IFC: The Good, The Bad, The Ugly

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CM1640   Opinion on the ability of the Industry Foundation Classes format (IFC) to provide the level of exchange necessary is divided: Is it the truly interoperable solution it was designed to be? Is it the only option when software vendors refuse to provide direct compatibility? Is it merely a Drawing Exchange Format (DXF) for the 21st century, incapable of providing a level of geometric coordination necessary for the majority of projects? Much has been said over the past 12 months or so about the need for an "Open BIM" solution. Even the UK government talks about "open sharable asset information" and there is plenty of evidence of one "open" solution communicating with another. Evolve Consultancy has worked with many consultants and contractors over the years, exchanging information between Autodesk®, Bentley®, and Graphisoft® authoring and collaboration tools. Is it the IFC standard that is to blame? Can we eliminate these issues? This class explains the key aspects of model structure and organization and how best to exchange coordinated information.

Learning Objectives

At the end of this class, you will be able to:

- Identify and list key areas for success and failure both in terms of graphics and metadata exchange

- Demonstrate IFC best-practice workflows and solutions to known issues

- Describe the actual technicalities of BIM exchange between major BIM software

- Set options for optimal IFC export and import

About the Speaker

Nigel is founding director of Evolve and has 20 years' extensive experience within the AEC industry. He has unique insight and first-hand understanding of cutting-edge design and construction data production and exchange practices.

Trained originally in structural engineering, Nigel has accrued invaluable experience in engineering and architecture through his work as Development Manager for notable projects including the Millennium Dome (O2 Arena) and the BBC Broadcasting Centre redevelopment.

Nigel provides pivotal services to high-profile clients including Ramboll, Nightingale Associates and Rogers Stirk Harbour + Partners.

Nigel regularly presents to major conferences in the US/UK and features in industry press. He is also chair of the AEC (UK) BIM Protocols Initiative, developing off-the-shelf protocols, based on British Standards, for the structuring and exchange of design documentations.

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Key Areas for Success

- Always confirm coordinate locations prior to beginning modelling.

- Consider the composition of your model, breaking down into linked models and worksets wherever possible to facilitate more efficient management of data.

- Plan your exchange requirements and reasons for exchange. Agree the required Level of Detail (graphics) and Level of Information (metadata) prior to exchange. "Just because you can, doesn't mean you need to".
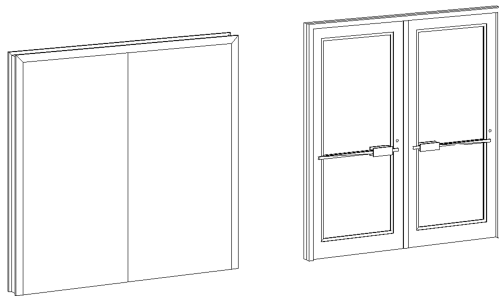
Comparison of graphical Level of Detail for the same door

- Use a Project BIM Execution Plan to record the requirements, expectations and exchange limitations. A free template developed on actual projects is available from Evolve Consultancy "Project BIM Execution Plan Template" .

- IFC should never be used as the de facto standard. Always research, review and test the most suitable exchange formats.

  e.g. For iterative geometry only design (exchanging models between architects and engineers) DGN/DWG is usually adequate and more reliable.

  e.g. For clash detection or scheduling (into Navisworks or Navigator) use NWC/NWD.

  e.g. Steel exchange should be done using CIS2.

- Where IFC is required, for design coordination and review, files should be exchanged in IFC 2x3 (*.ifc) Coordination View 2.0

- Autodesk Revit users should ensure their mapping of elements for IFC exchange for both import and export is correct to ensure reliable exchange.

- For exchange with Graphisoft ArchiCAD, import should be done using the Graphisoft add-in available here: http://www.graphisoft.com/downloads/interoperability.html. Supporting documentation is also available from this link. This add-in fixes a number of

known issues with IFC file transfer with Graphisoft ArchiCAD files into Autodesk Revit and it is imperative that this is used to avoid known issues. In particular this resolved the following – IFC GUIDS, Grids, Load-bearing slabs and Renovation status.

- Additional add-ins are also available for earlier versions of Autodesk Revit. These are available here:
  http://www.graphisoft.com/downloads/addons/interoperability/Archive.html.

- For export, the Sourceforge IFC Exporter for Revit should be used. These are available here: http://sourceforge.net/projects/ifcexporter/files/2013%20UI/.

