Software for Architecture,
Engineering and Construction

CYPE –Revit interoperability guide

USER GUIDE V.2.0

Developing projects with CYPE and REVIT

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1 Introduction

This guide establishes guidelines for the optimum communication between the architectural modelling application REVIT, and CYPE's specialist technical programs.

This communication is based on the **IFC** format (acronym for INDUSTRY FOUNDATION CLASSES). IFC is an **open data exchange format** in the architecture, engineering and construction sector. It is free to access (as it does not depend upon any particular developer), and it allows for the exchange of model information between applications from different developers.

It is not possible to develop efficient BIM models without taking into account the intended **BIM USES** from the start. In this case, by not including the requirements of the IFC format and of the CYPE tools as another BIM Use upon starting a new project with REVIT, it will lead to the appearance of interoperability problems that can end up halting the workflow. This is because there are two types of possible interaction with an IFC– **viewing the information that it contains** (e.g. with an IFC viewer) and **working with this information** (e.g. with CYPE's analysis solutions). Whilst the first case is relatively easy to achieve, the second interaction is very sensitive due to differences in the internal information structures of each software program.

The IFC format is capable of transferring data from one application to another, but this does not mean that this data follows the fundamental internal norms of the software which it is transferred to. For example, general purpose software like Revit or Archicad, allow the user to model elements in various ways. Such flexibility is possible because they do not have to respond to complex specific calculations for detailed code justifications. On the other hand, in CYPE's solutions there is usually only one way of modelling elements – the one which offers greater guarantees in the analysis processes of that tool. It is important to take these restrictions into account when choosing the way in which to model in the general purpose software if there is to be good communication.

2 IFC concepts

2.1 IFC terminology and structure

At CYPE we work so that the technician does not need to know in detail the internal structure of the IFC, automatically facilitating its "correct" generation from the modelling tools available in each program. Nevertheless, for a greater understanding of this guide some basic concepts surrounding this term will be clarified.

IFC is a format developed by the buildingSMART initiative for projects where there is collaboration between users of BIM applications made by different providers. This implies working in an **Open BIM workflow** as it does not depend on formats belonging to specific developers. The most up-to-date version is IFC 4 (major release), which complies with ISO 16739:2013. Just like with all ´BIM´ formats, the IFC format contains geometric entities with associated information in the form of parameters. These entities are grouped into **CLASSES** and **TYPES**. **CLASSES** are a general grouping of elements according to what they are (walls, floors, roofs etc.), associating attributes and dependencies to them. **TYPES** are a more specific grouping within classes, that distinguish between their individual specific components (for example, the CLASS IfcBeam, that describes any type of beam, hosts various specific TYPES of beam, such as BEAM, JOIST, HOLLOWCORE, LINTEL, SPANDREL, etc).

The standardised system of CLASSES and TYPES is fundamental during the import of an IFC as they are the programs' way of finding the entities that they need. For example, a structures application will search for a series of classes and types (e.g. IfcColumn) in order to import, interpret and work from. Each CLASS is also assigned a default and standardised set of basic parameters known as **P-SET.** For instance, the CLASS IfcWall is assigned a P-SET that contains parameters such as U-value, Load-bearing, Sound insulation class, Fire behaviour, etc. This is a set of data relevant to that CLASS that will be displayed in viewers and worked with in programs that import IFC.

Each IFC file is assigned a **MODEL VIEW DEFINITION (MVD)**; this is its function (what that IFC will be used for), so that its data is organised and optimised for that purpose. A structural MVD will mean that the IFC only contains information relevant to the analysis and calculation of the project's structure.

2.2 Features of a Revit IFC

In an IFC there are 3 types of element that Revit is capable of exporting according to the geometric operation with which they are generated:

1. **Extrusions:** of a straight extrusion profile.
2. **Sweeps:** through a direction vector.
3. **B-rep:** Boundary Representation. They can either be vertices with coordinates in space that join with the edges and form the object, or NURBS surfaces.

The three previous entities are correctly represented in the three-dimensional space of the IFC and can also be used for model coordination jobs. Each element, independent of the way the geometry has been generated, will have its own corresponding IFC class and type. For example, there can be a wall element of the class “IfcWall” that is a simple extrusion, but also an “IfcWall” that is a B-rep. In both cases the “IfcWall” could have exactly the same properties.

However, it should be remembered that each software program has its own rules regarding the generation of geometry. In general, the simpler the geometrical definition of an element, the more possibilities there are that another application is able to recognise the entity and continue working with it. The easiest are simple extrusions, whereas B-Rep are the most complex entity.

Due to the structure of Revit’s IFC exporter, when you export to IFC it will attempt to generate almost all of the entities as a simple extrusion profile. Only in cases where it is impossible to geometrically define them as an extrusion, the surface will be exported as a sweep, and in final instance, as a B-rep.

All of this is especially relevant to the way in which you model within Revit. Achieving a model which is capable of exporting itself entirely as a simple extrusion will greatly contribute to good communication with other tools, including CYPE’s suite of programs.

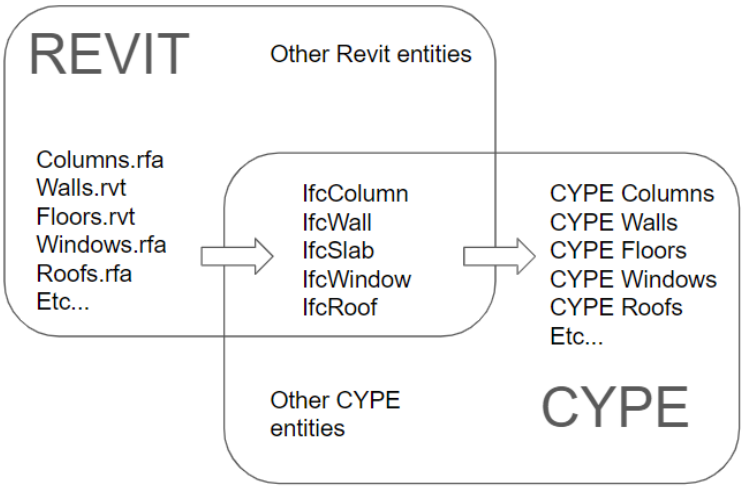
3 Revit - CYPE Workflow

3.1 General settings

The IFC format allows information to be exported from a specific application to other applications of other developers, in order to view and work with the information. The most important thing in the REVIT-IFC-CYPE workflow is the optimisation of the information that is exported to subsequent applications. This means that:

1. **It is safest to export simple models**, when you have the basic architectural elements relevant to development in specific applications (walls, partitions, slabs, doors, windows, etc). This does not mean that a detailed Revit model cannot be exported – section **4.1.2. Mapping settings** details how to specify which entities to export to IFC. Nevertheless, exporting a simple model is the best way to guarantee a fluid interoperability.
2. **Model as much as possible according to the guidelines laid out in this guide.** Each software program has an internal structure and logic designed for its correct operation, with different accuracy levels according to its function. Revit is a general purpose program, where there are various ways of doing things. However, it will be necessary to choose the work method where the structure of the entities is similar to the structure of the specialised applications. These applications require greater accuracy when carrying out calculations and code justifications of structures, energy analysis, acoustic analysis, installations, etc.

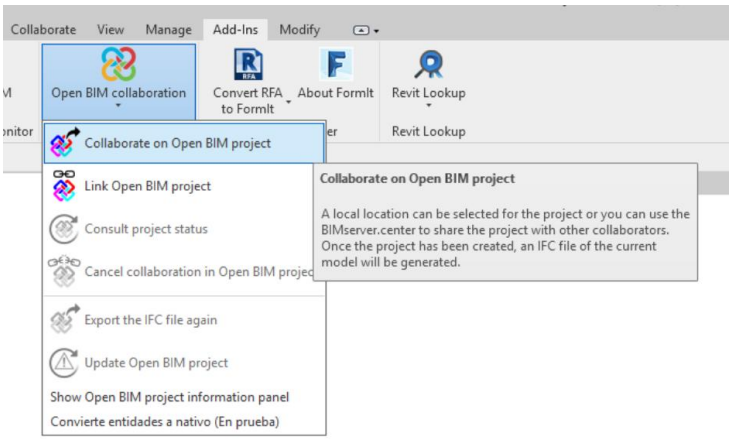
Finally, it must be kept in mind that CYPE has two types of program – those that allow the modelling of architectural elements (CYPECAD MEP, IFC BUILDER), and those that do not (CYPETHERM, CYPEPLUMBING, CYPELUX,etc.). Exporting to the second type is a lot easier than to the first. If you want to transfer your Revit model to a non-modelling application it can be successfully exported even without following all the guidelines in this guide. As a general rule, the more complex the exported IFC is, and the more features that the CYPE application has where you want to export to, the more accurate the model has to be to achieve the best interoperability.

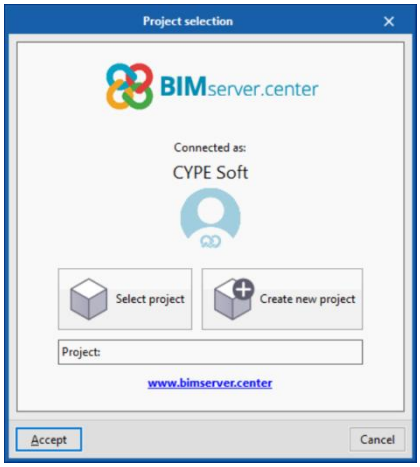


3.2 Open BIM plugin for Revit

The best way to export to IFC to guarantee an optimal communication between CYPE applications is to use the free export PLUGIN, available on the BIMserver.center STORE.

This PLUGIN facilitates the configuration of the IFC exporter integrated into Revit, allowing a direct link with our project on BIMserver.center. The default configuration of this plugin will function in the majority of cases, as long as the suggestions in this guide have been followed. You must keep in mind that the possible limitations in the exportation process are inherited from Revit's IFC exporter, developed by Autodesk.





By clicking on **COLLABORATE ON OPEN BIM PROJECT** two options appear:

1. Select an existing project- if there is a project on BIMserver.center where we want to take the exported IFC we can select it by clicking on this option. It will open a pop-up menu with a list of projects.
2. Create a project on BIMserver.center. It is possible to create a new project on the platform directly from Revit in a matter of seconds.

In both cases, an IFC will be exported that is uploaded to the cloud, and will allow for collaborative working and synchronisation with other IFCs uploaded to the same project – both those developed in CYPE programs and those created by another tool which are connected to the project.

When opening any CYPE application you can link directly to the project and its files and continue working as usual with the information you have generated in Revit. Furthermore, when the Revit file is synchronised with BIMserver.center you will be able to link the IFCs that already exist in this project, or those that will be added later, having access to all the information that they contain (for example, the element and material specifications

resulting from the analysis of the structure and installations). This last point is explained in more detail in point 10 of the guide.

3.3 Analysis of possible export errors

On occasions it is possible that the import to CYPE programs is not as expected and it is unclear why. When exporting the IFC with the PLUGIN and uploading it to BIMserver.center, a local IFC file is generated that serves as a conduit between Revit and the cloud. This file is found by default in **C:\ bim_projects\ user_XXXXX\ proy_XXXXX** (although this directory can be edited from the BIMserver.center synchroniser). There will be a folder structure that serves for organising the different files and establishing a good connection with Revit.

From here, the IFC file can be opened with any free IFC viewer (e.g. the BIMvision free viewer, available on BIMserver.center) and checked that all the geometry necessary to carry out the analysis in CYPE software has been exported – if it has been exported in its correct position, if it has the correct features etc. For example, it is essential that IfcSpaces have the 2nd Level Space Boundaries defined in order to carry out the energy analysis with this IFC model.

Additionally, and as a general rule, the most difficult export is to modelling programs such as CYPECAD MEP or IFCBUILDER: however, in this case it will be possible to solve this problem within these same programs, remodelling the parts that have not been correctly exported.

The goal is not to achieve an identical copy of Revit's geometry in CYPE programs, but rather to obtain a model with the necessary and sufficient information to carry out the relevant analyses and calculations.

4 General settings

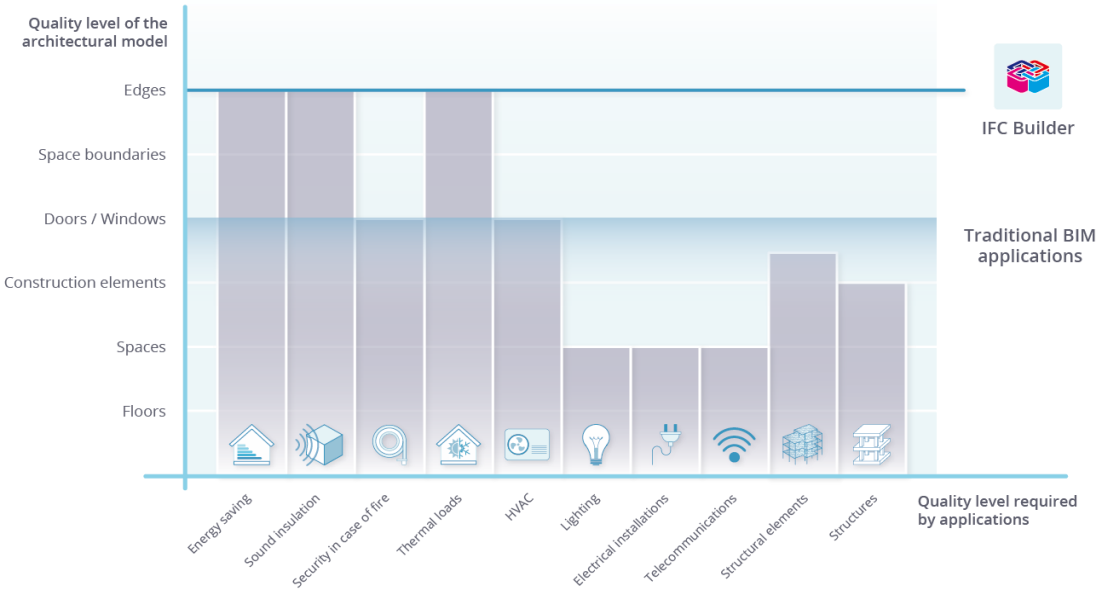
4.1 Mapping settings

The MAPPING TABLE for IFC export is a table that determines the translation from REVIT native entities to IFC entities. This table can be found in **Revit > Export > Options > IFC Options**.

> For a correct export ensure that **the necessary entities** for the desired analysis model and the **correct equivalence** between entities **are exported**.

The following table defines which REVIT entities need to be exported to which IFC entities depending on the applications to which the model is to be exported.

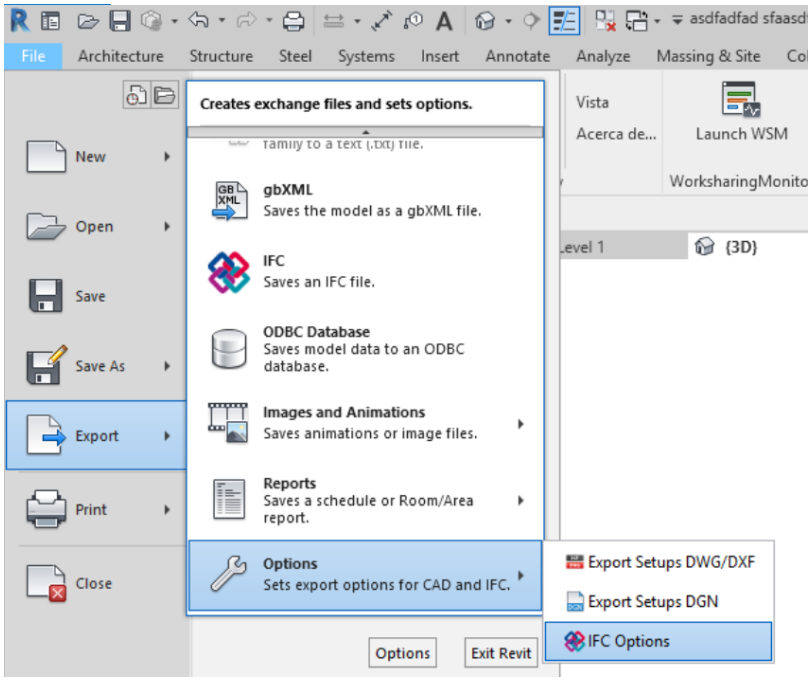
The goal is NOT to reproduce the entire Revit building in IFC, but rather to extract from the model the necessary information to carry out certain actions with specific tools.

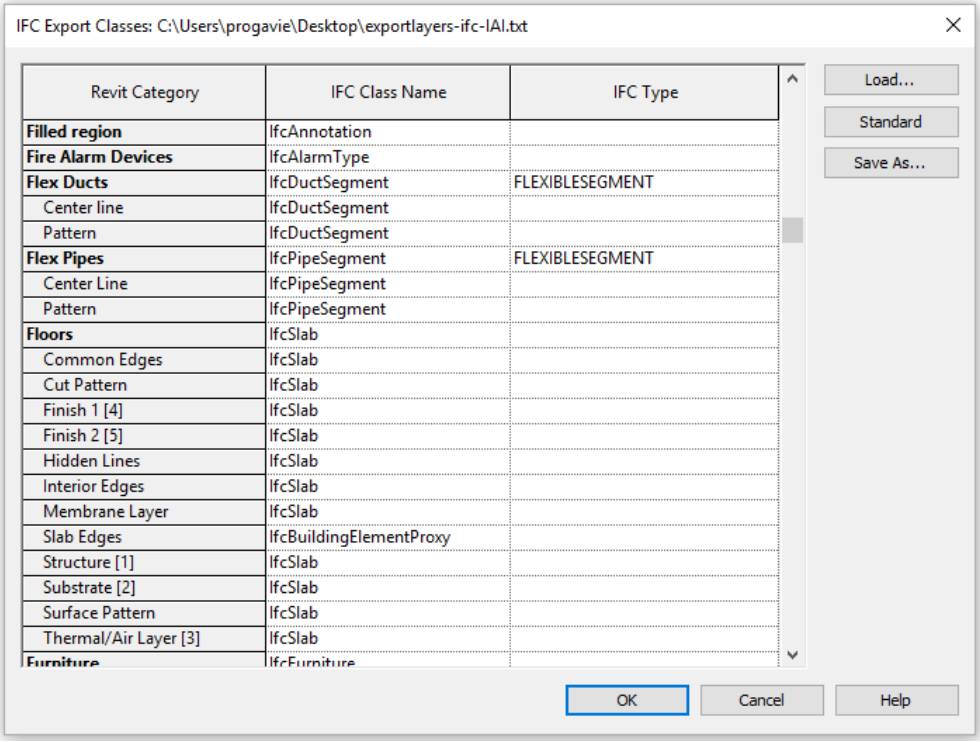


The graph above shows the amount of information that travels in the IFC (vertical axis), and how much of this information needs to be interpreted as native by the different disciplines of the project (horizontal axis).

Traditional BIM tools (Revit) are not capable of exporting the space boundaries (IfcSpace) needed, for instance, for accurate thermal analysis as well as the information needed to interpret thermal/acoustic bridges. However IFC analysis tools are continually improving and at CYPE we are working on a tool capable of interpreting this missing information to incorporate it automatically into the project. Alternatively, you can use the free BIM tool,

IFC BUILDER, or CYPECAD MEP, that guarantee a model which exports the maximum amount of information recognisable by the CYPE suite for these types of analysis.





