tree structure (when in the Quantities of the BIM model tab) or in the bill of quantities tab (when in the Bill of quantities tab and there are quantities associated to the selected components).

Likewise, any selection of elements in a hierarchical panel highlights the selected element or set of elements in the graphical window. Although similar, this behaviour is different in the Quantities tab and in the Bill of quantities window:

- **Quantities of the BIM model.** The selection of elements (*whether they are components, types, entities, or spatial hierarchies*) is highlighted *in blue* on the model. Furthermore, if there are selected elements in the *Quantities* panel, they are highlighted *in orange*.



- **Bill of quantities.** The selection of elements (*whether they are quantity lines, items, or work sections*), in addition to highlighting the elements in the model, makes the unaffected elements transparent.



Code	Ut	Summary	A	B	C	D	Quantity	Rate	Amount
1.2		Foundations							33.109,06
CSL010	m³	Reinforced concrete slab, made...					142,16	232,90	33.109,06
2		Superstructure							75.152,11
2.1		Structural concrete works							26.205,53
2.1.1		Flat slabs							17.371,31
EHL010	m²	Reinforced concrete flat sla...					227,97	76,20	17.371,31
2.1.2		Stairs							8.834,22
2.3		Windows and external doors							44.107,98
2.3.1		Wood							8.788,00
LEM010	Ud	Wooden entrance door					20,00	439,40	8.788,00
2.3.2		Aluminium							9.569,38
LCM015b	Ud	Exterior carpentry					23,00	416,06	9.569,38

### 3.3 Quantities of the BIM model tab

Clicking on this button activates the graphic environment that **allows the properties and quantities contained in the model to be read**. Users can establish the set of measurement rules they consider appropriate in order to **transform the data contained in the elements of the model into quantity lines belonging to items in the bill of quantities**. These criteria can be saved to be used in other similar projects.

In the interface for this tab, in addition to the graphical window and the upper toolbar, there are three information panels:

- **Tree structure.** Located at the top, it works as a navigation panel. A hierarchical tree displays the different components or objects contained in the model. It offers two configuration possibilities depending on the active selection in the upper toolbar: **Entities / Structure**. The first displays a tree that organises the components according to the **IFC entity** to which they belong (*IfcWall*, *IfcSlab*, *IfcSpace*, etc.). The second one allows the tree to be organised on the basis of the spatial structure taken from the BIM model (*Site*, *Building*, *Floor*, *Space*). As an example, the Entities configuration shows all the columns of the model "on the same branch", while with the Structure configuration it is possible to differentiate different branches according to their location, e.g., the floor they belong to.

	Class	Name
✗	> IfcBuildingStorey	00-SlabBase
✗	▼ IfcBuildingStorey	01-Ground floor
✗	▼ IfcColumn	
✗	▼ C_25x200cm	
✗	IfcColumn	Column_001
✗	IfcColumn	Column_001
✓	> C_25x25cm	
✓	> IfcCovering	
✓	> IfcDoor	
✗	> IfcOpeningElement	

*Naturally, items selected in the tree will be marked in the graphical window and vice versa.*

In addition to the hierarchical listing itself, each line is marked with a symbol indicating its linkage status with the quantities:

✗ indicates that no rule of measurement has been defined for that element or, in the case of a set of elements, that there are elements with no associated rule.

✓ indicates that a rule of measurement has been defined for this element (or for each element in the set) and that it is effectively linked to an item.

✗ indicates that not all properties required by the rule of measurement to define the corresponding item have been found.

⚠ indicates that no item has been generated from the element despite containing some defined rule of measurement.

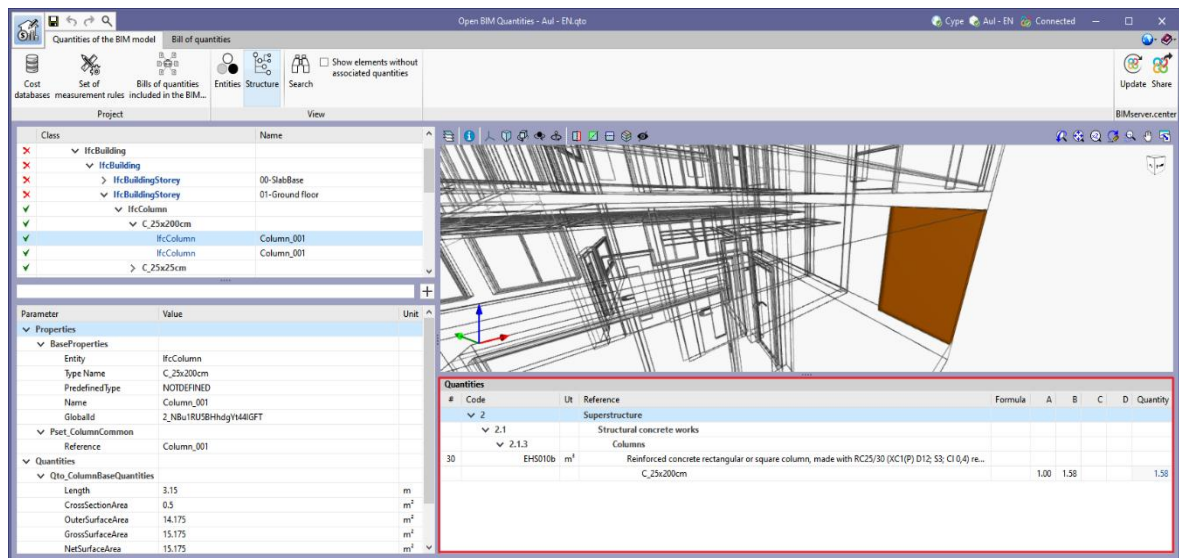
- **Parameter table.** It is located under the *Tree structure*. It displays a table with the **parameters of the individual element selected** in the tree structure or directly on the model. The parameter list depends on the *IfcQuantitySet* and *IfcPropertySet* defined in the IFC files imported to the job.

The parameters are divided into two groups: *Properties* (alphanumeric data) and *Quantities* (numeric data). These parameters allow entities to be identified and information to be obtained in order to create filters and extract quantities with the rules of measurement created in the set of measurement rules.

Parameter	Value	Unit
▼ Properties		
> BaseProperties		
▼ Pset_ColumnCommon		
Reference	Column_001	
▼ Quantities		
▼ Qto_ColumnBaseQuantities		
Length	3.15	m
CrossSectionArea	0.5	m <sup>2</sup>
OuterSurfaceArea	14.175	m <sup>2</sup>
GrossSurfaceArea	15.175	m <sup>2</sup>
NetSurfaceArea	15.175	m <sup>2</sup>
GrossVolume	1.575	m <sup>3</sup>
NetVolume	1.575	m <sup>3</sup>

Above the parameter table there is a search bar that allows content filtering and a button for creating Quick rules by directly selecting objects and properties. These quick rules will be incorporated into the active set of measurement rules.

- **Quantities table.** This panel, located below the graphic window, shows the quantities associated with each selected element. This panel remains empty as long as quantities are obtained from the model and its components. Once associated quantities are generated, this panel shows all the associated quantity lines, as well as the items and work sections to which they belong. As this is information about the quantities, this panel does not provide prices.

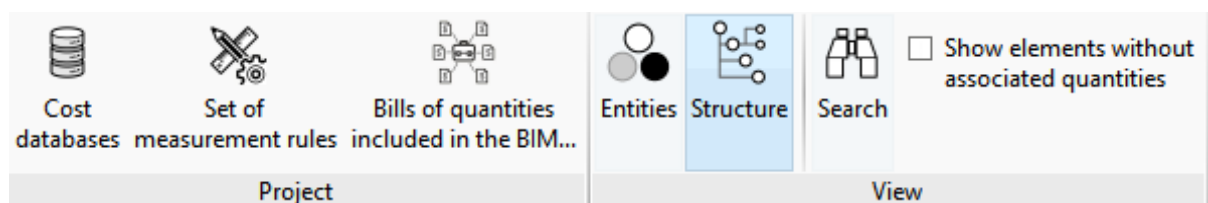


Clicking on the tree structure allows for the selection of individual elements, types, entities, or any hierarchical level of the spatial structure. In any case, this panel shows the quantities associated with the selected line on the tree.

- **Top toolbar.** The toolbar in the *Quantities of the BIM model* tab is divided into three sections: *Project*, *View* and *BIMserver.center*.

The tools in the *BIMserver.center* group have been explained above. **Update** allows the BIM reference models, stored in BIMserver.center, to be updated and kept synchronised. **Share** allows the bill of quantities to be uploaded to BIMserver.center in order to be consulted online and to be connected to other tools.

The tools contained in the *View* group have been partially reviewed. **Entities** and **Structure** allow toggling between the two options available for presenting the *Tree structure*. **Search** allows users to search for text strings included in the various classes of the IFC objects, or by name. Finally, a checkbox allows you to activate or deactivate the viewing of elements without associated quantities.



The tools contained in the *Project* group require some more specific details that will be discussed in later sections of this manual. In any case, the description of the tools is simple:

- **Cost databases.** Allows cost databases to be created and uploaded.



- **Set of measurement rules.** Allows sets of measurement rules to be created and associated to an item in the Cost database.
- **Bills of quantities included in the BIM project.** Allows bills of quantities generated by other tools in the Open BIM workflow and present in the models imported from BIMserver.center to be included.

## 3.4 Bills of quantities tab

Clicking on it activates the graphic environment that allows the generation and management of the quantities and the bill of quantities. From here, users can extract the quantities from the model and, based on this information, generate quantity lines belonging to assessed items. This process is carried out by means of a correspondence system (*mapping*) between the elements of the model and the items. For this process to take place, the reference cost databases, and the set of rules for establishing the necessary matches, i.e., the set of measurement rules, must be defined.

As well as the automatic generation of quantities and bills of quantities, in this tab it is also possible to carry out the traditional operations of quantity surveying software. For example, in situ items can be created or linked to concepts from a cost database or a standard reference bill of quantities, and it is possible to import complete databases as well as individual concepts from cost databases that have been developed according to the FIEBDC3 standard. The editing tools allow the bill of quantities to be edited manually (*adding, deleting, editing, or copying work sections, items, or quantity detail lines*). There are also tools for generating reports, and exporting or importing bills of quantities adapted to the FIEBDC-3 standard (.bc3).

In the graphical environment for this tab, in addition to the graphical window and the upper toolbar, there are two work panels:

- **Main bill of quantities window.** Located at the top, it displays the entire bill of quantities in a hierarchical manner. The bill of quantities is displayed in a tree form and each branch will display its lower hierarchical level (*if there are any*). The scheme is *Bill of quantities > Work sections > Items > Quantity lines*. Work sections can be inserted into other work sections, called *work sub-sections*.



Code	Ut	Summary	A	B	C	D	Quantity	Rate	Amount	%BIM	Energy cost	CO2 emissions	Total waste mass	Total waste volume
▼ Bill of quantities		Bill of quantities							318,789.98	100.00 %	577,511,906.776 MJ	57,115,190.785 kg	749,091,243.501 kg	468,733.503 m³
▼ 0		Facilitating works							7,117.35	100.00 %	0,000000 MJ	0,000000 kg	744,107,400.000 kg	465,067.125 m³
▼ 0.1		Groundworks							7,117.35	100.00 %	0,000000 MJ	0,000000 kg	744,107,400.000 kg	465,067.125 m³
▼ 0.1.2		Excavations							5,890.39	100.00 %	0,000000 MJ	0,000000 kg	744,107,400.000 kg	465,067.125 m³
▼ 0.1.2.1		Open-pit mining, on any type of land, using mechanical equipment and loaded onto lorries.					144.20	5.38	791.38	100.00 %	0,000000 MJ	0,000000 kg	291,236,000.000 kg	182,052.500 m³
▼ 0.1.2.1.1		Trench excavation for foundations up to 2m deep, on any type of land, carried out by hand and manually loaded onto...					224.17	22.88	5,129.01	100.00 %	0,000000 MJ	0,000000 kg	452,823,400.000 kg	283,014.625 m³
▼ 0.1.3		Soil filling and compaction							1,226.96	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 0.1.3.1		Mechanical compaction of soil, with manual reversible vibratory plate, until reaching a dry density of over 90% of the ...					338.94	3.62	1,226.96	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1		Substructure							51,734.08	100.00 %	237,493,096.000 MJ	48,279,955.500 kg	3,470,026.008 kg	2,312.662 m³
▼ 1.2		Foundations							51,734.08	100.00 %	237,493,096.000 MJ	48,279,955.500 kg	3,470,026.008 kg	2,312.662 m³
▼ 1.2.1		Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, poured with on-site ...					222.13	232.90	11,774.08	100.00 %	237,493,096.000 MJ	48,279,955.500 kg	3,470,026.008 kg	2,312.662 m³
▼ 1.2.1.1		Superstructure							30,796.49	100.00 %	14,585,703.888 MJ	2,476,379.444 kg	235,900.752 kg	0,180.064 m³
▼ 1.2.1.1.1		Flat slabs							17,371.31	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1.2.1.1.1.1		Reinforced concrete flat slab, horizontal, with free floor height up to 3m, 26cm total depth, made with ready-mixed C...					227.97	76.20	17,371.31	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1.2.1.1.1.1.1		02_Floor slab_35cm					1,00	177.69	177.69	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1.2.1.1.1.1.1.1		02_Floor slab_35cm					1,00	50.28	50.28	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1.2.1.1.1.1.1.1.1		Stairs							8,834.22	100.00 %	0,000000 MJ	0,000000 kg	0,000000 kg	0,000000 m³
▼ 1.2.1.1.1.1.1.1.1.1		Columns							4,590.96	100.00 %	14,585,703.888 MJ	2,476,379.444 kg	235,900.752 kg	0,180.064 m³
▼ 1.2.1.1.1.1.1.1.1.1.1		Windows and external doors							44,107.98	100.00 %	132,510,256.000 MJ	117,984.000 kg	53,219.440 kg	0,065.125 m³
▼ 1.2.1.1.1.1.1.1.1.1.1.1		Wood							8,788.00	100.00 %	75,397,156.000 MJ	846,936.000 kg	40,628.940 kg	0,044.140 m³
▼ 1.2.1.1.1.1.1.1.1.1.1.1.1		Wooden entrance door					20,00	439.40	8,788.00	100.00 %	75,397,156.000 MJ	846,936.000 kg	40,628.940 kg	0,044.140 m³

The table provides information about code, unit, summary, partial dimensions, quantity, resource, and amount. Furthermore, depending on the selection of options in the top toolbar, it displays additional information.