- Layers should be exported in line with the relevant country standards (e.g. AIA / NCADS, BS 1192:2007, etc). Whilst Autodesk Revit doesn't specifically use layers whilst modelling, these are required by other software for IFC exchange. Layers are determined in the DWG settings or .ini file for DGN export and the correct settings should be selected before IFC export.

- Models should be exported from Autodesk Revit with only the relevant information switched on. Only export the minimum required for collaborative purposes.

  e.g. For architectural exchange, switch off additional Building Stories created for structural steelwork levels. These 'additional' levels can be switched off by un-ticking the 'Building Story' box in the models section/elevation. (Note: this is only available in Autodesk Revit 2013 and above).

- Optimise all IFC 2x3 files using Solibri IFC Optimizer before exchange. This is available here: http://www.solibri.com/solibri-ifc-optimizer.html. This will optimize the files and create a vastly reduced file size before files are exchanged.

- Models should be reviewed before exchange in an independent IFC viewer. The following viewers can be used to review IFC models:

  Constructivity Model Viewer (PC only): http://www.constructivity.com/cmviewer.htm

  DDS-CAD Viewer (PC only): http://www.dds-cad.net/downloads/dds-cad-open-bim-viewer/

  Solibri Model Viewer: http://www.solibri.com/solibri-model-viewer.html

  Tekla BIMsight (PC only): http://www.teklabimsight.com

  xBIM Xplorer (PC only): http://xbim.codeplex.com/releases

Best Practice Workflows

You need to coordinate all project models so that they all reference in the same coordinate space when exchanged using IFC.

Prerequisites

1. A know coordinate point. You may need to refer to your survey for this information.

2. A base coordination model (normally a whole model of the building, preferably in relation to the site).

How to coordinate

In each package, you need to work in a method that allows for accurate modelling and cross-system collaboration. In our experience, the most suitable methods for coordination are:

Graphisoft ArchiCAD Model close to 0,0,0 and reassign the coordinates.

Autdesk AutoCAD: Model in World Coordinates
                     - No additional instructions necessary.

Bentley AECOsim Building Designer / MicroStation:
                     Model in the centre of the design plane and reassign the coordinates
   using Global Origin

Autodesk Revit: Model in internal coordinate space and apply Shared Coordinates.
                     - Full details below.

### To assign coordinates in Revit:

1. Identify the known coordinate point.

   If you are working to a linked CAD grid file, you may need to draw a location line before assigning the coordinates. The Specify Coordinates at Point tool doesn't work with intersections.

   It's also a good idea (although not critical) to place a Spot Coordinate at your "project origin" for information.
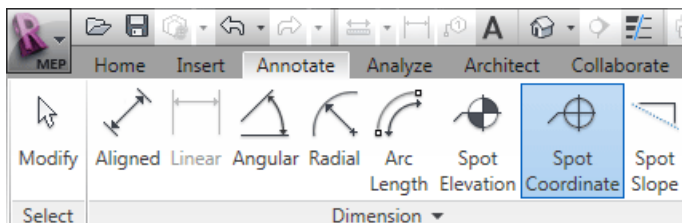

2. Go to the Manage tab > Project Location palette > Coordinates tool > Specify Coordinates at Point.
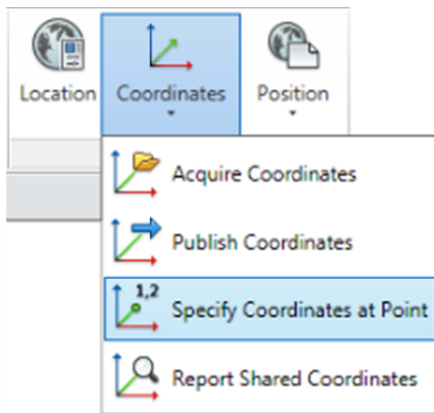
3. Click on the reference line.