Revit Category	IFC Class Name	IFC Type
Filled region	IfcAnnotation	
Fire Alarm Devices	IfcAlarmType	
Flex Ducts	IfcDuctSegment	FLEXIBLESEGMENT
Center line	IfcDuctSegment	
Pattern	IfcDuctSegment	
Flex Pipes	IfcPipeSegment	FLEXIBLESEGMENT
Center Line	IfcPipeSegment	
Pattern	IfcPipeSegment	
Floors	IfcSlab	
Common Edges	IfcSlab	
Cut Pattern	IfcSlab	
Finish 1 [4]	IfcSlab	
Finish 2 [5]	IfcSlab	
Hidden Lines	IfcSlab	
Interior Edges	IfcSlab	
Membrane Layer	IfcSlab	
Slab Edges	IfcBuildingElementProxy	
Structure [1]	IfcSlab	
Substrate [2]	IfcSlab	
Surface Pattern	IfcSlab	
Thermal/Air Layer [3]	IfcSlab	
Furniture	IfcFurniture	

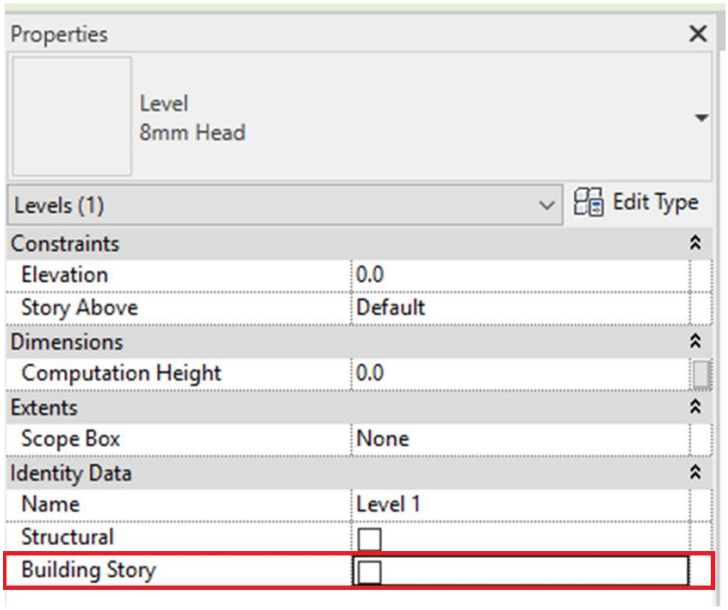
4.2 Levels

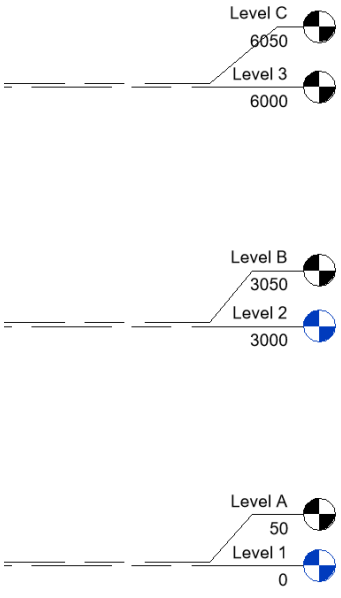
In Revit, it is common to work with several levels on the same floor – at least an architectural/ finished floor level, and one structural level. However, most of the analysis and calculation programs in the CYPE suite are designed to work with only one level per floor – that of its specific function.

To avoid excess floors in CYPE programs simply uncheck the **"building story" instance parameter for those levels that are not relevant for the analysis** to be carried out. That way, those floors will not be exported and you will be able to continue working only with the necessary levels with the specific tool.

> Be careful when exporting to modelling programs such as CYPECAD MEP or IFC BUILDER – the levels that are not exported cannot be used as a reference for the upper or lower boundaries of the walls.

Another alternative solution would be to leave these levels unchecked when importing the model to calculation programs.



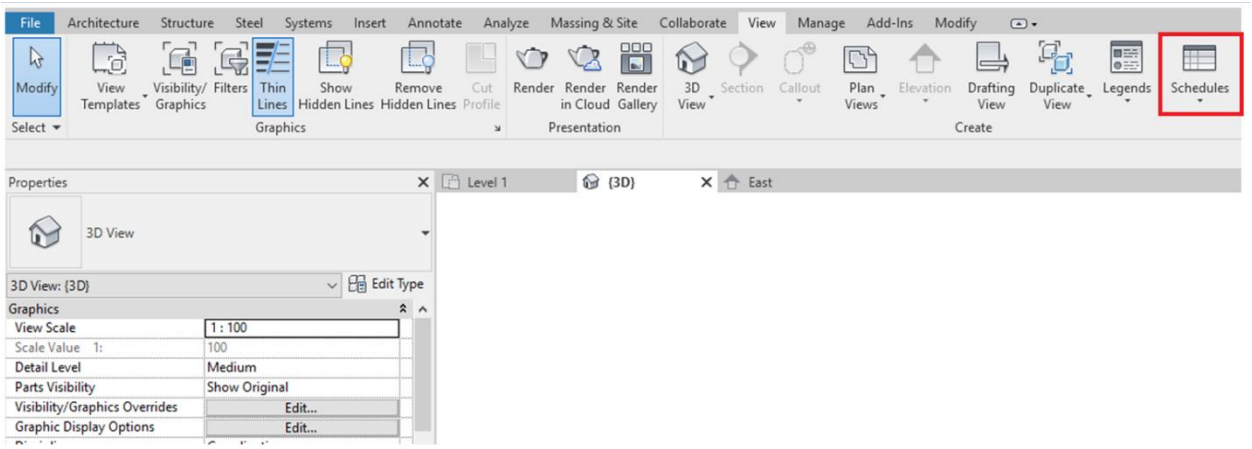


4.3 Rooms

The rooms are one of the most important entities, since they are the basis for many of the calculations and analyses that can be performed on the BIM model. It will be essential to define them correctly in order to ensure their accurate export and analysis by applying the following measures:

1. Deleting unplaced rooms and spaces.

When a room is deleted from any view in Revit it is deleted from the 3D space but it remains present in the project. To completely delete a room in a Revit project it needs to be done from the schedule. In order to do this, go to **View > Create > Schedule**, and create a schedule/quantities table including at least the area. The rooms that are not placed on the floor will have the value "**not placed**". From here they can be deleted, removing them completely from the project.

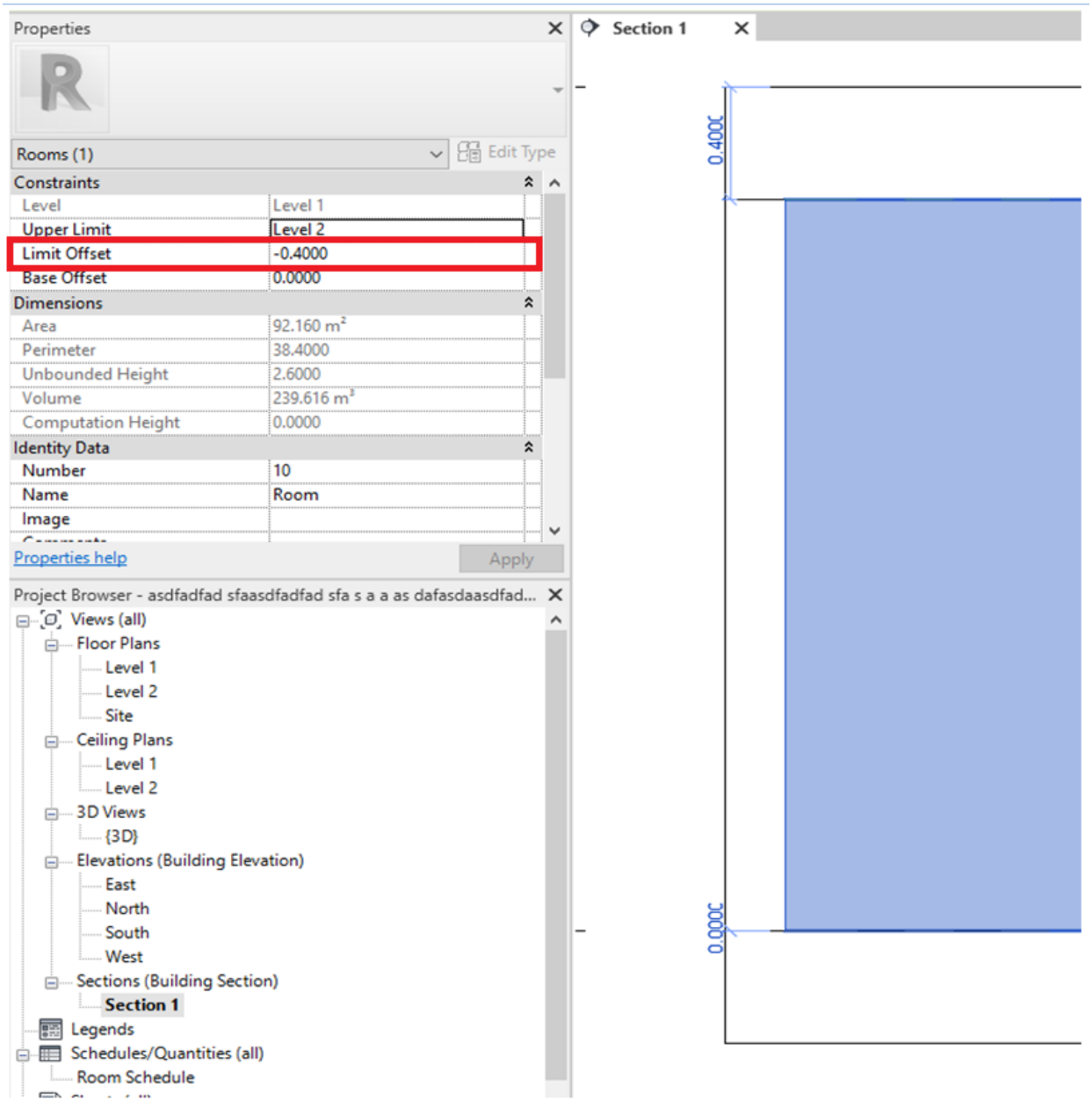


<Room Schedule>

A	B	C	D	E	F
Name	Level	Volume	Number	Perimeter	Area
Room	Not Placed	Not Placed	1	Not Placed	Not Placed
Room	Not Placed	Not Placed	2	Not Placed	Not Placed
Room	Not Placed	Not Placed	3	Not Placed	Not Placed
Room	Not Placed	Not Placed	4	Not Placed	Not Placed
Room	Not Placed	Not Placed	5	Not Placed	Not Placed
Room	Not Placed	Not Placed	6	Not Placed	Not Placed
Room	Not Placed	Not Placed	7	Not Placed	Not Placed
Room	Not Placed	Not Placed	8	Not Placed	Not Placed
Room	Not Placed	Not Placed	9	Not Placed	Not Placed

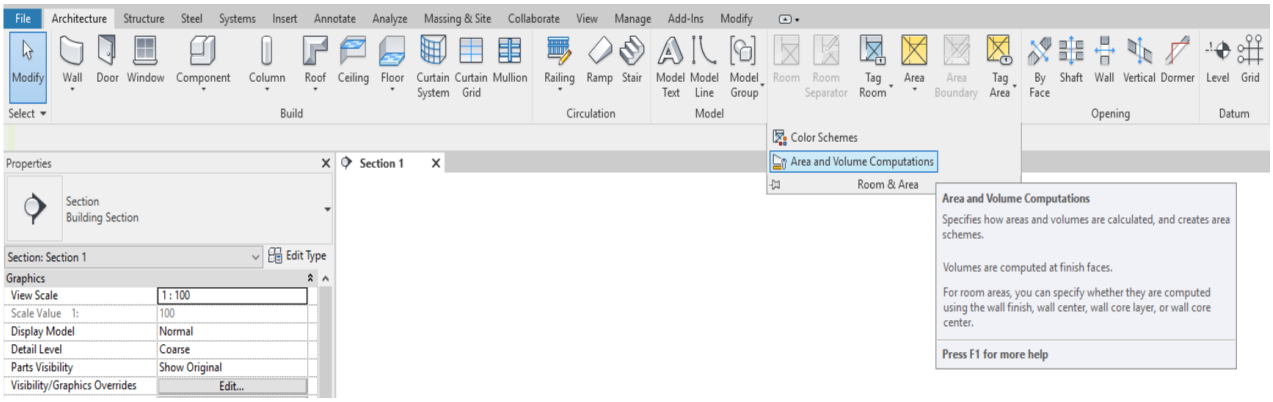
2. Adjusting the upper room boundary to the lower edge of the upper slab.

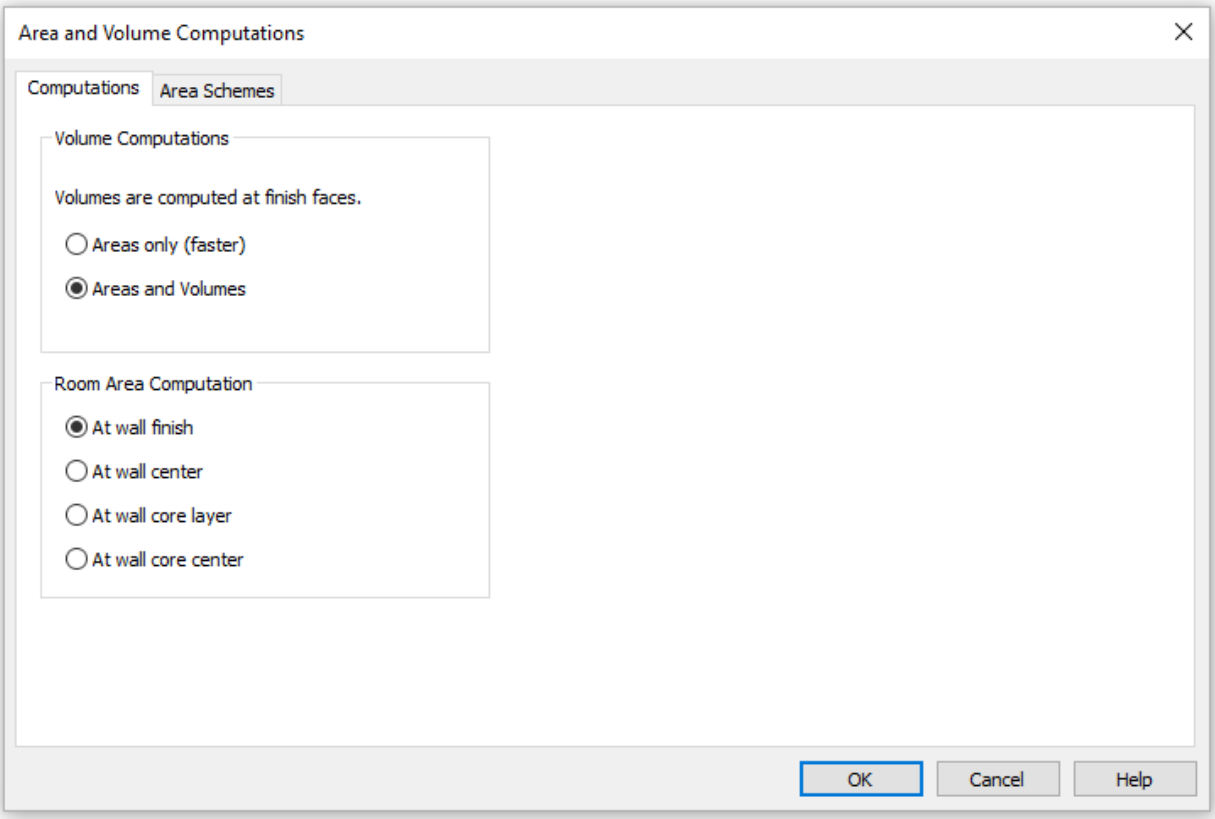
Currently, Revit's IFC 4 exporter has limitations when exporting rooms bounded by floors and ceilings. As opposed to IFC 2x3, it is not able to correctly "trim" the shape of the room with its horizontal bounding elements. This means that after exporting the IfcSpace will ignore its clash with the slabs. Therefore, to ensure that the volume of the room is correct when exported to IfcSpace, a higher negative offset equal to the thickness of the slab must be entered. This consideration is only necessary for the development of thermal and acoustic studies.



3. Checking that the volume of the rooms are being computed.

To guarantee that the areas and volumes correctly export to IFC, it is advisable to go to **Architecture > Room and area** and click and open the dropdown menu **> Area and volume computations**. Once you have accessed the area and volume computations menu the “areas and volumes” and “at wall finish” options should be marked.

