Tip Sheet

The TIP Sheet has been updated from October 2008

ArchiCAD 12
Mark Horrocks
Graphisoft New Zealand
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IFC in ArchiCAD – Communicating with Structural Engineers

Exchanging 3D Model data between ArchiCAD and your Structural Engineers can be done using IFC Transfer.

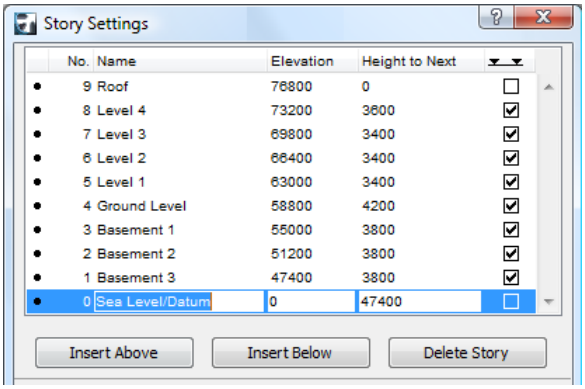
IFC – Industry Foundation Classes - is a neutral file format that makes it possible to exchange information between different CAD systems and other systems in the building and facility management sectors. Most commonly this will be between Architects and Engineers, allowing a higher level of co-ordination than is achievable with 2D files.

Initial Planning Tips

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.
   ArchiCAD 12 by default has IFC 2X3 installed, but IFC 2X2 can be downloaded and installed from the *Goodies* page. **Help > ArchiCAD 12 Goodies**.
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 *Using Partial Structure Display* 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. IFC 2X2 has similar filters but does not recognise ArchiCADs Partial Structure Display.
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) Most important is that the IFC file and ArchiCAD file have the same Story Levels. When setting up the project make sure that these are the same. It may mean that the Architectural model may have additional Levels that are not used by the Architect, but are necessary for the IFC model to place accurately within the Architectural model.

   The horizontal levels of your Projects in ArchiCAD are called Stories (not to be confused with the actual Floor Stories). To get the best results from ArchiCAD *AND* your IFC Transfer file we suggest that you DO NOT have negative Stories. Start your Project with Story 0 as your Sea Level/Datum. Story 1 will be your lower most modelled Floor; this could be your Ground Floor, Basement, Lower Level 7 etc. Story 2 becomes the next Floor and so on. Do not be tempted to create extra Stories for levels like Top of Railing, Top of Parapet, etc, as these are not Floors, they are simply heights of Objects placed on a specific Floor.

   Refer to ARCHICADselect TIP Sheet 'Setting up Stories' – November 2007 for more information on Setting up Stories.



5) When exporting an IFC model, it is good practice to check the IFC model in an 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

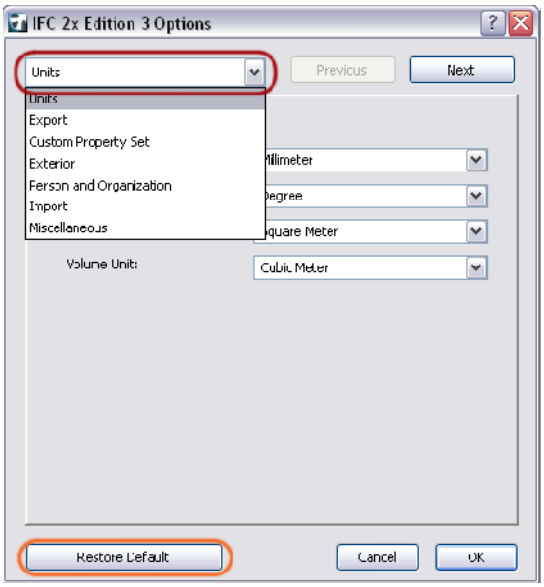
Additional information can be found at the following Wiki address: http://www.ifcwiki.org/index.php/Free_Software

Quick IFC Export Settings for Structural Connection

IFC allows structural engineers to use models created by architects in ArchiCAD. However, since structural engineers need to see only the load-bearing structure of the buildings, such as slabs, walls, beams and columns, the architectural models can be simplified with a customizable layer system in **Layers** and **Layer Combinations**, and through **Partial Structure Display** in ArchiCAD, as well as through the settings of the IFC saving procedure.

This document shows how the settings of IFC export affect the content and size of the models sent to structural engineers.

Model export can be performed with the **File > Save as** command. Set the output file extension to *IFC_2x3 (*.ifc)* in **Save as type**. A dialog box appears with all settings options collected under drop-down menus.
To start with the suggested initial settings, click *Restore Default*.

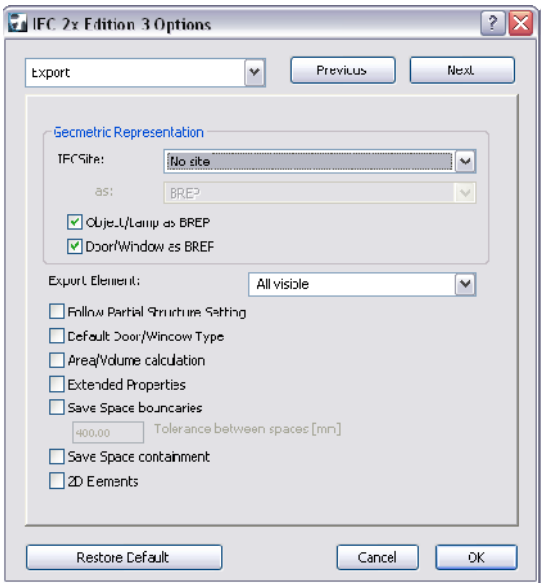


> **Units**

Specify the units of *Length, Angle, Area and Volume*.

> **Export**

Specify the way certain objects are handled.



"IFCSite"

Most of the structural software does not use *Site* data, in which case the *No site* option needs to be selected.

If *Site* and *Mesh* objects are needed, choose one of the four options and set it as Surface based. This will export a single surface based on the extent defined by a plan view.

"Object/Lamp as BREP" and "Door/Window as BREP"

If these checkboxes are enabled, ArchiCAD's objects, doors and windows will export their geometry in BREP (Boundary Representation) format. This may result in a significantly larger file size than if they were exported without the geometry.

A *BREP* is a geometric object that is specified by its boundary faces.

Normally it is better to disable this flag, because a smaller IFC file is created, and the *BREP* geometry is only used for visualization in most structural applications anyway.

