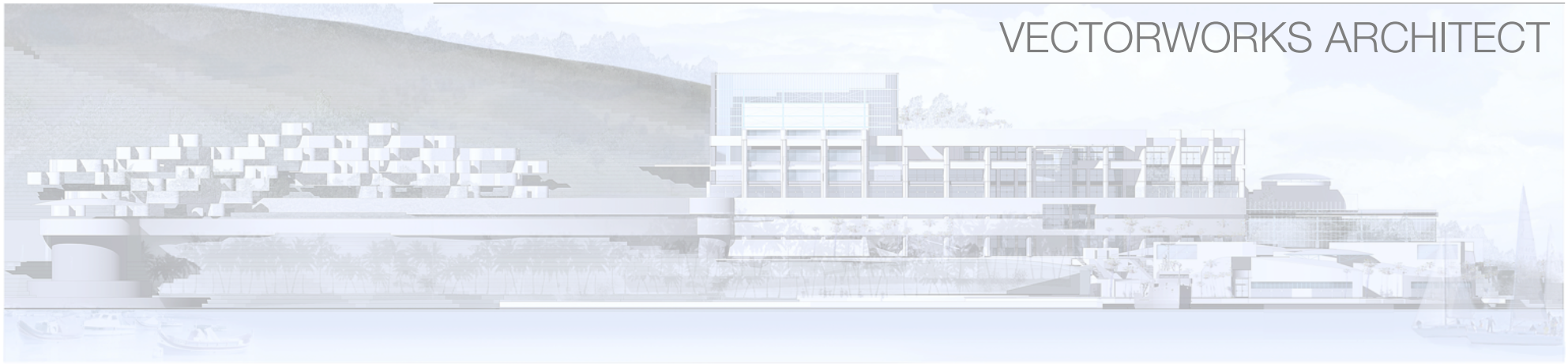
VECTORWORKS
A NEMETSCHEK COMPANY

SHARING YOUR MODEL WITH IFC

AN INTRODUCTION

VECTORWORKS ARCHITECT



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INTRODUCTION AND OVERVIEW

BIM authoring software such as Vectorworks has allowed architects and others within the AEC industry to create complex, data-rich 3D models to explore and document design. This new technology also means new ways to share information among all consultants on a project. It becomes essential to establish an agreed upon method and file format for exchange between the different disciplines on a team. In some cases, a traditional 2D, line drawing exchange such as a PDF or DWG, is needed to support those who have not entered the 3D realm. Other times, exchange of only geometry may be necessary for clash detection and as a "background" for referencing in the form a 3D DWG. However, if the file exchange needs to support Building Information Models and the sharing of geometry and data, then the IFC file format should be considered.

What is IFC?

IFC, or Industry Foundation Classes, is a standardized open source file format that is optimized for building information modeling. Much like PDF or HTML, the specification for the code is open-source and freely available to the public for use and for developers to create their own tools to handle the data format.

This means that all software vendors have equal access to the specifications and therefore, can create the necessary import and export technology. No single vendor controls this format or makes money from licensing this technology.

The most important thing to remember is that IFC encodes both geometry and data. Additionally, there are certain aspects of IFC that make it ideal for an open BIM exchange. These include:

Geometry – IFC geometry is robust and includes vectors, solids, surfaces, and so on.

Data – IFC supports three main aspects of the data in a BIM model:

> *Semantics* – the meaning or identity of a collection of geometry related to building objects, such as a window within a wall.
>
> *Relationships* – speaks to how the geometry is related to each other such as a door inserted into a wall
>
> *Properties* – definition of materials that includes data such as cost or model number

Central to the concept of IFC is the idea of "semantic objects." When the geometry of a model is identified as a building element and has "meaning" within the context of construction, it becomes a semantic object for a building information model. For this reason, IFC becomes an ideal file format to share a 3D model with associated data for the BIM process.

IFC is an international open standard, developed and maintained by buildingSMART International, for building models and data that permits information to be shared and maintained throughout the life cycle of a construction project: design, analysis, specification, fabrication, construction, and occupancy.

The capabilities and usage for IFC standards are evolving. Some examples of the use of IFC include:

- Collaborative design, where an architect exports an architectural model to a structural engineer for analysis and design, and then imports the structural model, in an IFC format, for coordination purposes
- Energy performance simulation and analysis of a building envelope and systems
- Automated analysis of code compliance
- Space planning and space inventory analysis

Why is IFC important?