Clicking on the symbol to the left of the concept name, the lower levels can be displayed or gathered (the > symbol indicates that there are lower levels).

Using the **cursors** can assist during navigation through any of the tree structures displayed by the application. The left or right scroll keys expand or collapse the active branch, the up and down keys allow users to scroll through the different branches of the tree structure. Alternatively, **double-clicking on a line displays all lower branches**.

- **Secondary bill of quantities window.** Located at the bottom, this window shows details or breakdown of the concept selected in the panel above. The information displayed depends on the nature of the selected concept. This panel allows the values to be edited.

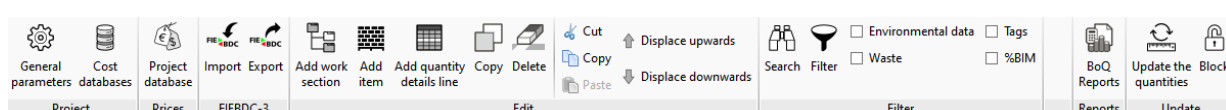
Code	Ut	Summary	A	B	C	D	Quantity	Rate	Amount
▼ 1		Substructure							33,109.06
▼ 1.2		Foundations							33,109.06
▼ 1.2.1		Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, poured with on-site mixer, and BS EN 10...					142,16	232,90	33,109.06
▼ 1.2.1.1		01_Concrete slab_60cm					1,00	142,16	142,16
▼ 2		Superstructure							79,743.07

Item	Breakdown	Waste	Ut	Summary	Quantity	Rate	Amount
▼ 1.2.1.1			m²	Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, poured with on-site mixer, and BS EN 10080:2005 steel, with an approxim...	142 m²	232,90	33,109.06
▼ 1.2.1.1.1			Ud	Approved rebar spacer for foundations.	5,000 Ud	0,15	0,75
▼ 1.2.1.1.1.1			kg	BS 4449 Grade B500B raw steel in bars, supplied in situ in a variety of diameters.	86,700 kg	1,22	105,77
▼ 1.2.1.1.1.1.1			kg	Galvanised tie wire, diameter 1.30mm.	0,425 kg	1,10	0,47
▼ 1.2.1.1.1.1.1.1			m³	Ready-mixed C25/30 (XC1(F); D12; S3; CI 0,4) concrete, in accordance with BS EN 206-1.	1,050 m³	82,65	86,78
▼ 1.2.1.1.1.1.1.1.1			h	3m vibratory wet screed.	0,333 h	4,67	1,56
▼ 1.2.1.1.1.1.1.1.1.1			h	On-site concrete mixer, for pumping concrete.	0,042 h	170,00	7,14
▼ 1.2.1.1.1.1.1.1.1.1.1			h	Skilled steel fixer.	0,544 h	18,10	9,85
▼ 1.2.1.1.1.1.1.1.1.1.1.1			h	Steel fixer assistant.	0,816 h	16,94	13,82
▼ 1.2.1.1.1.1.1.1.1.1.1.1.1			h	Skilled structural concreting.	0,009 h	18,10	0,16
▼ 1.2.1.1.1.1.1.1.1.1.1.1.1.1			h	Structural concreting assistant.	0,120 h	16,94	2,03
▼ 1.2.1.1.1.1.1.1.1.1.1.1.1.1.1			%	Other direct costs.	2,000 %	228,33	4,57

- If a quantity line is selected, the lower panel shows the quantity line details (type, comment, tags, partial dimensions, and reference BIM model).

- If an item is selected, the lower panel displays several tabs. The first identifies the concept, its factor and performance, the second displays its breakdown and the third displays the associated generation of waste.
- If a *work section* is selected, the lower panel displays two tabs. The first identifies the *concept* and its name, the second displays the associated generation of *waste*.
- **Top toolbar.** The toolbar for the *Bill of quantities* tab is divided into seven sections: *Project, Prices, FIEBDC-3, Edit, Filter, Reports* and *Update*.



- *Project.* Includes a couple of general configuration tools. From **General parameters**, users can define the currency, decimals, and percentages to be used for generating the different reports and documents. **Cost databases** is used in the same way as in the bill of quantities tab, it allows users to access the space for creating and editing cost databases.
- *Prices.* While the *Cost databases* tool provides access and allows the management of independent files acting as references for elaborating different bills of quantities, the only tool in this group, Prices, allows the particular configuration of the job in progress to be carried out (without affecting the reference cost databases). Activating this tool opens a working environment practically identical to that offered by the *Cost database* tool. It opens the active database and allows the same changes to be carried out (adding, deleting, or editing concepts) **that only affect the job in progress**. It includes a particular tool: **Price adjustment**, that allows the performance coefficients from the original cost database (*labour, machinery, or price*). This set of tools allows databases to be customised and adapted to the needs of the active job. The concepts created in this environment can be added to the job's bill of quantities.
- *FIEBDC-3.* Allows users to import into the bill of quantities or export their job in the FIEBDC-3 standard (.bc3).
- *Edit.* Presents the standard tools of a conventional bill of quantities generation program; with these tools users **can Add, Delete, Copy** or **Edit** concepts. In the main bill of quantities window and under the selected work section, it is possible to create work sections (work sub-sections) or add items; if the selected line corresponds to an item, it is also possible to add quantity detail lines that

will add quantities to the selected item. A subgroup allows users to edit (cut, copy, paste) or displace items in the bill of quantities tree structure.

- *Filter*. Includes useful tools for database management. The **Search** tool allows concepts to be located based on text strings present in the code or summary. **Filter** allows the information displayed to be filtered according to the tags previously assigned to the quantity lines. Finally, a series of checkboxes allow the columns concerning waste information, environmental data, tags assigned to quantity lines or percentage of the quantities taken from the BIM model to be activated.

*Given that the tools included in the Bill of quantities tab allow the job to be edited manually, it is interesting to know what percentage of the job comes directly from the model; for this purpose, the following option is available* ☐ %BIM

- *Reports*. **BoQ reports** allows all traditional documentation to be generated (quantities, bill of quantities, summary, etc.), as well as specific documents such as the specifications or environmental impact indicators. Documents can be exported to common text formats (.pdf, .docx, .txt, .html and .rtf).
- *Update*. Allows users to, as the name suggests, **Update the quantities** according to changes in the model and/or set of measurement rules. This update can be "hard" or "soft", i.e., you can generate a bill of quantities from scratch or simply update it (keeping all possible manual edits and bills of quantities that do not come from the models). The group includes the **Block** tool, to prevent the bill of quantities from being updated automatically.

## 4 Step by step

### 4.1 Defining a cost database (creating and editing)


Open BIM Quantities users **should view the BIM model as a quantitative repository** from which to extract the information needed to obtain quantities (*or quantification*). The model provides information, for example, on how many walls exist (and of what type) and how much each of these walls measures (*net area, gross area, length, height, thickness, etc.*). Naturally, this information will be available as long as the application generating the model has included it in the export to IFC format.

In order to obtain a bill of quantities, **this quantitative repository must be related to a qualitative repository**, i.e., a reference including the definition of the different items, with possible breakdowns, descriptions, etc.; in short, the information allowing the economic valuation and the definition of all the supporting documents to be obtained. In conclusion, **the BIM model itself can be considered as a source of quantitative information and the cost database as a source of qualitative information**. A cost database is a bill of quantities-type database.

The **Cost database** button is used to select an existing database or, if necessary, to create and store new cost databases and/or to edit existing ones. Users can add as many cost databases as they need or deem convenient, storing the different items organised according to zones, typology and/or countries.

To extract quantities from an entity in the BIM model, one or several sets of measurement rules must be created, clearly stating what is to be measured (*components of the model*) and to which item in the cost database it is to be linked.

#### 4.1.1 Steps to follow for adding a Cost database (creating or importing)

1. Click on the **Cost databases** button.
2. Press **Add**  to create or load a cost database.
3. Enter a name for the cost database being created.

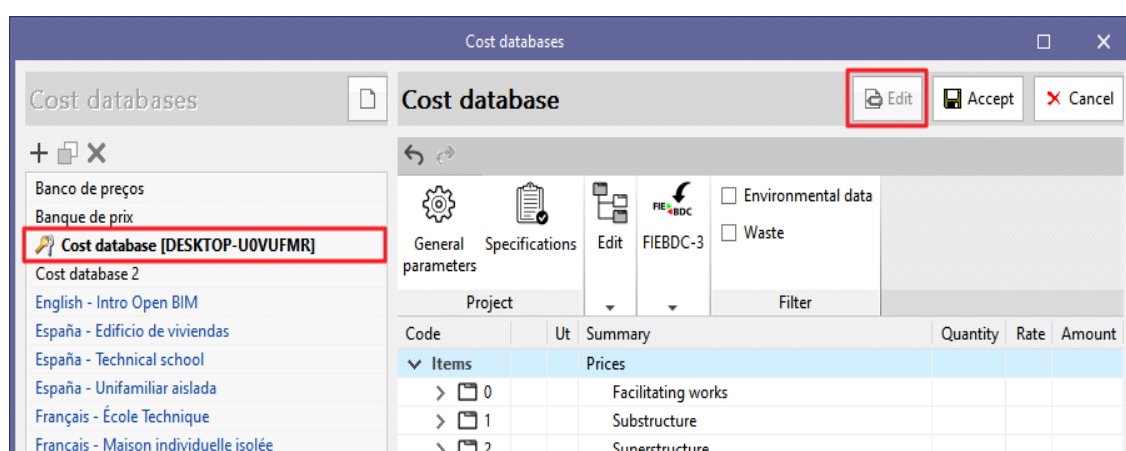
4. Enter the information requested for defining the new project. With the **Import .bc3 file (FIEBDC-3)** option an existing cost database can be imported. Naturally, this is a much more interesting option than creating a cost database from scratch. If the database contains graphical information or documents, it can also be added to the new database being created in Open BIM Quantities.
5. Click on **Accept**, and the cost database, either imported or newly created, will be added to the list.

**NOTE:** Existing cost databases can be copied or deleted by clicking on the buttons located next to the creation button. At the top there is a configuration button that allows the database search directory to be established; the default path is:

*C:\CYPE Ingenieros\QuantitiesData\Open BIM Quantities\Cost databases*

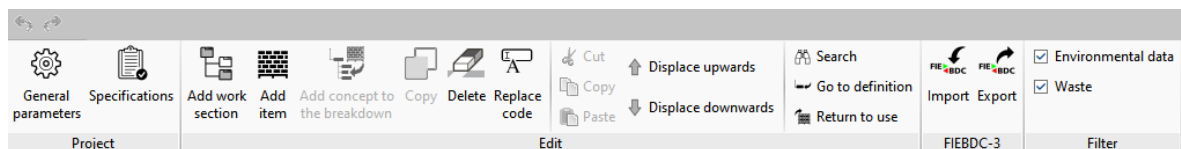
*The content of the .bc3 file to be imported may consist of a simple bill of quantities type or a non-parametric cost database.*

If the cost database is created without using a reference database, or if an existing cost database is to be edited, the **Edit** button must be selected. When a cost database is edited, it is blocked to prevent other users from modifying it at the same time (*a key symbol appears next to the name of the database being edited*). Editing the database unlocks access to all the stored information; the grey background changes to a white background and any concept or information contained therein can be consulted and/or edited.