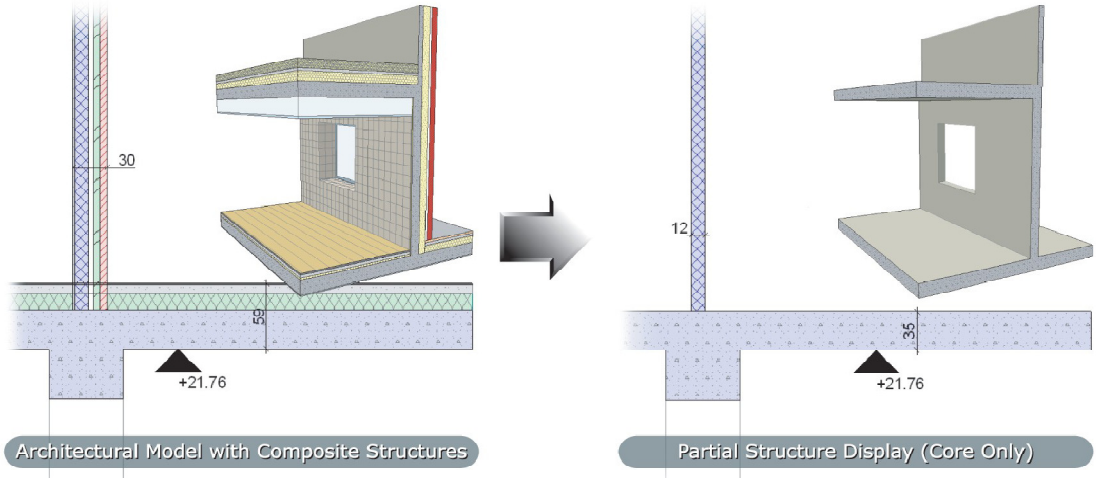
"Export elements"

Filter elements in the current ArchiCAD database for export. The possibilities are:

- **All**: Save every building element on every story of the building, visible or not.
- **All visible**: Save every visible element on every story.
- **All on current story**: Save every element on the current story visible or not.
- **All visible on current story**: Save every visible element on the current story.
- **All selected**: Save all selected elements on the current story.

"Follow Partial Structure Setting"

Enable this option to filter the 3D model according to the **Partial Structure Display** settings. If the **Core Only** option is active, only the load-bearing core skins of composite structures will be exported.



"Default Door/Window Type"

"Area/Volume calculation"

"Extended Properties"

"Save Space boundaries"

"Save Space containment"

Disable all these options, because they are not important for structural models.

"2D Elements" (*Text, Fill, Line, Arc/Circle, Polyline*)

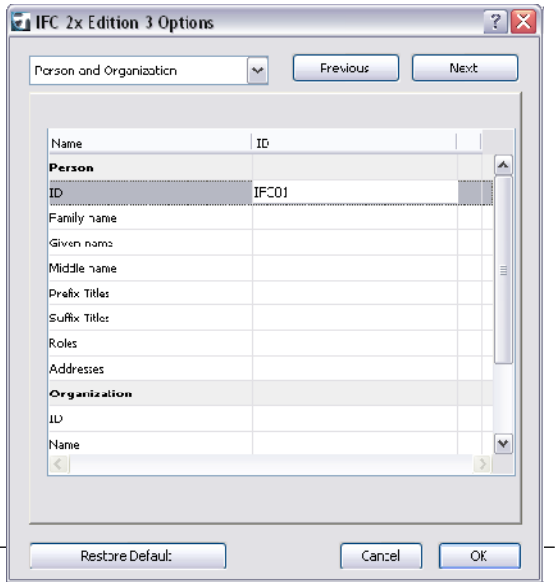
Enable this option if texts and draft are needed in addition to the structural objects. Disabling the option reduces the size of the IFC file.

> **Custom Property Set & Exterior**

Skip the dialog boxes by keeping these options disabled.

> **Person and Organization**

It is recommended to enter some data here (such as ID etc.) for easier project identification.

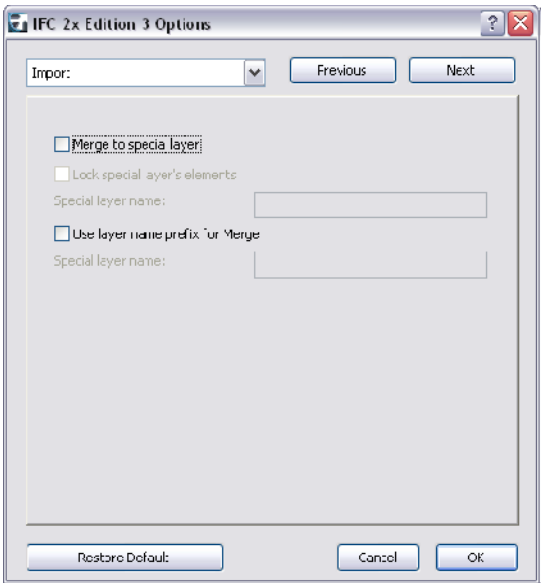


> **Import**

Settings of this dialog box affect the *Merge* command (*File/ File Special*) in ArchiCAD. With *Merge*, structural objects that will be reopened in ArchiCAD can be filtered by different rules (selection by structural type and/or item).

If subsequent import into ArchiCAD is not needed, disable (default) all *Import* options.

Enable *Import* options if structural objects are to be merged into one special layer or to be placed on defined layers in case you need to reopen the *IFC* file in ArchiCAD.



> **Miscellaneous**

Keep the default settings (*Restore Default*).

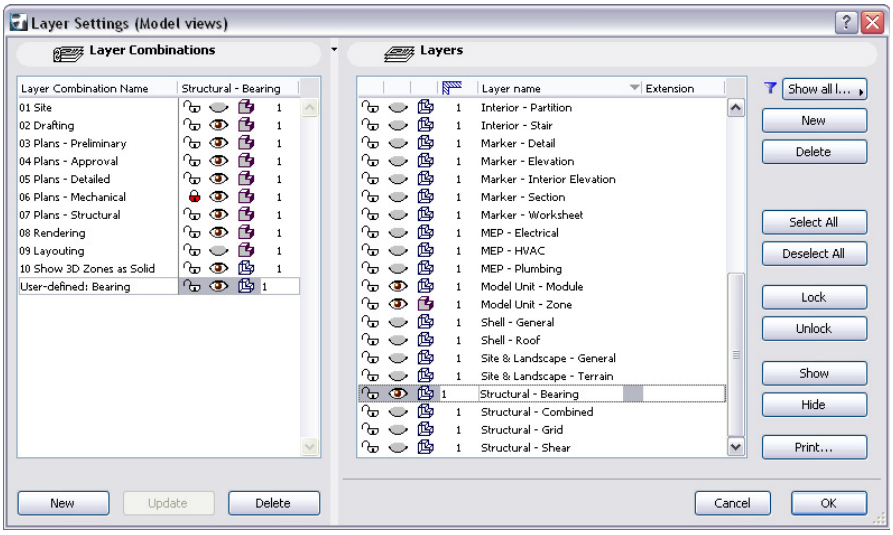
It is recommended that you always have the *Keep IFC Global Unique IDs* (*IFC GUIDs*) enabled. When exporting a new *IFC* file, the *IFC GUIDs* currently in the model will be retained, rather than a new set created. Enabling this setting is the default option and should be used to maintain a consistent model if you are using other *IFC*-based tools.

Press **OK** to validate export settings. The subsequent IFC file can then be issued to your Consultants and opened in the target structural software.