Being an open source file format, IFC supports a more collaborative BIM process allowing each project stakeholder to make meaningful contributions to the project using the best-suited tool for the job. Every member of the project team has different needs and different end-goals. That means that they will be using the BIM model for different purposes and to gather or generate different or unique data. There is no single application that can fulfill all these different uses and needs. If each project member is able to use

USING IFC IN VECTORWORKS

the tool of their choice, then they are able to do their part in an efficient, effective, and executable manner. All the while creating a model that can be shared and effectively used throughout the BIM process.

Some other benefits of using the IFC file format include: ownership of your project contribution and the ability to be independent of limitations of versioning found in proprietary file formats, portability and accessibility of project information from different applications, and the extensibility of an IFC file.

What does IFC mean for Vectorworks users?

For Vectorworks users, IFC is the file format needed to share *both* the geometry and data within their BIM model with the project owner, the project consultants, construction manager, facilities manager, and other project team members who are not using Vectorworks.

Vectorworks supports Building Information Model (BIM) interoperability using the Industry Foundation Classes (IFC) file format. Vectorworks currently supports IFC versions 2x2 and 2x3 and has been certified by buildingSMART International for the export of models based on the IFC2x3 Coordination View 2.0 – Architecture model view definition, as well as the import of any IFC2x3 Coordination View 2.0 model. This manual assumes the use of at least Vectorworks Architect.

Vectorworks Architect provides you with the necessary tools to create a complete and useful IFC model. Nearly all default content within Vectorworks Architect is tagged for IFC export requiring minimum effort by the user.

With the IFC Data command, you can assign IFC object types and properties to custom-built geometry so applications that “read” IFC files can identify these objects.

Additionally, when IFC files are imported into Vectorworks, the IFC objects within the file are brought in as a particular and flexible kind of plug-in object called an “IFC Entity.” An IFC Entity is created because the properties of objects created in other programs cannot easily be matched to all the corresponding Vectorworks object properties and controlling parameters. For more detailed information on the export and import of IFC files, see the Export/Import Section of this guide.

The semantic definition of an IFC Entity - IfcColumn, IfcWall or IfcWindow, for example, is maintained and displayed. Like a group or symbol, an IFC Entity can contain a collection of geometry, and, like a plug-in object, it can be inserted into walls and has sets of data and properties attached. With this generalized import capability, Vectorworks can import any kind of object supported by the IFC standard.

Space objects are somewhat unique in that when an IFC file containing space objects created in another program is imported into Vectorworks, the IfcSpace objects are correctly translated into corresponding Vectorworks Space objects.

IFC Objects and Property Sets in Vectorworks

An IFC object is a building object that has been defined by both its occurrence and type. This means that a building object created in Vectorworks, either with the default objects or a user-created object, can be tagged as an IFC object to define its semantics, properties, and its relationship to other building objects.

When an object is tagged for IFC, it is assigned an IFC Property Definition known as a Property Set or PSet. An IFC Property Definition captures an objects dynamically extensible property set, or associative data. This set of properties is attached to the object’s occurrence and type. More than one property set can be associated with an IFC object, including custom property sets that are defined by the Vectorworks user.

IFC Object Tags for Standard Objects

IFC Object Tags for Standard Objects

Most intelligent objects supplied with Vectorworks Architect through the default building tools or symbol libraries are designated with their appropriate IFC tag by default. Blow is a list of major building components and their corresponding IFC object tags.

