

ARCHICAD IFC 2X3 GUIDE

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Introduction

IFC – Industry Foundation Classes - is a neutral file format that makes it possible to exchange information between different CAD systems and other systems in the building and facility management sectors. The IFC format is ISO-certified and can be integrated into any existing quality assurance policies your office may have. IFC is developed in part by the IAI – the International Alliance for Interoperability. Today there are over 600 members with 12 chapters around the world. For more information, see: www.iai-international.org.

Graphisoft has played an active role within the IAI organization and supports the latest IFC standard, IFC 2x3. The IFC standard enables ArchiCAD to communicate with other disciplines within the context of the building model, and to coordinate a building project entirely in 3D. The building model can also be exported back to literally hundreds of other systems that support IFC.

The BIM, or “Building information model,” is one of the biggest advances in the building industry’s working methods since the introduction of CAD software. The gap between CAD software and hardware has closed dramatically the last few years, making it economically viable to coordinate projects in 3D.

BIM is NOT synonymous with 3D projects. Three-dimensional geometric representation is only one part of the digital deliverables. A project includes non-graphical information, such as calculations that are used in surveying, facility management and energy calculation.

But the first and perhaps most important step toward a full BIM working method is to model and coordinate in 3D. Architects, engineers, HVAC contractors and clients all gain from using a BIM model. A BIM model can gradually encompass information used by facility managers, accountants, and environmental regulators. Even in a later stage of the model's life cycle, BIM is useful for real estate agents, security companies, fire brigades and cleaning contractors.

A prerequisite for a successful BIM project is that intelligent information can be exchanged between different software and even operating systems, throughout the stages of the building process. This interoperability demands a neutral file format with an open standard that supports different systems. IFC is such a system, enabling us to synchronize building models between the disciplines much more easily. With its user-friendly interface and high degree of customizability, the IFC add-on for ArchiCAD enables users to communicate in an efficient way, to focus on the needed elements and to locate any errors in design development.

This Guide has been created to provide ArchiCAD users an insight into the IFC standard and how it works in ArchiCAD. The IFC version discussed in this Guide is 2x3 for Graphisoft's ArchiCAD 12.

Installation of IFC 2X3 in ArchiCAD 12

The IFC 2X3 add-on installed with ArchiCAD 12 is located in the Add-ons/Import-Export folder in the ArchiCAD program folder.

For the latest beta and final releases of the IFC add-on, see Graphisoft's web site:

<http://www.graphisoft.com/support/ifc/downloads/public/>

Please note that IFC 2X3 is the default add-on for ArchiCAD 12. IFC 2X2 can be downloaded through the Goodies page, available through ArchiCAD's Help menu.

New Features in IFC 2X3 Add-On for ArchiCAD 12

- 1) New IFC tree interface
- 2) New IFC section in Settings dialog boxes
- 3) Handling of all standard IFC PSets
- 4) Handling of all IFC types and properties with simple values
- 5) Handling of complex properties
- 6) Custom property creation
- 7) Merge partial IFC model to ArchiCAD plan
- 8) Merge partial ArchiCAD model to IFC model (*not yet available in released version*)
- 9) Partial Structure Settings
- 10) User interface for generating and editing the configuration XML file for PSet mapping
- 11) Option to display localized IFC keywords on user interface

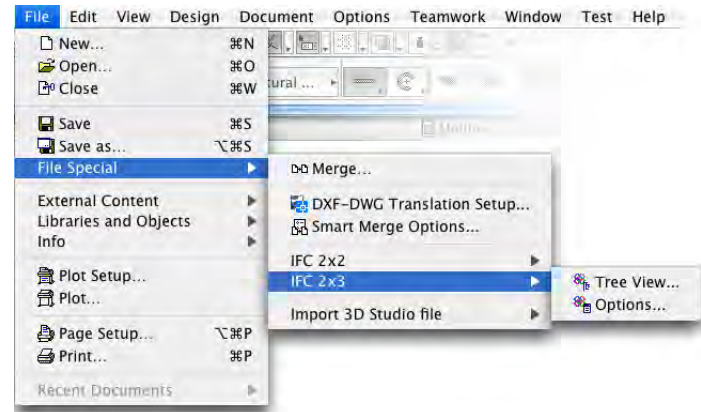
Helpful Hints in Planning an IFC Project

- 1) First, decide which IFC version (e.g. 2x2 versus 2x3) should be used. Ensure that your partners, who will be using the IFC file, have compatible programs enabling them to read your file version.
- 2) Next, consider what type of information should be exported to the different disciplines. Different disciplines will require different parts of the total informational flow of an IFC-project. For example, building engineers will want the load-bearing parts of the building (see *Structural-Related IFC Features* later in this document), while an HVAC consultant will need a richer model with more internal information. Once these issues are decided, the IFC 2X3 Add-On's interface enables you to filter the building information model accordingly before exporting it.
- 3) It is good practice, in a newly started project, to start with a simple model for export, to verify that all of the required information is exported and imported correctly into and from each discipline's respective program. Once this simple model has been exported and read correctly, then more information can be added to the model successively.
- 4) When exporting an IFC model, it is good practice to check the IFC model in a IFC viewer. There are many free IFC viewers on the market that can be readily downloaded.:
 Solibri Model Viewer: <http://www.solibri.com>
 DDS IFC Viewer: <http://www.dds-cad.net/>
 Nemetschek IFC Viewer: <http://www.nemetschek.co.uk/ifc>
 Additional information can be found at the following Wiki address:
http://www.ifcwiki.org/index.php/Free_Software

IFC Interface in ArchiCAD

Menu Commands

Once the Add-On is installed, the two IFC settings dialog boxes ("Tree View" and "Options") can be accessed from: File > File Special > IFC 2x3.

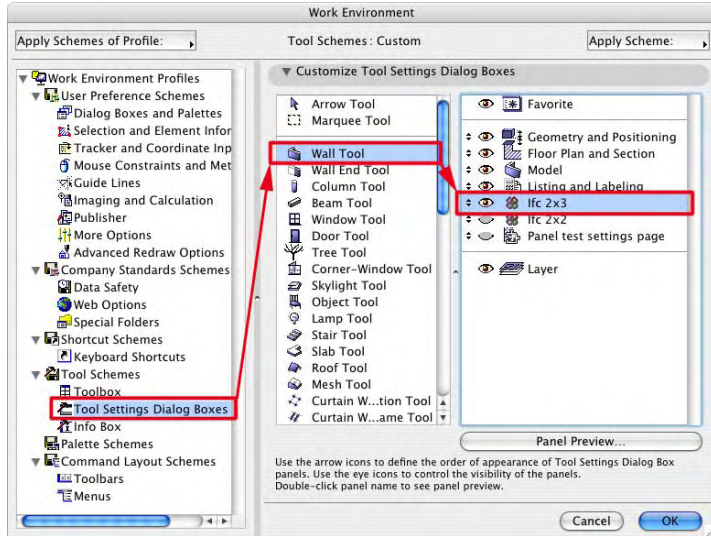


IFC Panel in Tool Settings

Even after you have loaded the IFC add-on to ArchiCAD 12, the IFC panel in each Tool Settings dialog box is hidden by default.