Once in the editing space, there are three different panels:

- **Toolbar.** Contains all the tools needed for adding or editing concepts to the cost database being edited. It also allows users to import or export to FIEBDC-3 format or to activate or deactivate the visibility of environmental and/or waste information.



- **Tree structure.** Displays a hierarchical outline of the complete cost database in the form of a tree. This tree shows the work sections, work sub-sections, items, and breakdowns at different levels. The structure of the database itself appears under the main "Items" branch. A second branch, called "Resources", shows the elementary concepts that make up the database.

Code	Ut	Summary	Quantity	Rate	Amount	Energy cost	CO2 emissions	Waste unit mass	Unit waste volume
> 1		Substructure							
> 2		Superstructure							
> 3		External and internal walls							
> 4		Insulation and waterproofing							
> 4.1		Thermal insulation							
> 4.1.1		External Thermal Insulation Composite System...							
NAS010	m²	External thermal insulation for ETICS syste...	1 m²	13,45 EUR	13,45 EUR	125,029945 MJ/m²	7,047995 kg/m²	0,000000 kg/m²	0,000000 m³/m²
mt16aaa010	kg	Adhesive mortar for bonding insulat...	4,000 kg	0,19 EUR	0,76 EUR	17,530000 MJ	2,300000 kg		
mt16pep010ad	m²	Rigid expanded polystyrene foam bo...	1,050 m²	8,15 EUR	8,56 EUR	107,499945 MJ	4,747995 kg		
mt16aaa021a	Ud	Expansion plug and polypropylene sc...	6,000 Ud	0,08 EUR	0,48 EUR	0,000000 MJ	0,000000 kg		
mo054	h	Skilled insulation installer.	0,100 h	17,82 EUR	1,78 EUR	0,000000 MJ	0,000000 kg		
mo101	h	Insulation installer assistant.	0,100 h	16,13 EUR	1,61 EUR	0,000000 MJ	0,000000 kg		
%	%	Other direct costs.	2,000 %	13,19 EUR	0,26 EUR				
> 5		Roofs							
> 6		Internal Finishes							
> 7		External works and drainage							
> 8		Waste management							
> Resources		Prices							
mq01pan010a	h	120 kW wheel loader with a 1.9m³ bucket.	1 h	40,23 EUR	40,23 EUR	0,000000 MJ/h	0,000000 kg/h	0,000000 kg/h	0,000000 m³/h
mo113	h	Construction labourer.	1 h	15,92 EUR	15,92 EUR	0,000000 MJ/h	0,000000 kg/h	0,000000 kg/h	0,000000 m³/h
%	%	Other direct costs.	1 %			0,000000 MJ/%	0,000000 kg/%	0,000000 kg/%	0,000000 m³/%
mq01ret020b	h	Backhoe loader, 70 kW.	1 h	36,52 EUR	36,52 EUR	0,000000 MJ/h	0,000000 kg/h	0,000000 kg/h	0,000000 m³/h
mq02rod010d	h	Reversible vibratory plate, 300kg, 70cm operating widt...	1 h	6,39 EUR	6,39 EUR	0,000000 MJ/h	0,000000 kg/h	0,000000 kg/h	0,000000 m³/h
mq02cia020j	h	12 tonne tanker truck	1 h	40,02 EUR	40,02 EUR	0,000000 MJ/h	0,000000 kg/h	0,000000 kg/h	0,000000 m³/h

- **Secondary panel, definition zone.** Located below the previous one, it shows information about the selected concept and allows it to be edited. The available tabs and the information shown in each of them depend on the nature of the selected concept. This is the panel where the information necessary for the definition of each concept will be entered.

4.1

Thermal insulation

4.1.1

External Thermal Insulation Composite System...

NAS010

m²

1 m²

13,45 EUR

13,45 EUR

125,029945 MJ/m²

7,047995 kg/m²

0,000000 kg/m²

0,000000 m³/m²

mt16aaa010

kg

4,000 kg

0,19 EUR

0,76 EUR

17,530000 MJ

2,300000 kg

mt16pep010ad

m²

1,050 m²

8,15 EUR

8,56 EUR

107,499945 MJ

4,747995 kg

Item

Description

Graphical information

Attached documents

Specifications

Technical information

Waste

Code

NAS010

Unit

m²

Type

Unclassified

Calculated price

13,45 EUR

Fix the price
















Summary




External thermal insulation for ETICS systems, made of a rigid expanded polystyrene panel, in accordance with BS EN 13163, with smooth surface and straight rabbet edge, white colour, 60mm thick, performance does not deteriorate with age, water vapour resistant, thermal resistance of 1.58 m²K/W, thermal conductivity of 0.038 W/(mK), butt-jointed and fixed with adhesive mortar and mechanical fasteners.

Key terms



Description of the tools contained in the top toolbar:

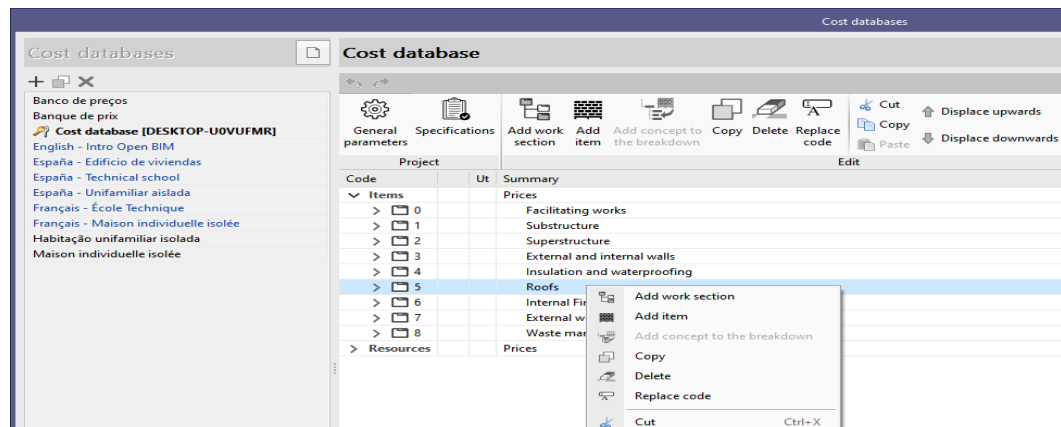
	<b>General Parameters</b>	Allows the currency and decimals for the quantities, prices, and imports to be set
	<b>Specifications</b>	Allows sections for the Specifications document to be added. These sections will be available for the definition of each concept.
	<b>Add work section</b>	Allows work sections or sub-sections for generating the structure of the cost database to be created.
	<b>Add item</b>	Allows an item to be added to the selected work section.
	<b>Add concept to the breakdown</b>	Allows an existing unit concept to be added the breakdown of the selected item.
	<b>Copy</b>	Allows work sections, items, and breakdown concepts to be copied. The program alerts users when a code is repeated.
	<b>Delete</b>	Allows work sections, items, and breakdown concepts to be deleted.
	<b>Replace code</b>	Allows the code of the selected concept to be replaced. This tool, unlike the manual editing of a line, modifies all those linked to the concept.
	<b>Cut</b>	Allows concepts to be cut and pasted in another position.
	<b>Copy</b>	Allows concepts to be copied and pasted in another position.
	<b>Paste</b>	Allows concepts that have been previously cut or copied to be pasted.
	<b>Displace upwards</b>	Allows the selected concept to be displaced upwards.
	<b>Displace downwards</b>	Allows the selected concept to be displaced downwards.
	<b>Search</b>	Allows users to search for a concept included in the database. The tool searches by summary text, code, or key term. Double-clicking on any of the filtered concepts places users on the first line of the tree structure that matches the selection.
	<b>Go to definition</b>	When a breakdown concept of an item is selected, the corresponding branch of the "Resources" section opens, displaying information about the concept.

	<b>Return to use</b>	Allows users to return to the item forming part of the selected element concept.
	<b>Import</b>	Allows bills of quantities and cost databases to be imported in FIEBDC-3 (.bc3) format.
	<b>Export</b>	Allows the cost database to be exported in FIEBDC-3 (.bc3) format.
	<b>Environmental data</b>	Shows or hides columns related to environmental data.
	<b>Waste</b>	Shows or hides columns related to waste generation data.

### 4.1.2 Steps to follow for adding work sections to a cost database

1. If the cost database is not open, select it from the left column and click on the **Edit** button at the top of the screen. Hover the cursor over the *Items* branch.
2. Click on the **Add work section** button.
3. Enter a code and a summary for the work section to be created; a *key term* that can be detected by the **Search** tool can also be entered. The first work section will be created under the main concept of the job; from this point onwards, new work sections can be added under the main concept or work sub-sections can be created by placing the cursor on one of the created work sections. The procedure is identical.
4. If external files are to be added to the cost database being edited, the **Import FIEBDC-3** option can be selected. The dialogue box allows an existing cost database in FIEBDC3 format to be imported. With the **Update cost database** option new work sections can be added to the previously existing structure of the cost database.
5. Click on the **Accept** button located in the top toolbar and the cost database will save all the modifications that have been made.

**NOTE:** Right-clicking on any concept in the tree opens a context menu that allows the main functions, including the creation of work sections, to be executed.



### 4.1.3 Steps to follow for adding simple concepts

1. If the cost database is not open, select it from the left-hand column and click on the **Edit** button, located at the top of the screen. Click on the *Resources* branch.
2. Click on the **Add item** button.
3. Introduce a *Code* for the new concept (the blue arrow allows any of the existing codes in the database to be used. When using a repeated code, the program displays a warning message in the *summary* cell).
4. Indicate, in the *Type* field, the nature of the simple concept (*labour, machinery, material or unclassified*). Simple waste-type concepts can also be entered; these concepts, without an associated price, allow environmental and waste generation data to be associated with the items to which they belong.
5. Define the *Unit of measurement*.
6. Type in the *Resource*.
7. Enter the description of the concept in the *Summary* field.
8. Optionally, a *Key term* which can be detected by the **Search** tool can be added.
9. If external files are to be added to the cost database when editing, the **Import FIEBDC-3** option can be selected. The dialogue box allows an existing cost database in this format to be imported. The **Update cost database** option allows new work sections to be added to the previously existing structure in the cost database.
10. Click on the **Accept** button to close the table and the new concept will be added to the cost database and will then be available for inclusion in the new items being created.

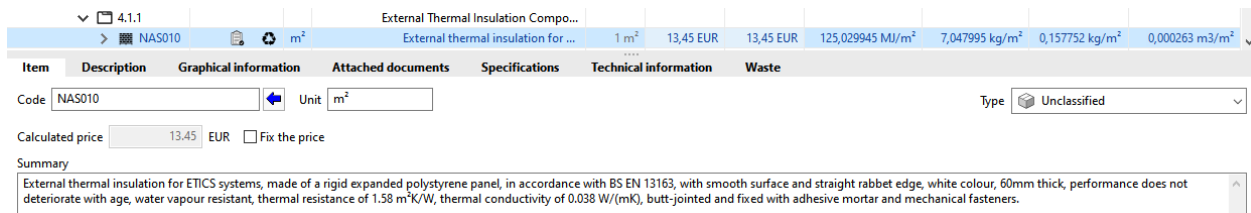
Resource	Description	Graphical information	Attached documents	Specifications	Technical information	Waste
Code	mt09mif010ca	Unit	t	Type	Materials	
Rate	29.52	EUR				
<p>Summary</p> <p>Factory-made masonry cement mortar, grey colour, M5 grade (5N/mm<sup>2</sup> compressive strength), supplied in bags, in accordance with BS EN 998-2.</p>						
<p>Key terms</p>						

**NOTE:** Any operation can be undone (CTRL+Z) or redone (CTRL+Y) by clicking on the arrows at the top of the toolbar.

#### 4.1.4 Steps to follow for adding items

1. If the cost database is not open, select it from the left-hand column and click on the **Edit** button, located at the top of the screen. Hover the cursor over the work section where the items are to be created.
2. Click on the **Add item** button.
3. Introduce a *Code* for the new item (the blue arrow allows any of the existing codes in the database to be used. When using a repeated code, the program displays a warning message in the *summary* cell).
4. Indicate, in the *Type field*, the nature of the simple concept (for items, *unclassified* should be selected).
5. Define the *Unit of measurement*.
6. If users wish to create an item without a breakdown, the *Resource* must be indicated. If an item with a breakdown is to be created, the price is not indicated.
7. Enter the description of the concept in the *Summary field*.
8. Optionally, a Key term which can be detected by the **Search** tool can be added.
9. If external files are to be added to the cost database when editing, the **Import FIEBDC-3** option can be selected. The dialogue box allows an existing cost database in this format to be imported. The **Update cost database** option allows new work sections to be added to the previously existing structure in the cost database.