Base Cabinet = IfcFurnishingElement

Bath-Shower = IfcFlowTerminal

Ceiling Grid = IfcCovering

Clothes Rod = IfcFurnishingElement

Column = IfcColumn

Column Wrap (Architectural column) = IfcCovering

Comm Device = IfcDistributionFlowElement

Compartment Sink = IfcFlowTerminal

Counter Top = IfcFurnishingElement

Curtain Wall (Straight & Curved) = IfcCurtainWall

Curtain Wall Frames = ifcMember

Curtain Wall Panels = IfcPlate

Desk = IfcFurnishingElement

Door = IfcDoor

Drilled Footing = IfcFooting

Simple Elevator = IfcTransportElement

Escalator = IfcTransportElement

Fireplace = IfcDistributionFlowElement

Floor = IfcSlab

Framing Member = IfcMember *or* IfcBeam

Grab Bars = IfcRailing

Guardrail (Curved & Straight) = IfcRailing

Handrail (Curved & Straight) = IfcRailing

HVAC Damper = IfcDistributionFlowElement

HVAC Diffuser = IfcDistributionFlowElement

HVAC Elbow Duct = IfcDistributionFlowElement

HVAC Flex Duct = IfcDistributionFlowElement

HVAC Outlet = IfcDistributionFlowElement

HVAC Splitter = IfcDistributionFlowElement

HVAC Straight Duct = IfcDistributionFlowElement

HVAC Transition = IfcDistributionFlowElement

HVAC Vertical Duct = IfcDistributionFlowElement

HVAC Vertical Elbow = IfcDistributionFlowElement

Incandescent Fixture = IfcDistributionFlowElement

Landscape Wall (including Arc and Bezier) = IfcWall

Massing Model (on layer mapped to site) = IfcBuilding

Mullion = IfcMember

Parking Spaces = IfcSpace

Pilaster = IfcColumn

Pillar = IfcColumn

Piping Run = IfcDistributionFlowElement

Plant = IfcBuildingElementProxy

Ramp = IfcRamp

Receptacle = IfcDistributionFlowElement

Roadway (all types) = IfcTransportElement

Roof = IfcRoof (containing instances of IfcSlab)

Roof Face = IfcSlab

Seating Layout = IfcFurnishingElement

Round Wall = IfcWall or IfcWallStandardCase

Wall = IfcWall or IfcWallStandardCase

Site Model = IfcSite

Shelving Unit = IfcFurnishingElement

Slab = IfcSlab

Space = IfcSpace

Stair = IfcStair

Switch = IfcDistributionFlowElement

Table = IfcFurnishingElement

Tables and Chairs = IfcFurnishingElement

Toilet Fixture = IfcFlowTerminal

Utility Cabinet = IfcFurnishing Element

Wall Cabinet = IfcFurnishingElement

Window = IfcWindow

Workstation Counter = IfcFurnishingElement

Workstation Overhead = IfcFurnishingElement

Workstation Panel = IfcFurnishingElement

Workstation Pedestal = IfcFurnishingElement

Additionally, as of Vectorworks version 2010, nearly all symbols in the following symbol libraries have appropriate IFC2x3 object types pre-attached, so that symbols used from these libraries properly export to IFC2x3:

Architect Sampler.vwx

Equip-Office Equipment.vwx

Equip-Residential Appliances AGA Ranges.vwx

Equip-Residential Appliances SubZero USA.vwx

Equip-Residential Appliances Wolf USA.vwx

Equip-Residential Appliances-Audio Video.vwx

Equip-Residential Appliances-Imp.vwx

Equip-Residential Appliances-Metric.vwx

Equip-Restaurant Equipment-Imp.vwx

Fixtures-Imp.vwx

Furniture-Furnishings and Scenic Elements.vwx

Furniture-HMI-Modern Classics.vwx

Furniture-Knoll.vwx

Furniture-Misc-Imperial.vwx

Furniture-Misc-Metric.vwx

Furniture-Office.vwx

Furniture-Residential.vwx

Furniture-Systems HMI-Typicals.vwx

Furniture-Systems-Imp.vwx

Furniture-Systems-Metric.vwx

Openings-Windows Velux Skylights.vwx

Electrical-Lighting Fixtures Int & Ext.vwx

Electrical-Lighting-Imp.vwx

Electrical-Panels-Imp.vwx

Electrical-Panels-Metric.vwx

Electrical-Power Devices-Metric.vwx

HVAC-Equipment-Imp.vwx

Sanitary-Fixtures.vwx

Sanitary-Kohler Baths.vwx

Sanitary-Kohler Bidets.vwx

Sanitary-Kohler Faucets Bathtub & Shower.vwx

Sanitary-Kohler Faucets Kitchen.vwx

Sanitary-Kohler Faucets Lavatory & Bidet.vwx

Sanitary-Kohler Lavatory Sinks 01.vwx

Sanitary-Kohler Lavatory Sinks 02.vwx

Sanitary-Kohler Showers.vwx

Sanitary-Kohler Sinks.vwx

Sanitary-Kohler Toilets.vwx

Sanitary-Kohler Whirlpools.vwx

When exporting objects such as doors, geometric information (width, height, opening direction, etc.) is automatically exported, as this is based on the "physical" geometry of the object. This way model checking applications like Solibri can find collisions with other geometry such as columns, low ceilings or MEP elements like air pipes. When these objects have a default IFC tag they are also assigned an appropriate default property set associated with the IFC object. For example, a default door object is tagged as an IfcDoor and has the IfcDoor Pset associated with it (see Figure 1). Other Psets can be assigned to the object as needed.