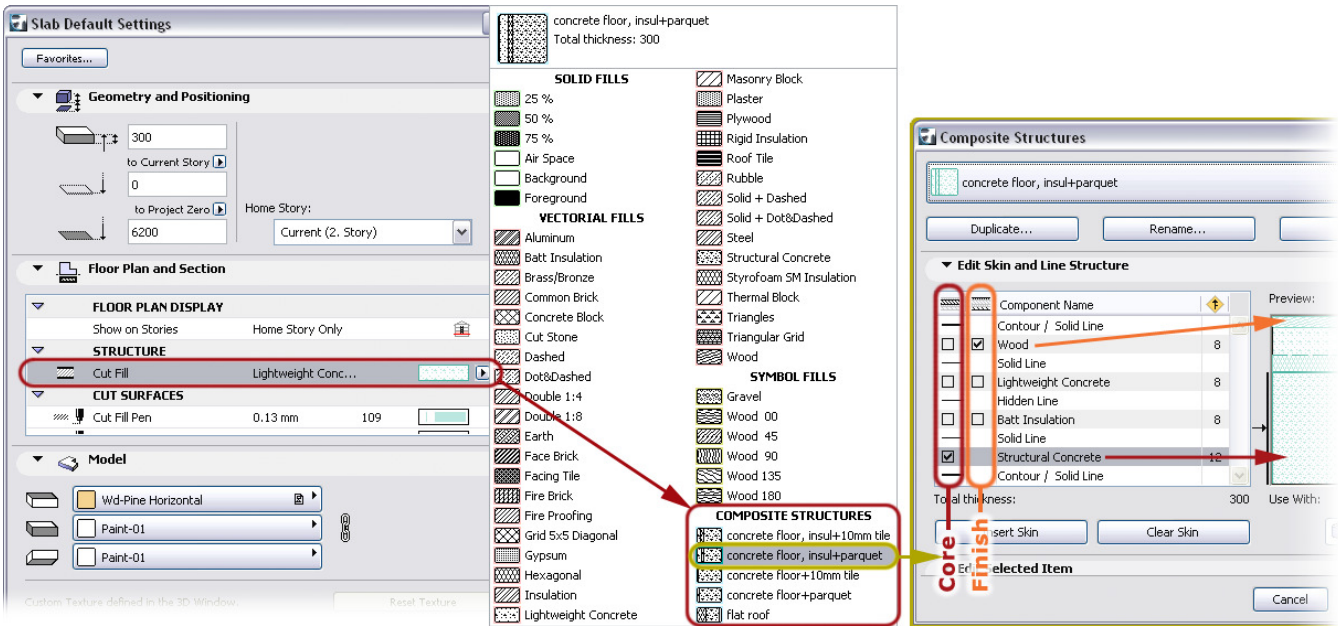
Using Partial Structure Display for Structural Connection

The **Partial Structure Display** function and the layer system in ArchiCAD allow you to display and output architectural elements in a simplified form. For example, when working with structural engineers, you may prefer to publish a structural plan or export an IFC file that shows only the real load-bearing structural elements such as the core of complex and composite elements.

As a first step, the load-bearing structural part of an architectural model may be filtered out of the entire structure by using **Layers** and **Layer Combinations** (**Document > Layers > Layer Settings**). For example, structural elements (slabs, walls, beams, columns etc.) can be placed on one single layer, or elements on independent layers can be grouped in a single **Layer Combination**.



The **Partial Structure Display** settings influence composite and complex structures only. *Slabs, Walls* and *Roofs* can be defined as composite structures in ArchiCAD. The load-bearing part of a composite or complex structure is the *Core* skin. The next figure shows how you can set *Core* and *Finish* skins for composite structures (**Options > Element Attributes > Composites**).



Partial Structure Display affects the display of elements in 2D and 3D windows alike, and it can be assigned to the following window types:

- *Floor Plan*,
- *3D Window*,
- *Section/ Elevation/ Interior Elevation/ 3D Document*

  Each instance of these window types can have its own Partial Structure Display setting (for example, you can have three Section windows with three different Partial Structure Display settings).

  Exception> You cannot set a **Partial Structure Display** setting for a drawing-type *Sections* or *Elevations*.

- *Worksheet and Detail*

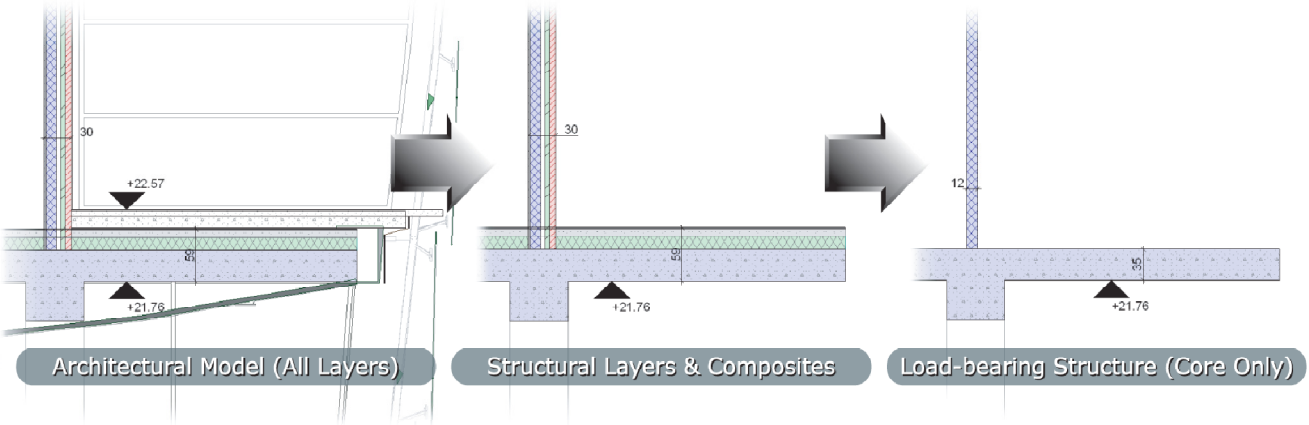
  If the source viewpoint is in the *Floor Plan* or is an *Auto-update viewpoint*, you can set *Partial Structure Display* settings for *Worksheets* and *Details* (separate ones for each window, if needed).

Partial Structure Display (Core Only) can be set for the current window at three different locations, dialogs:

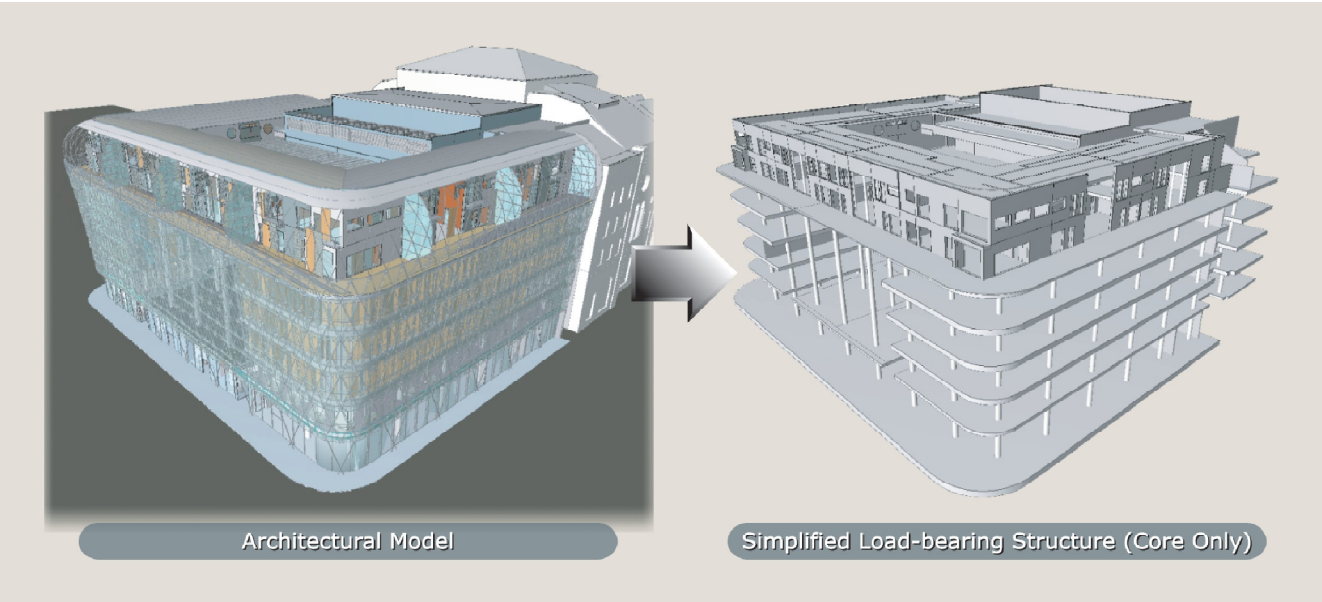
1. **Document > Partial Structure Display**;
2. **Properties > Settings** in the **Organizer Project Map**;
3. **Partial Structure Display** pop-up in the **Quick Options** palette.