- Click on the **Accept** button to close the table and the new item will be added to the cost database and will then be available for inclusion in the new items being created.



### 4.1.5 Steps to follow for adding breakdowns to an item

- If the cost database is not open, select it from the left-hand column and click on the **Edit** button, located at the top of the screen. Hover the cursor over the work section where the breakdowns are to be added. If there are no breakdowns in the cost database, they can be created following the steps included in the previous section, *"Steps to follow for adding simple concepts"*.
- Press the Add concept to breakdown button.
- Introduce a **Code** for the simple concept to be added (the blue arrow allows any of the existing codes in the database to be used. When using a repeated code, the program displays a warning message in the *summary* cell).
- Indicate the **Quantity** of the simple concept required per item.
- Click on **Accept** to close the dialogue box.
- Add as many breakdowns as necessary to completely define the item. The item is defined according to the simple concepts that it is broken down into and its price will depend on these quantities and resources.

**NOTE:** Items with breakdowns show the calculated price by default. The Item tab in the sub-window displays a checkbox (Fix the price) that allows the calculated price to be cancelled and an alternative one to be set manually.

[illegible]

#### 4.1.6 Steps to follow for completing the definition of the created concepts

1. With the cost database in edit mode, select the concept to be completed. Depending on the concept selected, a series of tabs are displayed in the lower sub-window. In the case of **work sections**, it is possible to consult and/or edit their *Code*, *Summary* or *Key Terms* from the *Work section* tab. From the *Specifications* tab external texts or files (.rtf or .html) can be added, provided that work sections have been defined using the **Specifications** tool, which can be found in the upper toolbar.
2. For **items** and in addition to the data entered when they are created (visible in the Item tab), it is possible to add a detailed *Description*, *Graphical information* in the form of an image or CAD file, *Attached documents* (images, texts, CAD, videos or PDFs accompanied by a description), data for the *Specifications* under the same conditions as those indicated for the work section concept and *Technical information* related to its physical, environmental or coding properties for waste. A final *Waste* tab shows the computation according to the waste concepts included in the breakdown and the amount of waste.
3. At a lower level, if one of the **breakdown concepts** included in an item is selected, it will have access to a single tab in which the *concept code* and its *quantity* will be shown as editable. From this tab the items with breakdown can be redefined.
4. From the *Resources* branch, the **simple concepts** are selected; for this purpose, the secondary window shows, just as with the items, several definition tabs. In the first one, called *Resource*, the data entered during the creation of the concept can be consulted and edited. In those remaining, users can add a detailed *Description*, *Graphic information* in the form of an image or CAD file, attachments (images, texts, CAD, videos, or PDF) accompanied by a description, data for the *Specifications* under the same conditions as those indicated for the work section concept and *Technical information* related to its physical, environmental, or coding properties for waste. A final *Waste* tab shows the





### 4.1.7 *Steps to follow for adding a set of units from a .bc3 file*

1. If the cost database is not open, select it from the left-hand column and click on the **Edit** button.
2. Locate the .bc3 file to be uploaded from a local path on your computer.
3. Drag the icon of the .bc3 file over the work section where the file is to be added. A dialogue box will appear showing the content of the file; this box displays a column on the left with several options:
  - **Assign concept.** Allows one item to be replaced by another (if it is dragged over an existing item). When replacing one item with another, the code, summary, breakdown, graphic information and attached documentation of the existing item can either be maintained or not, or it can be taken from the one being dragged or copied.
  - **Add concept.** Allows, as its name suggests, a new item to be added without affecting the rest of the existing scheme.
  - **Import the complete file.** Allows complete .bc3 files to be imported for their incorporation into the structure. In this case (import of individual items) it makes no difference.
  - **Code.** If the **Assign concept** option is chosen, activating it will cause the value in the Code field to be substituted.
  - **Summary.** If the **Assign concept** option is chosen, activating it will cause the value in the Summary field to be substituted.
  - **Work section structure.** The option is available when the Add concept option has been previously chosen. Activating this option transfers not only the item containing the information stored in lower levels, but also the entire route of work sections from its higher levels. The work section structure of the original base will be reproduced in the cost database being edited. If this option is activated, the item will be placed in the "Items" section.
  - **Breakdown.** As its name suggests, it allows the breakdown of the item to be added. The simple concepts become part of the "Resources" structure.
  - **Graphical information.** Allows users to copy the possible graphical files associated with the item being copied by means of the drag and drop option.

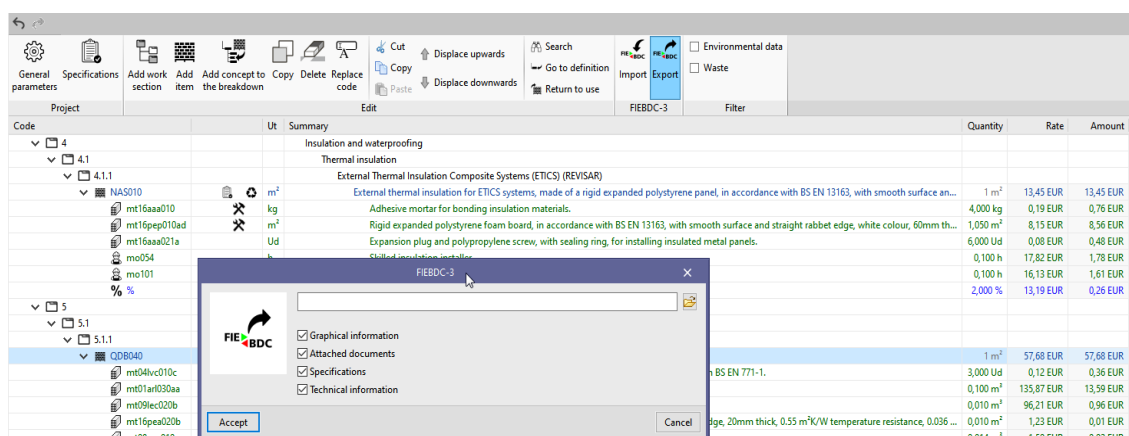
- **Attached documents.** Allows users to copy the possible document files associated with the item being copied using the drag and drop option.
- **Specifications.** Allows the possible information associated with and referring to the specifications to be incorporated into the cost database.
- **Technical information.** Allows the possible information associated with physical properties, environmental data, etc., to be incorporated into the cost database.

**NOTE:** The two applications (Open BIM Quantities and the file explorer used) must have the same user permissions for importing .bc3 files using this procedure in order to work correctly.

Once the cost database has been created, it can be used in the Open BIM Quantities application or exported to any other quantities and cost estimation software that can open .bc3 files.

### 4.1.8 Steps to follow for exporting the cost database created

1. If the cost database is not open, select it from the left-hand column and click on the **Edit** button.
2. Press the **Export** button in the FIEBDC-3 group.
3. Select a route for the export and attachments to be incorporated.



## 4.2 Creating a basic set of rules of measurement

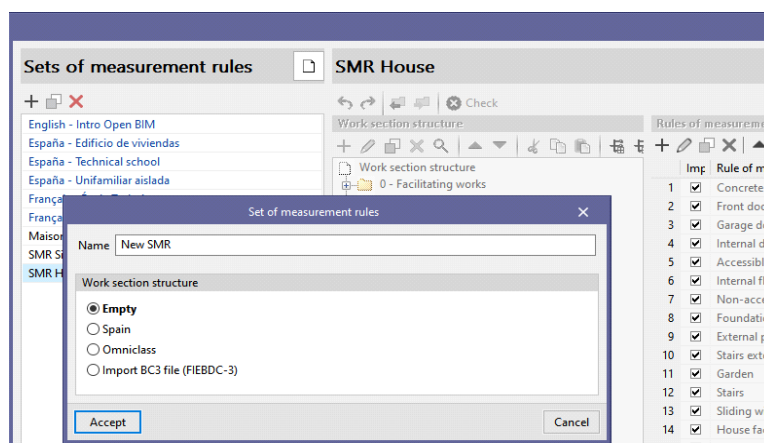
Once the BIM model is available, on the one hand, as a **quantitative repository** from which to extract the necessary information for obtaining the quantities (*or quantification*) and, on the other, the cost database or **qualitative repository** with the definition of the different items, with possible breakdowns, descriptions, etc., it is now time to link them together. This task is carried out with the **sets of measurement rules**.

Within the context of Open BIM Quantities, a *set of rules* should not be confused with *rules*; a *set of rules* refers to several rules. A model can be measured with a single set of rules or by combining several of them.

The **Set of measurement rules** button is used to define sets of measurement rules and is used to transform the data contained in the entities of the BIM model into actual items for the bill of quantities. Applying a set of measurement rules transforms the data contained in the model elements (visible in the **Parameter Table**) into quantity lines belonging to items included in the previously defined cost database. The set of "intelligent" rules allows elements to be filtered according to their properties, and also defines which of their amounts will be used in the quantities of the items be generated.

### 4.2.1 Steps to follow for creating a set of measurement rules

1. Click on the **Set of measurement rules** button.
2. Select the **Add** button.
3. Type in a name for the new set of measurement rules being created.
4. Select a work section structure for organising the different rules being created. Select the **Empty** option in order to avoid starting from a predefined work section structure.



**NOTE 1:** Existing sets of measurement rules can be copied or deleted by pressing the buttons next to the creation button. A configuration button is available at the top to set the directory for searching for sets of measurement rules. By default, this path is:

*C:\CYPE Ingenieros\MeasurementData\Open BIM Quantities\Mapping files*

**NOTE 2:** If the rules being created are related to the structure of a cost database, it is advisable to start from the work section structure defined for that cost database. The cost database can be exported as a readable .bc3 file from the set of measurement rules creation menu.

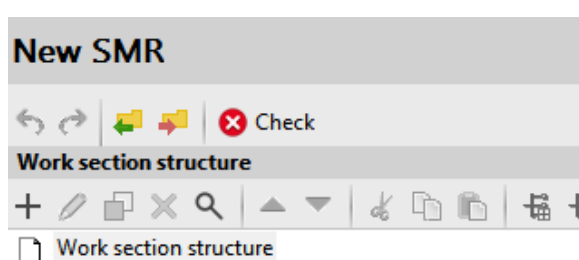
The content of the .bc3 file to be imported can be formed by a standard bill of quantities or by a complete cost database.

Alternatively, the application proposes alternative work section structures, adapted to the OmniClass standard.

Once the set of measurement rules has been created, the different measurement rules must be included by clicking on the **"Edit"** button. When a set of measurement rules is edited, it is blocked to prevent another user from modifying it at the same time (a key symbol appears next to the name of the set of rules being edited).

Once the editing area is accessed, in addition to the column with the list of available sets of measurement rules, there are two separate panels:

- **Work section structure.** Displays the work section structure selected when creating the set of measurement rules. The displayed structure is no longer linked to the reference, if used, i.e., modifications can be made to adapt the work section structure to the specific requirements of the current set of measurement rules. For this purpose, a toolbar appears at the top of the screen to *Add, Edit, Duplicate, Delete, Search, Displace, Cut, Copy* or *Paste* work sections, as well as a couple of buttons for expanding or collapsing all rows in the tree structure.



5. Above the toolbar for editing the structure, some tools are added for undoing (CTRL+Z) or redoing (CTRL+Y), and for importing or exporting the work section structure (in FIEBDC-3 format) or for checking the integrity of the created structure.
  - **Rules of measurement.** Displays the rules of measurement added to the sets of measurement rules once they have been created.
  - **Secondary panel, errors, and warnings.** It will appear, where applicable, when there are errors or warnings in the created set of rules. It will be displayed at the bottom of the set of measurement rules window.

## 4.2.2 Steps to follow for creating a basic rule of measurement

**PREVIOUS NOTE:** In the following instructions, some configuration examples will be shown; these examples (although they can be used for any other model) will refer to a model created with CYPE Architecture, specifically, to the "Single-family detached house" example model, included in the program. The model, once shared on the BIMserver.center platform as an IFC file, will work as any other IFC file generated from alternative modelling programs.

The reference cost database used in the examples will be an existing one.

1. If the cost database is not open, select it from the left-hand column and click on the **Edit** button located at the top of the screen.
2. Click on the **Add** button located in the *Rules of measurement* panel. Enter a name for the rule of measurement being created.
3. Enter "Walls", for example.
4. Click on **Accept**, and the Rules of measurement panel will be split into three. The panel on the left contains a column with the rules of measurement included in the set, the panel on the right has a *Selection* panel at the top and an *Items* panel at the bottom.
5. Press the **Add** button located in the *Selection* panel. The application displays a window in which you can define the different fields necessary for filtering elements. The following fields must be defined:
  - **Logical operator.** The selection of elements can be carried out by means of a combination of conditions; this operator allows to choose between the operators [AND] and [OR]; thus, it allows to establish necessary or alternative conditions for the filtering of elements during the selection.