An important thing to note is that behavior or transference of information from a default object's settings may not always translate to the appropriate fields of the default Pset that is attached to the object. For example, an "out of the box" wall style having data definitions such as an R-value or a fire rating will translate to the appropriate IFC Property Set field (IfcWallCommon) *automatically*. On the other hand, these settings for a door object will not. The user will have to assign the appropriate Pset *and* fill in the fields.

This guide will cover the behavior of some default objects in order to help you understand the behavior of the IFC data dialog box and the IFC export. Not all objects will be covered in detail. The hope is that with a better understanding of the IFC export behavior; the user will be able to troubleshoot any problems that arise due to missing data and/or geometry.

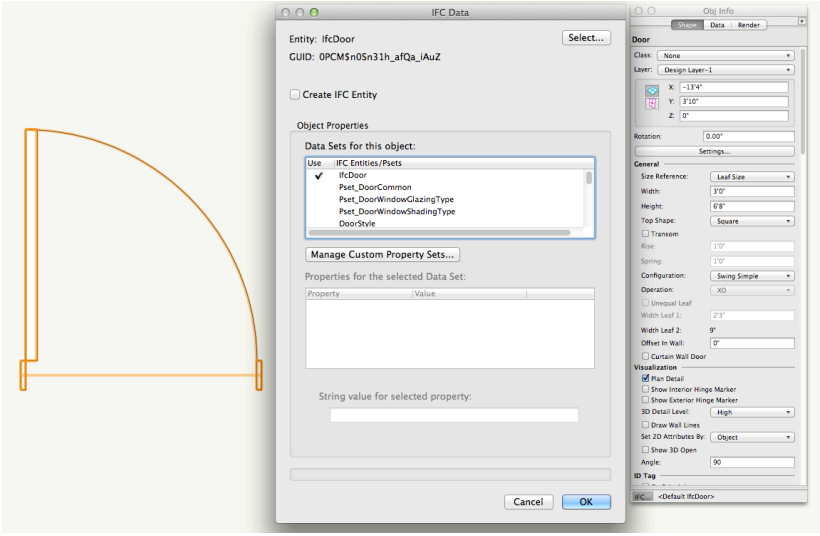

Figure 1 – IFC Object Type and Property Set for default Vectorworks Door PIO.

Assigning IFC Data to Objects

As mentioned before, when a Vectorworks project is exported as an IFC file, Vectorworks default building objects and the identified default library symbols that are pre-assigned IFC data, will be exported as IFC objects. However, custom-made objects are not exported unless they receive IFC assignments prior to export. IFC assignments to these objects can be done with the "IFC Data" command. Assigning IFC data to an object does not alter it in any visible way within Vectorworks. The object can still be edited with standard Vectorworks tools and commands.

To assign IFC data:

1. Select the object, group, or symbol instance (symbols that have been placed in the drawing) for assignment of IFC data. More than one item can be selected at one time.
2. Select the menu AEC > IFC Data

NOTE: Alternatively, you can access the IFC Data Dialog by pressing the IFC button found at the bottom left of the Object Information Palette. If you do not see the IFC button, go to the pull-down menu at the top right of the OIP and select "Show IFC Data" at the bottom of the menu (Figure 2).

The "Select IFC Entity" dialog box opens, listing available IFC object types (Figure 3). Here you select the IFC Object type to assign to the building object. Most entities supported by Vectorworks for export can be found in the "Simple List." Refer to the "IFC Object Tags for Standard Objects" section to use as a guide for tagging custom made objects.

3. Select the IFC object type and click OK. The IFC Data dialog box opens (Figure 4). Under "Object Properties," select the Property Set to assign to the IFC object by adding a check mark under the "Use" column. You can select multiple Property Sets. If you are attaching a custom property set, select the "Manage Custom Property Sets…" button (see the Custom Property Sets section for more information).

To enter the desired values for the properties of the selected Data Set, use the second window to select the property and the "String value" field (see Figure 4).

For more detailed information regarding the available fields in the IFC Data Dialog, visit Vectorworks 2016 Help online.