The *Partial Structure Display* settings are saved with the view. The following figures are examples of *Partial Structure Display* settings applied for different views.

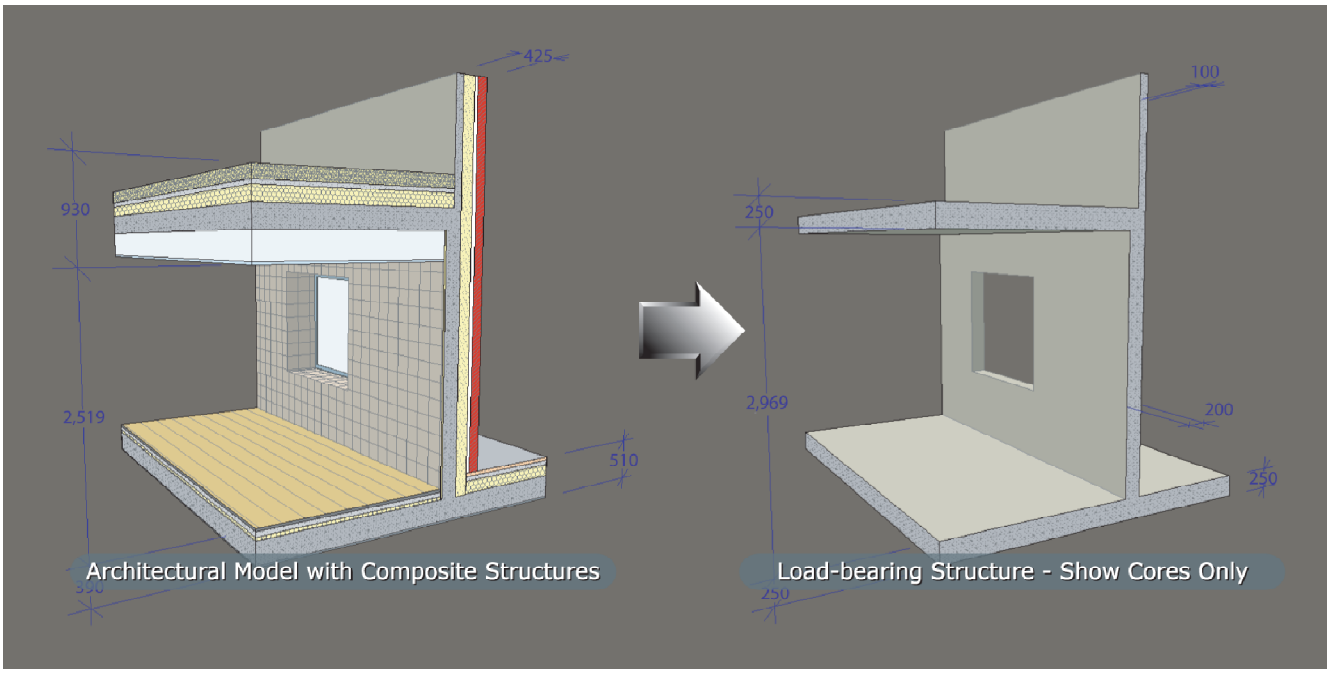
> Sections



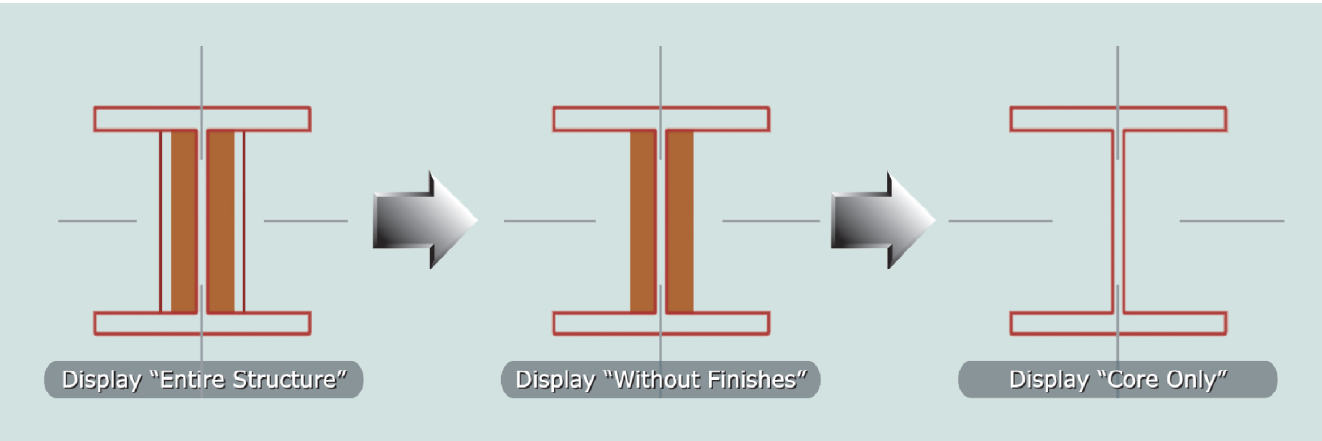
> 3D View



> 3D Document



Although *Columns* and *Beams* can have a *Core* and a veneer part, they are not considered composite elements for the purposes of *Partial Structure Display*. To display a column/beam with its core, create a Complex column/beam, set the veneer component as a *Finish*, and then switch *Partial Structure Display* to *Core Only*.



If you would like to save only the simplified state – that is, the load-bearing structure – of the current model as an IFC file, the following settings have to be considered during the saving procedure. This is the assumption of the **Quick IFC Export Setting**.

- **Export elements**
  Filter elements in the current ArchiCAD database for export. To consider the current view defined by a *Layer Combination*, choose the *All visible* or *All visible on current story* option (depending on whether you would like to save elements on every story or on the current story).

- **Follow Partial Structure Setting**
  Enabling this option saves elements with their displayed state set at *Partial Structure Display* settings (it affects composite and complex structures only).

Comparing the Structural and Architectural Models Using IFC and Trace & Reference

Depending on the results of strength analysis and design calculations, the structural engineer may propose changes in the layout, size and profile of structural elements. In addition to the 2D structural documentation set created in various file formats (*PDF, DWG* etc.), ArchiCAD can open 3D structural reference models saved as IFC files. Furthermore the differences between the original and the reference models can be displayed with the so-called *Trace & Reference* feature in ArchiCAD.

This document goes over the recommended comparison steps between:

- **Architectural model** (*Original*) The original ArchiCAD model simplified to load-bearing structure (see Partial Structure Display)
  and
- **Structural model** (*Reference*) The imported IFC model that includes the changes made by the structural engineer.