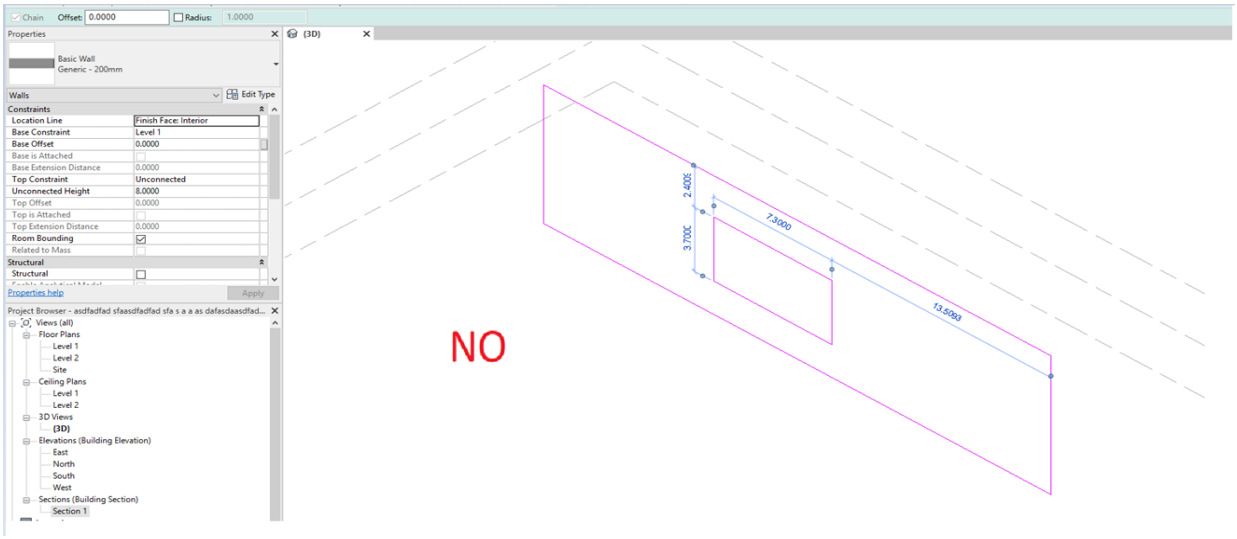




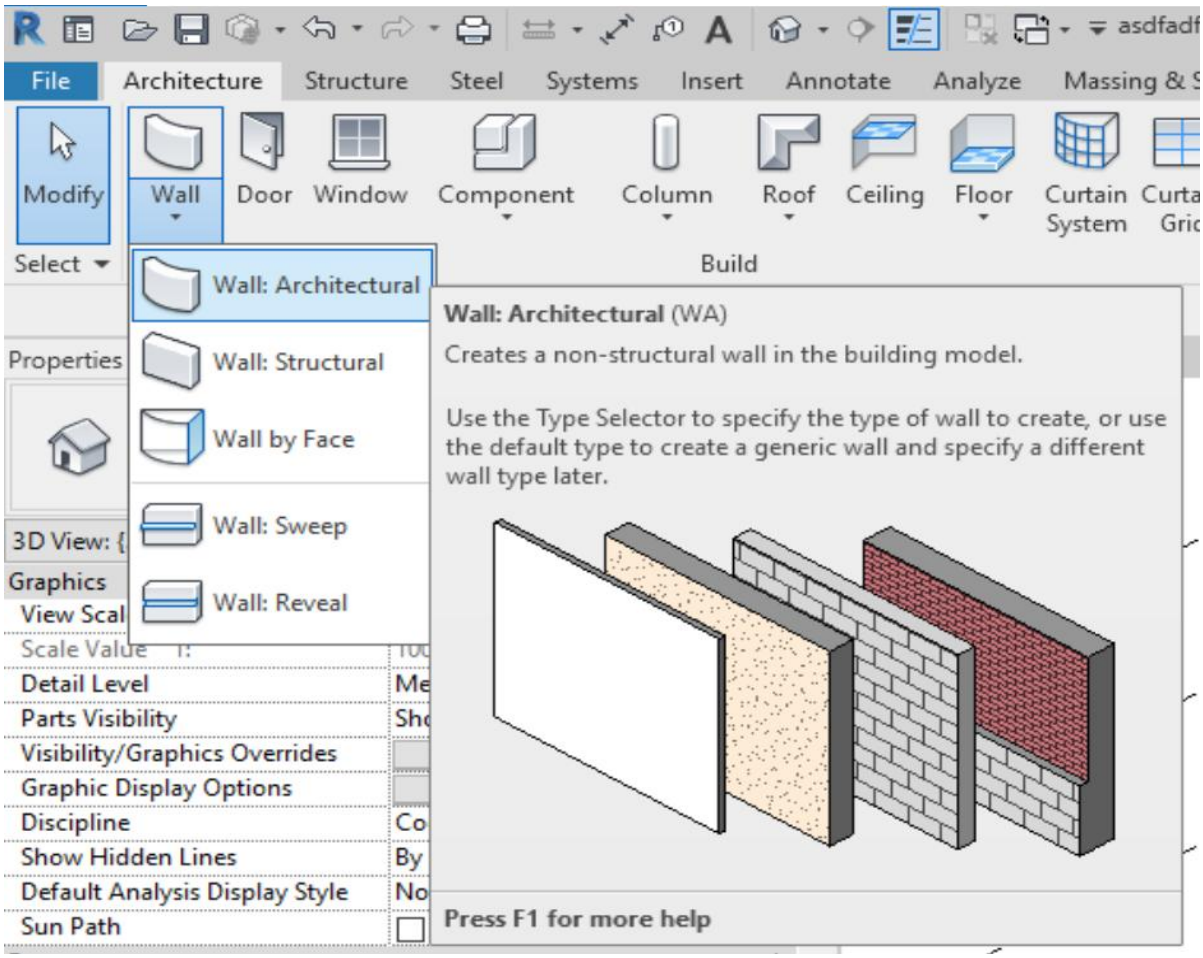
4.4 Walls

It is advisable to observe the following guidelines to ensure that the walls are correctly exported from Revit to IFC and that the entities are legible by CYPE software.

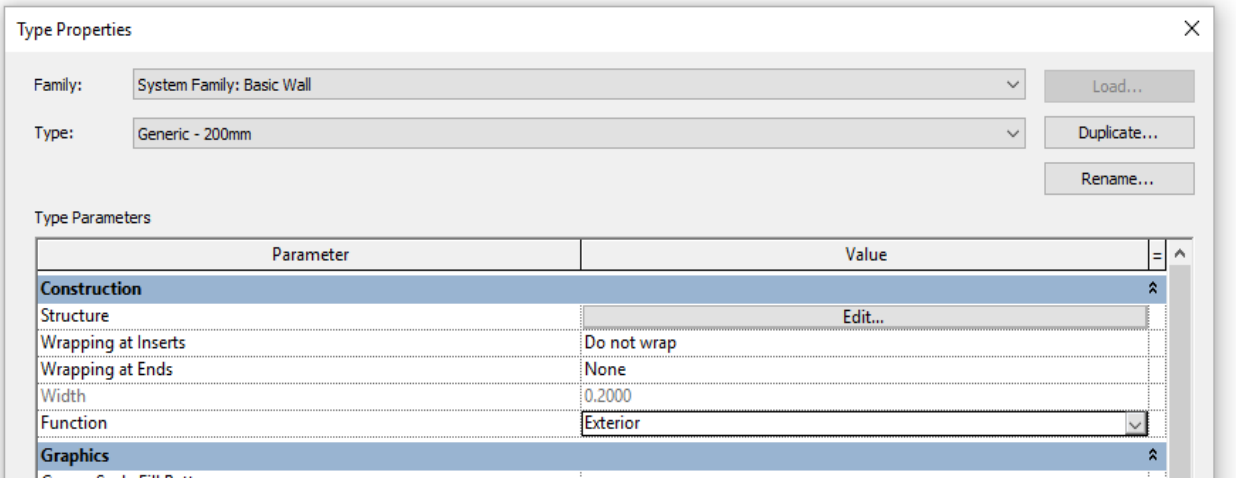
1. The use of upper and lower constraints for slabs and roofs, avoiding the modification of the wall profile sketch.
2. It is recommended that the walls **go from level to level and that there is a wall per floor**. This is especially important when exporting to modelling programs like CYPECAD MEP or IFC BUILDER. Otherwise the results of the import in these programs may be unpredictable.
3. The use of the **wall opening by face** tool instead of drawing openings in the sketch of the wall.



4. It is imperative that the walls are a single integral element in layers- as is outlined in Autodesk's official documentation. It is not recommended to work with exported models where each wall layer has been modelled as a separate and independent wall type/instance.
5. It is preferable to create linear walls instead of walls by face. If the export is carried out to non-modelling programs (like CYPECAD MEP or IFC BUILDER), it will also be possible to export more complex walls, with the limitations inherited from Revit's IFC exporter developed by Autodesk.



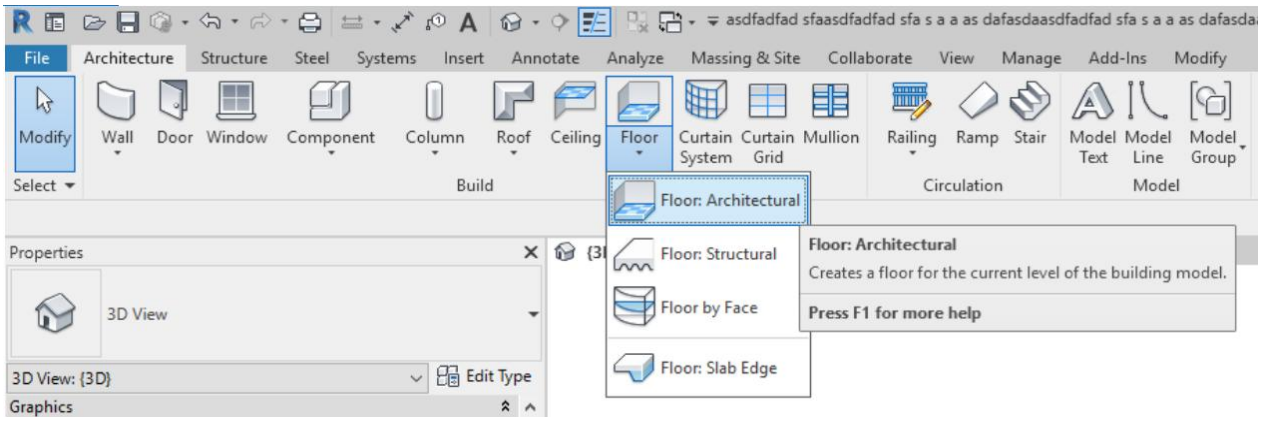
6. The correct definition of the **function** type parameter (exterior/interior**)** of all the walls according to whether they are enclosure or partition walls (for thermal or acoustic analysis programs).



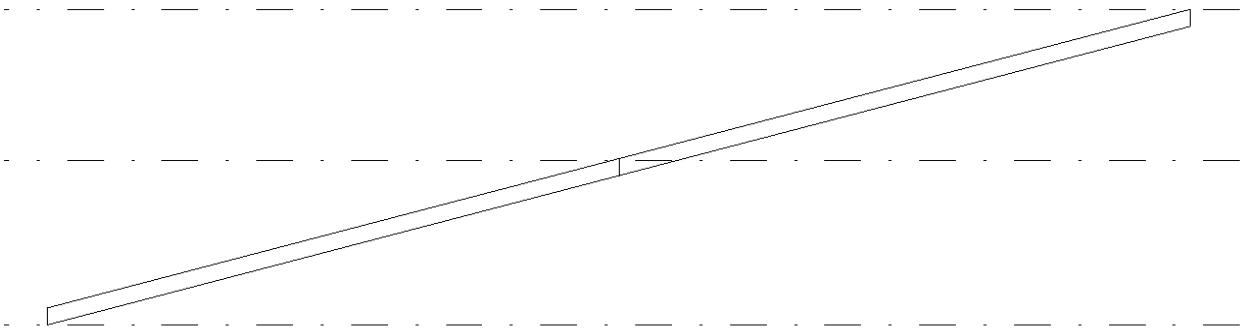
4.5 Floors

The floors are usually defined by perimeter. As with walls and roofs, it is best to model trying to obtain shapes that can be generated in IFC by simple extrusion. To this end, it is recommended to:

1. Use the floor by definition of boundary lines instead of “floor by face”, although the last option will also be possible in non-modelling programs.



2. Avoid sloped floors that exceed levels. In this case it would be advisable to create an independent sloped floor in each level, with the meeting points of the floors being at the upper and lower edges of the respective levels. This is especially relevant when exporting to modelling programs such as CYPECAD MEP or IFC BUILDER.



3. It is recommended to avoid the use of modifications of sub-elements to create slopes, since this could compromise the geometric condition of the parallelepiped floor. Instead, for sloped floors the definition of the family’s inherent slope arrow is recommended.

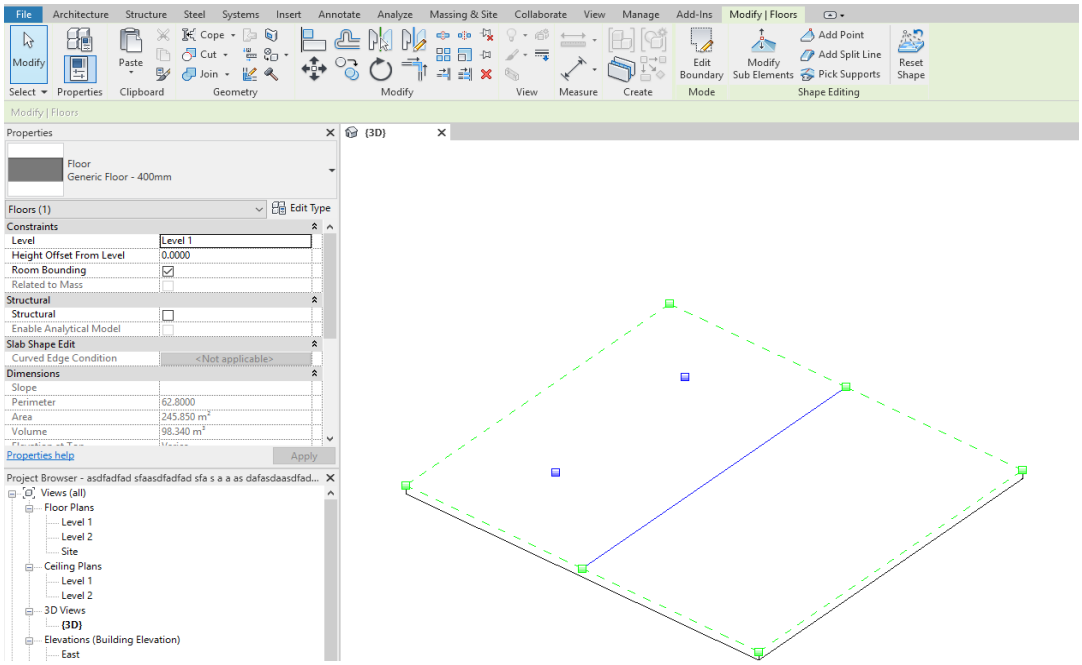
4.6 Roofs

For the same reasons stated in previous sections, it is important to model in such a way that the IFC file can read the entities as simple extrusion profiles.

To this end and to optimise the best communication between programs, it is recommended to employ, as much as possible, the following modelling practices:

In general:

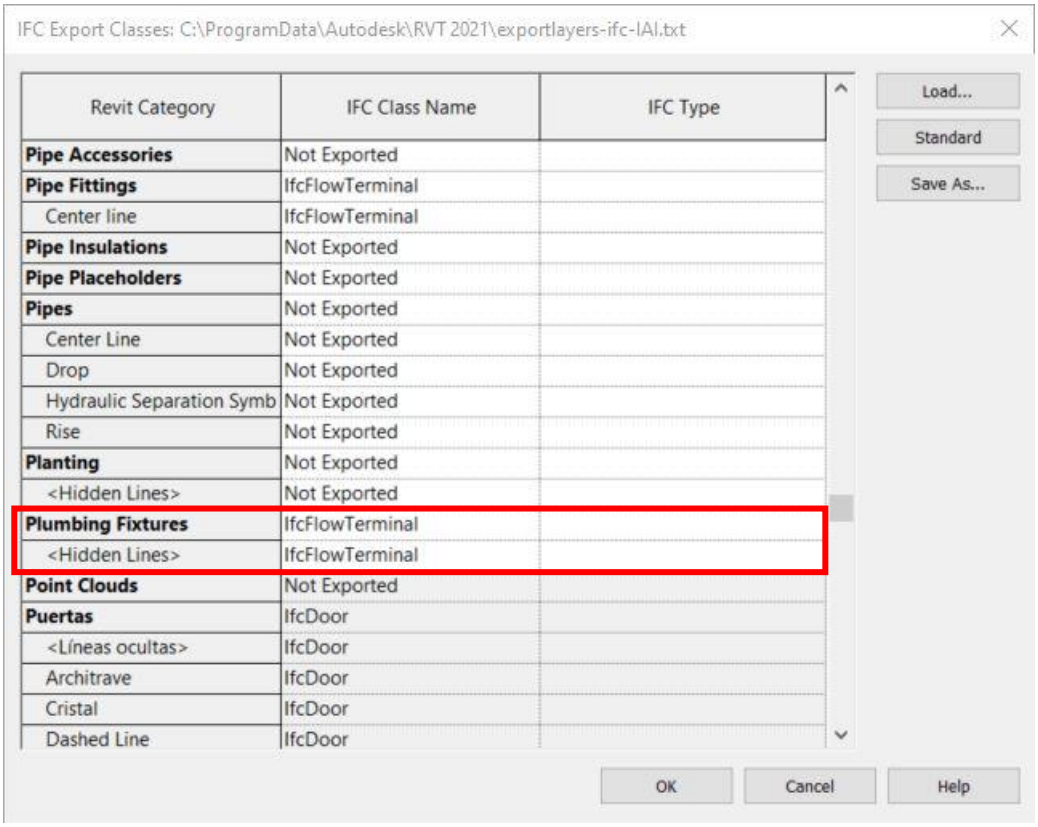
1. Create the roofs from the “Roofs” group and not from the “Floors” group. This will allow thermal/acoustic analysis programs to be able to distinguish between both elements and correctly carry out the analyses.
2. It is recommended to create roofs by footprint and not by extrusion.
3. Associate the roofs to levels to be exported, avoiding gaps as much as possible.
4. Sub-elements defined to divide hips or to simulate the evacuation slopes into flat roofs will not be considered. This slope entered in Revit is not considered as useful data for further calculations and analysis.
5. When exporting to modelling programs such as CYPECAD MEP or IFC Builder, sloped roofs must not exceed levels (e.g. placing the base at level 1 and the roof ridge at level 3); ideally, they will be contained within the same level (base at level 1 and roof ridge at level 2). Otherwise their relationship with the walls linked to them will be unpredictable.



4.7 Plumbing fixtures

The plumbing fixtures are a fundamental part of the architectural model, the reading of which is essential in order to be able to carry out the analysis and modelling of hydraulic installations, as well as other discipline installations such as the shower or bath zones to locate the electrical outlets in the bathroom.

For this reason, when exporting from REVIT using the plugin, each plumbing fixture must be differentiated. In this case, REVIT does not consider this option in its IFC export settings. For example, in REVIT the plumbing fixtures are all the same when exported in addition to them being assigned an incorrect IFC entity, and no distinction is made beyond this category:



Revit Category	IFC Class Name	IFC Type
Pipe Accessories	Not Exported	
Pipe Fittings	IfcFlowTerminal	
Center line	IfcFlowTerminal	
Pipe Insulations	Not Exported	
Pipe Placeholders	Not Exported	
Pipes	Not Exported	
Center Line	Not Exported	
Drop	Not Exported	
Hydraulic Separation Symb	Not Exported	
Rise	Not Exported	
Planting	Not Exported	
<Hidden Lines>	Not Exported	
Plumbing Fixtures	IfcFlowTerminal	
<Hidden Lines>	IfcFlowTerminal	
Point Clouds	Not Exported	
Puertas	IfcDoor	
<Líneas ocultas>	IfcDoor	
Architrave	IfcDoor	
Cristal	IfcDoor	
Dashed Line	IfcDoor	

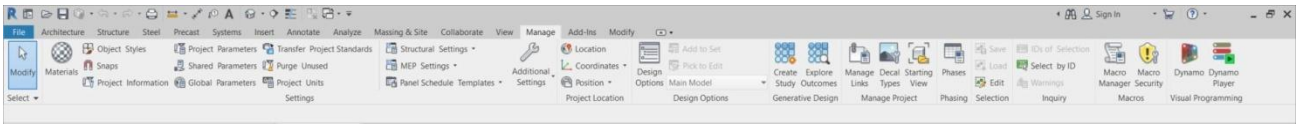
Therefore, the user will be responsible for assigning the distinction between the plumbing fixtures by creating two shared or instance project parameters, which will have priority over the IFC export settings, and are the following:

- IfcExportAs
- IfcExportType

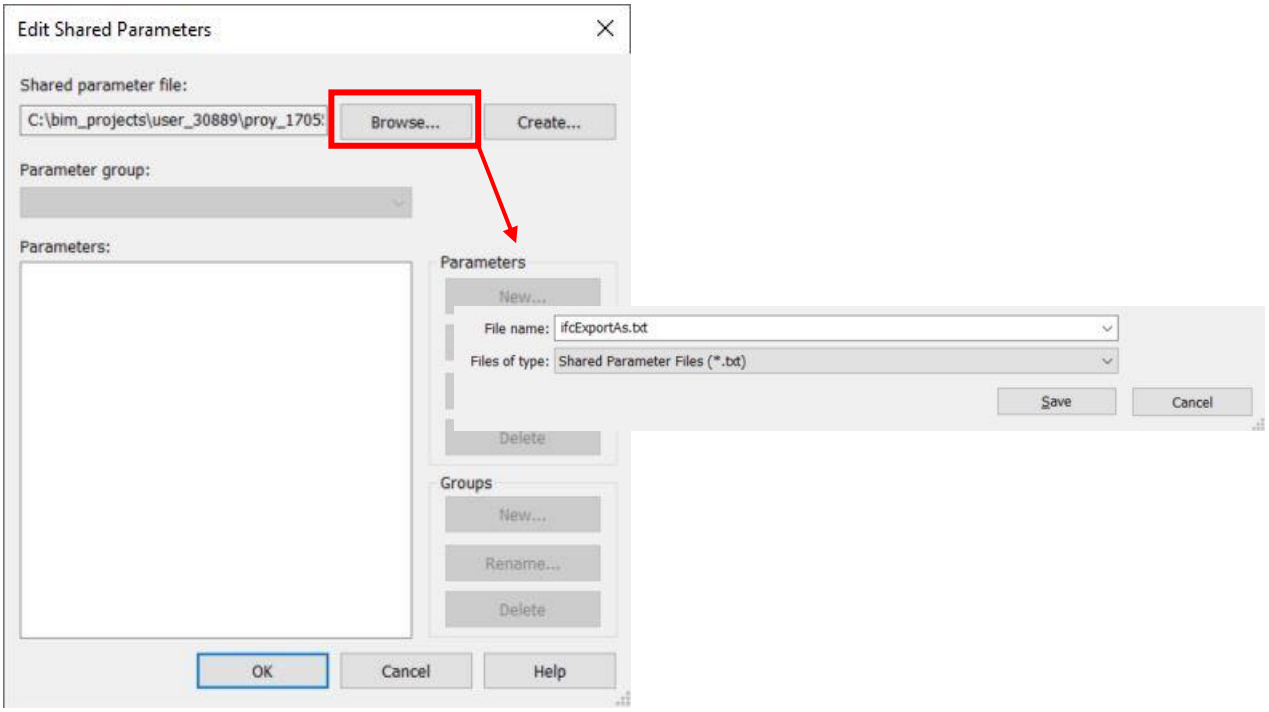
The first one will define the IFC entity whilst the second will define the IFC type.