   The Specify Shared Coordinate dialog will open. Enter the Coordinate points, the correct datum (Elevation) and the angle to True North. This will allow you to model orthogonally in Revit but still have reference to the correct coordination orientation.
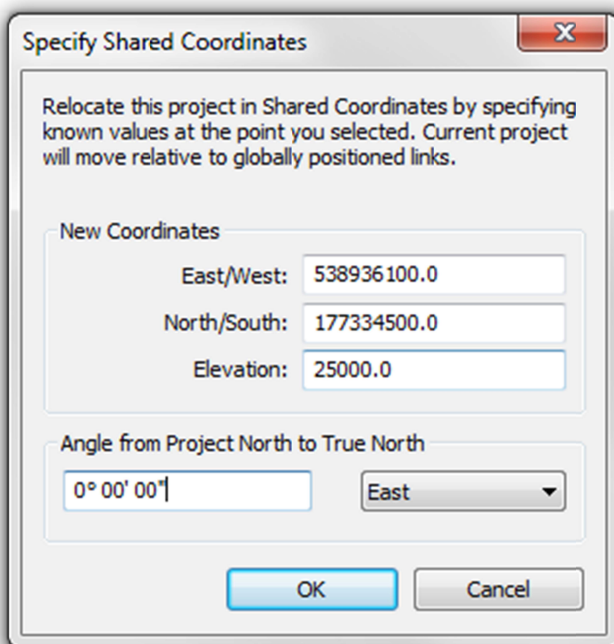
4. The project is now set up to use Shared Coordinates.

5. When creating or working with any other model, always use this base coordination model to "Acquire Coordinates" from (or "Publish Coordinates").

Technicalities of BIM Exchange

- **Sourceforge IFC Exporter** for Revit:
  http://sourceforge.net/projects/ifcexporter/files/2013%20UI/.

- **Autodesk Exchange Apps** Revit IFC Export Alternate UI 2014:
  http://apps.exchange.autodesk.com/RVT/2014/en/Detail/Index?id=appstore.exchange.autodesk.com%3arevitifcexportalternateui2014%3aen.

Additional IFC content is available from http://revit.autodesk.com/library/html/index.html:

- **IFC Metric Template.rte**. This file allows you to create new projects that are already set to the IFC standard.

- **IFC Parameter Upgrade.rvt**. This file enables you to upgrade an existing project to contain IFC parameters by reading the instructions contained in the IFC Parameter Upgrade.rvt file.

- **IFC Shared Parameters.txt**. This file contains the shared IFC parameters if you want to manually update an existing project to contain all or some of these parameters.

List of IFC certification: http://www.buildingsmart-tech.org/certification/ifc-certification-2.0/ifc2x3-cv-v2.0-certification/participants

Software claiming IFC support: http://www.buildingsmart-tech.org/implementation/implementations

Schema descriptions: http://www.buildingsmart-tech.org/ifc/IFC2x3/TC1/html/ifcproductextension/ifcproductextension.htm

IFC Import & Export

Many different modelling packages exist in the market place all using their own programming languages, each producing specific file formats that only open in the host programme.

When working as individuals on a model specific files cause no issues, it becomes problematic when there is a need to collaborate on a team. It would be great if everyone used the same software but in reality this rarely occurs, the Architect may be using Revit, the Structural Engineer may be working with AECOsim and so on. A generic file type for sharing information is required for the collaboration process to succeed.

In the 2D industry CAD users have often utilised DXF file formats for exchanging data between collaborating parties on a project. DXF is a common file format that is recognised by all the CAD software providers. The IFC (Industry Foundation Classes) format follows the DXF idiom of converting specific file formats into a generic standard, providing access to model information with many different products, which also includes free viewers.

As with the DXF file format IFC has certain limitations, dealing as a translator between different products inherently means not all the information gets converted, for this reason it is important that all files are inspected before issuing to the project team.

The following information will guide the Revit user through the process of generating an IFC file for export and also on importing a file from an external source. The aim is to provide the user with relevant information on the processes and any pitfalls to be aware of.

SETTING UP THE EXPORT TO IFC

Before embarking on the export process it will be necessary to configure the IFC mapping parameters to maximise the file translation process of the native model.