If only one condition for the selection is to be included, the AND operator must be retained.

- **Parameter.** The selection of elements must be made according to some of the parameters defining them. In the *Quantities of the BIM model* tab, there is a Parameter Table under the Tree structure. This table shows a window with the parameters of the individual element selected. The prior consultation of the property parameters allows establishing the condition to be fulfilled.
- The definition of the *Parameter* also requires selecting the corresponding *Type* and *Group*. The definition of these fields is effectively straightforward with the help of the arrow on the right.
- **Condition.** The previous step defines the parameter where to search, however, the condition has not yet been created. By setting a condition, the filtering criteria are established based on the value of the previously defined parameter. The possible conditions cover a wide spectrum (equals, does not equal, is greater than, contains, etc.); once the type of condition has been established, the value of the parameter must be chosen.

Again, the arrow on the right makes it easier to select the desired values by allowing a text string search and direct selection of one of the matches shown in the list.

For example, if you want to select "ETICS Façade" type elements, simply select the condition "equals" and, in the search application, type in "ETICS" and select the element from the list.

**NOTE 1:** Naturally, setting the conditions will be an entirely individual matter, determined by the nature of the model to be measured. In the example shown, it is assumed that the model includes walls whose type has been named "ETICS Façade" in the source application. The fact that this designation has only been used to define one type of wall guarantees that, by applying the criteria used, all the walls (and only those) that meet this condition will be selected.

**NOTE 2:** The value of a cell can be copied from any table in Open BIM Quantities by right clicking the mouse. This operation helps to capture values that can be used in searches.

**NOTE 3:** At this point you can save the rule; as far as it is incomplete, the program displays a warning message (The items associated with the rule of measurement have not been defined); the warning symbol will also be displayed next to the affected lines in the tree structure.

6. Press the **Add** button located in the Items panel. The application displays a window where the various fields required for associating an item and the quantities formula can be defined.

However, if a reference cost database is available, it is easier to make the association in another way, therefore please close the open window.

7. While the rule of measurement is still selected, click on the **Assign Codes** button above the *Rules of measurement* panel (note that the reference cost database is displayed next to this button). This operation opens a new panel that allows for navigation over the work section structure of the reference cost database.

A number of tools are displayed at the top:

- **Assign.** Used to replace items previously associated to the rule with new items.
  - **Add.** Allows new items to be added to the rule of measurement.
  - **Work sections.** Captures the structure of work sections in the cost database and assigns it to those in the set of measurement rules. This correspondence between the codes assigned to the work sections and the association made to the items is necessary. These will be included in the work section whose code matches the one assigned to the item (so that, if there is no match, the item will not be included in the bill of quantities).
  - **Search.** Allows users to search for a concept included in the database, the tool searches by text, summary, code, or key term.
  - **Synchronise.** Activating it allows any of the items selected on the *Item* panel of the **Rules of measurement** to be found in the cost database.
8. Select the item to be associated to the created rule and click on the **Add** button located at the top of the open panel. All the fields in the *Data* section will have been filled in with those corresponding to the selected item. The *Quantity* section at the bottom of the screen should be checked.

For example, when working with an existing cost database, the work unit associated with code "FFX01", corresponding to "Outer skins in cavity wall, partially supported by a floor slab" can be selected.

9. In the *Quantity* section the quantity criterion of the previously filtered elements must be established. The formula field allows the definition of formulas and operations from the partial dimensions shown at the bottom (A, B, C and D). However, if the elements have amount data whose value to be transferred to the quantities can be directly captured, this can be achieved by simply selecting it from any of the lines corresponding to the partial dimensions.

For example, in order to measure walls by their net surface, users can simply select the NetSideArea parameter by clicking on the blue arrow to the right of any of the available partial dimensions and then on the parameter shown in the list (if necessary, a text for the search, e.g., "area", can be entered). All other fields in the *Quantities* section are left blank.

**NOTE:** Again, establishing sets of measurement rules is an entirely unique process and is determined by the nature of the model in question. In the example shown, it is assumed that the model includes walls with quantity parameters and, among them, the parameter indicating the value of the net area "NetSideArea". In any case, clicking on the arrow shows the parameters available for the quantity measurement of the previously selected (filtered) elements; these can refer to the net or gross area, volume, length, height, width, etc. The formula field allows these values to be used as partial dimensions that users can operate with.

10. Click on the **Accept** button in the *Item* window and, if no further rules are to be added, click on **Accept** in the *Set of measurement rules* window. The new rule will be added to the *Set of measurement rules*. The *Set of measurement rules* can be edited, and new rules can be added at any time.

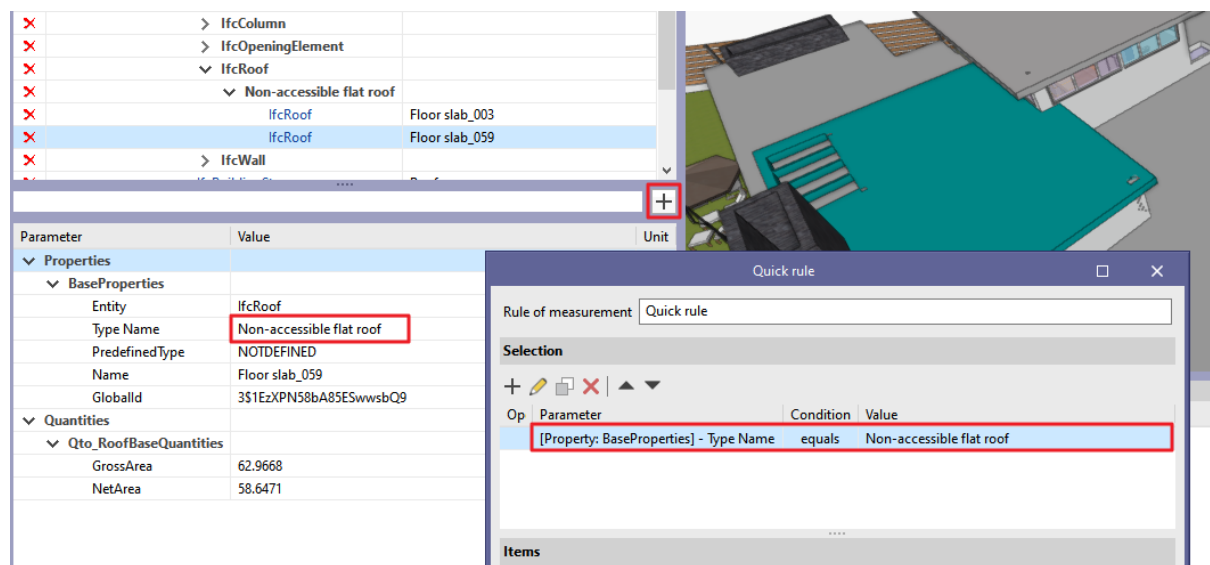
**NOTE 1:** It should be noted that the set of measurement rules will have been saved in the path indicated above and can be shared for the quantities of jobs that use the same patterns.

**NOTE 2:** At this stage, users may move to the *Bill of quantities* tab and click on the **Update the quantities** button. Select the matching cost database and click **Accept**. The bill of quantities is generated with the quantities of all the walls in the model, which are associated to the price and description of the associated item and within the work section corresponding to the structure defined in the set of measurement rules. If you click on the item or one of its quantity lines, the related element will be highlighted in the graphic window.

**NOTE 3:** By updating the quantities and returning to the *Quantities of the BIM model* tab, the quantities panel below the graphical window is activated and completed for the measured elements.

**NOTE 4:** Having a naming protocol for different projects means that the criteria created will be applicable to different models, which means that there is no need to define new rules for managing quantities and cost estimations for new jobs.

As well as the general procedure for defining rules of measurement, the program offers an alternative procedure for creating *Quick Rules*. This procedure is available from the main area in the *Quantities of the BIM model* tab and is related to the *Parameter table*. At the top of this table, there is a search bar that allows filtering by content and a button for creating these *Quick Rules* by directly selecting objects and properties. These quick rules will be incorporated into the active set of measurement rules.



### 4.2.3 Steps to follow for creating a quick rule

1. Select an element; this can be carried out either in the *Tree structure* or in the graphic window itself.
2. Select one of the properties shown in the *Parameter Table*.
3. Click on the **Quick Rules** button at the top of the Parameter Table. The Selection section will have been automatically filled in and the *Parameter* and *Condition* fields will have been adapted to the properties of the selected element.
4. Type in a name for the rule being created.
5. Furthermore, an item must be associated with it. This can be done by clicking on the **Add** button in the *Item* section. However, if you have a reference cost database, it is easier to make the association otherwise; therefore, click on **Accept** without adding items.
6. Click on **Sets of measurement rules** in the toolbar of the *Quantities of the BIM model* tab, where the quick rule has been added to the active set of measurement rules. The set of measurement rules can be edited and the quick rule to be assigned to the item can be selected.

7. Click on the **Assign Codes** button above the *Rules of measurement* panel. Once the reference cost database has been opened, the definition of the item and its quantities should be completed as described in the previous section "*Steps to follow for creating a basic rule of measurement*".

## 4.3 Creating particular rules; non-biunivocal relations

The previous section provides the basis for defining sets of measurement rules. However, **such a biunivocal relationship between model types and items is not always possible** (although it can certainly solve a large majority of situations). In many cases, there will be non-biunivocal correspondences to deal with, i.e., it may be the case that one element or type in the model should yield several items and, on the other hand, that one type should yield different items, depending on other particular parameters of the elements.

The first case will be developed with a particular example. The possible range of cases is wide, but by continuing to focus on walls, there are essentially two possible situations: the wall can be modelled and exported as a single layer element or it can be broken down into sheets that are exported as independent elements and, therefore, individually measurable.

In the example shown in the previous section, the walls have been exported as single elements. A common situation is that the type must be associated to several items, each one of them in reference to each of the compositional layers of the wall.

### 4.3.1 *Steps to follow for modifying a set of measurement rules and associating several items*

1. If the set of measurement rules is not open, select it from the left-hand column and click on the **Edit** button located at the top of the screen.
2. Select the rule of measurement to be modified. Since the aim is to add new items belonging to a reference cost database, click on the **Assign codes** button, located on the *Rule of measurement* panel (*note that, next to this button, the reference cost database is displayed*). This operation opens a new panel, identical to the one used to define the first association.

3. Select the item to be added to the created rule and click on the **Add** button located at the top of the open panel. All the fields in the *Data* section will be filled in with the fields corresponding to the selected item.

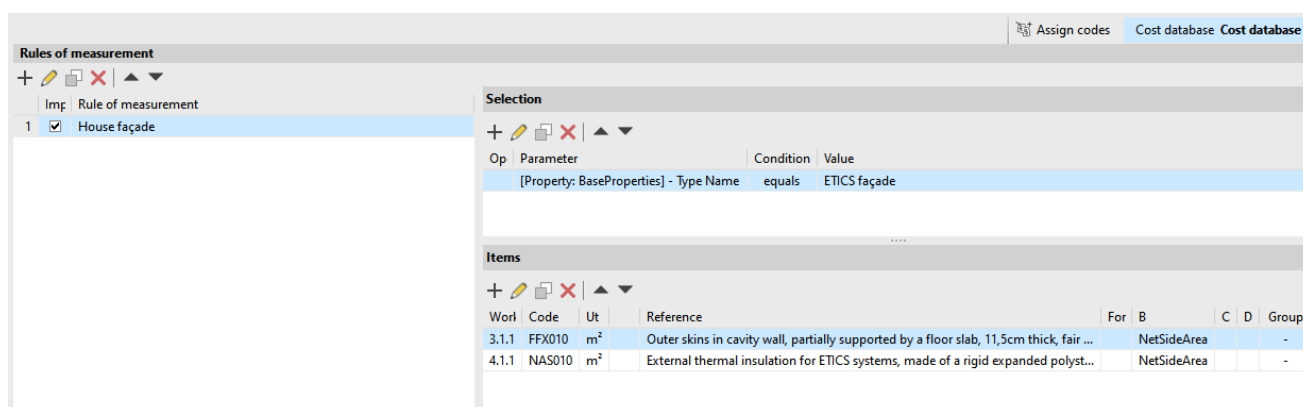
For example, when working with an existing cost database, the item associated with code "NAS010", corresponding to "External thermal insulation for ETICS systems" can be selected.

**NOTE:** The **Assign** button causes the substitution of an item previously associated with the rule of measurement. If you wish to add a new item, you must use the corresponding option.