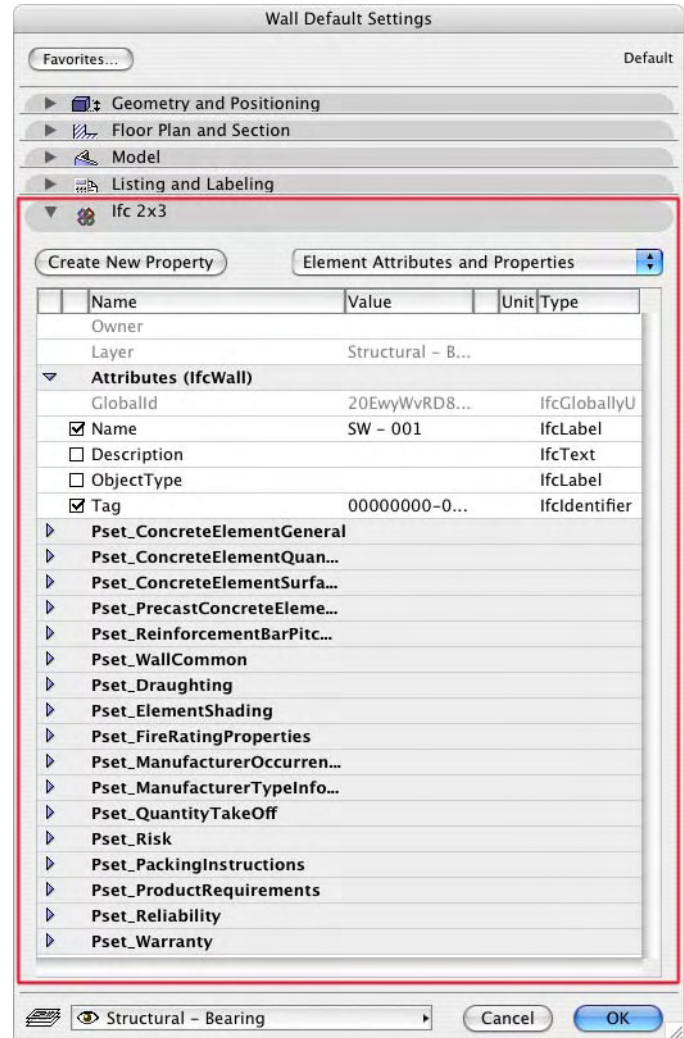
To show the IFC panels, go to Options > Work Environment, and open the Tool Settings Dialog Boxes page, as shown below.

For each tool, click the eye icon of the IFC 2X3 panel to make it visible.



The IFC panel can be shown in the Settings dialog boxes of the following ArchiCAD tools: walls, columns, beams, doors, windows, objects, stairs, slabs, roofs, corner windows, skylight, lamp curtain wall and the zone.

In each such Settings dialog box, the IFC Panel looks like this:



Basic IFC Terms and Definitions

GUID

Globally unique ID. A GUID is a string assigned to each element, both in ArchiCAD and in IFC. As its name indicates, a GUID enables a program to identify and differentiate elements, since each element has been assigned a unique ID.

An element's GUID in ArchiCAD is not the same as its GUID in IFC.

IFC Entity

Project information from ArchiCAD saved in IFC is represented as a set of entities - such as elements, materials, and their relationships.

Each entity (for example, an IFC Wall) includes a fixed number of attributes, plus any number of additional properties.

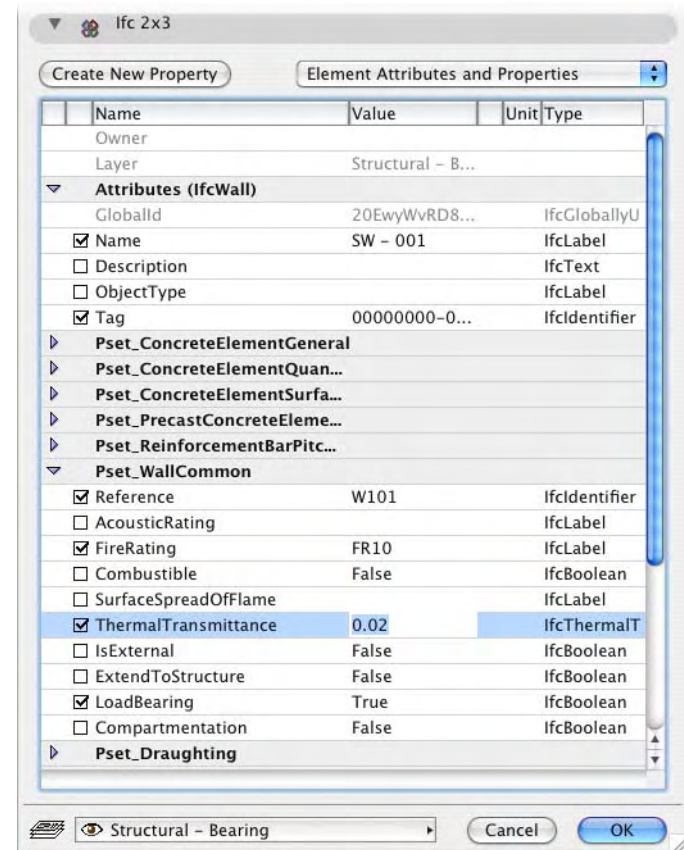
Attribute

An attribute helps to define an IFC Entity.

Each entity (for example, an IFC Wall) has Attributes that include its name, description and GUID (called a Tag in the IFC panel's Attribute list).

Each Attribute has a Name, Value, and Type. For example, the Wall whose Settings are shown here has the following attributes: GlobalID, Name, Description, Object Type, and Tag.

By default, few attributes are checked, to minimize IFC file size. Check any additional attributes to include them in the IFC export.



Property

Properties are additional parameters assigned to an IFC entity. Properties are grouped into Property sets (Psets); these are listed as drop-down items in the element's IFC Panel. Click on the Pset name to display the parameters it contains.

By default, most IFC entities include standard **Property Sets**. In ArchiCAD's Element Settings dialog boxes, you can create custom properties and custom property sets too. (See *Create New Property*.)

As with attributes, few of the properties are checked by default, to minimize IFC file size. Check any additional properties to include them in the IFC export.

For an example, see *Enable Load-Bearing Property*.

Create New Property

To create a new IFC Property for an ArchiCAD element, click the Create New Property button on the IFC 2X3 panel of the element's Settings dialog box. (The same button is available in the *IFC Tree View* dialog box.)



First, create a custom Property Set (use the **Name of Property Set** field). Then type in the name of the new custom Property. Use the drop-down menus to adjust the new property's Property Type and Value Type.

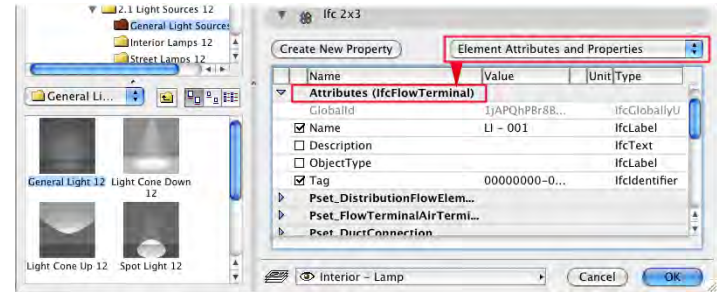
Note: To avoid errors, do *not* use the standard PSET_ prefix when giving a name to your custom Property Sets.