Note > *Trace & Reference* works only with 2D views of the 3D model, such as *Floor Plan, Section* and *Elevation*. This feature allows the comparison of two views/drawings on the same screen.

Recommended Comparison Steps in ArchiCAD

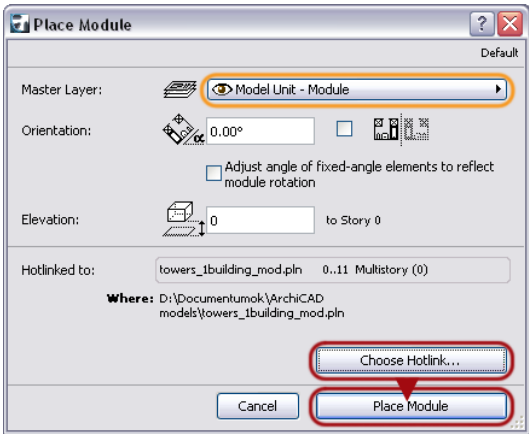
1. Open the Reference IFC model in ArchiCAD (**File > Open**).

2. Define a new layer (named for example "**Reference**" layer; **Document > Layers > Layer Settings**) and assign the model (the imported structural elements) to it.

3. Save the *Reference* model as PLN.

4. Open the *Original* ArchiCAD model.

5. Insert the *Reference* model as an embedded module into the *Original* model.

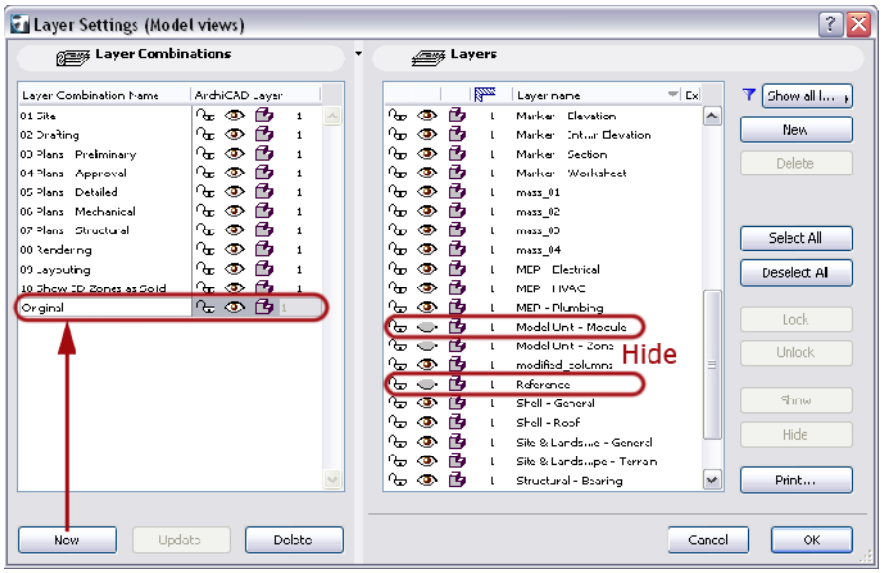


Use the *Place Hotlinked Module* command (**File > External Content**) and browse for the PLN file saved in the 3rd step with *Choose Hotlink*. The Reference model will be placed on a layer (the default is Model Unit – Module) set at Master Layer.

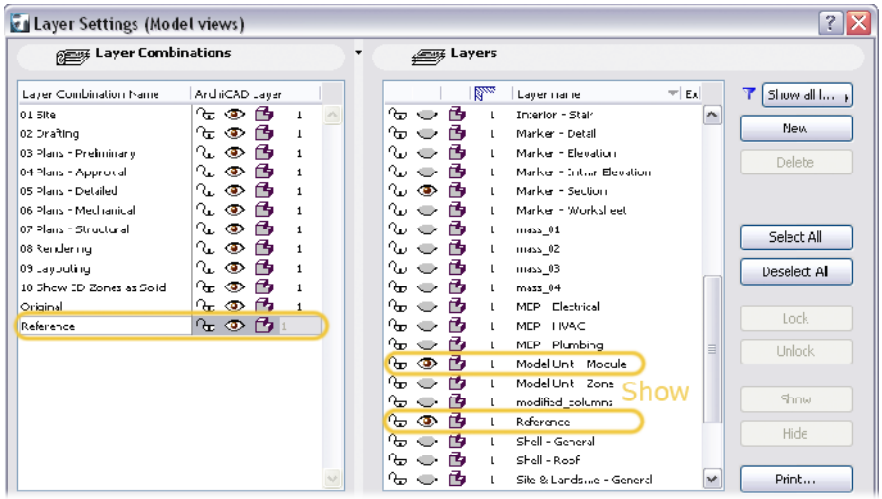
To compare the Original to Reference, it is suggested that the inserted module be placed at the same position as the Original (use Drag command, if needed).

6. Define two Layer combinations to separate the layers of the *Original* model from the layers of the embedded module (*Reference*). For example:

1. "**Original**" layer combination:
Hide *Model Unit – Module* and *Reference layers*.

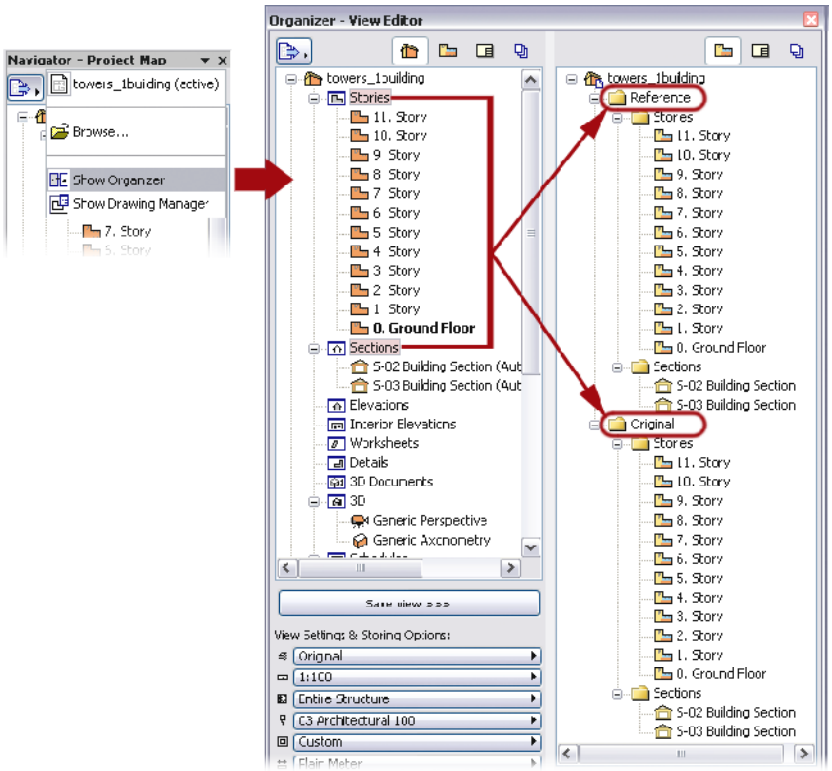


2. "**Reference**" layer combination:
Hide all layers and show *only Model Unit - Module* and *Reference layers*.