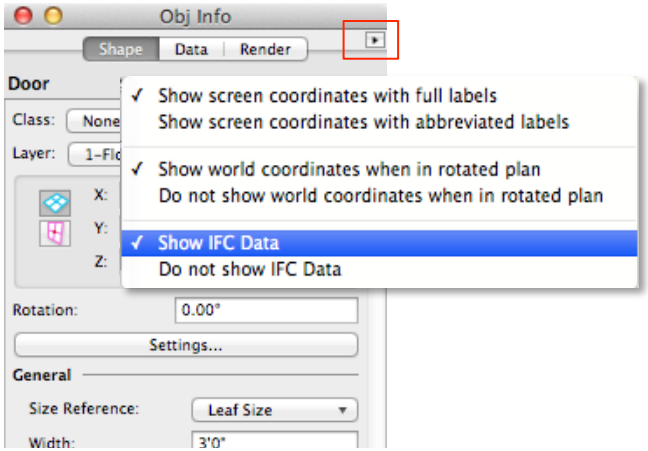

Figure 2 – Object Information Palette pull-down menu within the "shape" pane.

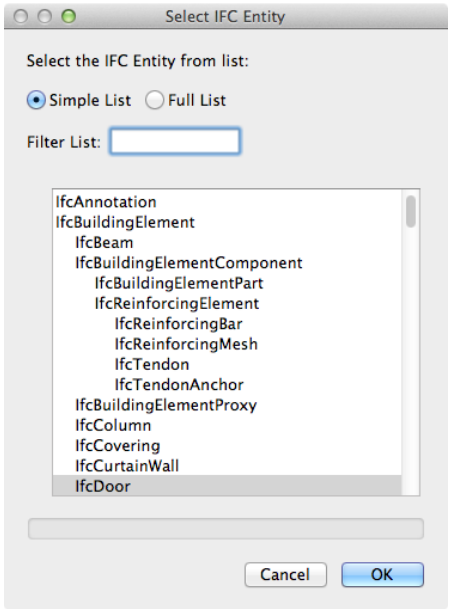

Figure 3 – "Select IFC Entity" dialog box.

4. Click OK to assign the IFC data to the object. The Object Info palette will now display the selected IFC object (IFC value type and the object name, if any) when Show IFC Data is enabled on the palette. Objects like walls and slabs, with default IFC data assigned, display with <Default> to indicate that the default IFC data has not been modified.

NOTE: When attaching data to a symbol there is the option to either attach the data to a specific instance of the symbol, or to the symbol definition. When applying IFC data to the symbol instance, you will see the following dialog: (Figure 5). If you select "Yes," the IFC data will be attached to all current instances of the symbol as well as the symbol definition. This means that any future placement of the symbol will include the data as well. Select "No" if the IFC data is to be applied only to the selected instance of the symbol.

To attach IFC data to a symbol definition through the Resource Browser, select the symbol definition in the Resource Browser, right-click and select IFC Data from the menu. After attaching the data, you will see the following dialog: (Figure 6). This attaches the IFC data to future symbol placements, and to any current instances that do not have IFC data already attached to them. This option is best for making a "universal" change to the symbols through one operation.

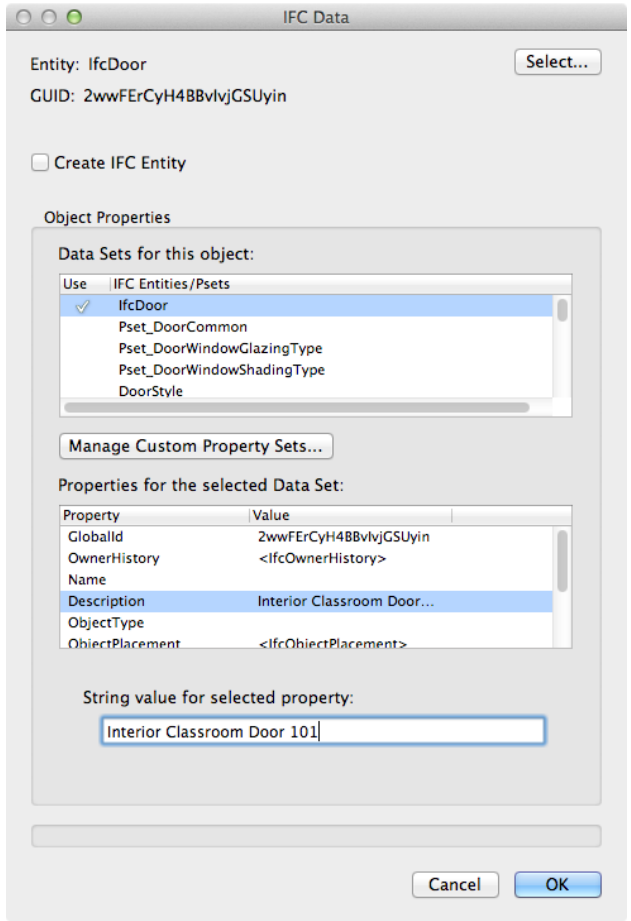

Figure 4 – "IFC Data" dialog box.