From the **Revit** icon choose **Export**, at the bottom of the list there is an **Options** menu that provides access to further settings.
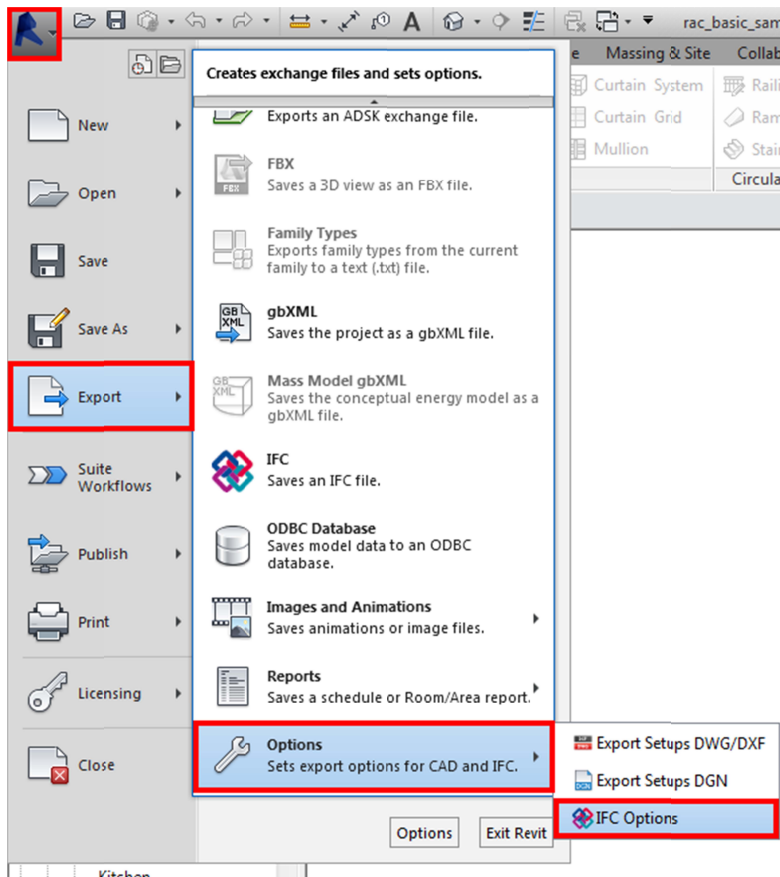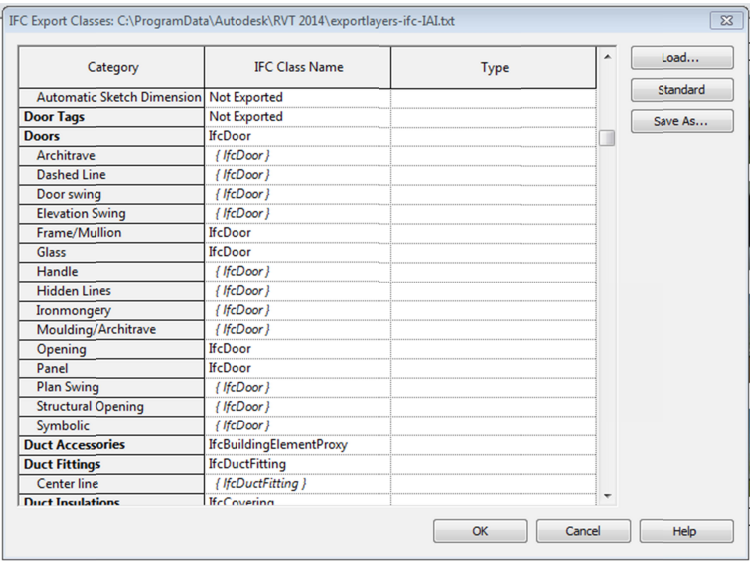
NB: You will need to scroll down, watch out for scroll arrows at the bottom of the list.
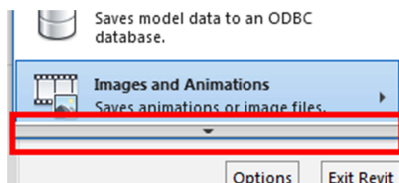
The **IFC Options** opens the **IFC Export Classes** dialogue by default this will be configured with the **exportlayers-ifc-IAI.txt**, which denotes items based on the IFC schema.