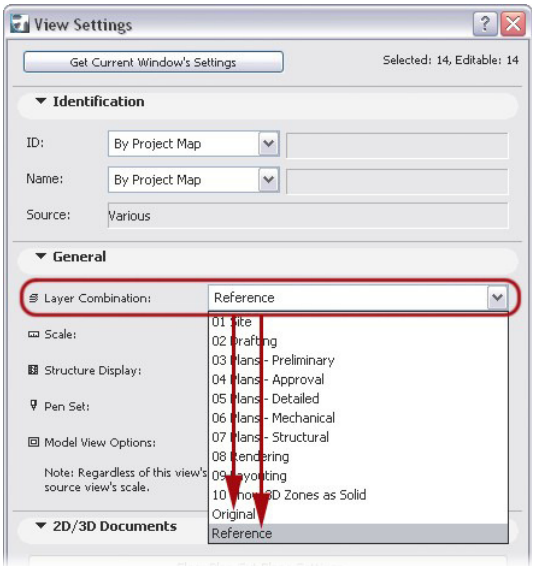


7. Define *Sections* where you would like to check modifications.

8. Define two groups (*Folders*) for the main project views (stories, sections etc.) in the **Organizer** (for example *Original* and *Reference* view folders).



9. Associate the *Original* and *Reference* layer combinations to the appropriate views, in View Settings.



10. Compare *Reference* to *Original* with *Trace & Reference*. To access its palette, choose **Window > Palettes >Trace & Reference**. Trace & Reference works with two views:

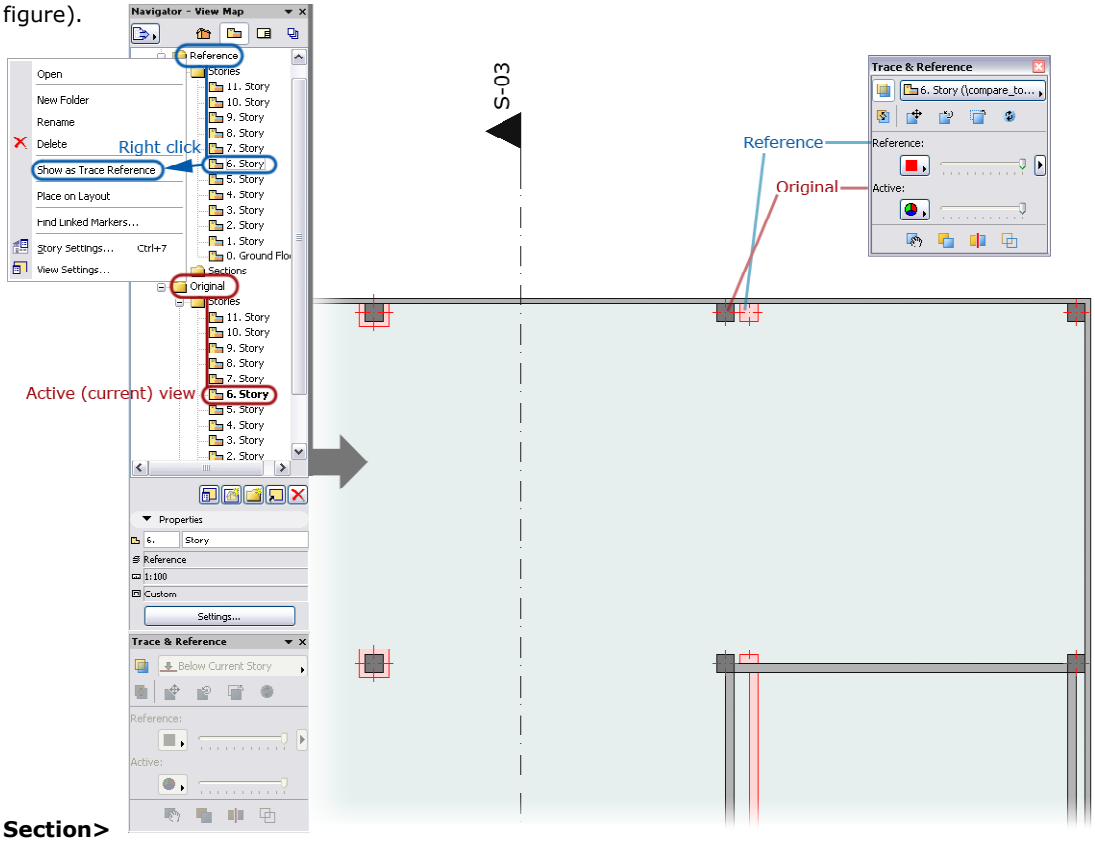
1. *Active*:
   The actual model or drawing you are currently working on.

2. *Trace Reference*:
   Optionally it is placed on top of or underneath the currently Active content. This acts as a kind of underlay, making it easy to compare multiple model views/drawings on the same screen.

Below are examples of how Trace & Reference works for comparing floor plans and sections of the *Original* and the *Reference models.*

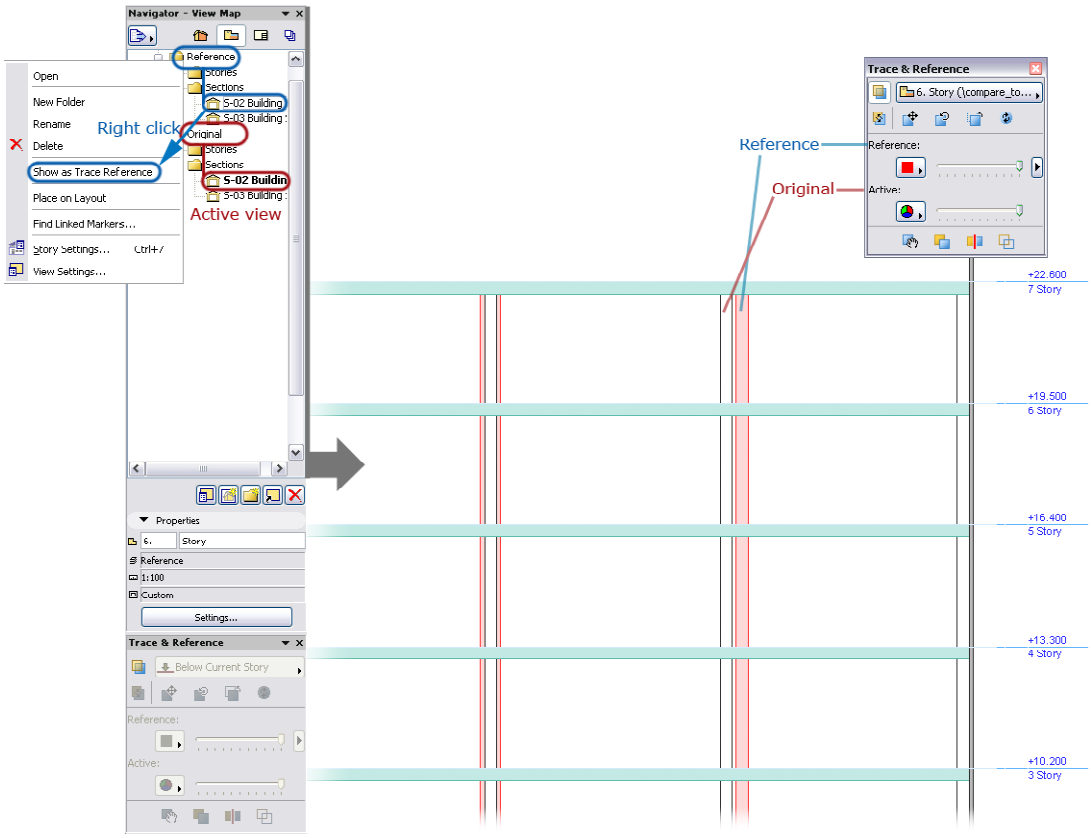
Floor Plan>

Activate a story view of *Original* (Active) in the *Navigator – View Map*. Right-click on the same story view (name) of *Reference*, and choose **Show as Trace Reference**. The Reference objects are shown in a particular colour (for example in red in the next figure).