To add another new property to the custom property set, first select the property set from the first pop-up (**Existing Property Set**), then add another new custom property.

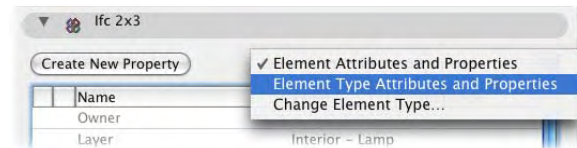
IFC Element Type

The Element Type concept enables you to add yet another layer of classification to some IFC entities. Entities belonging to a particular Element Type can share certain properties. If you change one Element Type property, that property will be modified for all entities belonging to that Element Type.

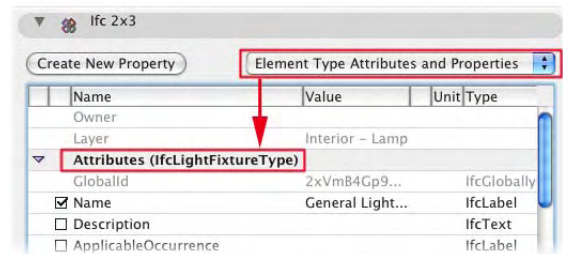
For example, by default, both a Lamp object and an Air Diffuser are considered to be a Flow Terminal in IFC, as shown in this Lamp's dialog box:



However, you can more narrowly classify the Lamp by its Element Type in addition to its generic IFC element name. At the top of the Lamp's IFC panel, switch the pop-up from "Element Attributes and Properties" to "Element *Type* Attributes and Properties."



Now the Lamp Settings shows the attributes and properties of its Type (Light Fixture) rather than being considered generically as a Flow Terminal. Here, you can check the attributes and parameters which you would like to export by *Type*, to enable a more exact classification of the element in IFC.



Save and Apply IFC Parameters in ArchiCAD

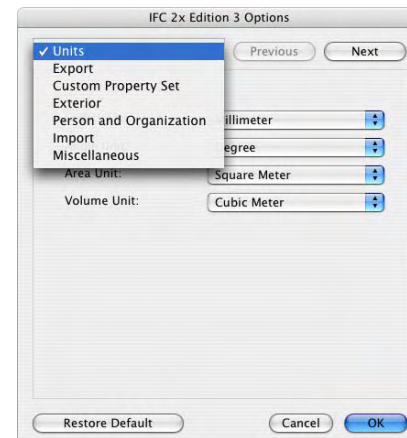
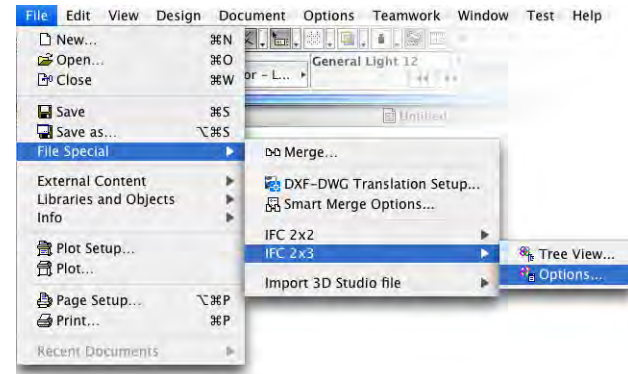
To maximize performance, the workflow for saving and applying IFC parameters for ArchiCAD elements differs from standard element creation in ArchiCAD. It is recommended that you use the following workflow:

- 1) **Adjust** attributes and properties in each element's Default Settings dialog box (IFC 2X3 Panel).
- 2) **Save** the adjusted Default Settings as a **Favorite**. Create as many Favorites for each element as you need (e.g. "IFC Internal Wall;" "IFC External Wall").
- 3) **Place** elements as needed to construct the model in ArchiCAD.
- 4) **Select** the elements to which you will apply IFC parameters.
- 5) In the Selection Settings dialog box, click **Favorites**, then **apply** the appropriate Favorite Settings to the selected elements.

Note: You cannot use the pipette shortcut (pick-up/transfer parameters) to transfer IFC information from one wall element to another. The recommended way to apply IPC parameters to ArchiCAD elements is to Apply Favorites, as described above.

IFC Options

To set options for import, merge and other IFC configuration settings, go to File > File Special > IFC 2X3 > Options.



This dialog box also appears automatically every time you execute the File > Save As *.ifc command. (If you do not want this dialog box to appear after every Save As IFC command, uncheck the corresponding box in the *Miscellaneous Options* page of this dialog box.)

There are seven pages of options accessible from this dialog box. Use the drop-down list, or the Previous/Next buttons to navigate among them.

At the bottom of any page, you can click **Restore Default** to discard your options changes and return to the default settings.

Below are explanations and recommendations for export settings for IFC2x3:

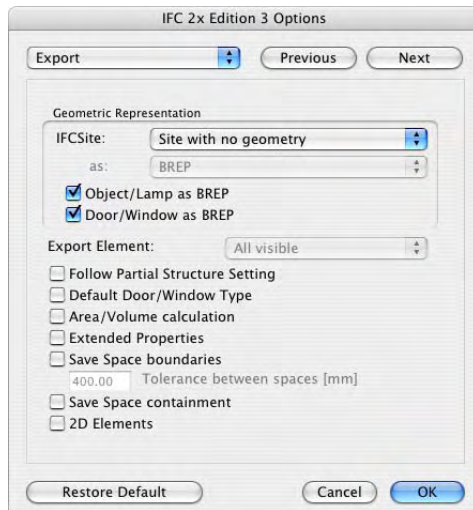
Units Options

Define the units (Length, Angle, Area and Volume) for an IFC project when exporting from ArchiCAD.

Note: Units are only set when exporting an IFC model from ArchiCAD, not when importing an IFC model.

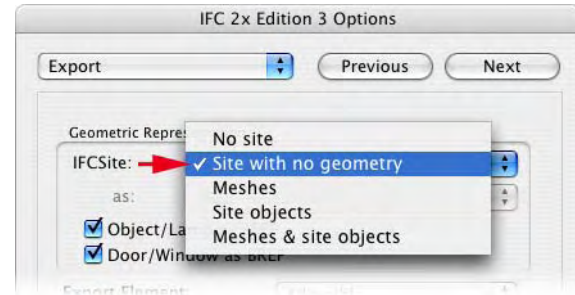
Export Options

Use this page to filter elements in the ArchiCAD database for export.



Geometric Representation

In IFC, a “site” is a defined point with exact geographical coordinates. Usually, the site has no geometry (the default setting for IFCSite is “Site with no geometry.”)



Alternatively, you can add geometry to the IFCSite by exporting ArchiCAD mesh(es), or GDL objects you have specifically created as “Site objects”, or all of the above (“Meshes and site objects.”)