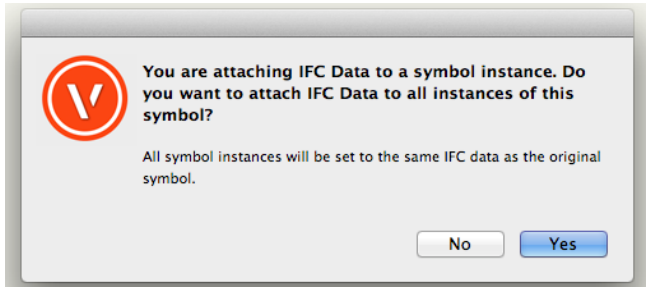

Figure 5 – Option to attach IFC data to a single instance of a symbol or all instances.

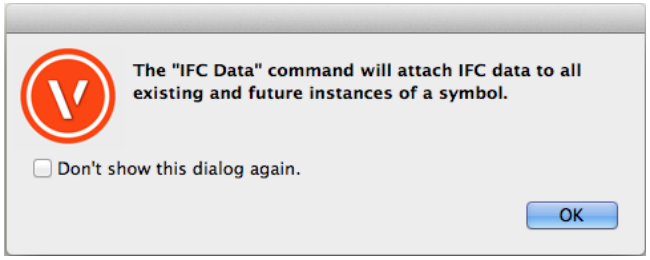

Figure 6 – Dialog that appears when attaching IFC data to a symbol via the Resource Browser.

To View and Edit IFC Data

The data attached to Vectorworks objects or IFC entities, whether created in Vectorworks or imported from an IFC file, can be viewed and edited with the "IFC Data" command or from the IFC button in the Object Information Palette.

To access IFC data:

1. Select the IFC entity or Vectorworks object.

NOTE: Multiple items can be selected.

2. Select AEC > IFC Data

Alternatively, click IFC Data from the Object Info palette (see Figure 7).

NOTE: When multiple items have been selected, edits apply to all eligible objects in the selection.

3. When the items to be edited have been specified, the IFC Data dialog box opens. View or edit the IFC data as described in "Assigning IFC Data to Objects" above.

If an IFC entity was selected, the IFC Data dialog box displays the data attached to the entity as described in "Assigning IFC Data to Objects."

If a Vectorworks default building object was selected, the IFC Data dialog box displays the corresponding IFC Object type.

If a group contains multiple objects with differing IFC object types, the IFC tag assigned to the group will not be assigned to the individual objects. That is, the objects within the group will retain their respective IFC tags.

NOTE: If a *symbol* contains multiple objects with different IFC object types, a property set cannot be set to the symbol definition or symbol instance itself. Instead the objects within the symbol should be grouped and the appropriate PSet is then attached to the group within the symbol

NOTE: If the IFC tag seen at the bottom of the Object Information Palette is preceded by "Default," it simply means the default IFC data on this object has not been modified.