The difference between project parameters and shared parameters is that project parameters only appear in the project being used whilst shared parameters can be assigned to various projects.

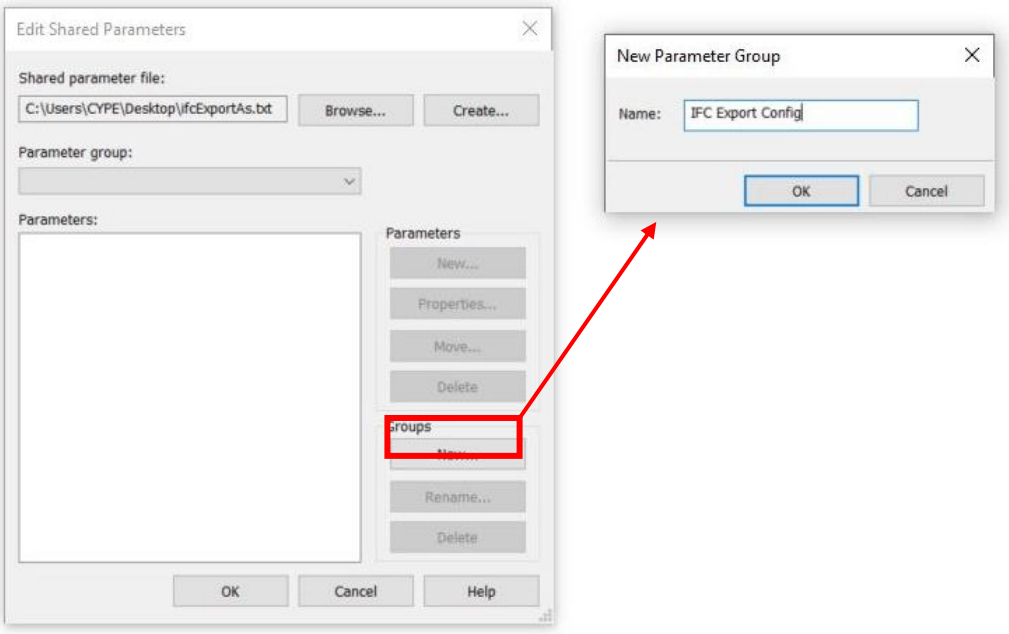
To create these parameters, in the REVIT program go to the top browser in the Management tab and in the Configuration area click on the shared parameters or project parameters button:



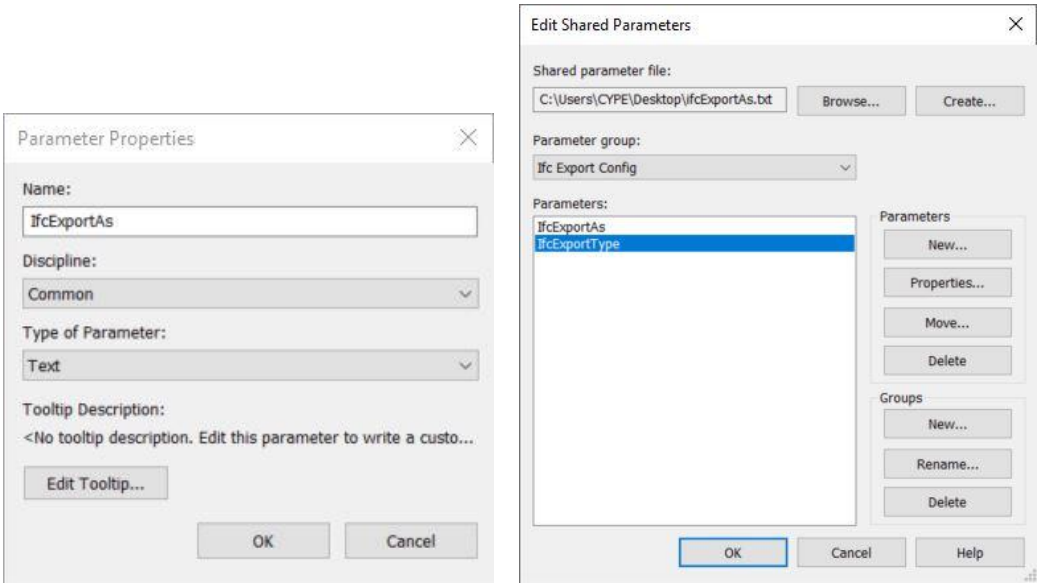
Next, follow the steps for shared parameters . Once you have clicked on the shared parameters button, you will have to create a group of parameters in the pop-up window otherwise you will not be able to create the shared parameters. This group is given a name by the user. In this case it will be called IfcExportAs:



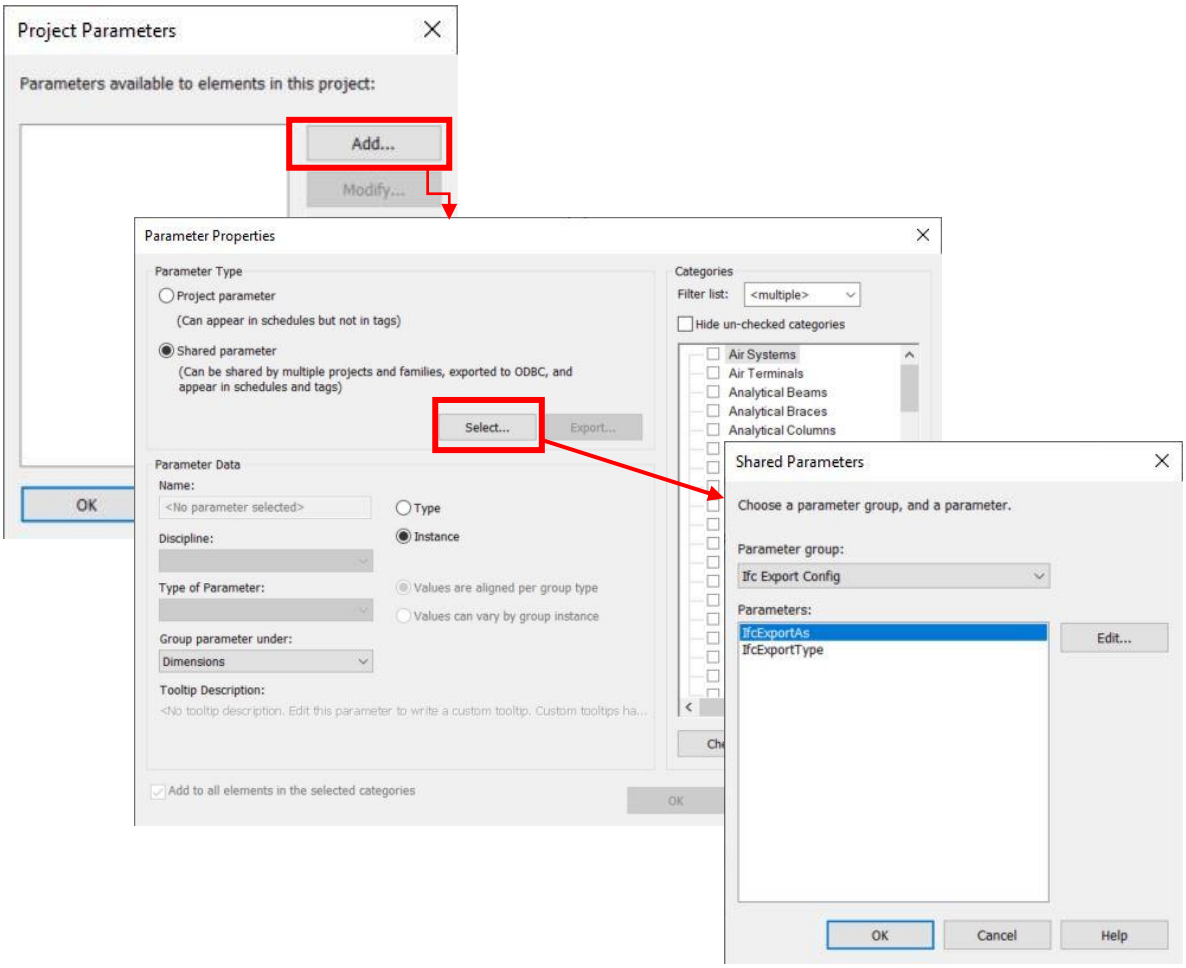
Once this has been done, create a new group:



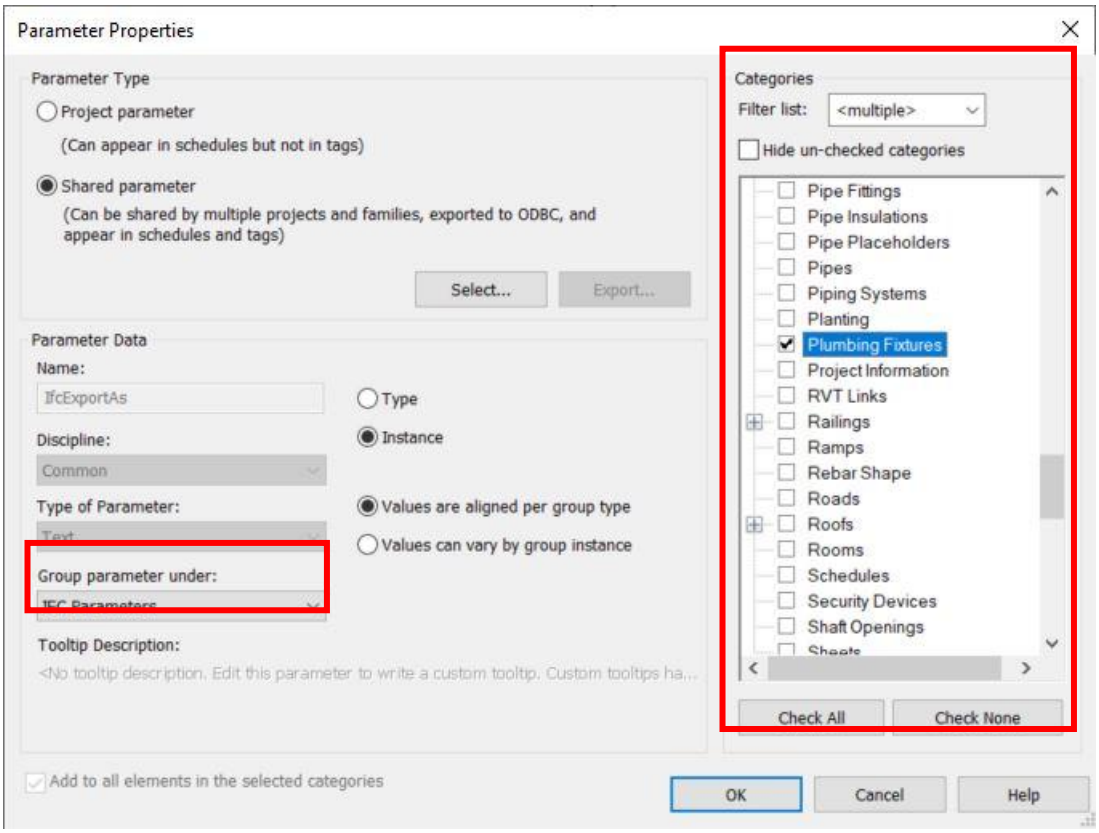
This now allows the necessary parameters to be created. These will be text type parameters:



Once these parameters have been created, go to the project parameters and add them:



These parameters are instance parameters that will be grouped into IFC parameters and applied to the family categories to be exported by specifying more than what is included in the IFC export configuration, such as the plumbing fixtures for example:

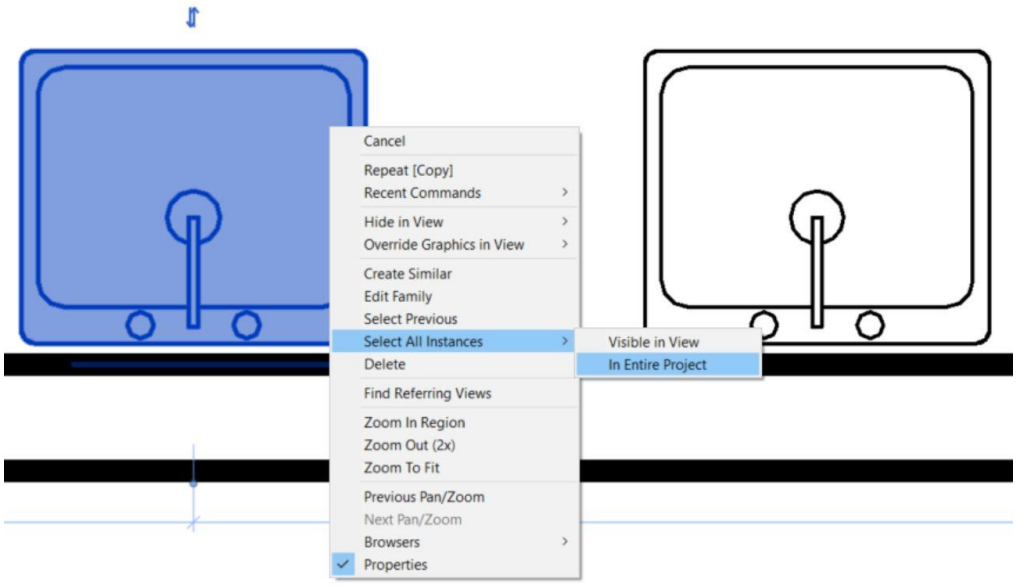


Once the parameters have been created, both the IFC entity and the IFC type must be assigned to each of the hydraulic elements. The entities and types for the different plumbing fixtures are defined in the IFC standard:

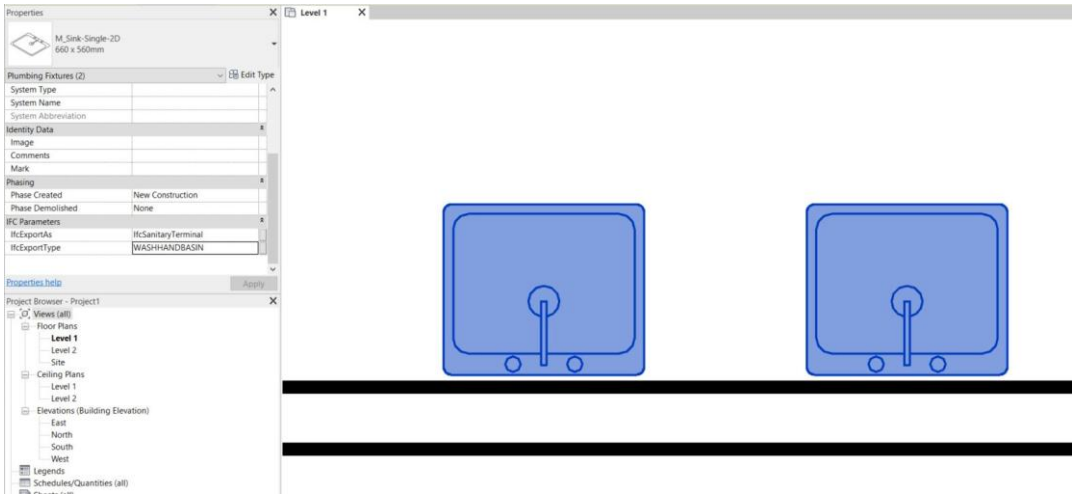
	Entity IFC	Type IFC
Wash basin	IfcSanitaryTerminal	WASHHANDBASIN
Toilet	IfcSanitaryTerminal	TOILETPAN
Shower	IfcSanitaryTerminal	SHOWER
Bath	IfcSanitaryTerminal	BATH
Bidet	IfcSanitaryTerminal	BIDET
Sink	IfcSanitaryTerminal	SINK
Washing machine	IfcElectricAppliance	WASHINGMACHINE
Dishwasher	IfcElectricAppliance	DISHWASHER

It is very important to enter the entities and types with the corresponding capital and lower case letters.

Finally, as this is an instance parameter, it will have to be entered element by element. As a quick solution, since in a project there are many elements that are the same, by right clicking on one of them and clicking select all instances in the whole project, all the elements of the same type can be selected at the same time:



Once selected the two parameters will be filled in:



Once all of the plumbing fixtures have been defined, by exporting them they can be read by all programs that require it, such as the CYPEPLUMBING programs (Water Systems and Sanitary Systems), among others.