To save a site object (for example, if you have created a site geometry from a combination of meshes and slabs), you must save it as IFC_SITE.GSM. (Select the mesh/slab elements in ArchiCAD, then use the **File > Libraries and Objects > Save Selection As...** command.)

Note: Capital letters must be used.

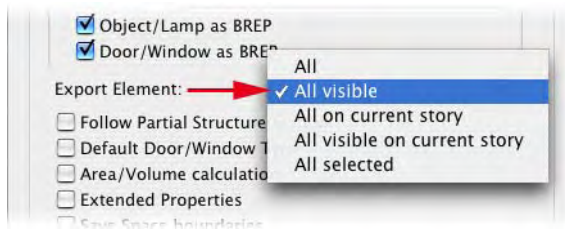
If you are exporting any of these kinds of site geometry, the next pop-up is activated.

- **Surface based format** or **Geometric set format:** use these options if you want to reduce the overall size of the IFC model
- **BREP:** A BREP (boundary representation) is a geometric object that is specified by its boundary faces. This option will give you the most detailed geometric representation, but may also include a lot of unwanted information. Its usefulness is generally limited to visualization. Use this option only if you want a richly detailed model.

Object/Lamp and Door/Window as BREP

It is recommended to leave these boxes *checked*. For these elements, the additional detail provided by BREP is usually an advantage despite the larger file size.

Export Element



By default, all visible elements will be exported. To change this setting to any of the other listed options, execute the **File > Save As ...** command, and choose the IFC file format. The Options dialog box appears, in which this control is now active.

Note: If the Options dialog box does not appear, go to the *Miscellaneous Options* page of this dialog box and make sure the corresponding box is checked.

Follow Partial Structure Setting

As of ArchiCAD 12, composite and complex (profile) elements can be displayed using partial structure settings: either Core Only, Without Finishes, or Entire Structure. Check this box to take ArchiCAD's Partial Structure settings into account when exporting to IFC. (If you leave this box unchecked, all composite and complex elements will be exported as Entire Structures.)

See also Layer Settings and Partial Structure Display.

Default Door/Window Type

It is recommended to leave this box *unchecked*.

Checking this box will classify all doors and windows as a single, default Type, narrowing the range of their parameters. IFC doors and windows are not affected by this setting.

Area/Volume Calculation

Check this box to include Area and Volume calculations in the IFC model (for example, if you will need quantity takeoffs for cost estimation purposes.)

See IFC Settings for Quantity Takeoff.

Extended Properties

If the IFC project is expected to do a "round trip" (i.e. you will merge it back into ArchiCAD), then it is advantageous to use this setting when exporting the model to IFC. This option will enable ArchiCAD to try to map the original object when you import the IFC model again.

Note: Choosing this option will significantly increase the IFC file size.

Save Space boundaries

Check this box only if you are using the IFC model in thermal calculation applications (e.g. with Energy Plus). Using this option increases processing time and file size dramatically.

Space boundaries define the logical connection between ifcSpaces (zones in ArchiCAD) and the building elements (e.g. walls and slabs) that enclose them.

See IFC Settings for Thermal Calculation.

Save Space containment

Check this box if you are using the IFC model in facility management applications.

Space containment defines the relationship between ifcSpace (zones in ArchiCAD) and IFC Furnishing or Distribution elements within the space.

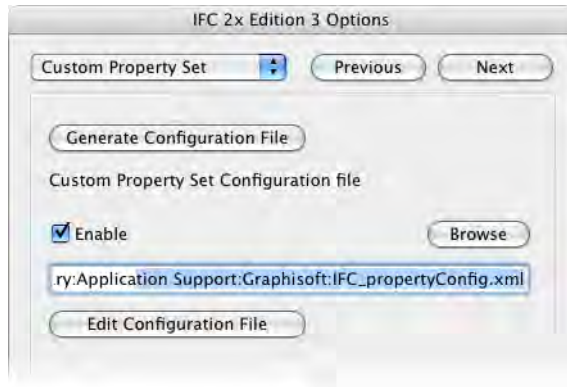
2D Elements

IFC2x3 is able to save text, labels, symbols and fills.

Custom Property Set Options

Use these controls if you want to include all or selected ArchiCAD Library Part parameters when exporting to IFC.

Note: If you do not load or generate a Property Set Configuration file here, parameters of ArchiCAD Library Parts will *not* be exported to IFC.

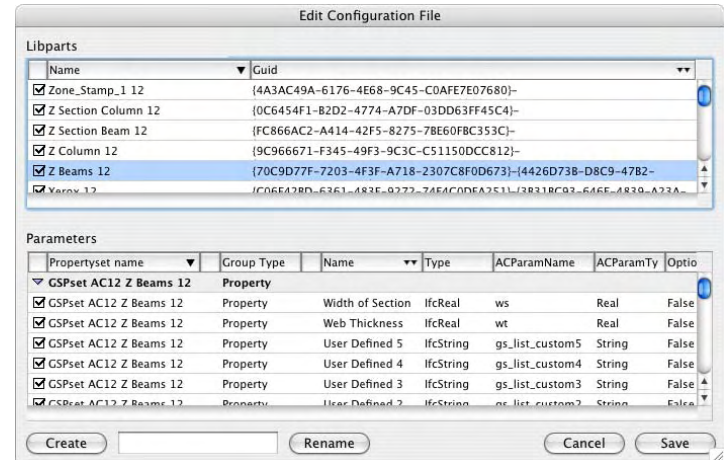


To export all Library Part parameters (regardless of whether these LibParts have been placed in the model) with their default mapping definitions, check the **Enable** box.

Then do one of the following:

- either click **Browse** to load any property configuration file (.xml),
- or click **Generate Configuration File** to generate a default .xml file with mapping definitions based on the currently loaded library.

Edit Configuration File: To narrow the set of parameters, or to rename any of them, click this button to open an editing window.

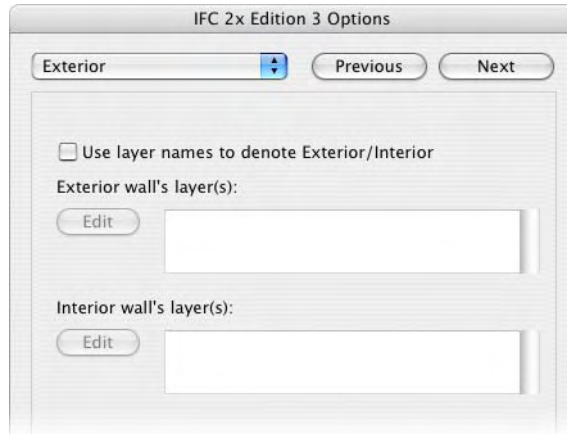


At the top of the window, check/uncheck the Library Part names to limit the parameters to be exported.

For each selected Library Part name, its parameters are shown in the bottom half of the window, with their default IFC parameters. As needed, edit any of the Property names. The properties will be exported to IFC under the names you enter here.