The IFC Export Classes should be edited so items listed as **not exported** export correctly. Selecting **Load…** from the dialogue will list the default location of the settings files, a copy of **exportlayers-ifc-IAI.txt** should be made before attempting any editing.
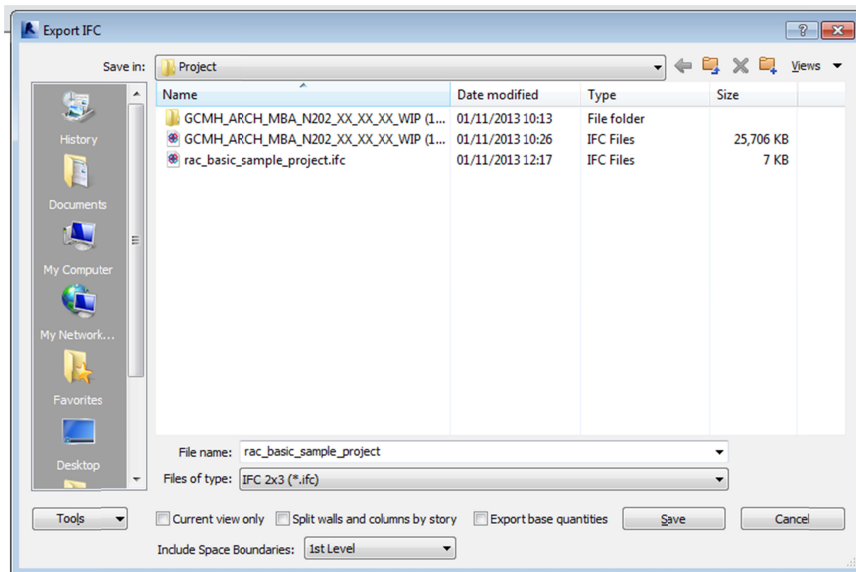
EXPORTING TO IFC

When a model is ready to be issued to the team the export process is relatively simple.

Click on the main **Revit** > **Export** > **IFC**
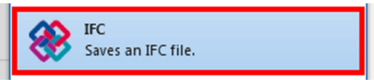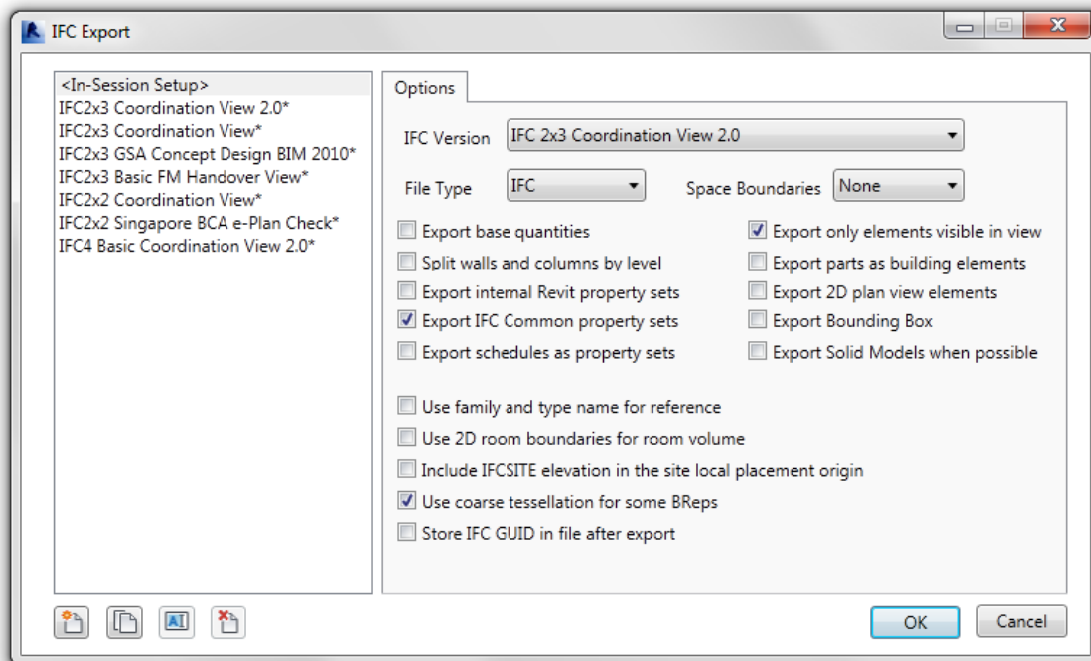

The **Export IFC** window will open.
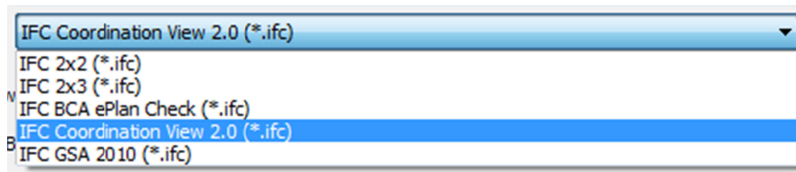
The standard Export IFC dialog box:

Using the alternative Export IFC interface:

Following company standards the destination folder should be set to the correct project output directory and a standard file name should be used.