4.8 Links

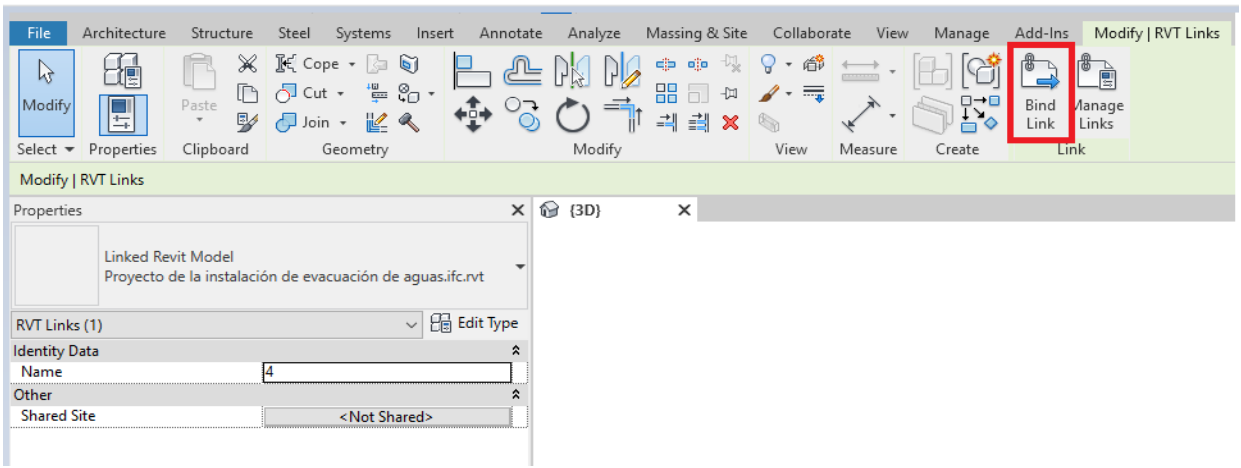
One of the limitations of Revit's IFC exporter is the export of links to IFC.

The exporter has many problems with the geolocation of links (correct export when coordinates are referenced to the Reference Point), and their correct relative positioning if they are moved or rotated. As for links where symmetry has been applied it does not even work.

Therefore, the best way to guarantee a correct and stable export if the project shares Reference Point Coordinates will be to bind all the links that you want to bring to IFC and export the unified project. This can be done in a separately saved temporary file whose purpose is the correct export to IFC. To attach, select the link and click on **Modify > Link > Bind**.

The **binding** of all the links can be difficult at times, since large projects can contain a great number of objects and geometry and Revit is not capable of supporting many elements simultaneously due to excessive RAM usage. In these cases you must be bear in mind that the important thing is not to transfer the whole model to IFC but only the elements relevant to what you want to achieve. It is therefore recommended to delete all categories that do not serve this purpose, optimising the file's entities and being able to finally carry out the binding of all the links.

In the case of other types of shared coordinates they can be exported and the plugin will unify all Revit links in a single IFC.

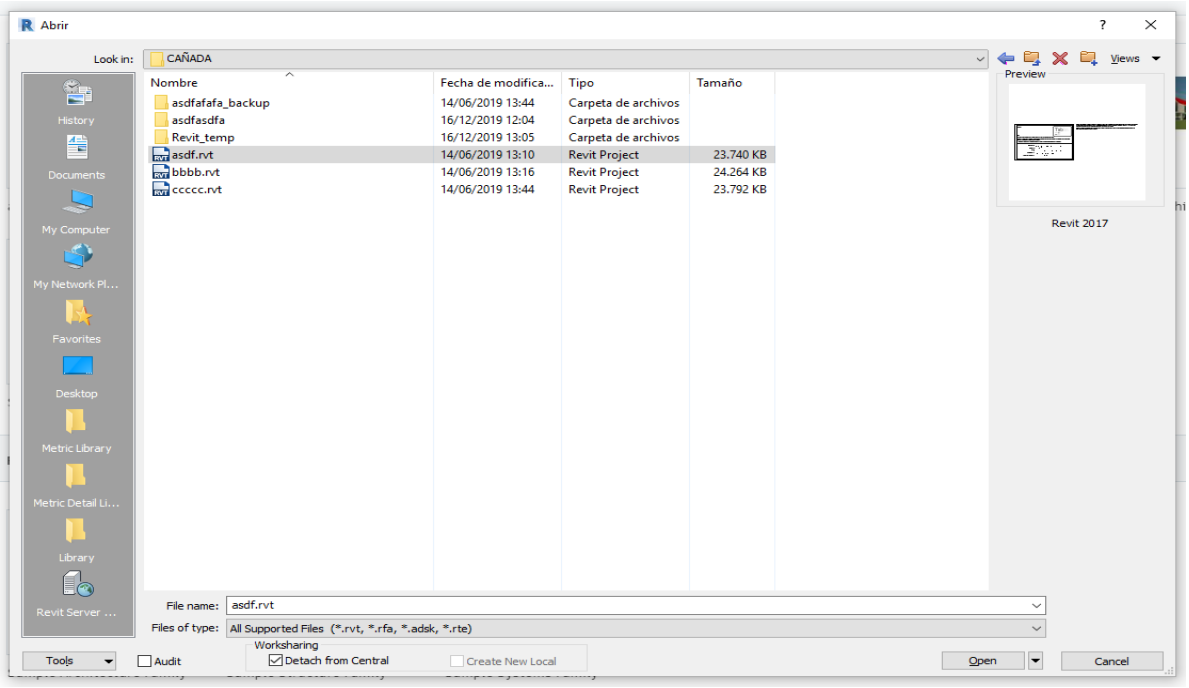


4.9 Central and local models; worksets

In the case of models where collaboration between users is taking place, it is possible to export to IFC from any of the project's local files. However, in order to avoid possible issues and errors with Revit's IFC exporter due to the user's ownership permissions for the worksets where the entities to be exported are located, a good practice is to create a temporary copy of the local file that is detached from the central file. This can be done by opening the file from Revit's file opening manager, where the box "detach from central" must be checked. Ideally, the worksets will also be discarded.

This temporary file will be needed only when exporting, and it only needs to be created once. Once the IFC file has been exported with the necessary entities and the correct import has been checked in the corresponding specific CYPE applications, the temporary detached .rvt file can be deleted. It is important to carry out the export with the free CYPE for Revit PLUGIN and following all the guidelines in this guide to guarantee an optimal interoperability.

To integrate the information generated in CYPE tools into the workflow of teams that work collaboratively in Revit, simply create new IFC files from those specific applications containing the necessary technical information and code justifications, which can then be linked back to Revit from any of the local files using the "Link IFC" tool within the corresponding worksets. Changes made in the CYPE applications will be synchronised when the linked IFC files are overwritten and their updated information is transferred to the central model.



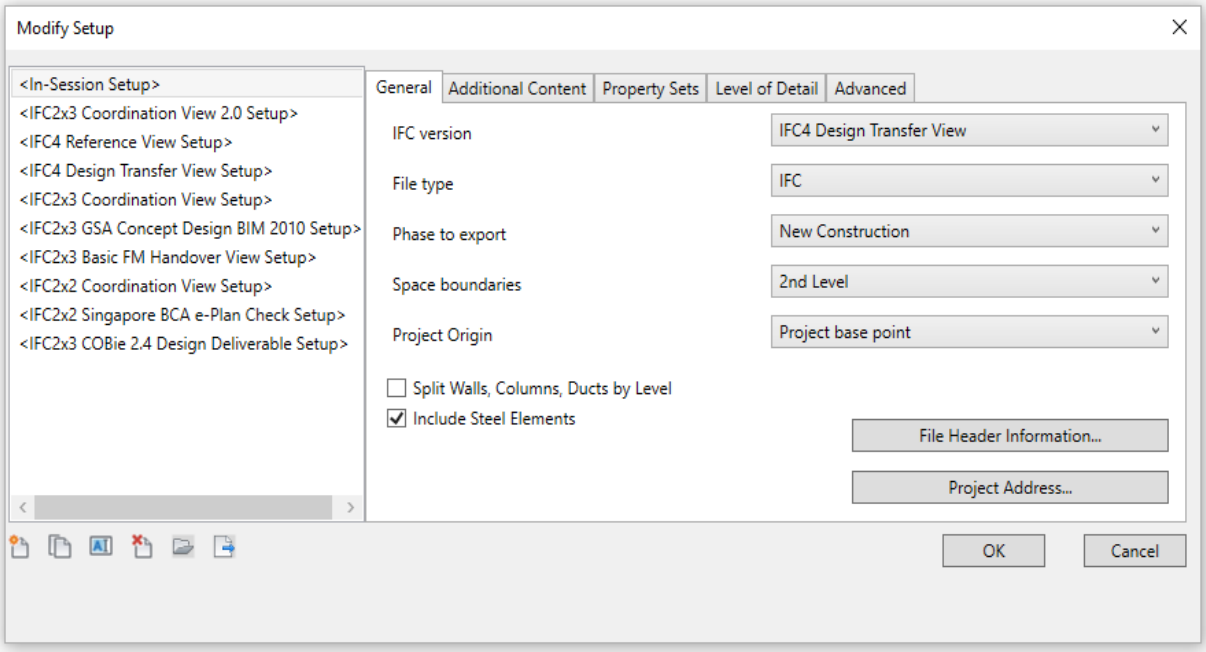
4.10 Origin, base and survey points

In Revit there are three origin or reference points: the origin point (invisible and linked to the survey point, the real centre of the file), the base point (circular, local project centre) and the survey point (with a triangle symbol, global centre of the project)

This is especially important when working on projects that contain linked files, as it is very easy for such files to be moved from their federated position in the export process. This is one of the biggest limitations of Revit's IFC exporter.

In general, it is best to export using the survey point in order not to lose the georeferencing of the model. However, due to the limitations of Revit's native exporter this guide recommends using the survey point if linked files exist.

The other solution is to connect all the links when exporting (in a temporary file whose sole purpose will be the generation of the IFC) and to also export from the survey point. Otherwise the federation of the linked models will be compromised, and it is very likely that they will move from their correct position in the export process.

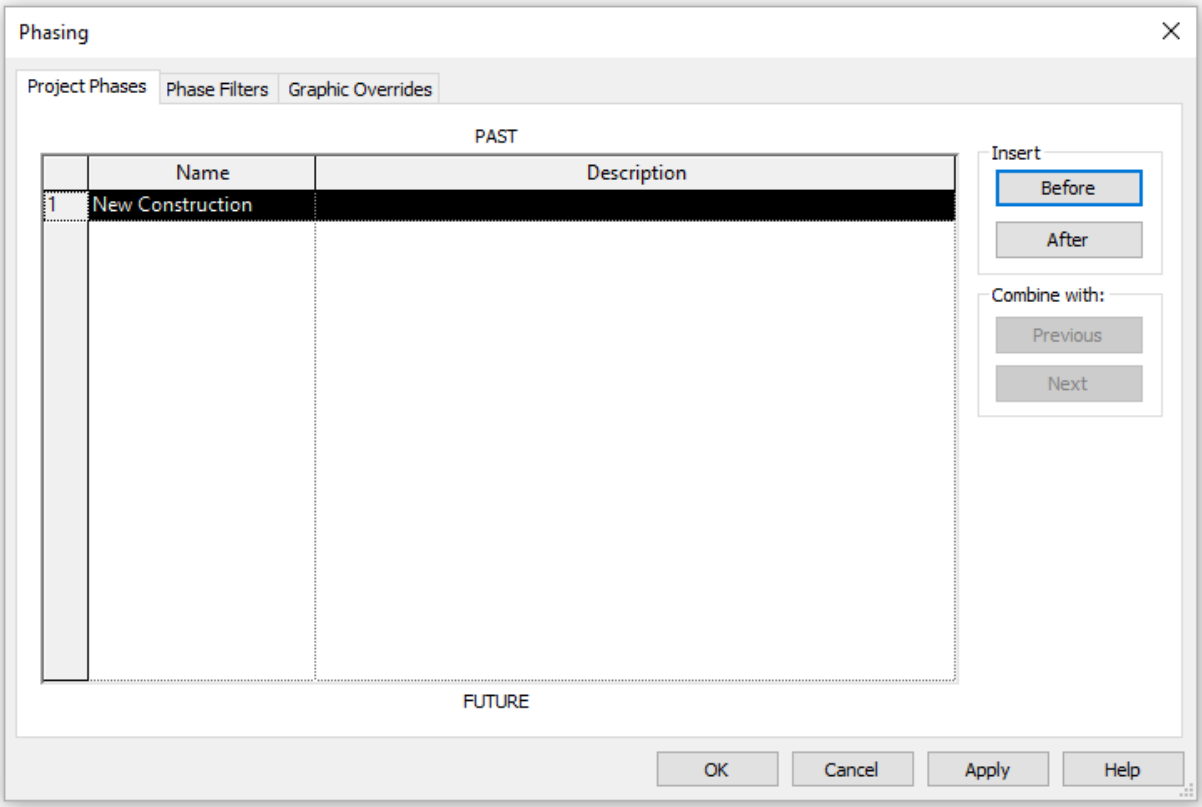


4.11 Phases

One of the limitations of Revit's IFC exporter is that it only allows one phase to be exported at a time. In any case, the phases will not be relevant for CYPE's calculation and analysis programs, and as such, the best and most stable way to export to IFC will be to delete the phases that contain elements that are not needed, and to connect the phases that do, leaving the project with just one phase. This can be done in **manage> phases**.

When connecting phases it is important to check that no element information is lost – in particular, the rooms – and that in the Energy Settings and Revit's IFC Exporter (point 3.1.16), the chosen phase is selected.

This would only need to be done when exporting to IFC. In order to not lose project information, this can be done by previously saving the file in a temporary parallel copy that will only be used for export. At the end of the process we will be able to bring to Revit the different analysis IFCs generated with CYPE programs, and assign the linked IFCs to their respective phases.



5 Structures

5.1 Structural analysis with CYPECAD

Revit's communication with CYPECAD will allow us to take advantage of some of the information developed in Revit for the analytical definition, structural analysis and automatic generation of the justification report. Furthermore, it will be possible to consolidate the information in BIMserver.center or in Revit via IFC.

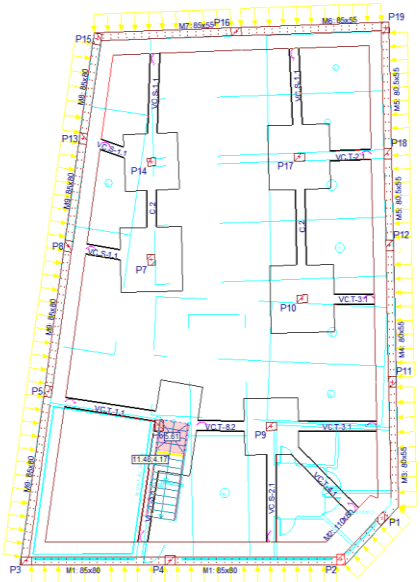
For good communication between Revit and CYPECAD it will be necessary to:

1. Model the **columns** as structural and architectural columns. The columns will be exported as IfcColumn, which CYPECAD is able to import as native columns.
2. Model the **slabs** as Floors, which will be imported as boundaries that can be converted into native CYPECAD slabs at the click of a button.

In CYPECAD the structural elements can be defined in detail (beams, columns, slabs) with their respective characteristics, as well as the forces exerted on the structure.

For an optimal communication between Revit and CYPECAD, this should be done using the free Open BIM for Revit plugin.

Once the calculation has been completed the file can be exported from CYPECAD to IFC, which will contain the geometry, analysis data and justification report. Moreover, you will be able to obtain automated rebar plans for all the concrete elements in DWG format.

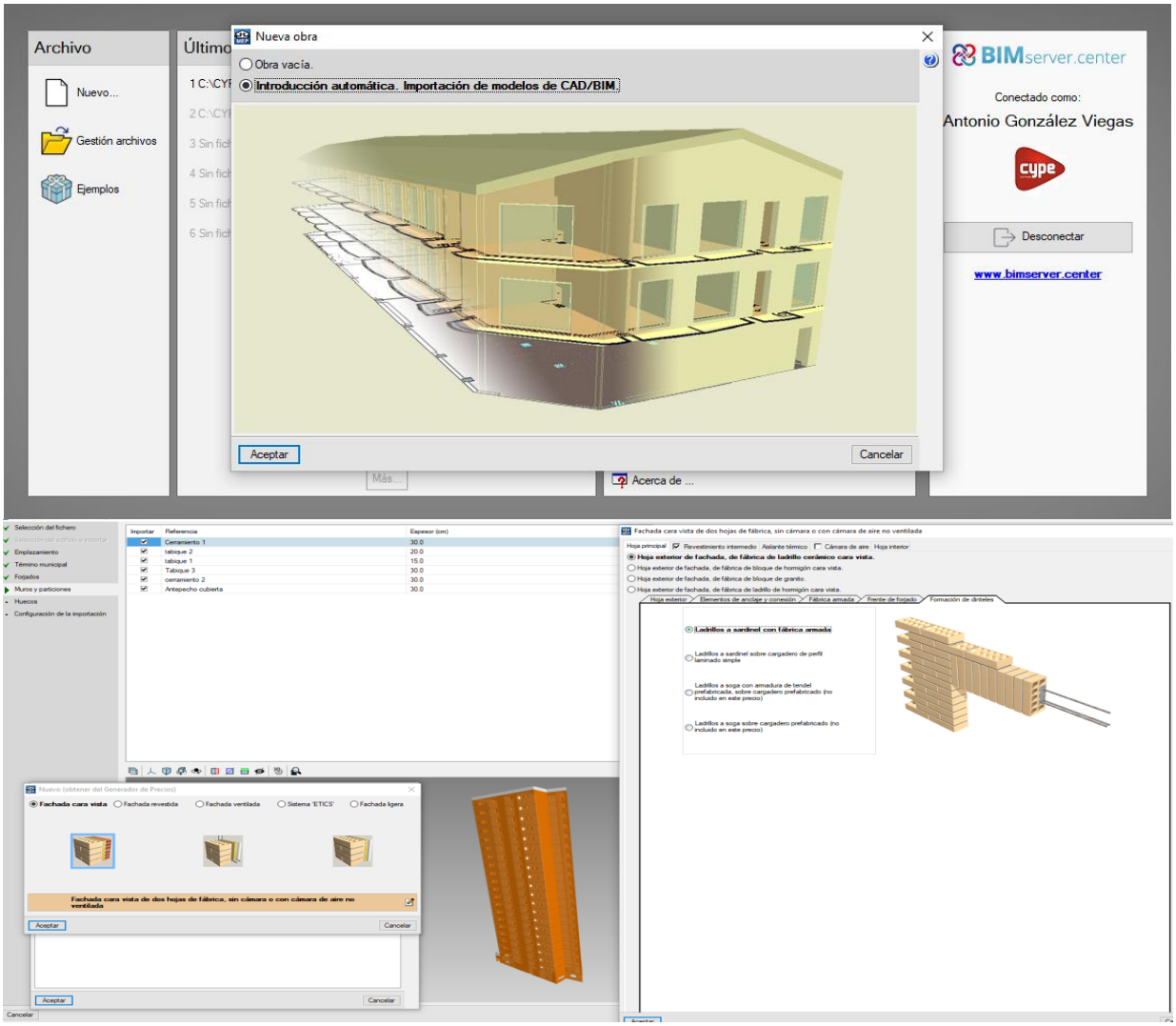


6 Installations

6.1 Analysis of general installations

It is common to work with the CYPECAD MEP tool to calculate small or medium sized installations and automatically justify specific code checks. From this program all of the code check sections related to energy efficiency, noise protection, fire, plumbing, sanitation, HVAC, solar thermal, lighting, electricity, telecommunications and lightning conductors will be able to be resolved.