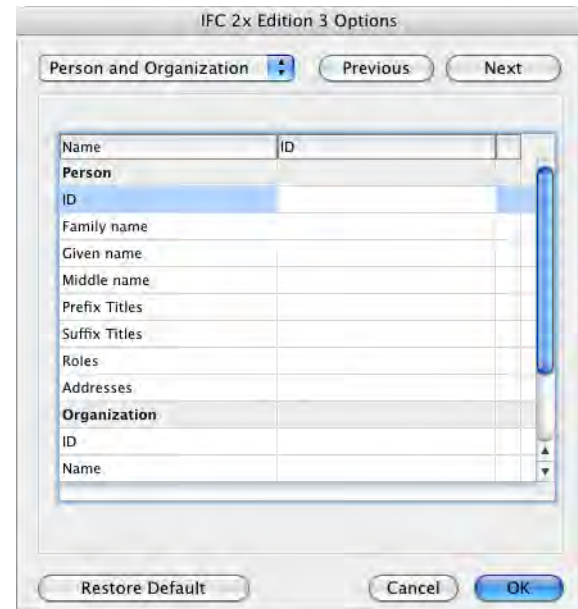
Exterior Options

Use these options to optionally classify Walls as either “Interior” or “Exterior” by defining ArchiCAD layers for them.



Person and Organization Options

Use this page to enter general information about the project owner and organization. This information will serve as additional properties of the IFC element.

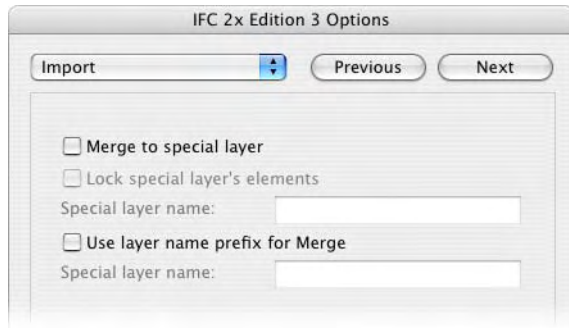


Import Options

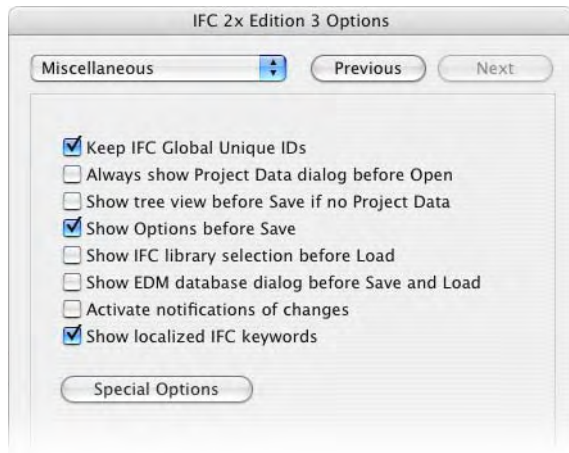
These options affect the Merge function, used to merge an IFC file into an ArchiCAD project. (See *Merge IFC to ArchiCAD*.)

Use these options if you wish to differentiate IFC file elements from the original ArchiCAD elements by placing them onto a separate layer. To do this, check the **Merge to Special Layer** box. You then have further options: to lock these merged elements; and to assign a name to the Special Layer.

Alternatively, check the **Use layer name prefix for Merge**. This means that while merged IFC elements will remain on their respective separate layers, these layers will each get a uniform prefix.



Miscellaneous Options



Keep IFC Global Unique IDs: This option affects the GUIDs of IFC elements that you plan to re-export from the ArchiCAD plan. As a rule, this box should remain checked, to maintain a consistent model if you are using other IFC-based tools.

However, if you plan to use the exported IFC file as a separate, duplicated model, you can uncheck the box: the exported elements will gain new IFC GUIDs.

Always show Project Data dialog before Open: The displayed Project Data dialog gives you information on the building hierarchy of the imported IFC file (which might contain multiple buildings).

Show Options before Save: By default, the IFC Options dialog box is displayed when you Save an ArchiCAD file as IFC.

Show IFC library selection before Load: When opening an IFC file in ArchiCAD, this option means that the location of the IFC default library will be displayed.

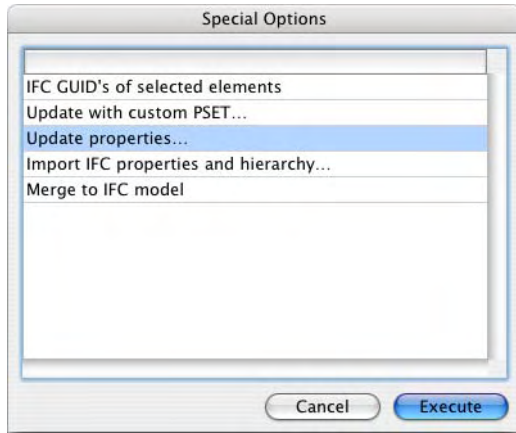
Show EDM database dialog before Save and Load: This option displays and gives you access to an internal database used when exporting to IFC.

Activate notification of changes: If the IFC add-on is running in ArchiCAD, this option will send all project modifications to the IFC data buffer of ArchiCAD at once. (This will slow down the program.)

Show localized IFC keywords: This option affects the language (as shown on the interface only) of IFC keywords (properties, attributes, etc.)

Special Options

This button, on the Miscellaneous page of IFC options, gives you access to a set of custom functions (often in “test mode”) that may vary depending by release and language version.



Special Options may include:

IFC GUID's of selected elements: This command enables ArchiCAD Report to display IFC GUID's.

Update with custom PSET: Updates the ArchiCAD file based on a chosen ifc configuration file.

Update properties: Updates the ArchiCAD file by updating the parameters of all IFC properties.

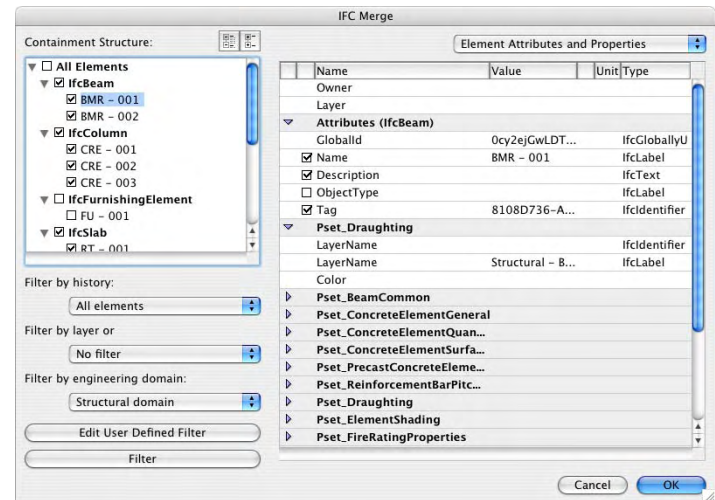
Merge IFC to ArchiCAD

To merge the IFC model to the current ArchiCAD file, use this command:

File > File Special > Merge

Important: You should save the ArchiCAD file before merging an IFC file.

Use the appearing IFC Merge dialog box to filter the elements to be merged.



In the top left window (labeled “Containment Structure”), IFC entities are listed one by one. (Their properties and attributes are displayed at the right.) Check/uncheck the boxes depending on whether you want to merge them.