Complete the *Quantities* section as explained in the previous instructions "Steps to follow for creating a basic rule of measurement".

Repeat the operation to add new items to the rule of measurement.

**NOTE:** If quantities are established, each space will have generated a quantities line associated with the selected item. The quantities of each of these lines will have been obtained as the product of the perimeter and the 1.2 factor. The bill of quantities will show both the formula and the partial dimensions in columns.



Op	Parameter	Condition	Value
	[Property: BaseProperties] - Type Name	equals	ETICS façade

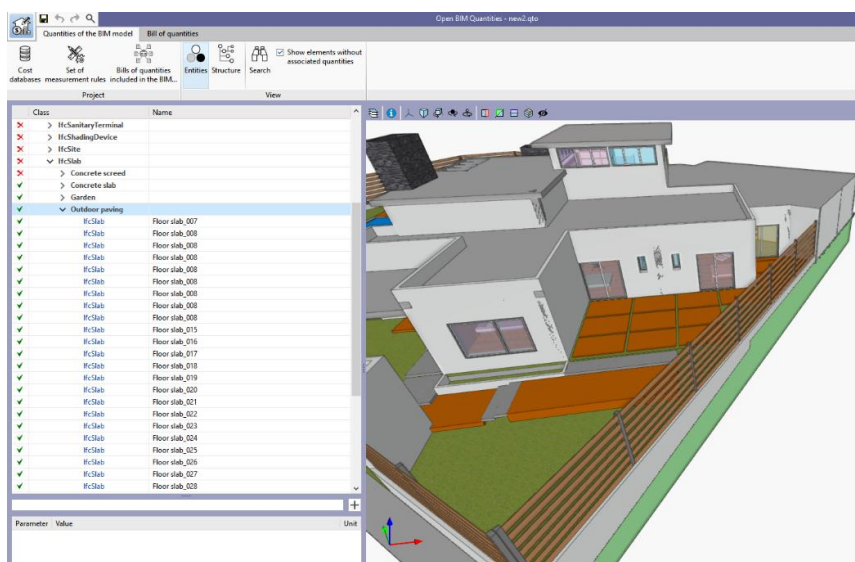
Worl	Code	Ut	Reference	For	B	C	D	Group
3.1.1	FFX010	m²	Outer skins in cavity wall, partially supported by a floor slab, 11,5cm thick, fair ...	NetSideArea				-
4.1.1	NAS010	m²	External thermal insulation for ETICS systems, made of a rigid expanded polyst...	NetSideArea				-

The example shown above shows the usual case of associating several items to all the elements belonging to the same type. Sometimes association by type is not granular enough. If so, more restrictive selection criteria must be used (selection criteria can be defined as a combination of conditions).



### 4.3.2 Steps to follow for decoupling types based on other parameters

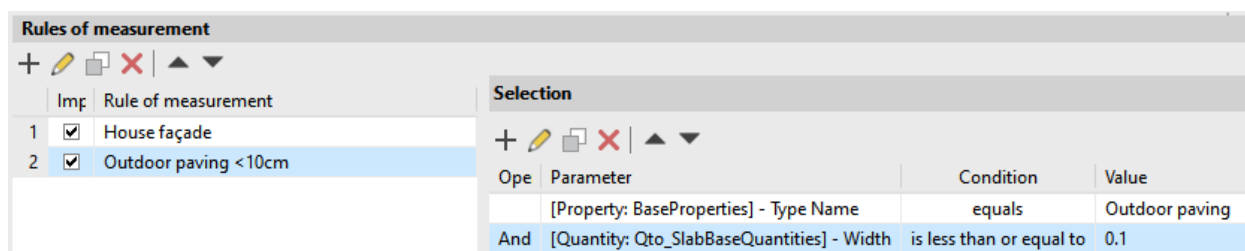
**PREVIOUS NOTE:** The example below will refer both to the "Single-family detached house" and to an existing cost database, included in the program. The model includes outdoor paving, they all share the same Type Name: "Outdoor paving". A criterion will be simulated whereby those with a thickness less than or equal to 10cm should be associated to the item with code "CSL010" and the rest to items with code "CLS". The volume of concrete shall be measured.



1. If the set of measurement rules is not open, select it from the left-hand column and click on the **Edit** button located at the top of the screen.
2. Click on the **Add** button located in the Rules of measurement panel. Type in a name for the rule of measurement being created.
3. Enter, for example, "Outdoor paving <10cm".
4. Click on the **Add** button located in the *Selection* panel. The application will display a window in which the different fields needed for filtering elements can be defined. The following must be defined:
  - **Logical operator.** As two conditions must be met, keep the [And] operator.
  - **Parameter.** The first condition (necessary but not enough) is related to the type, so select the "Type name" parameter.

- Condition. Keep the "equals" condition and, in the search application, select "Outdoor paving" from the list.
5. Click on **Accept** and repeat the operation to create a new line in the selection panel. The following must be defined:
- **Logical operator**. As two conditions must be met, keep the [And] operator.
  - Parameter. The second condition is related to the thickness; therefore the "Width" parameter must be selected (the name of these parameters can be consulted and copied from the parameter table panel).
  - **Condition**. Change the condition to "is less than or equal to" and type in 0.1.
6. Press the **Assign codes** button, located on the *Rules of measurement* panel.
7. Select the item to be added to the created rule and click on the **Add** button at the top of the open panel. All the fields in the *Data* section will be filled in with those corresponding to the selected item.
- Assign the item associated to code "CSL010" corresponding to "Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; Cl 0,4) concrete".
8. Complete the *Quantities* section as explained in the previous instructions ("*Steps to follow for creating a basic rule of measurement*").
- Assign the available parameter "NetVolume" to the quantities, which will give the volume value for each element.

**NOTE:** If the quantities are now updated, only the screeds belonging to the "Outdoor paving" type with a thickness of 10 cm or less are included in the bill of quantities.



The quantities of some outdoor paving still need to be generated in the project. Creating a rule to generate the quantities for all of them is very simple if the previous rule is used as a starting point.

### 4.3.3 Steps to follow for creating a rule from an existing one

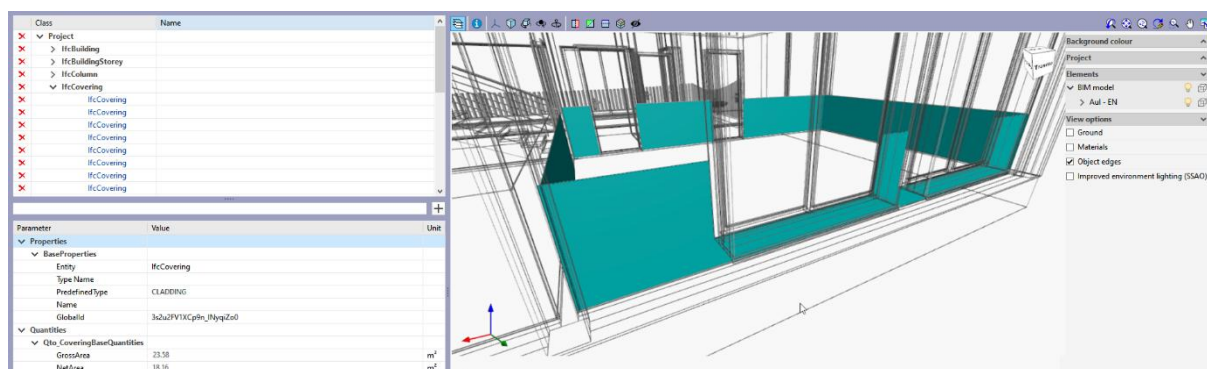
1. If the set of measurement rules is not open, select it from the left-hand column and click on the **Edit** button located at the top of the screen.
2. Select the reference rule for creating the new rule of measurement and press the **Copy** button above the list of rules. Enter a name for the new rule being created.
3. Enter, for example, "*Exterior screeds >10cm*".
4. Select the second of the conditions entered in the selection panel and click on **Edit** in the top bar of the panel, making the appropriate changes.
5. For this particular case being described, the change would consist of modifying the "*is less than or equal to*" condition to the "*is greater than*" condition. The *0.1m* value should be retained to select the remaining external floors.
6. Click on the **Assign codes** button, located on the *Rules of measurement* panel.
7. Select the item to be assigned to the new created rule and click on the **Assign** button located at the top of the open panel. The new item will replace the previous one.  
Assign the item associated with code "CSL010", corresponding to "Reinforced concrete slab, made with poured, ready-mixed C25/30 (XC1(F); D12; S3; Cl 0,4) concrete".
8. No further operations are required if the quantities formula does not need to be modified. In order to modify the quantities formula, clicking on the **Edit** button in the toolbar of the *Items* panel will suffice.
9. Click on the **Accept** button to save all the changes made to the *Set of measurement rules*.

**NOTE:** *If the quantities are now updated, all screeds belonging to the "External screeds" type are included in the bill of quantities; however, depending on their thickness, they will be associated with different items.*

## 4.4 A specific case: measuring spaces and coverings

In an ideal BIM model, spaces (*IfcSpace*) and coverings (*IfcCovering*) are modelled. If this is the case, measuring the different types of coverings, which should correspond to the different predefined types (*ceiling*, *flooring*, *cladding*, *roofing*, etc.), is no more difficult than measuring more conventional elements such as those discussed in previous sections.

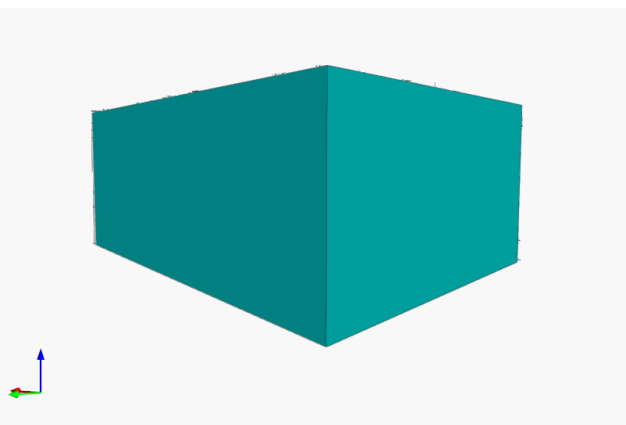
To filter these elements, e.g., vertical cladding, an entity (*Entity* = *IfcCovering*) and predefined type (PredefinedType = Cladding) are selected.



If the element contains amount properties (*NetArea* or *GrossArea*), the quantity to be generated can be extracted directly, either considering the openings or not.

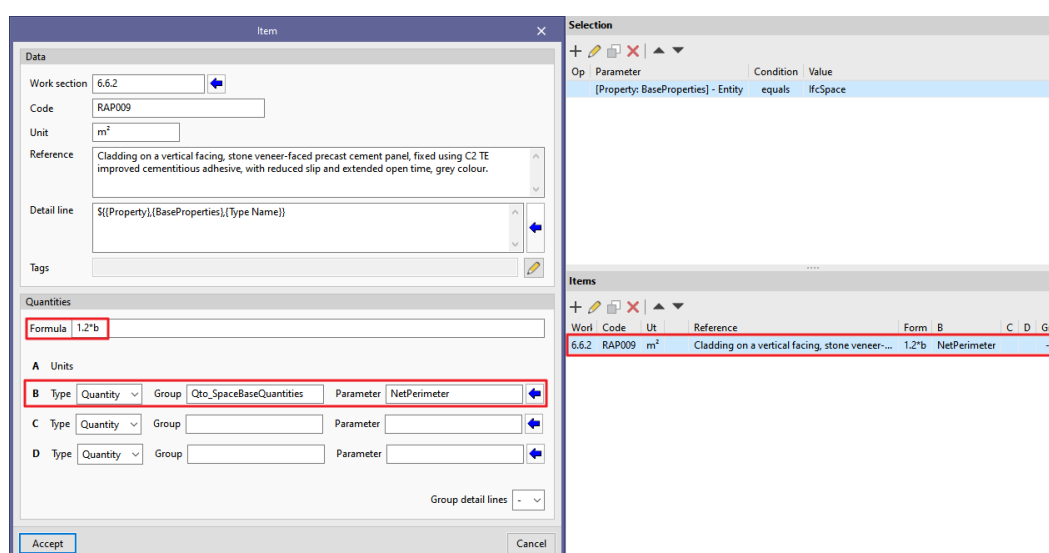
However, a sufficiently detailed model is not always available. **Not having fully defined covering entities is not a problem for obtaining detailed quantities of these types of components.** If the model includes spaces (*IfcSpace*), associations can easily be created for the items defining these coverings in the bill of quantities.