By exporting to IFC with the free Open BIM plugin for Revit and then importing the IFC by searching in the local folder **C: > bim_projects > project folder > IFC**, you can quickly redefine all the construction elements of the project and automatically generate all the required calculations and justification reports.



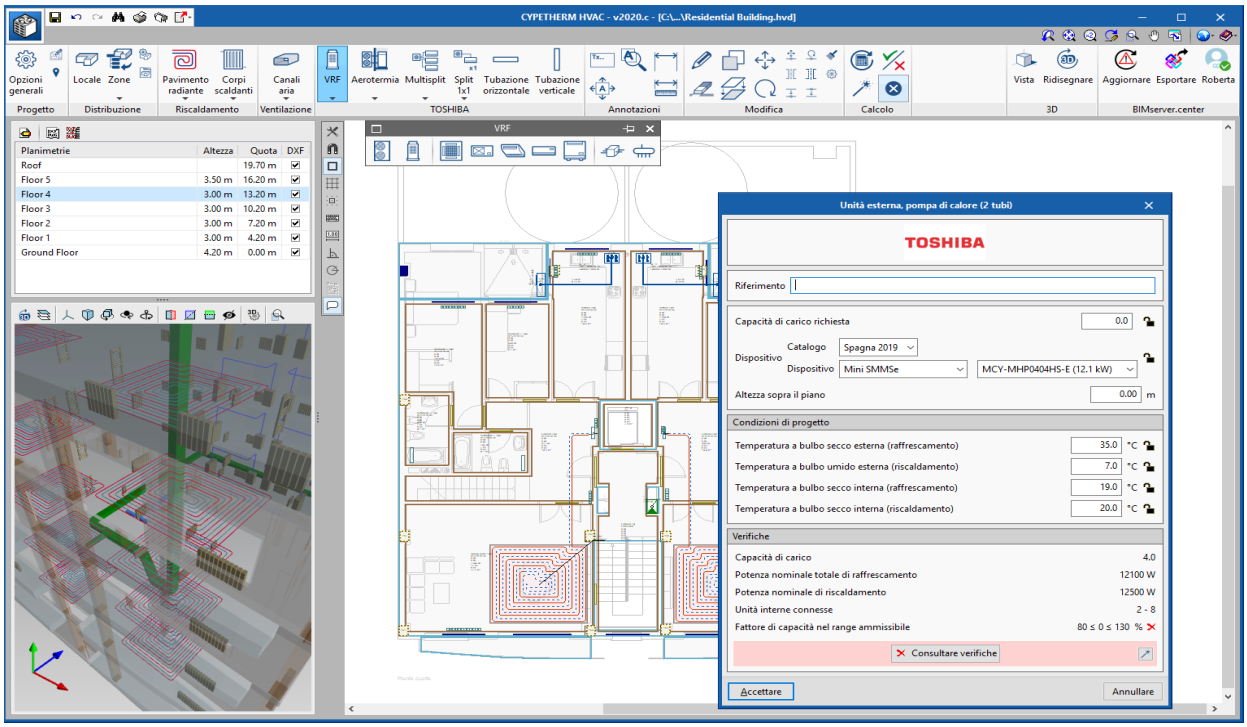
6.2 Analysis of editable installations

The new applications that CYPE is developing, integrated into the Open BIM workflow, extend the possibilities of CYPECAD MEP whose approach is more general. They offer the designer and engineer design tools that reach higher levels of detail and definition in installations of energy efficiency, fire protection, plumbing, waste water, electricity, HVAC, noise protection, etc.

Many of these applications have been custom-designed with particular products from specific manufacturers and allow users to analyse specific systems with automatic justification of the corresponding codes that apply. Furthermore, the decentralisation of disciplines into more sophisticated applications makes it possible for several users to work collaboratively on the same project – with cloud synchronised tools for tracking changes, coordination of disciplines, clash detection and multiplatform augmented reality.

The communication with these applications is similar to the case of structures – using the free Open BIM plugin for Revit. Simply export the architectural elements and the spaces with their respective IFC Classes in order to be able to analyse the corresponding installation.

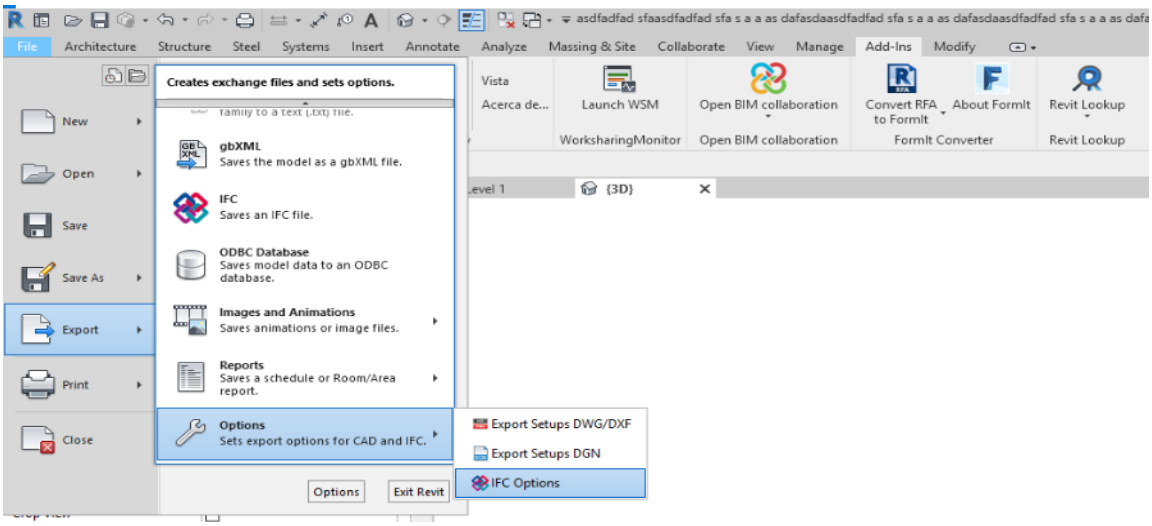
Once the calculations have been carried out, they will be updated in BIMserver.center, where you can continue developing the project alone or collaborate with other users, or consolidate the information back into Revit.

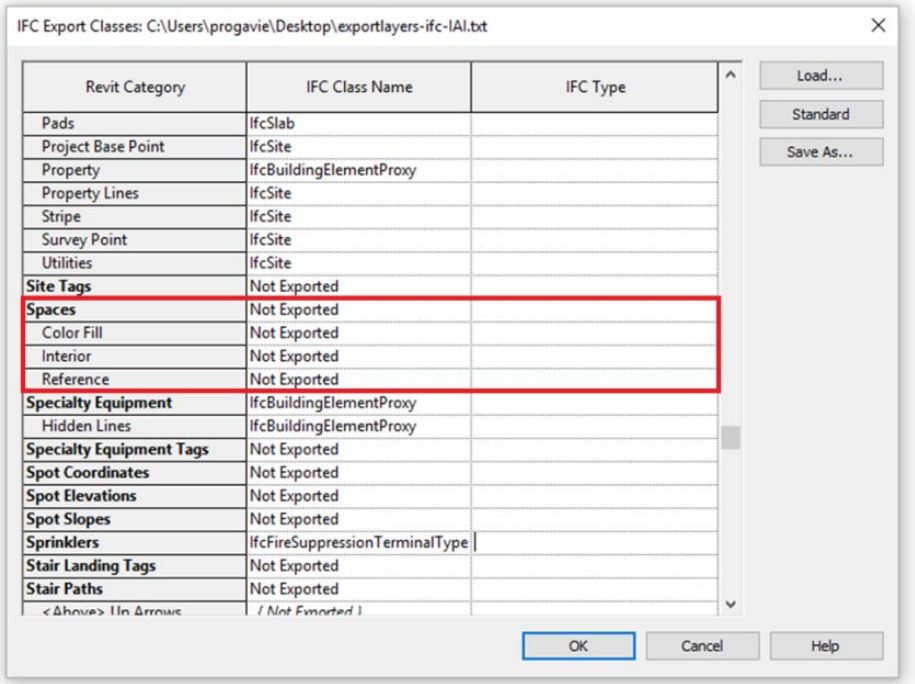


7 Energy analysis

7.1 Spaces

Revit spaces are also exportable entities to IfcSpace meaning that both rooms and spaces in Revit can be worked with and exported to IFC in the same way. In any case, if both entities exist in the project it must be ensured that there is no overlap in the exported IFC; that is to say, the mapping sheet must be configured so that the spaces are not exported. To do this, go to **File > Export > Options > IFC Options**, and write "**not exported**" in the boxes referring to the spaces.



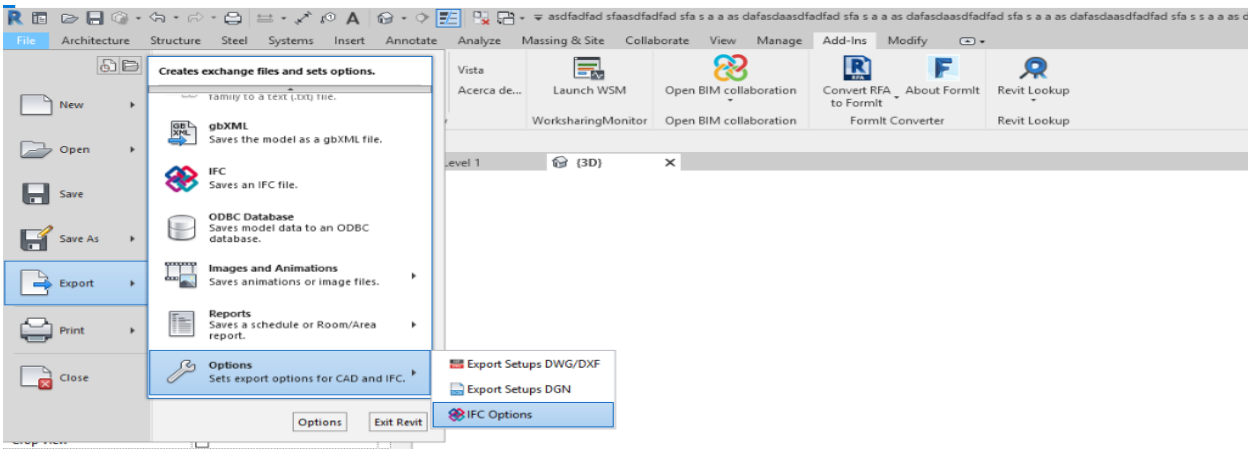


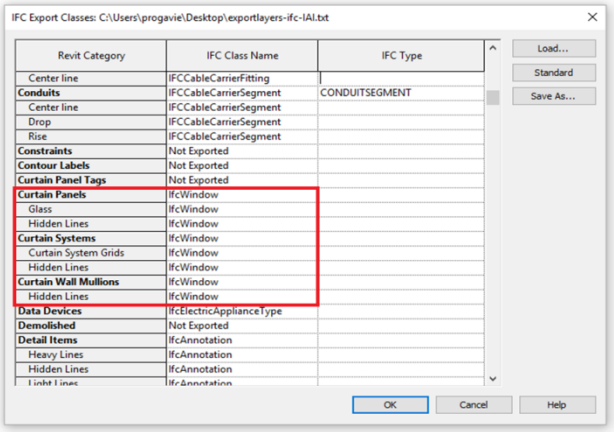
7.2 Curtain walls

For curtain walls everything described for normal wall families will apply. Additionally, for correct reading and analysis in CYPE software, the following needs to be taken into account:

In general:

In the case that you want to export to analysis and calculation tools only (e.g. CYPETHERM or CYPELUX): in the export mapping table to IFC entities, the curtain walls (curtain wall systems, curtain wall panels and curtain wall mullions) must be exported as IfcWindow and not as IfcCurtainWall, as is the default setting.



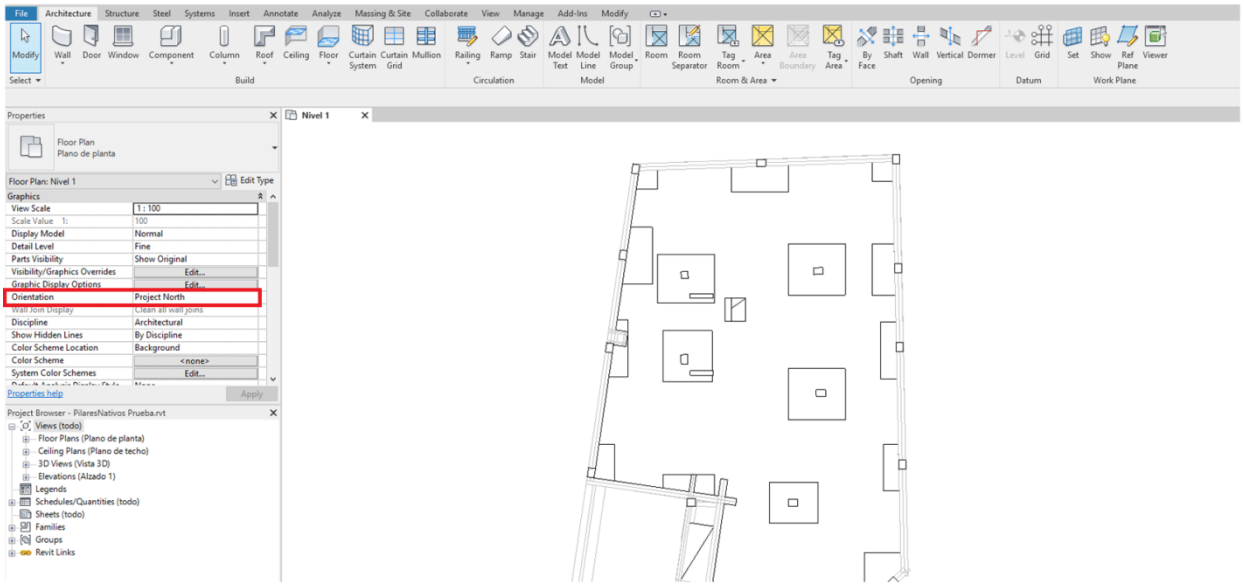


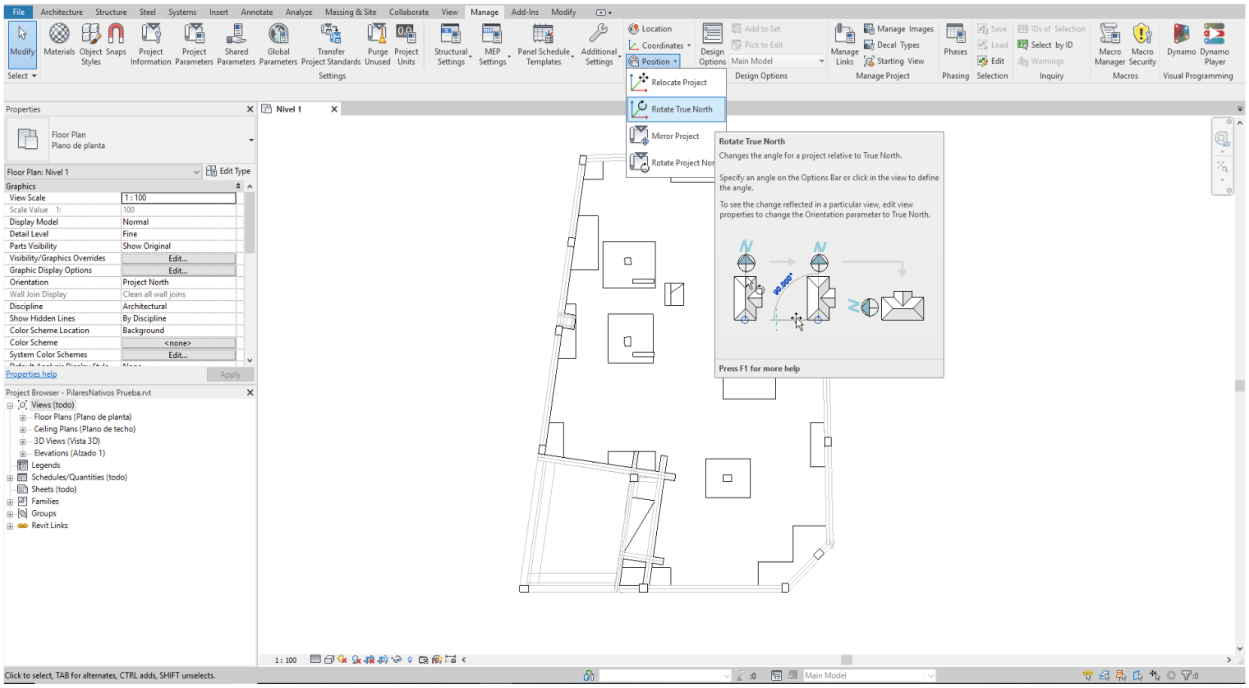
Exportating to other modelling programs:

When exporting to other modelling programs such as CYPECAD or IFC BUILDER, Revit does not allow the curtain wall generation system to be exported to IFC as an importable and geometrically editable element. It will be necessary to convert the curtain walls to normal walls and to create window families in them that go from the floor to the roof, similar to the curtain wall that was planned.

7.3 North of the project

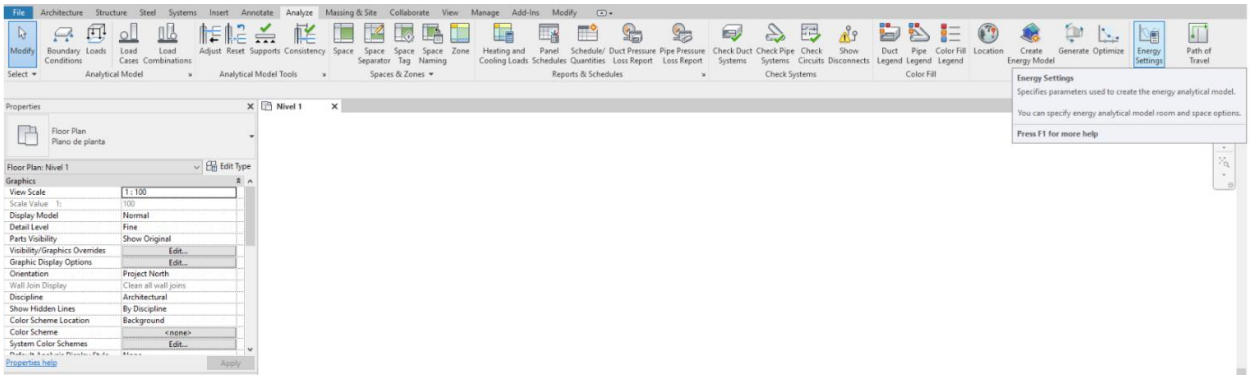
It is possible to establish the orientation of the project directly in Revit. To do this, go to any view of the floor and in viewing properties select **Orientation > True north**. Next, go to **Manage > Position > Rotate true north** and the geographic orientation of the project can be defined.