To make this process easier, filter the contents of this window using any of the filters below:

- by history (i.e changed elements only, or all elements)
- by layer or owner

- by engineering domain. You can select among 2 predefined engineering domain filters (Structural and HVAC) or create your own filter using the “Edit user defined filter” button.

Click OK to execute the Merge process.

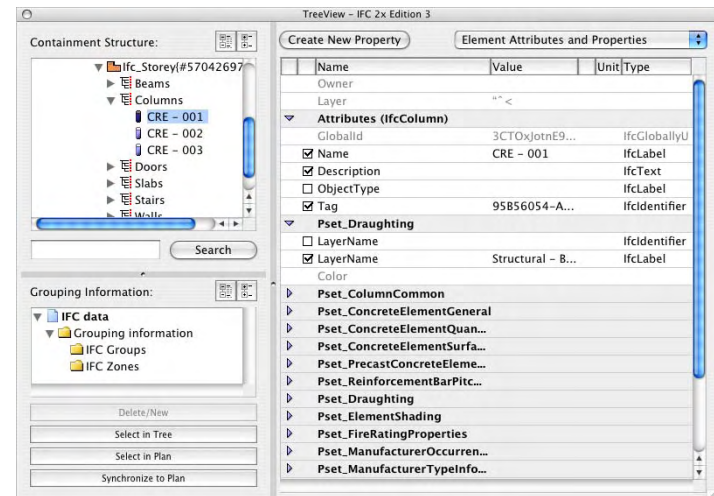
Note: The Special Layer preferences you set in the Import page of IFC Options will affect the Merge process. (See *Import Options*.)

Note: The Merge function deletes the original ArchiCAD element if it has the same GUID as the merged IFC element.

IFC Tree View

The IFC Tree View provides a hierarchical overview of the current project’s IFC model database. Use the Tree View dialog box to access model information, and to edit and update the entire ArchiCAD project.

To open Tree View, go to **File > File Special > IFC 2X3 > Tree View**.



The left side displays the IFC model hierarchy (**Containment Structure**) listing IFC entities one by one (classified according to element type). Use the two tree-view icons above this window to open or collapse the hierarchy display.

The right side of the dialog box displays the attributes and properties of any element you have selected on the left. (Alternatively, click the pop-up to display Element Types with their properties. (See also *Create New Property*.) As in the Tool Settings dialog boxes, here too you can create a New Property or Property Set. (See *Create New Property*.)

To locate a specific element in the hierarchy more easily, you can use the Search function, just below the tree structure window: enter the element's IFC GUID (or any portion of it) in the text field, then click **Search**. Clicking any item in the Search results window will show you that element's location in the tree view.

Use the **Grouping Information** section (below left) to create IFC Groups and IFC Zones as needed. IFC Groups and IFC Zones are optional classifications that serve to further classify your elements in IFC.

To create an IFC Group or an IFC Zone:

- 1) Select the folder you need under Grouping Information (e.g. "IFC Groups").
- 2) Click the New Group/Zone button.
- 3) Give a name to the new Group or Zone.

The newly created Group/Zone folder appears in the list. Now, click any one or more entities in the Containment Structure hierarchy above. Drag and drop them into the Group/Zone folder you have created below.

Note on Spaces and Zones: In IFC Tree View, an ArchiCAD Zone (usually, an individual room) is listed in the **Spaces** category. One or more such spaces can be grouped in an **IFC Zone** (usually, a set of multiple spaces), which should not be confused with an ArchiCAD zone.

The Tree View dialog box is a modal dialog box; you can keep it open while working in the model. If you add, delete or modify elements in the model, press the **Synchronize to plan** button to refresh the tree dialog.

Select in plan: Select one or more entities in the tree view hierarchy, then click the Select in Plan button to select and zoom to that entity in the ArchiCAD model window.

Select in Tree: Click this to find any selected model elements' location in the Tree View hierarchy.

Structural-Related IFC Features

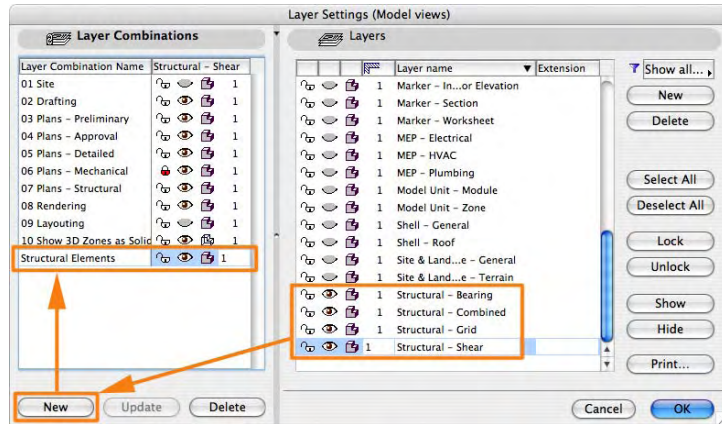
Structural models are simplified versions of architectural models – containing only load-bearing elements such as columns, beams, slabs and walls. In case of composite structures (such as multi-layered walls, slabs etc.) only the structural component – for instance the reinforced-concrete core – should be considered as load-bearing element. Structural applications will use the structural model as the main information input to define the analytical model to be used through the analysis and design calculations.

ArchiCAD advises IFC specific settings to help in main segments of the architectural-structural model exchange.

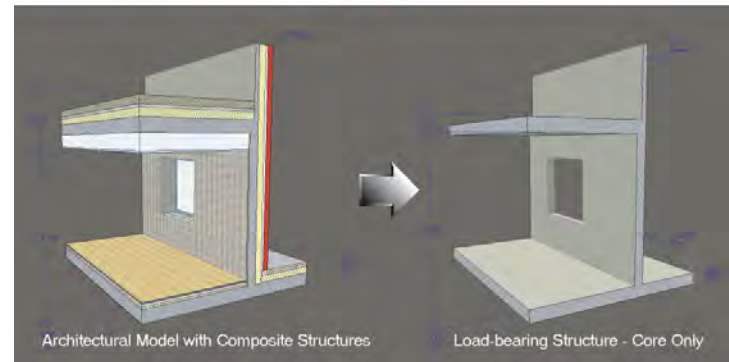
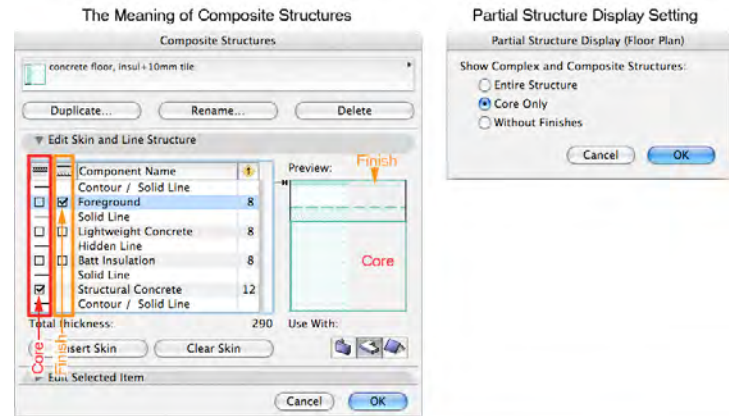
Layer Settings and Partial Structure Display

The **Partial Structure Display** function and the layer system in ArchiCAD allow you to display and output the load-bearing structural elements (simplified architectural elements).