There are five file type options to choose from:

- **IFC Coordination View 2.0** is the recommended file type to use when coordinating BIM projects.
- **IFC 2x2** is the second release of the IFC2x Platform, published in May 2003
- **IFC 2x3** is the third release of the IFC2x Platform, published in Feb 2006
- **IFC BCA ePlan Check** This is a certified variant of IFC 2x2 used for submitting files to the Singapore BCA ePlan Check Server. When exporting to this file type, users should make sure that all room bounding elements are selected.
- **IFC GSA 2010** is the U.S. General Services Administration version.

The alternative Export IFC interface offers the additional options:

- **IFC4 Basic Coordination View 2.0** for IFC 4 support.

At the bottom of the **Export IFC** dialogue are additional options:
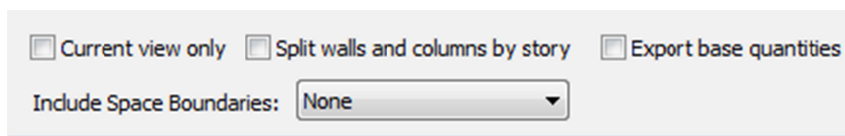
Current View Only exports only the entities that are shown in the current view
Split walls and columns by Story creates separate IFC files for each of the floors to help minimise the IFC file size on larger projects.

Export Base Quantities exports additional meta-data about elements for quantitative calculations. Although useful, this additional information can make the IFC file sizes large.

Include Space boundaries provides the level of room/space boundaries to be exported:
Set to **None** room/space boundaries are not exported.

Set to **1st level** the room/space boundaries are included but are not optimized to split elements with respect to spaces on the opposite side of the boundary.

Finally set to **2nd level** the room/space boundaries are included and are split with respect to spaces on the opposite side of the boundary.

Once a file has been exported verify the IFC model by opening it in an IFC viewer or import the file back into Revit to see the results.

SETTING UP THE IFC IMPORT

Opening or importing an IFC file follows the same principles as the export process. Click on **Revit > Open**
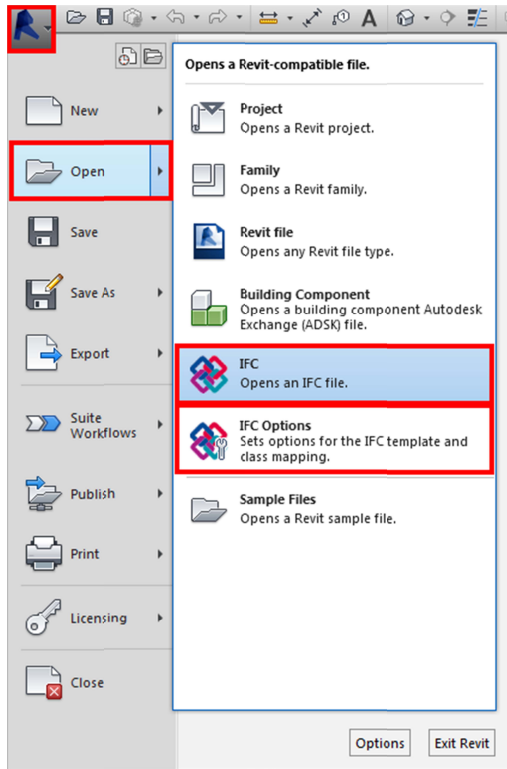