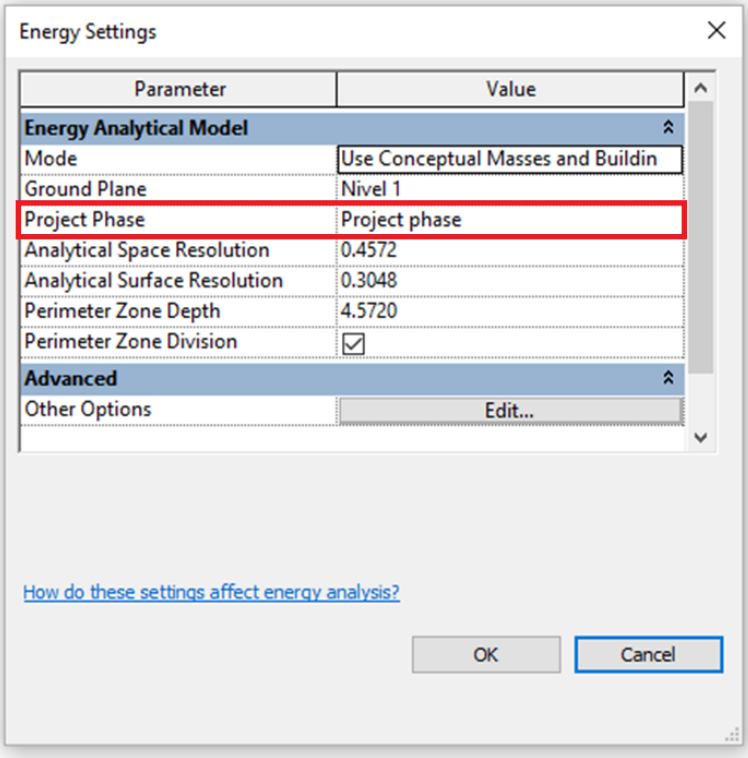




7.4 Energy settings

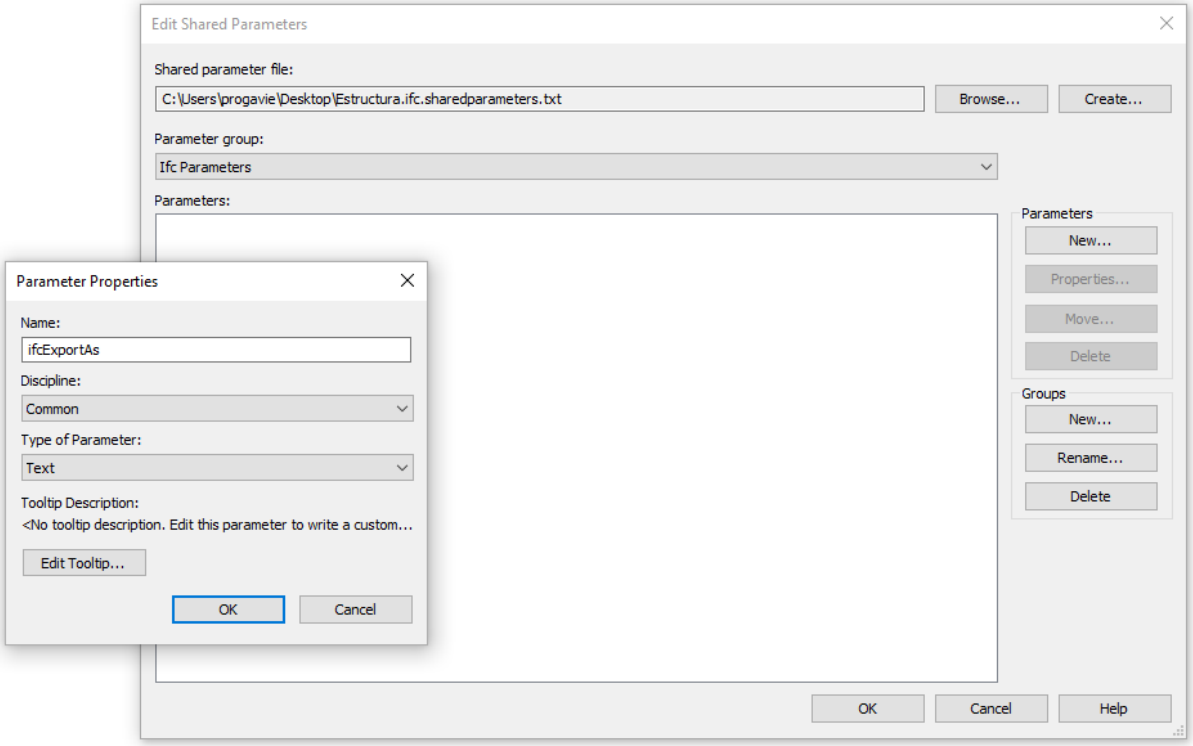
To export the rooms correctly check in **Analyse > Energy Optimisation > Energy Settings** that the defined PROJECT PHASE is the phase that will be exported to IFC.





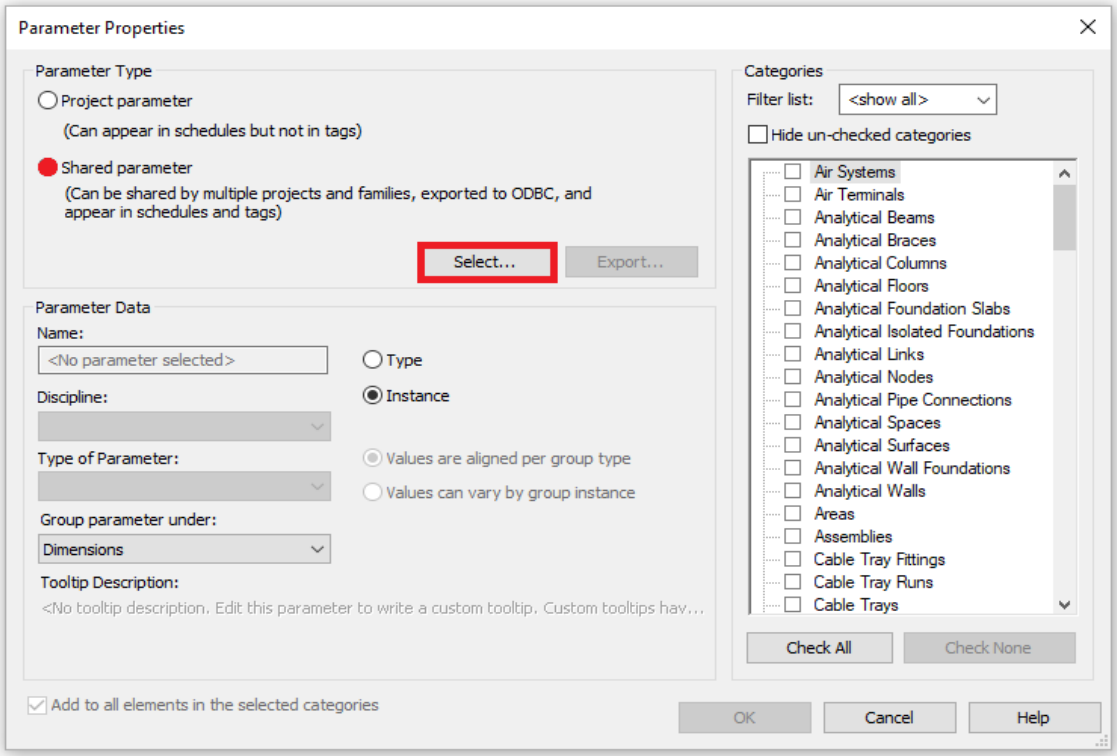
7.5 Foundation slabs and screed

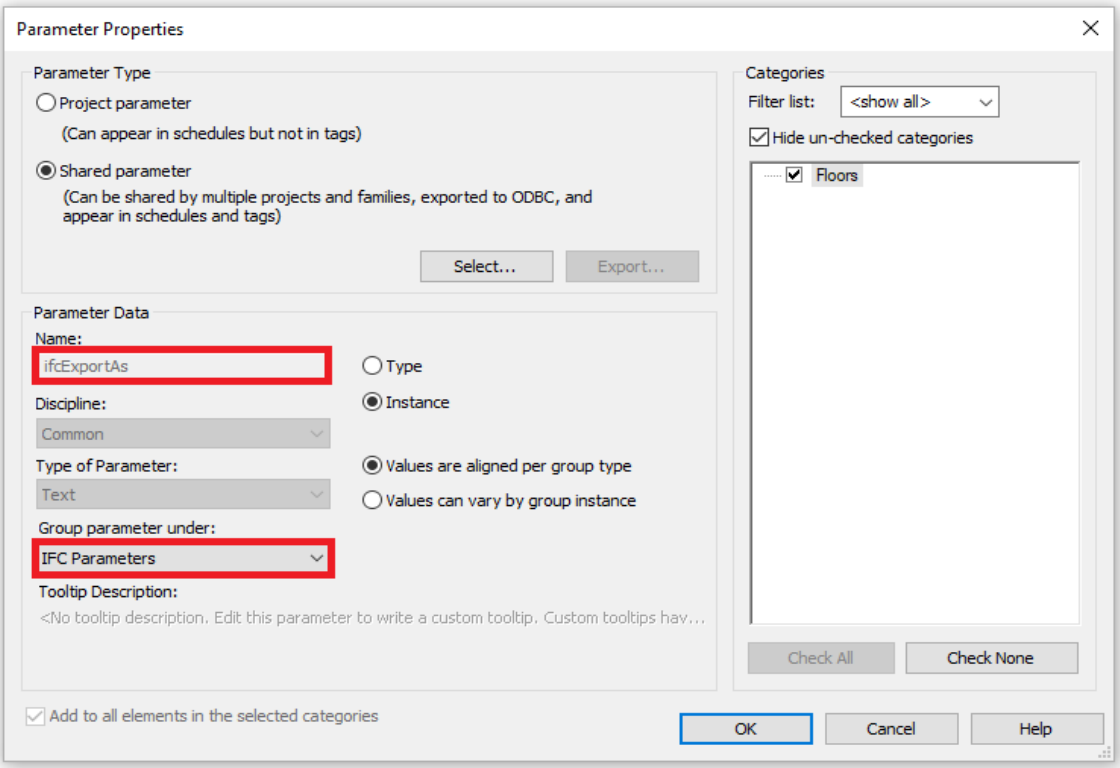
By default, Revit does not export foundation slabs and screed as defined in the IFC standard. In order to export these elements an adjustment will need to be made so that CYPE applications can recognise them. For this purpose it is necessary to define not just the CLASS of the floor (IfcFloor), but also its TYPE (BASELAB) (see point 2).



Fortunately, in Revit the TYPES can be defined by instance. Simply create a Shared Project Parameter: go to **Manage > Settings > Shared Parameters > Create**, select their location, and then create a new GROUP and a new PARAMETER with the name "ifcExportAs". It is important that it is called exactly that, without the speech marks and with the upper and lower case letters, selecting TEXT as the parameter type.

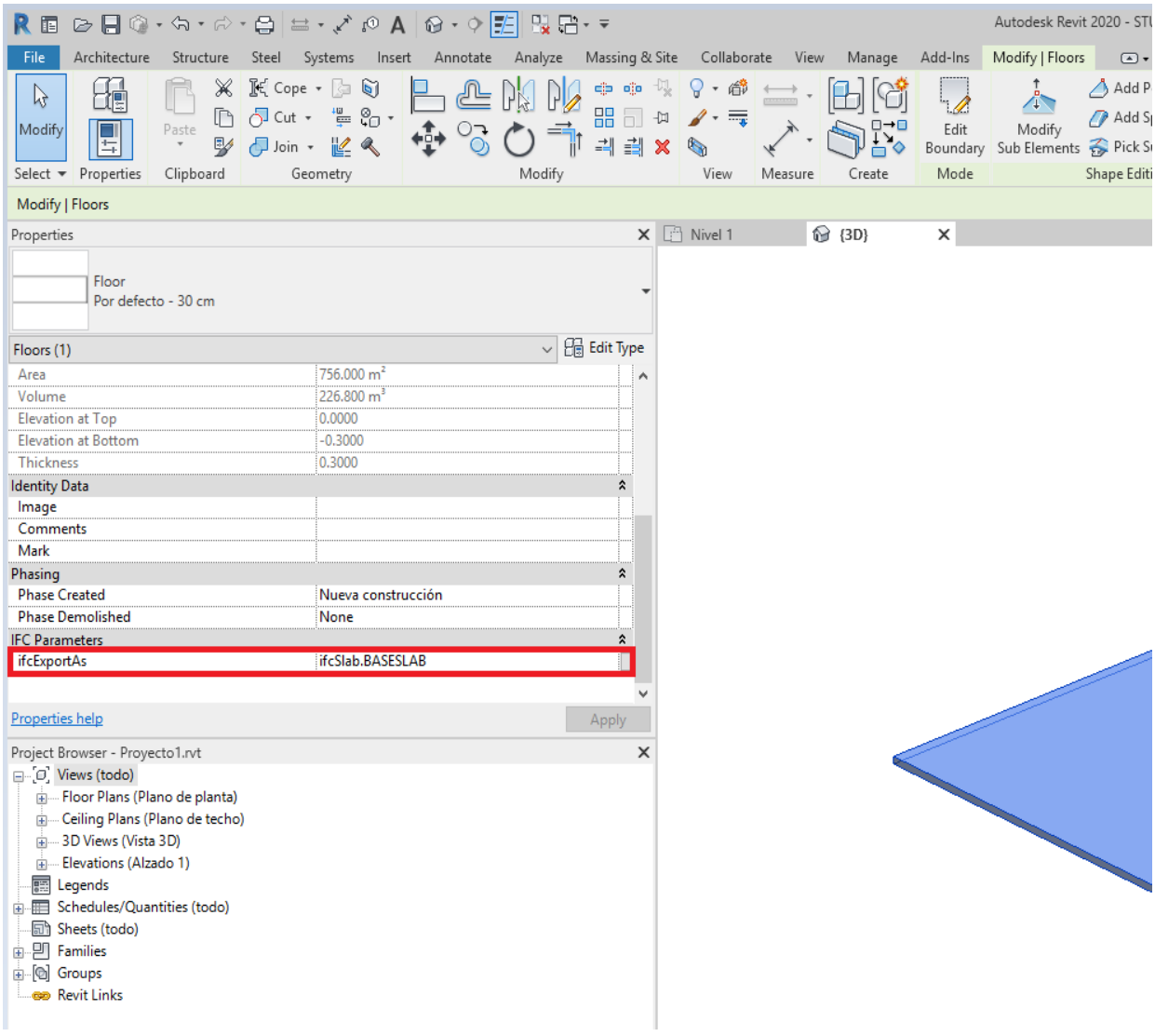
Next, enter the shared parameter created as an instance project parameter. To do this, go to **Manage > Settings > Project Parameters > Create**, and click on **Shared Parameter > OK**. Select the .txt file created previously and the "**ifcExportAs**" parameter. Apply it to the Floor Category, make sure that it is grouped under IFC Parameters and click on **OK**.


Parameter Properties
Parameter Type
Project parameter
(Can appear in schedules but not in tags)
Shared parameter
(Can be shared by multiple projects and families, exported to ODBC, and appear in schedules and tags)
Select...
Export...
Parameter Data
Name:
<No parameter selected>
Type
Discipline:
Instance
Type of Parameter:
Values are aligned per group type
Values can vary by group instance
Group parameter under:
Dimensions
Tooltip Description:
<No tooltip description. Edit this parameter to write a custom tooltip. Custom tooltips hav...
Categories
Filter list:
<show all>
Hide un-checked categories
Air Systems
Air Terminals
Analytical Beams
Analytical Braces
Analytical Columns
Analytical Floors
Analytical Foundation Slabs
Analytical Isolated Foundations
Analytical Links
Analytical Nodes
Analytical Pipe Connections
Analytical Spaces
Analytical Surfaces
Analytical Wall Foundations
Analytical Walls
Areas
Assemblies
Cable Tray Fittings
Cable Tray Runs
Cable Trays
Check All
Check None
Add to all elements in the selected categories
OK
Cancel
Help


Parameter Properties
Parameter Type
Project parameter
(Can appear in schedules but not in tags)
Shared parameter
(Can be shared by multiple projects and families, exported to ODBC, and appear in schedules and tags)
Select...
Export...
Parameter Data
Name:
ifcExportAs
Type
Discipline:
Instance
Common
Type of Parameter:
Values are aligned per group type
Text
Values can vary by group instance
Group parameter under:
IFC Parameters
Tooltip Description:
<No tooltip description. Edit this parameter to write a custom tooltip. Custom tooltips hav...
Categories
Filter list:
<show all>
Hide un-checked categories
Floors
Check All
Check None
Add to all elements in the selected categories
OK
Cancel
Help

Now all of the floors will have the project parameter ifcExportAs. What is written in this box will determine which CLASS and TYPE of IFC entity this specific instance will have – this has priority over the general mapping table.

In order for it to work, "**ifcClass.IfcType**" needs to be written inside the box; therefore, in this case we will write **IfcSlab.BASESLAB**. Now this floor will be exported as IfcFloor and CYPE will be able to recognise it directly as a foundation slab or beam in both analysis (CYPETHERM) and modelling programs (CYPECAD MEP).

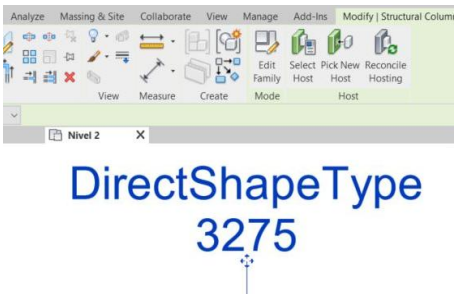


It is also possible to export this element as a slab, without making any adjustments, and then change its features in the target program.

8 Exporting from CYPE to Revit

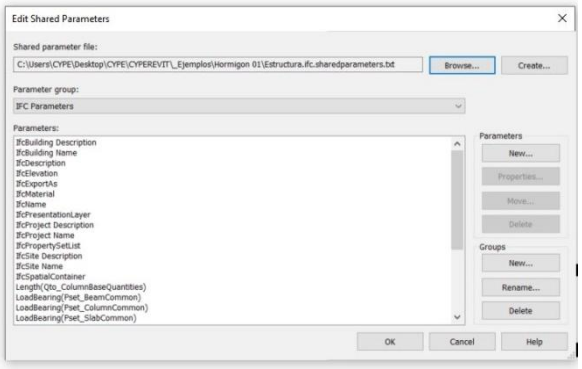
8.1 Tags

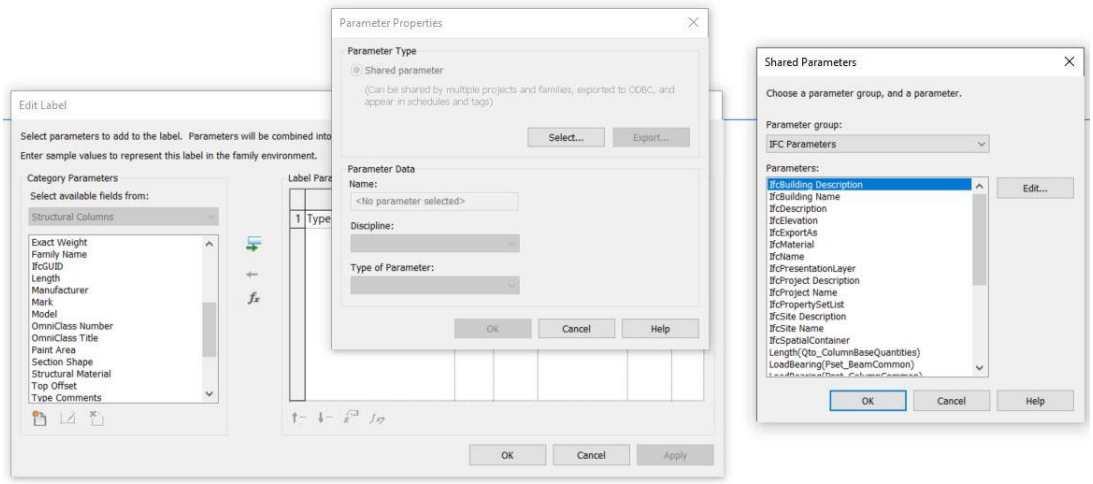
When an IFC is linked, Revit's native importer automatically creates a shared parameters file (FileName.ifc.sharedparameters.txt) in the project's directory, which contains the type and instance parameters of the linked IFC entity. To tag a linked IFC entity (for example, a column from a CYPECAD structure) the following steps are required:



1. Create a new tag family (or modify an existing one).
2. Load the shared parameters file created when the IFC was linked in Revit's family editor.
3. Enter in the tag text the parameter in question (for example, IfcName).