As a first step, the load-bearing elements of an architectural model can be filtered out from the entire structure by using **Layers** and **Layer Combinations** (Document > Layers > Layer Settings).

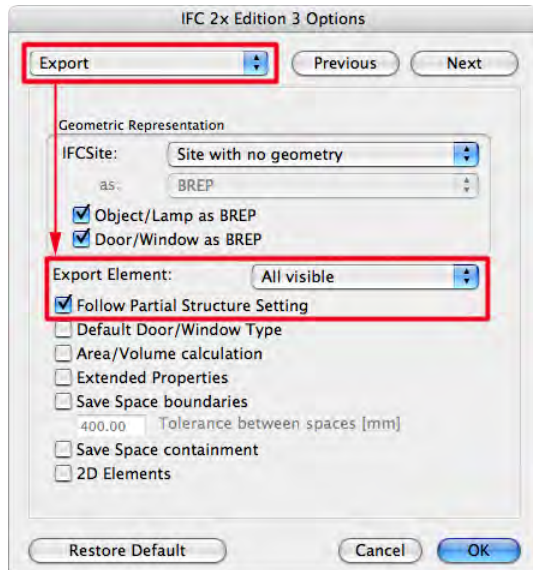


The **Partial Structure Display** (Document menu) settings influence composite (Slab, Wall and Roof) and complex (Wall, Column and Beam) structures only. The load-bearing part of these elements is the *Core* skin.



Please note that the Partial Structure Display settings are view specific. The Partial Structure Display of the Floor Plan view will be considered when exporting an IFC file having the Floor Plan as the active view.

To save the “structural” elements considered in the simplified architectural model view, apply the following settings on the *Export Options* page of IFC Options:



Export element

To consider the active layers (defined by a Layer Combination) of the current view, choose the “All visible” or “All visible on current story” option (depending on whether you would like to save visible elements on every story or only on the current story).

Follow Partial Structure Setting

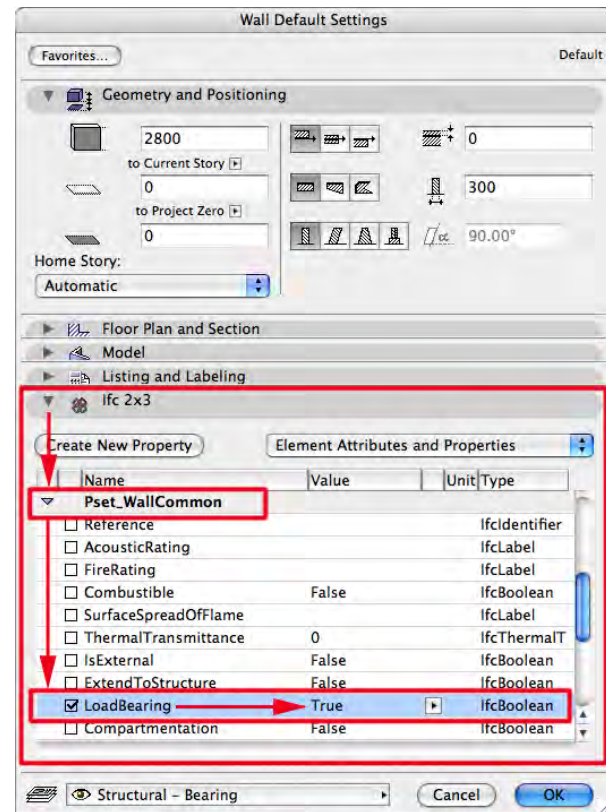
Enabling this option saves composite and complex elements selected at Export element with their displayed state set at Partial Structure Display settings (it affects composite and complex structures only).

Enable Load-Bearing Property

Some structural software applications are able to differentiate between load-bearing (structural) and non-load-bearing building elements. To enable this type of differentiation of elements in model exchange, ArchiCAD enables architects to expand the basic elements properties to include load-bearing behavior.

If you show available sets of IFC attributes in the elements’ Settings Dialog (see *IFC Panel in Tool Settings*), the load-bearing feature can be added to new or selected structural elements.

The figure shows how the load-bearing option can be activated (“True” value) for walls at Pset_WallCommon/ LoadBearing:



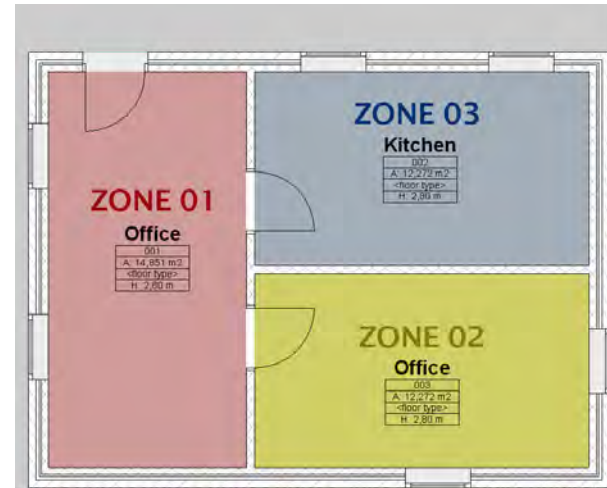
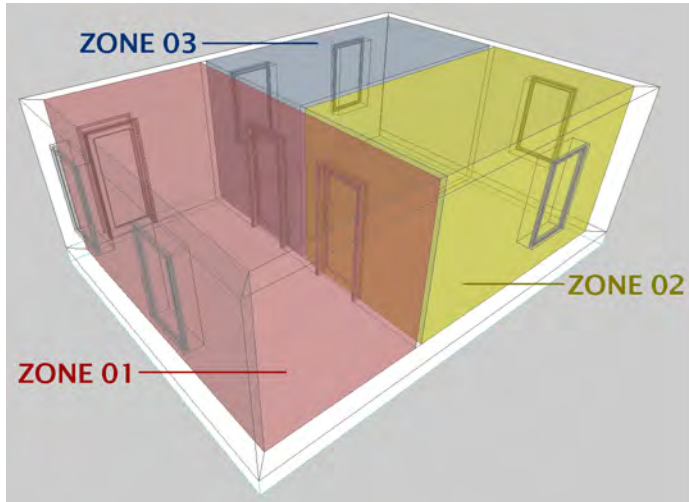
Please note that the activation and modification of IFC attributes works only in Floor Plan views.