There is an **IFC Options** menu, this needs setting up in the same way as the export options and presents an almost identical dialogue box:
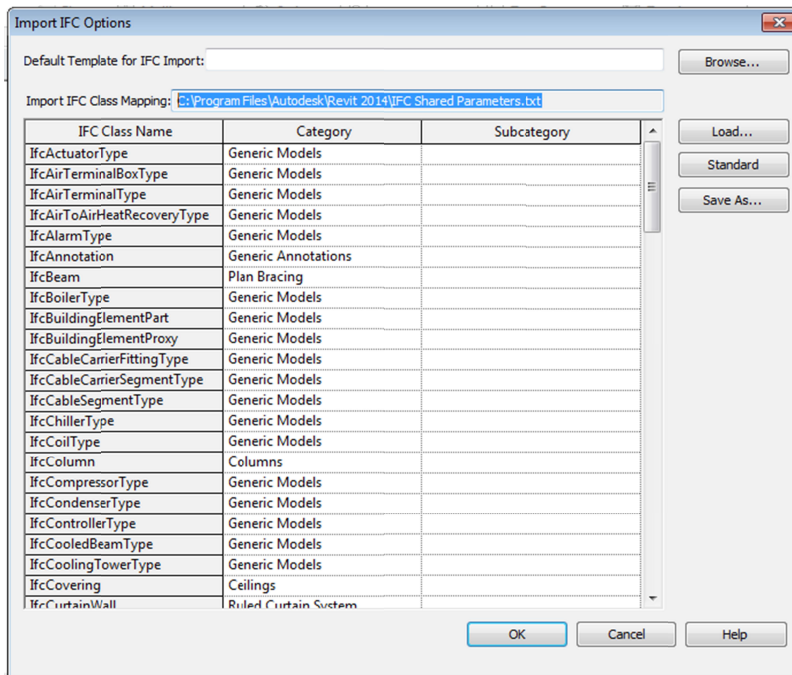
Clicking the **Standard** button will create a new IFC mapping file based on the delivered standard. Again it is recommended that this is customised, which can be achieved by choosing the **Save As…** button to create an **Import IFC Class Mapping File.txt** based on the delivered standard.

Once the mapping has been set choose the **Revit** icon and select **Open > IFC** this opens a standard looking file open dialogue box **Open IFC File**:
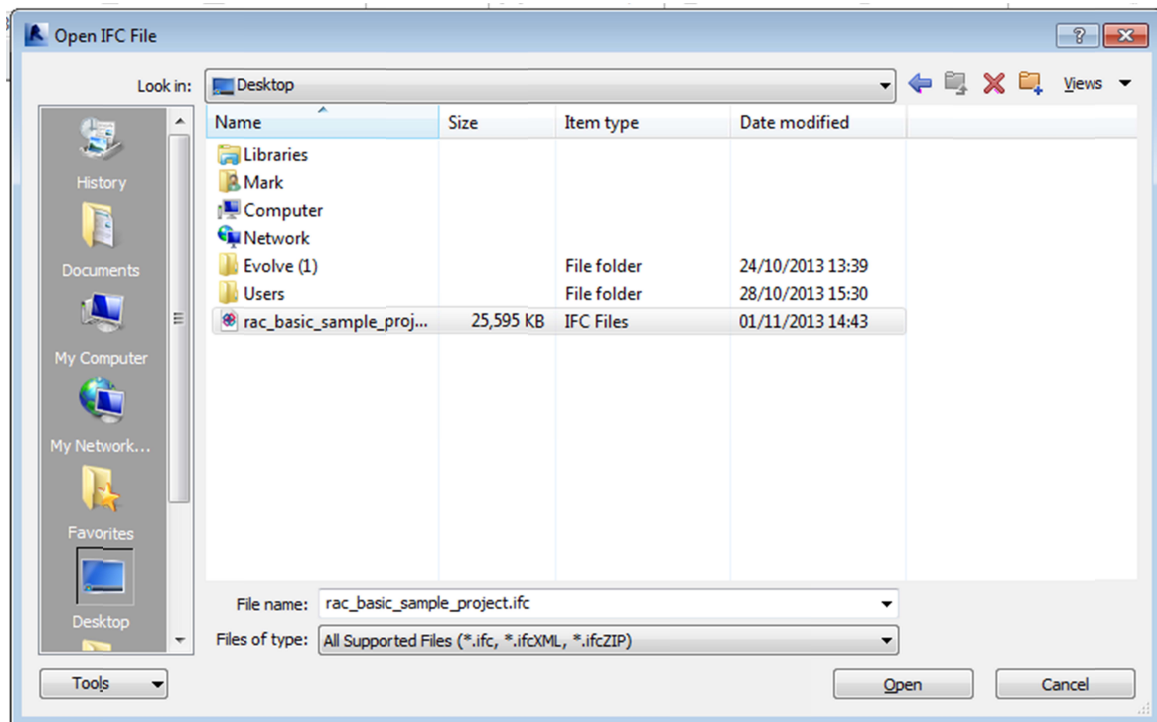
There are three supported file types available:

IFC this is the typical default

IFC-XML is an XML format defined by ISO 10303-28. This format is suitable for interoperability with XML tools and exchanging partial building models. Due to the large size of typical building models, this format is less common in practice.

IFC-ZIP is a ZIP compressed format consisting of an embedded IFC.

Simply browse to the correct directory and choose the file to be opened, the Import IFC Class Mapping File will be applied during the opening process.