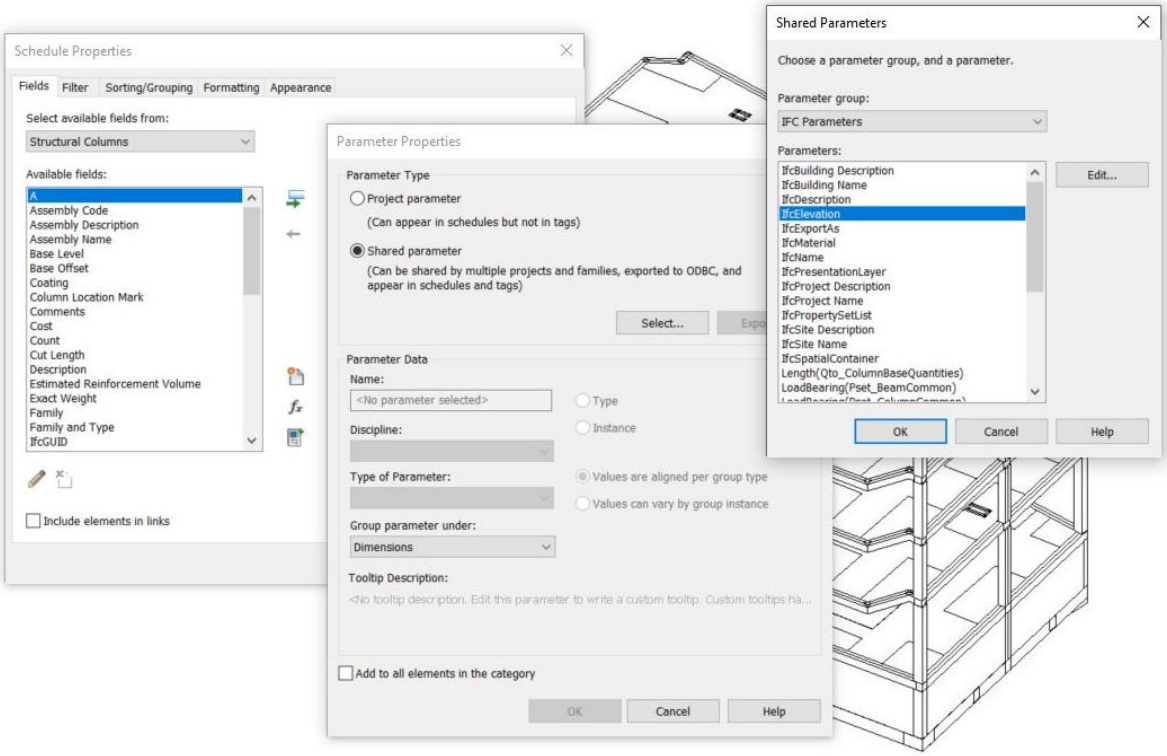
By loading that tag family into the project, it will be possible to tag all of the columns without any problems. It will even be possible to tag multiple columns at once using the "tag all" tool if the "include elements from linked files" box is activated.





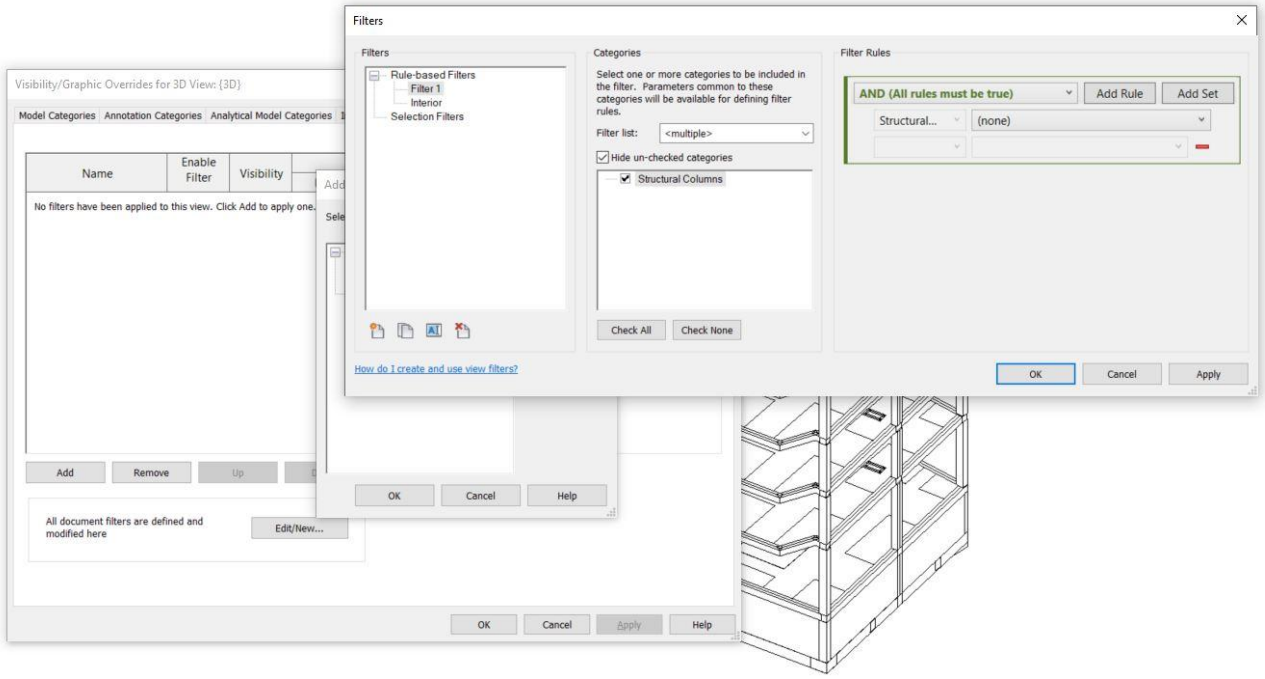
8.2 Schedules

To create schedules with IFC links, create a new schedule whose “properties” > “fields”> “include elements in links” box is activated. You can tabulate all IFC parameters by loading them in the available fields from the same shared parameters file.



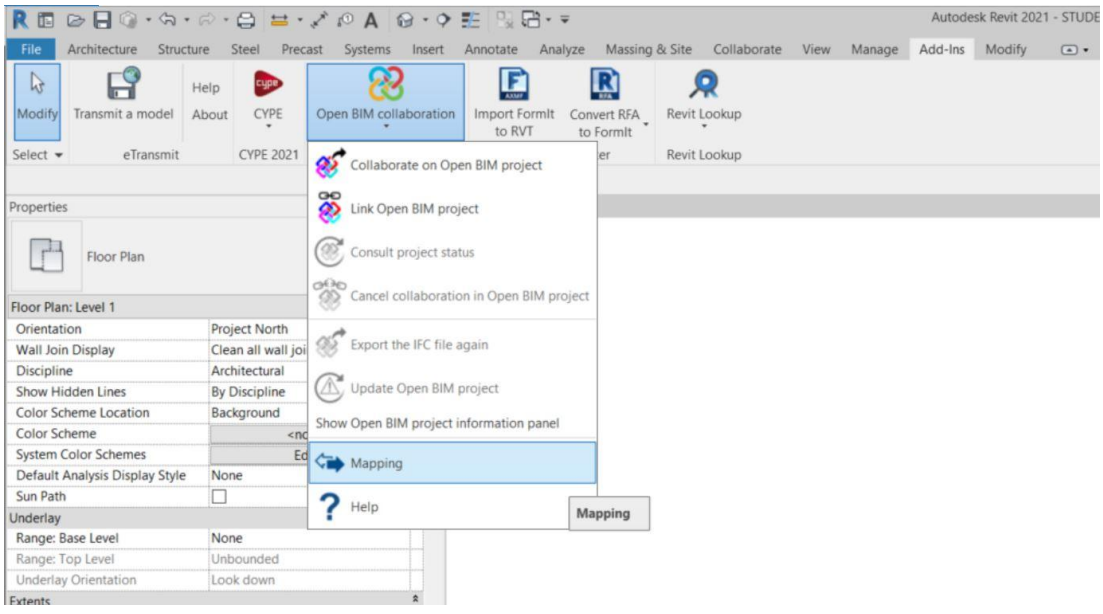
8.3 Filter

To filter simply create new project parameters from the shared parameters file applied to the corresponding categories. Be aware that although the imported IFC entities are imported as DirectShape and their geometry cannot be edited, the importer assigns them a category according to their origin IFC CLASS (for example, an IfcWindow is imported as a DirectShape in the Windows category). Then go the filters editor and apply a new filter on the same categories as the project parameter in question.



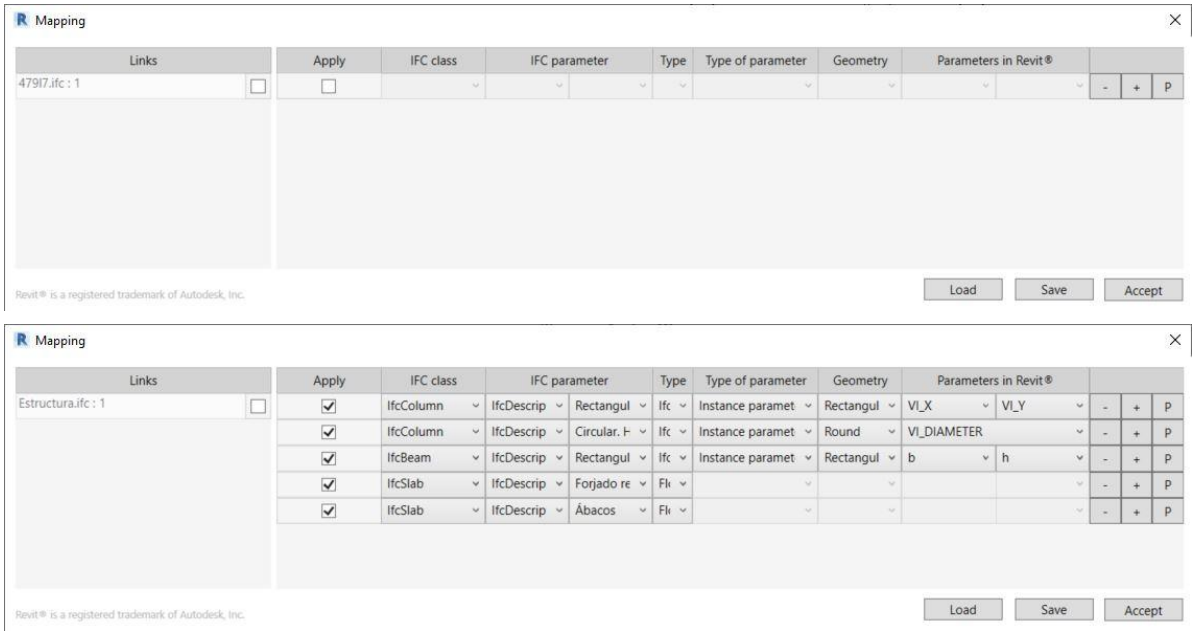
8.4 Convert to native

The Open BIM plugin for Revit is now able to convert IFC entities generated with CYPE applications to native Revit families loaded in the current project. This feature can be found in the Mapping button in the plugin's main menu.



This opens the mapping menu where mapping lines can be created to establish equivalences between the IFC entities imported into Revit, such as DirectShape, and the

existing families in the project. The table is filled from left to right and the mapping tables can be saved with the Save button, so that they can be reused in different projects.

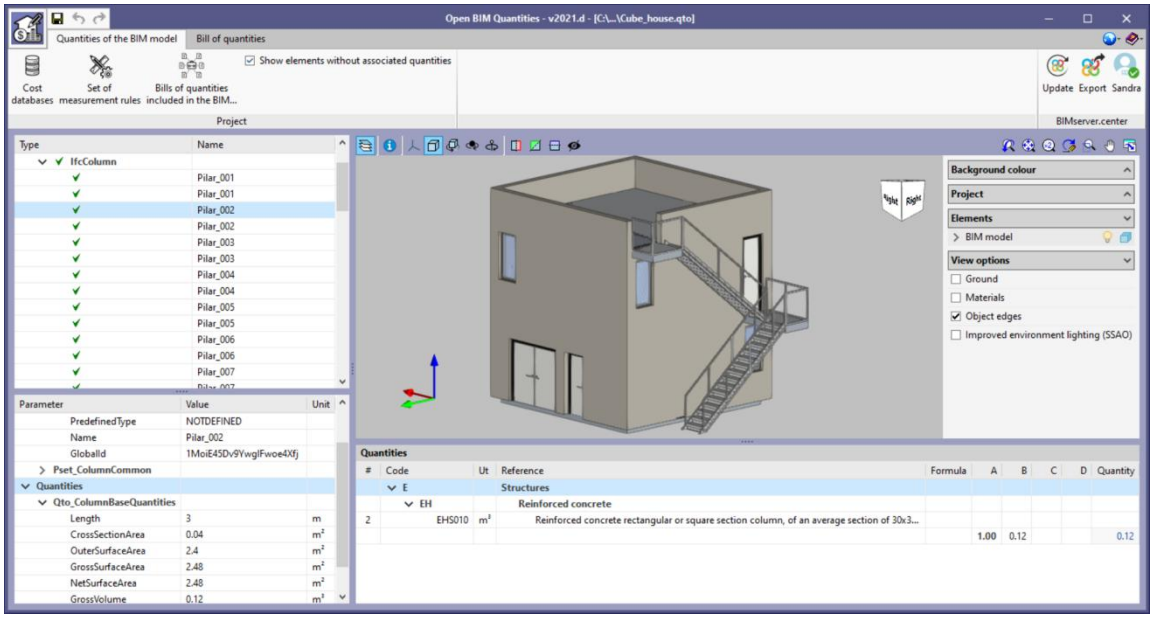


Once the table is complete the specific entities can be converted by clicking on Ok. This will start the conversion process of the entities and will show a loading bar with the status of the process. Once the transformation is finished, specific family instances will be created. The families can be mapped by type or instance. Mapping families by instance allows users to select the instance parameters that determine the size of the entities so that these elements will automatically adapt to the IFC measurements. For example, the concrete columns will adapt their X and Y dimensions to the dimensions of the imported IFC element.

In the current version this is not possible with type parameters. In these cases, it will be necessary to create a mapping line for each type used. This will be used, for example, when mapping structural steel elements. In general, the system families (walls, floors, etc) cannot have measurements dependent on the instance parameters in the same way as the loadable families, and consequently the plugin only allows them to be mapped by type. The P button to the right of each mapping line allows the value of the type and instance parameters of the DirectShape entities to be captured and to transfer them to the type/instance parameters of the created entities.

9 Bill of quantities

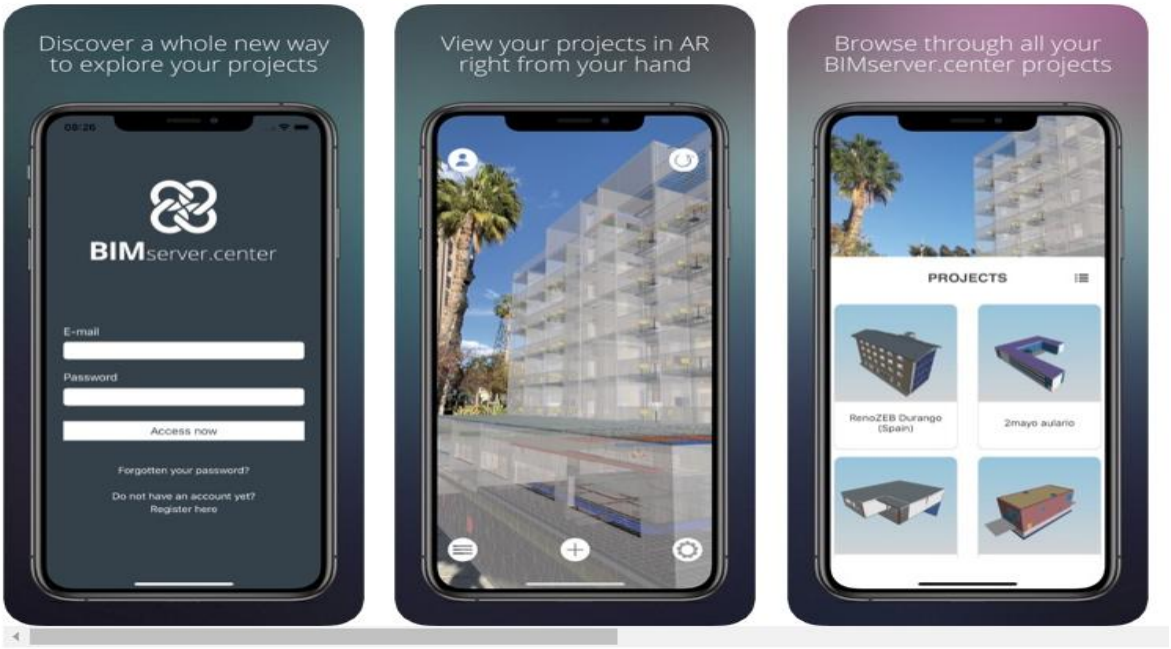
The quantities can be automatically exported via IFC by using the Revit add-on and exporting the job to BIMserver.center. These quantities can be combined with cost databases using Open BIM Quantities, which generates sets of measurement rules that can be saved for later projects, and allows for the automated generation of bills of quantities in real time based on a Revit model.



10 Augmented reality

The free BIMserver.center AR application, available for iOS and Android, allows users to view any BIM project that has been exported to IFC in Augmented Reality at any scale, both models exported from CYPE programs and models exported from Revit with the free Open BIM for Revit plugin mentioned in point 3.2.

This greatly increases the possibilities to view and review the project – allowing the display of 3D scaled models from all the disciplines analysed in the project, and being able to select all of its elements to access the associated information.

These models are synchronised with BIMserver.center so that they don't take up space on devices, allow the immediate display of all the BIM projects of the user in question and are updated with the latest version of all the files that constitute the Open BIM projects.

Issues and coordination reviews will also be updated in this virtual model in real time, connected to a mobile phone notification system.