Parameter	Value	Unit
<b>Properties</b>		
BaseProperties		
Entity	IfcSpace	
Type Name	Classroom	
PredefinedType	UNDEFINED	
Name	C_01	
LongName	Classroom	
GlobalId	3r5wNjaej26vw5rg8980p	
Pset_SpaceCommon		
IsExternal	False	
<b>Quantities</b>		
Qto_SpaceBaseQuantities		
NetFloorArea	33.9854	m²
GrossFloorArea	33.9854	m²
NetVolume	95.1591	m³
GrossVolume	95.1591	m³
NominalHeight	2.8	m
Height	2.8	m
ClearHeight	2.8	m
FinishCeilingHeight	2.8	m
NetPerimeter	23.58	m
GrossPerimeter	23.58	m
NetCeilingArea	33.9854	m²
GrossCeilingArea	33.9854	m²
NetWallArea	49.724	m²
GrossWallArea	66.024	m²



A correctly defined space contains amount data for volumes, various areas, and perimeters, and, from the value of these parameters, the number of coverings can be determined. For example, the quantities of a ceiling covering can be obtained from the value of the *NetCeilingArea* parameter, a floor covering can be taken from the value of the *NetFloorArea* parameter; or even the linear measurement of a baseboard or the surface measurement of a frieze or a skirting board can be obtained from the value of the *NetPerimeter* parameter.

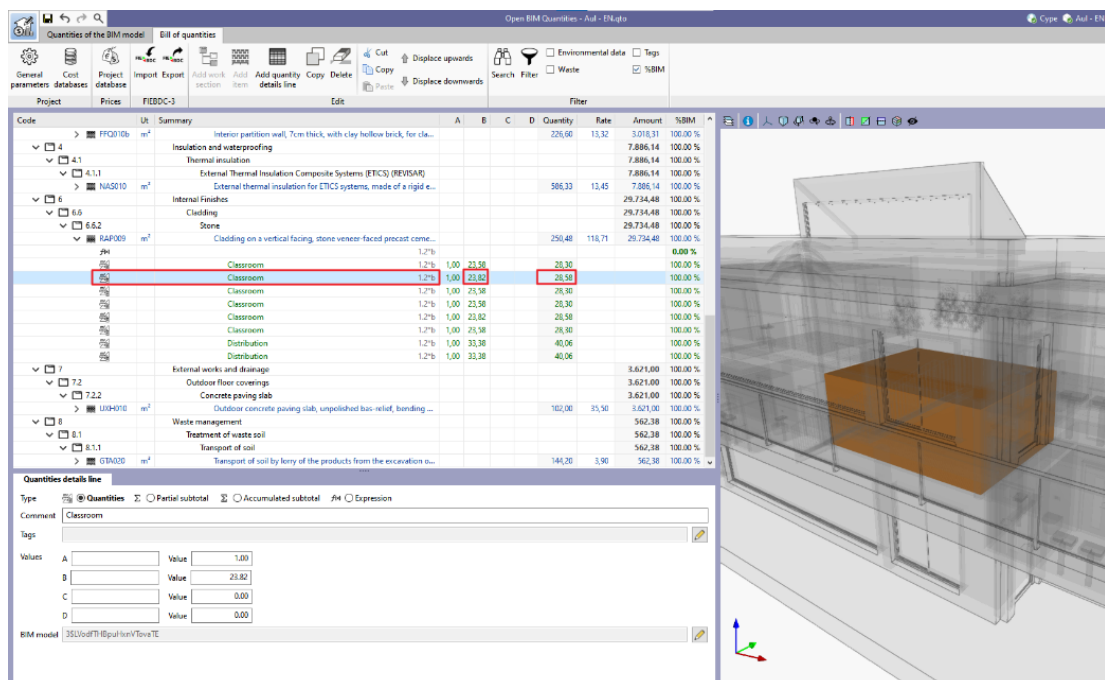
#### 4.4.1 Steps to follow for obtaining the measurement of a frieze from the *IfcSpace* data



1. If the set of measurement rules is not open, select it from the left-hand column and click on the **Edit** button located at the top of the screen.
2. Click on the **Add** button located in the *Rules of measurement* panel. Enter a name for the rule of measurement being created.
3. Add a selection criterion; since the operation is to be performed on spaces, select the *Entity* parameter and the condition equal to *IfcSpace*.
4. Add, if necessary, more granular selection criteria; otherwise, the quantities to be generated shall be carried out on all the spaces contained in the model.

5. Add an item (if working with a reference cost database, select it by clicking on **Assign codes** in the *Rules of measurement* panel).
6. In the Item window, configure the required fields in the *Quantities* section. For example, to measure the frieze by surface, set the partial dimension in one of the available sections and select the *NetPerimeter* parameter.
7. To operate with the previous partial dimension, type the formula into the *Formula* section. For example, if the height of the frieze is 120cm, the value of the perimeter must be multiplied by 1.2. If the parameter in line B has been selected, the formula "1.2\*b" must be entered.

**NOTE:** If the quantities are now updated, all screeds belonging to the "External screeds" type will be included in the bill of quantities; however, depending on their thickness, they will have been associated to different items.



The screenshot displays the 'Open BIM Quantities - Aut - D14g1a' window. The main area shows a 'Bill of quantities' table with columns for Code, Summary, A, B, C, D, Quantity, Rate, Amount, and %BIM. The table lists various construction items such as 'Interior partition wall', 'Insulation and waterproofing', 'External Thermal Insulation Composite Systems (ETICS)', 'Internal Finishes', 'Cladding', 'Stone', 'Classroom', 'External works and drainage', 'Outdoor floor coverings', 'Concrete paving slab', 'Waste management', and 'Transport of soil'. The 'Classroom' item is highlighted in blue, and its details are shown in the 'Quantities details line' panel at the bottom. The details panel includes fields for Type, Comment, Tags, and Values (A, B, C, D) with corresponding input boxes. A 3D model of a building structure is visible on the right side of the interface.



## 4.5 Generating the bill of quantities

Although in previous sections several bills of quantities have already been proposed to observe the effect that the different rules of measurement have on the generation process, in this section the focus will be on the possibilities offered by the tools included in the *Bill of quantities* tab.

**NOTE:** *Wherever necessary, the explanation of the tools contained in the different groups of the top toolbar, as well as the general functioning of the different panels, can be found in the "Overview of the interface" section.*

**The *Bill of quantities* tab is aimed at both generating and managing the bill of quantities.** First of all, its generation will be the main focus of attention. Indeed, there is little to say; the process is simple and immediate; however, this is only possible after a model, a reference cost database and a set of measurement rules are already in place.

### 4.5.1 *Steps to follow for obtaining a Bill of quantities*

1. Review, using the first tool in the toolbar, the *General Parameters*. Modify the currency, decimals, or percentages settings, if necessary. The settings can be imported or exported using the icons on the right-hand side.
2. Review the Cost database configuration. The Cost database work environment is accessible under the *Bill of quantities* tab, just as it was under the *Quantities of the BIM model* tab. The association of item codes is carried out against the active cost database; from here any available cost database can be selected (and/or edited) in order to be set as the active database.
3. Nothing should be changed here when the cost database defined at an earlier stage is to be used.
4. Move to the far right and click on the **Update quantities** tool. A small menu will appear that allows users to choose between two update options:
  - **Delete the data of the current bill of quantities.** As the name suggests, it completely deletes the contents of the current bill of quantities before a new dump is carried out.
  - **Update the current bill of quantities.** Replaces the components affected by possible changes in the model or set of measurement rules (items, quantity

lines, etc.) without deleting those that are not affected (e.g., those originating from manual editing or importing external files).

The menu also offers the possibility of modifying the active cost database, i.e., the one used to obtain the bill of quantities. A selector will appear next to the activation box and, to the right of it, a button for accessing the editor and a second button where the elements to be included in the bill of quantities (summary, breakdown, graphic information, etc.) can be selected. It will also offer a shortcut to the **Price adjustment** tool, which allows the performance coefficients for labour, machinery, or price to be modified. Click on **Accept** once all the desired operations have been carried out.

Nothing should be changed here when the definitions of the cost database defined at an earlier stage are to be used.

#### 5. Determine the Exchange rate between currencies if necessary.

This should only be done if the currency used in the cost database is different from the one used in the bill of quantities.

#### 6. Finally, the bill of quantities has been obtained according to the configuration defined in the previous steps. Note that, despite the points mentioned above, the bill of quantities can be obtained with the default options (and this will be the case in most situations).

The main bill of quantities window displays the result. A colour code identifies the different concepts; the **work sections** are shown in black text; the **items** are shown in blue if they are correctly defined (if the price of the concept has not been defined, they are shown in a mustard colour, as well as the codes of the higher levels); and the **quantity lines** are shown in green.

4	Insulation and waterproofing								0,00
4.1	Thermal insulation								0,00
4.1.1	External Thermal Insulation Composite Systems (ETICS) (REVISAR)								0,00
NAS010	External thermal insulation for ETICS systems, made of a rig...	m <sup>2</sup>				586,33	0,00		0,00
6	Internal Finishes								29.734,48
6.6	Cladding								29.734,48
6.6.2	Stone								29.734,48
RAP009	Cladding on a vertical facing, stone veneer-faced precast ceme...	m <sup>2</sup>				250,48	118,71		29.734,48
fM			1.2*b						
1.2*b	Classroom		1.2*b	1,00	23,58		28,30		
1.2*b	Classroom		1.2*b	1,00	23,82		28,58		
1.2*b	Classroom		1.2*b	1,00	23,58		28,30		

The secondary window of the bill of quantities shows the rest of the associated information. The *breakdown* of items shows the different **simple concepts** in green (red, if any of them does not exist in the reference database).

Code	Ut	Summary	Quantity	Rate	Amount
▼ Items		Prices			
▼ RAP009	m <sup>2</sup>	Cladding on a vertical facing, stone veneer-faced precast cement panel, fixed using C2 TE improved cementitious adhesive, with reduced slip and extended open time, grey colour. (The decomposition concepts have not...	1 m <sup>2</sup>	112,81	112,81
mt19ppc010a	m <sup>2</sup>	Stone veneer-faced precast concrete panel, made with black slate slabs on a mortar base reinforced with metal wiring, 61cm x 15.2cm large and 4 to 6 cm thick. Includes brick corner pieces.	1,050 m <sup>2</sup>	98,10	103,01
mt09mcr021q	kg	High performance cementitious adhesive, C2TE, with reduced slip and extended open time, in accordance with BS EN 12004, grey colour.	2,500 kg	0,60	1,50
mo022	h	Skilled natural stone fixer.	0,320 h	19,03	6,09
mo060		The code of the item does not exist.	0,320	0,00	0,00
%	%	Other direct costs.	2,000 %	110,60	2,21

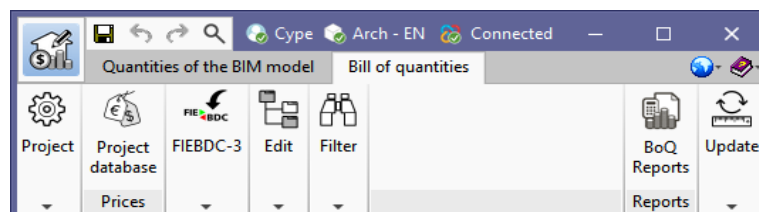
The process for obtaining bills of quantities has been completed.

## 4.6 Editing the Bill of quantities

This section focuses on the management and editing of the resulting bill of quantities. The tools and processes are similar to those of any other basic program for generating bills of quantities.

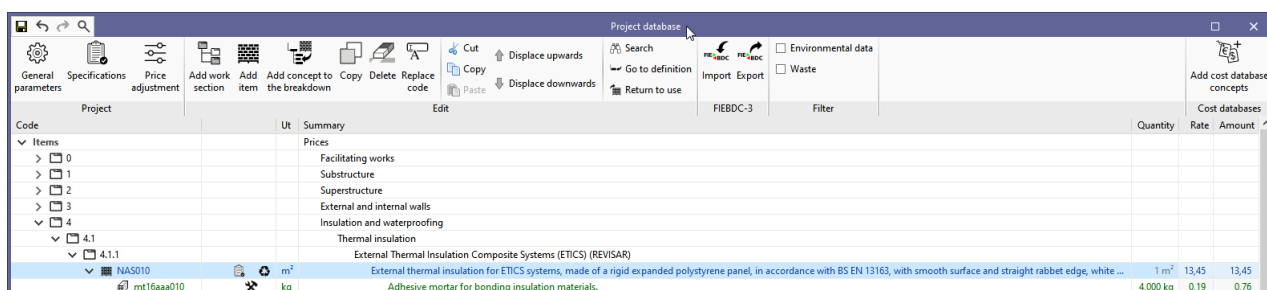
**NOTE:** Wherever necessary, the explanation of the tools contained in the different groups of the top toolbar, as well as the general functioning of the different panels, can be found in the "Overview of the interface" section.

There are generally two possibilities for editing the bill of quantities. The first consists of editing the project database, so that concepts can be modified or added or defined in the project (without affecting the cost databases). The second is to manually edit the bill of quantities itself.