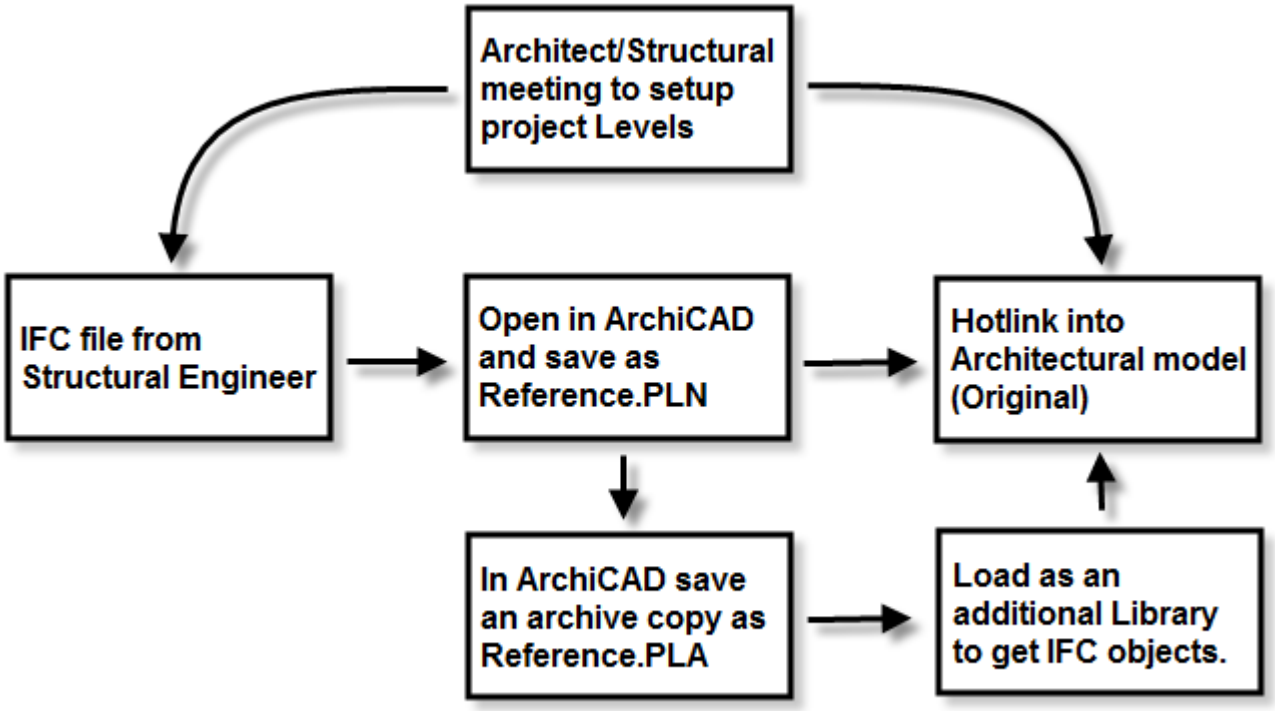
Section>

Do the same steps as described at *Floor Plan* to compare the Sections of the two models.



See more about the functions and the possibilities of Trace & Reference Palette in ArchiCAD Help.

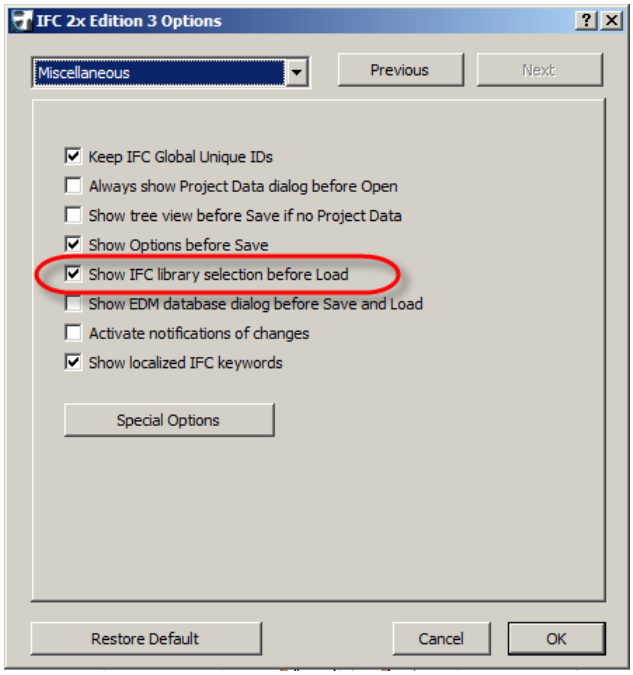
Architectural/Structural IFC Workflow into ArchiCAD



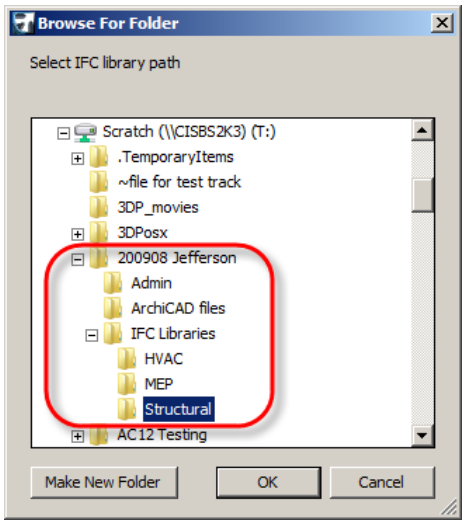
IFC within an ArchiCAD Teamwork Office

IFC models can be successfully used in a Teamwork situation. The main issue is the IFC Library. When you first import an IFC model you are asked for a location to place the IFC Library, typically this is your Local Drive. In a teamwork scenario this needs to be on a shared drive, so all teamwork members have access to it.

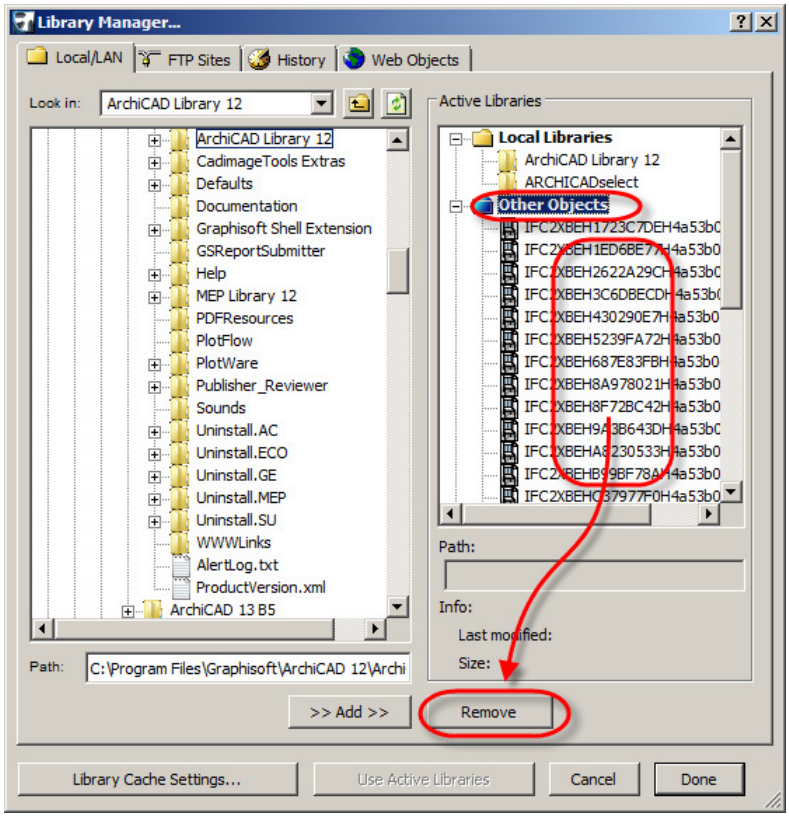
Within the IFC 2x3 Options, the **Miscellaneous** tab has a tick box to **Show IFC Library selection before Load**, this should be ON, and will be if you use the **Restore Default** button as set out earlier in this document.