For more information on structural-related IFC features, see:

<http://www.graphisoft.com/products/archicad/solutions/structural.html>

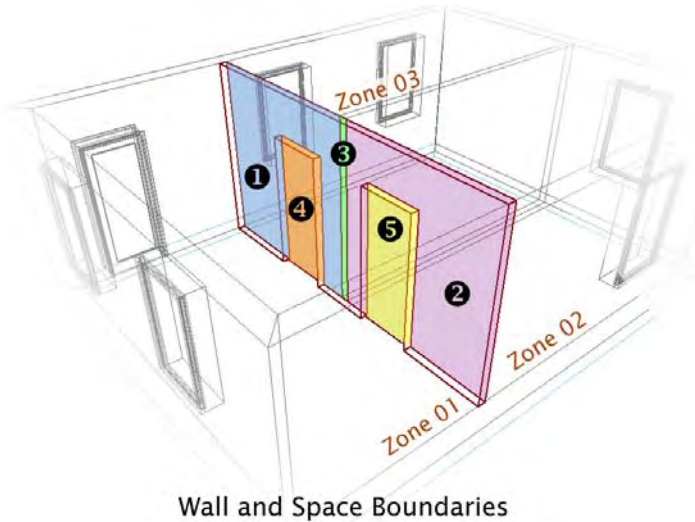
IFC Settings for Thermal Calculation

ArchiCAD with its Zone concept gives perfect input for thermal calculation software applications. Zones are 3D solids in geometrical aspect and in normal cases are bordered by two slabs and four walls.

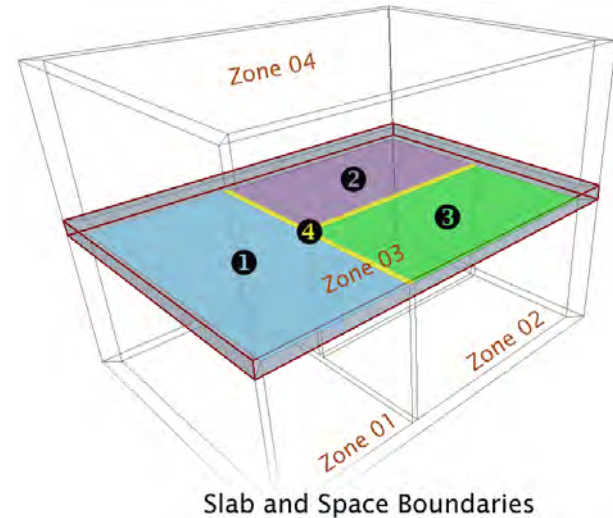


ArchiCAD calculates the position and the size of elements that border Zones.

In practice, the structural elements (e.g. walls, slabs and roof), windows and doors all have different thermal conductivity properties. Therefore, ArchiCAD divides the zone boundaries according to the areas defined and cut by connected elements and openings.



Wall and Space Boundaries



Slab and Space Boundaries

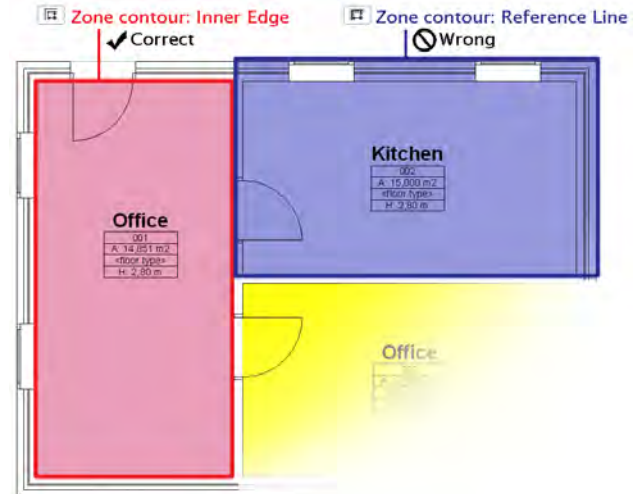
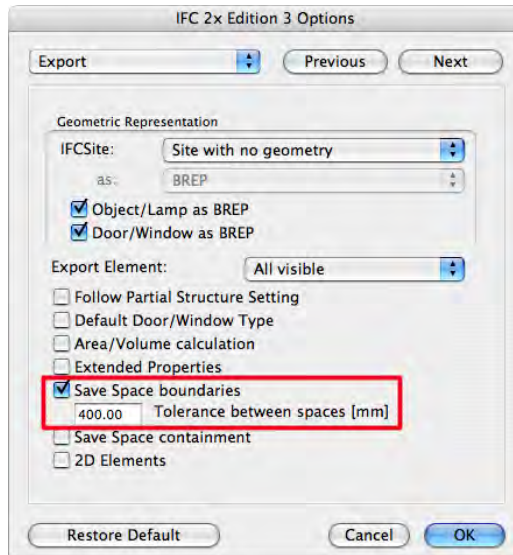
Space Boundaries:

- 01 - Wall part defined by Zone03
- 02 - Wall part defined by Zone02
- 03 - Wall part cut by connected wall
- 04 and 05 - Area defined by door opening

Space Boundaries:

- 01 - Slab part defined by Zone01
- 02 - Slab part defined by Zone03
- 03 - Slab part defined by Zone02
- 04 - Slab part without thermal convection

ArchiCAD can store Space boundaries (wall and slab parts) and their relations (IFCRelSpaceBoundary) together with the zones (IFCSpace) in IFC files. Just activate the “Save Space boundaries” option in the Export tab of the IFC saving dialog (Save as).



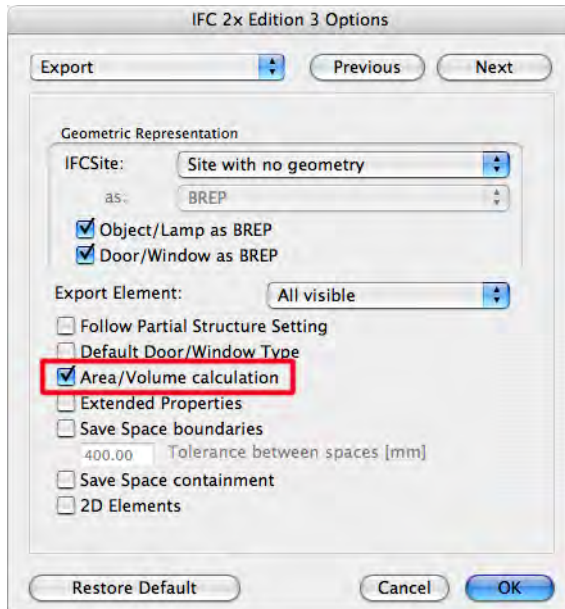
The *Tolerance between spaces* means the maximum distance between neighboring zones or - in other words - the thickest wall/slab.

Note: Space boundary calculation in ArchiCAD only works if you have placed the zones using Inner Edge definition method.

IFC Settings for Quantity Takeoff

To provide Quantity Takeoff parameters (for example for cost estimation applications), ArchiCAD calculates quantities of the following elements: Wall, Column, Beam, Slab, Roof (slab) and Zone.

Activate the Area/Volume calculation option in the Export tab of the IFC Options dialog (after you have done a File > Save as IFC).



For example, in the case of walls, the following quantities (IFCElementQuantity) will be saved in IFC files:

- Height,
- Perimeter,
- Gross volume,

- Net volume (volume reduced e.g. by columns embedded into the wall),
- Gross Floor Area (doors are not considered),
- Net Floor Area (area reduced by door footings),
- Gross Wall Area (openings are not considered),
- Net Wall Area (area reduced by openings).