Remember that the **Project Database** tool, included in the *Prices* group, allows a particular configuration of the ongoing job to be carried out (without affecting the active cost database). Activating this tool opens a working environment almost identical to the one offered by the **Cost database** tool; it opens the active bank and allows the same changes to be made (adding, deleting, or editing concepts) that will only affect the current job. It includes a particular tool: **Price adjustment**, which allows the performance coefficients of the original cost database (labour, machinery, or price) to be modified. This set of tools allows databases to be customised and adapted to the needs of the active job. The concepts created and/or modified in this environment will be considered in the bill of quantities.

**NOTE:** Nothing should be changed here when the definitions of the cost database defined at an earlier stage are to be used. However, sometimes the different rules may use a code that is not included in the cost database, or a defined item may not have a price, or one of the definitions in the cost database may need to be changed for the current job. With this tool the necessary changes can be made without affecting the reference cost database.



#### 4.6.1 Steps to follow for editing the project database and completing the bill of quantities.

1. The items used in your bill of quantities can be defined from the **Project database**. Click on the tool in the *Prices* group.
2. Check the bill of quantities to see if any items are displayed in mustard or if any codes are in red.
3. Locate the item to be priced in (mustard colour) and select it.
4. In the secondary window, open the *Item* tab and fill in the *Price* field if the concept is to be retained as an item without breakdown. If converting it into an item with breakdown, proceed in the same way as when defining an item belonging to the cost database (see the "*Steps to follow for adding breakdowns to an item*" section); in this case, the price will be transformed into a calculated price.
5. Review and/or complete the remaining required fields for the item.
6. Repeat the operation for the rest of the mustard-coloured items.
7. Identify the pending item with undefined breakdowns (code in red). Copy the code of the non-existing simple concept.
8. Scroll down to the *Resources* section and add the required unit (see section "*Steps to follow for adding simple items*").

9. Repeat for the remaining single concepts in red.
10. When all operations have been completed, close the *Project Database* window. The bill of quantities will be automatically updated according to the changes made.
11. To save the configuration of the *Project database*, it can be opened and saved as a .bc3 file. Otherwise, if the quantities are updated from a cost database, the configuration made will be lost. Note that this database is dynamic and refers to the status of the bill of quantities.

Please note that by editing the *Project Database*, this **does not change the quantities but the way in which they are translated into a bill of quantities**. The manual editing of the bill of quantities allows it to be edited without to any scope limitations. To do this, the tools contained in the top bar should be used in a similar way as in any other basic application for generating bills of quantities.

#### 4.6.2 *Steps to follow for manually editing the bill of quantities*

1. To add a new work section, hover over the header of the bill of quantities and click on the **Add work section** tool (if you want to create a work sub-section, hover over the header of an existing work section). A code and a summary must be entered. The scrolling tools can be used to relocate the new work section in the structure.
2. To add a new item, go to the header of the work section where the item is to be included and click on the **Add work section** tool. Enter a code (the blue arrow allows you to use any existing code in the project database). A factor and a performance must be defined.
3. To add new quantity lines, hover over the item where they are to be included and click on the **Add quantity details line** tool. Define the *Quantities* type and enter, if desired, a comment, label and complete the required partial dimensions. Additionally, it can be associated to the BIM model by means of the unique identifier (GUID) corresponding to the element to be linked (which can be consulted in the *Quantities of the BIM model* tab).
4. Besides the quantity lines themselves, the same tool can be used to include a partial subtotal, a cumulative subtotal, or an expression. In the latter case, a formula that operates on the value of the partial dimensions can be entered. This formula will be considered for calculating the amount of the quantity lines below it.
5. To incorporate complete partial bills of quantities, you can do so using .bc3 files via the **Import** tool in the *FIEBDC-3* group.

6. As well as creating concepts, users can **Copy, Delete, Move**, or use the clipboard tools on any existing concept with the other tools.
7. Once the manual editing of the bill of quantities has been completed, the **Block** tool can be selected in order to prevent it being updated.

**NOTE:** *One interesting thing to note is that as quantity lines are added manually (without being linked to model components), the %BIM of the bill of quantities is reduced (this column can be activated using the corresponding tool in the Filter group).*

## 4.7 Generating reports



Generating lists is immediate; users only need to click on the **BoQ reports** tool and activate the required reports out of all those available:


- Quantities
- Cost breakdown structure
- Priced bill of quantities
- Detailed priced bill of quantities
- BoQ summary
- Specifications
- Environmental impact indicators
- Construction and demolition waste

Configuring these reports allows additional data to be added (*Project, Location, Developer, Author, Date*), visible in the different reports to be generated.

Furthermore, the tool can be used to narrow the reports to those items that meet a filter condition defined by a tag (remember that measurement lines can include a value in this tag field).

Special attention should be paid to the reports that are to be generated using the information included in the different concepts.

- **Specifications.**  The concepts included in the cost database that include information related to generating specifications are shown with an identifying icon. This information, which can be edited, allows a list of conditions to be included in the specifications.
- **Environmental impact indicators.**  Another icon marks the concepts including technical information. This technical information can include *Energy Cost* and *CO2 Emissions* data that allow the environmental impact indicators report to be obtained.

- **Construction and demolition waste.**  In the same way, the concepts including information on the associated waste generation will be identified with their corresponding icon. This information is visible from the *Waste* tab associated to each concept. For concepts with a breakdown, the total amount of waste is a calculated value obtained from the information contained in each breakdown. However, this valuation can be edited manually for each item or simple concept from the table accessed by clicking on the **Waste** button located on the right-hand side of the table.

## 4.8 Exporting the bill of quantities to FIEBDC-3 format



As well as generating reports, the bill of quantities can be exported in standard FIEBDC-3 (.bc3) format so that it can be read by any compatible application.

In order to carry out the export, users simply need to use the **Export** tool in the *FIEBDC-3* group, assign a name to the file, and activate the option to include associated information (graphical information, attached documents, specifications, and technical information).

## 4.9 Connecting to BIMserver.center

The generated information can be shared at any time during the development of the project. To do this, simply go to the *Quantities of the BIM model* tab and click on the **Share** tool to upload a copy of the model **to BIMserver.center** and make it available to those collaborating in the project.

In a totally transparent process for the user, the application creates a copy of the model in .IFC format, saves it in a local path of the work team and, using the synchroniser, uploads the model to the **BIMserver.center** cloud.

The application can generate other information exchange files such as .bc3 files, project reports or results for automatic incorporation into the project memory by using specific applications.

The reports will be uploaded as a PDF file and both these and the .bc3 file itself will be downloadable from the **BIMserver.center** cloud so that they can be used by any collaborator in the project. In any case, the native files, sets of measurement rules, etc., will not be shared.



## 4.10 Updating with changes in the model

As anticipated in the introduction to this document, since detailed priced bills of quantities are obtained automatically and almost instantaneously and synchronised with the updated models included in the project, Open BIM Quantities aspires to become not only a final tool for obtaining the bill of quantities once the modelling process is completed, but also a **design tool** that helps with decision-making during the definition process itself.

Once the basis of the quantities process has been defined (*selecting cost databases and defining the rules of measurement and sets of measurement rules*), any changes to the models can be immediately reflected in the bill of quantities.

### 4.10.1 *Steps to follow for editing the bill of quantities manually*

1. If any of the models used as reference for the quantities is updated in **BIMserver.center**, the **Update** button in the **BIMserver.center** tool group flashes and displays a warning symbol. Click on it.

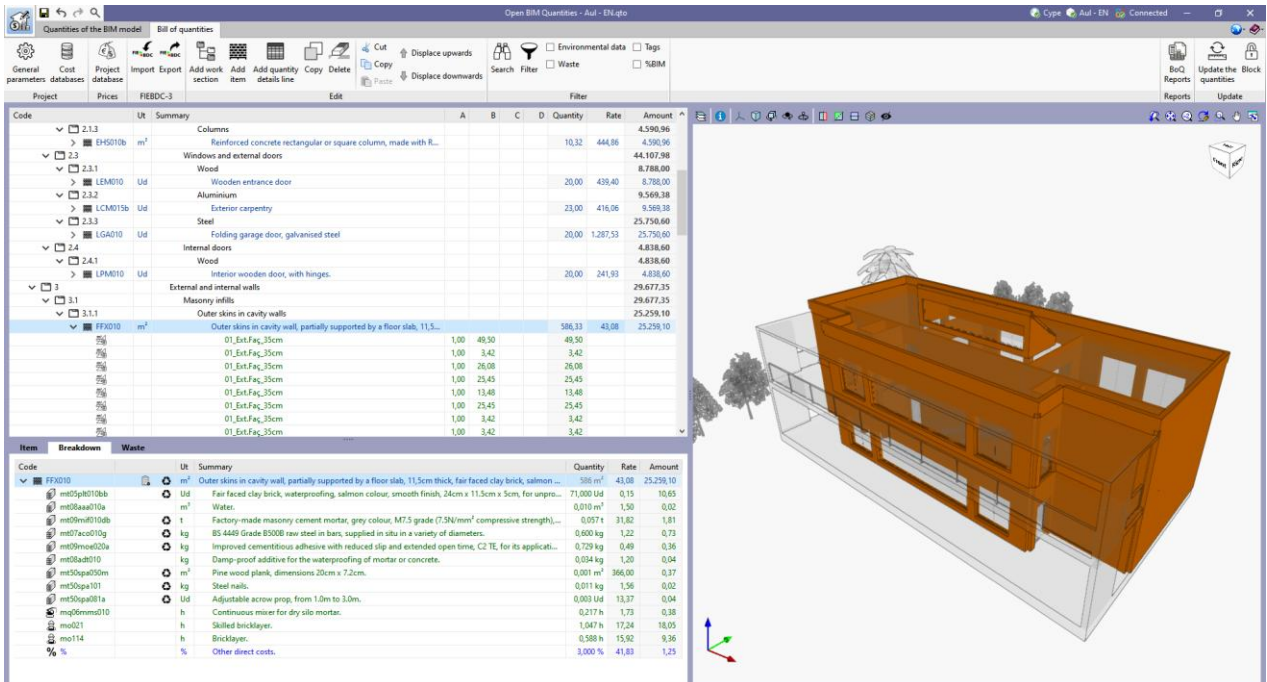
A table will be displayed with all the models linked to the collaborative project. The different columns provide information about possible changes. Activate the checkbox of the model(s) whose update will be imported. Click **Accept**.

2. In the graphical window, the possible modifications to the model can be seen from a graphical point of view. If no changes are to be made to the set of measurement rules to be used, simply activate the *Bill of quantities* tab, and click on **Update the quantities**. To generate a new bill of quantities from scratch, select the **Delete the data of the current bill of quantities** option. If modifications have been made or measurements have been added manually and the editing is to be retained, select the **Update the current bill of quantities** option. Click **Accept** and the bill of quantities will be immediately updated.

**NOTE:** *Choosing the Update the current bill of quantities option will keep those elements entered manually in the bill of quantities, as well as those that may have disappeared from the template. The Delete the data of current bill of quantities option is always a more accurate option to ensure that the model and the bill of quantities match.*

If, as is often the case, the economic factor is a further conditioning factor in the project, being able to obtain detailed priced bills of quantities automatically will help at any time during the development of the project.

Open BIM Quantities, like all other Open BIM applications, benefits from the collaborative, multidisciplinary and multi-user workflow provided by **BIMserver.center**, based on Open BIM technology.



The screenshot displays the Open BIM Quantities software interface. The main window is titled "Open BIM Quantities - Aut - EN-gio". The interface is divided into several sections:

- Top Bar:** Contains various icons for file operations, editing, and viewing. It also includes a search bar and a filter dropdown.
- Left Panel:** A tree view showing the project structure, including "General parameters", "Cost", "Project database", "Import", "Export", "Add work section", "Add quantity", "Copy", "Delete", "Cut", "Displace upwards", "Displace downwards", "Paste", "Filter", "Environmental data", "Tags", "BIM", "Reports", "Update the quantities", and "Block Update".
- Main Table:** A detailed Bill of Materials (BOM) table with columns for "Code", "Ut", "Summary", "A", "B", "C", "D", "Quantity", "Rate", and "Amount". The table lists various construction items such as "Columns", "Reinforced concrete rectangular or square column, made with R...", "Windows and external doors", "Wood", "Wooden entrance door", "Aluminium", "Exterior carpentry", "Steel", "Folding garage door, galvanised steel", "Internal doors", "Wood", "Interior wooden door, with hinges", "External and internal walls", "Masonry in cavity walls", and "Outer skins in cavity wall, partially supported by a floor slab, 11.5...".
- Right Panel:** A 3D model of a building, showing the structure and the placement of the various construction items listed in the BOM table.