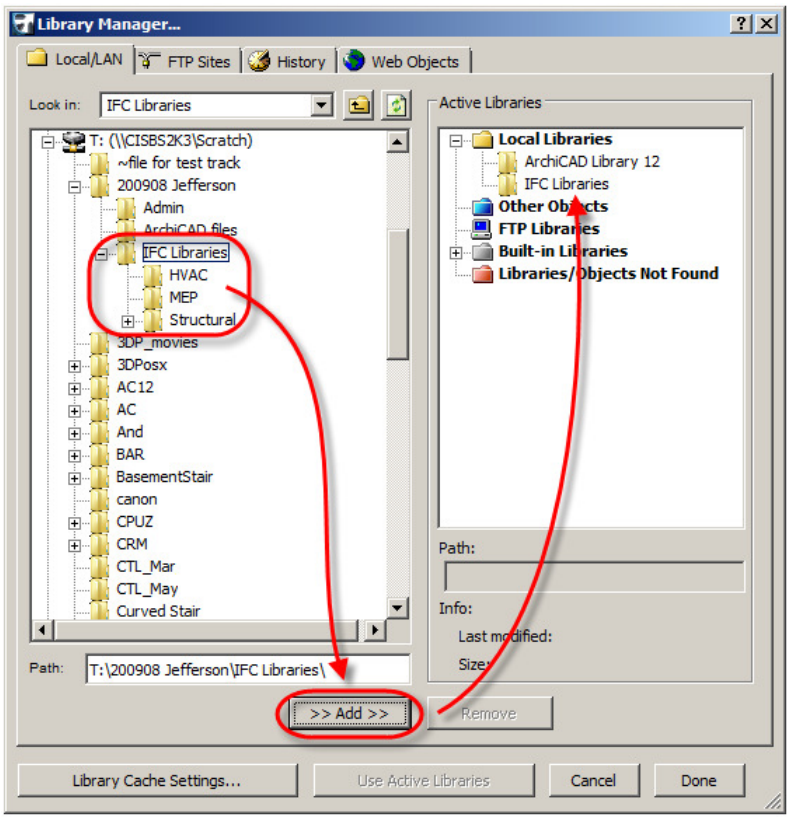
When you now import an IFC Model you will be prompted to save the IFC Library. It is recommended that this Library be on a shared drive, preferably in the project folder in a folder called IFC Libraries.



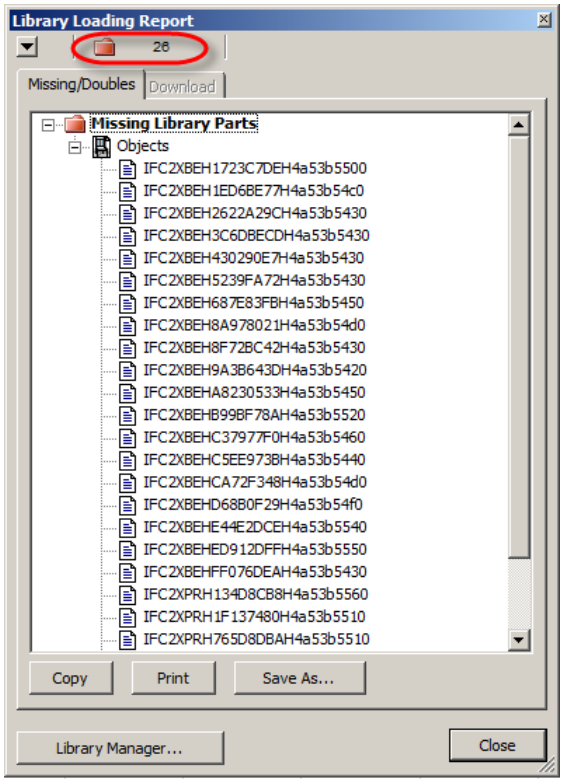
When you now open the **Library Manager** you will see all the IFC Objects listed in **Other Objects**. Select these and **Remove** them.



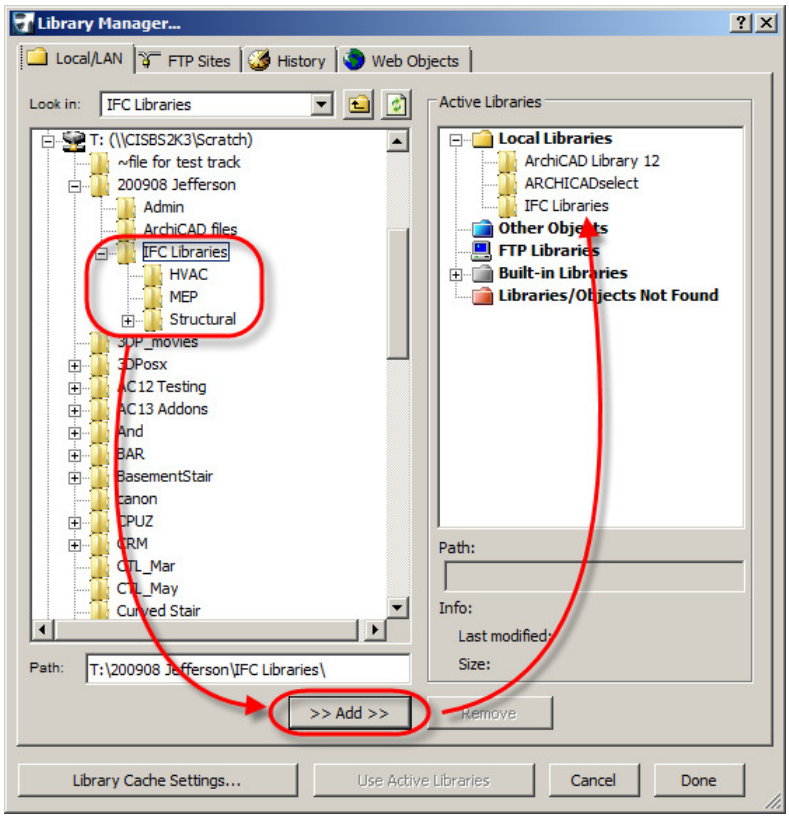
Then load just the IFC Library from the Shared Drive. And save the file as a standard ArchiCAD pln.



Now when this merged IFC .pln file is Hotlinked into your working file you will get a warning of missing Objects.



Open the Library Manager and Add the IFC Library from the Shared Drive.



Document compiled from various Graphisoft IFC Guides.