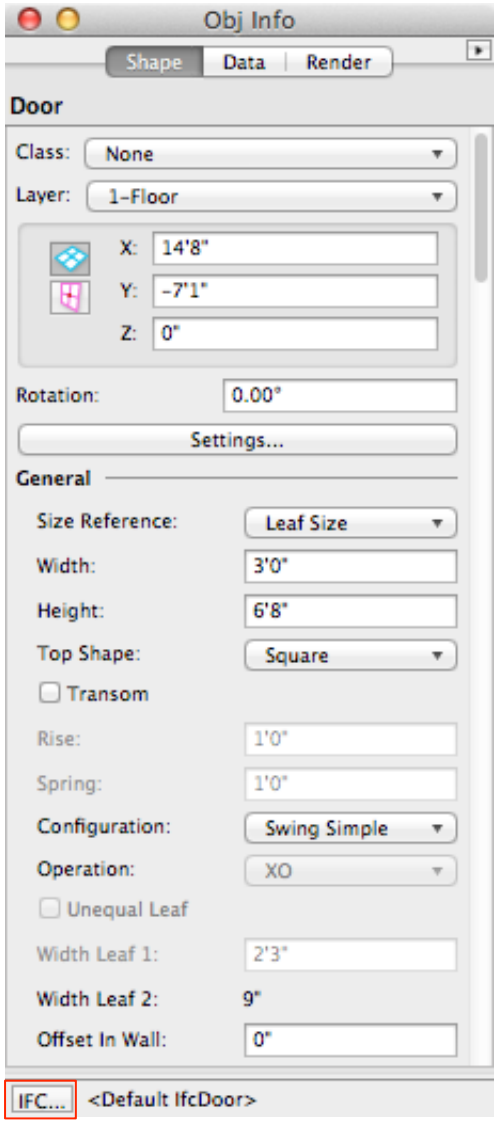

Figure 7 – IFC Data button located at the bottom left of the OIP.

Assigning IFC Data to Space Zones

Most Vectorworks space information (type of use, etc.) is automatically written to the corresponding data fields of the IFC PSet. However, space areas, or *zones*, are a special case and are addressed here.

A zone is a collection or group of spaces. IFC Zones are different from IFC Spaces insomuch that an IFC Zone cannot exist without an IFC Space. However, an IFC Space does not need to be associated with a zone. Space zones have many purposes such as defining programmatic use or a fire compartment or area of refuge.

The "IFC Zones" command attaches IFC data to the specified zones in the current file. This means that zones must already exist in the file. Zones are initially created when they are assigned to a space object. This can either be done from the Occupancy pane of the Space Settings dialog box (Figure 8) or from the Object Information Palette (Figure 9).

To attach IFC data to zones in the file:

1. Select AEC > IFC Zones

The IFC Zones dialog box opens.

2. Zones in use in the file are listed above the divider line; available IFC zones are listed below the divider. Select a zone and click OK.

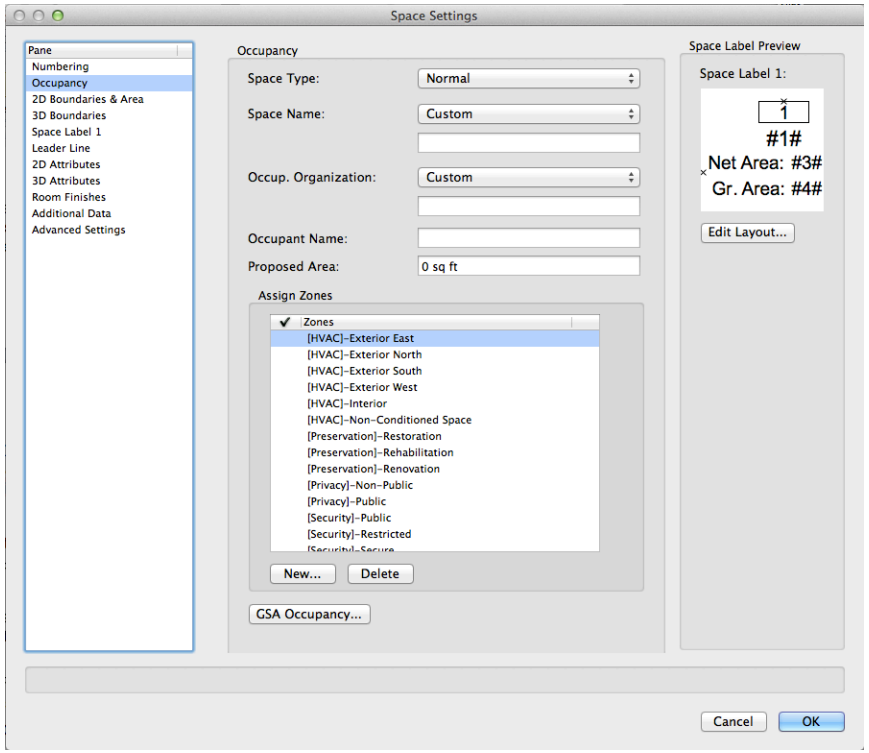

Figure 8 – Assigning Space Zones through the Space settings dialog.

NOTE: Only one zone can be selected at a time.

3. The IFC Data dialog box opens. The object type is automatically set to ifcZone, and the property Name value set to the zone name.

4. Click OK to attach the IFC data to the zone.

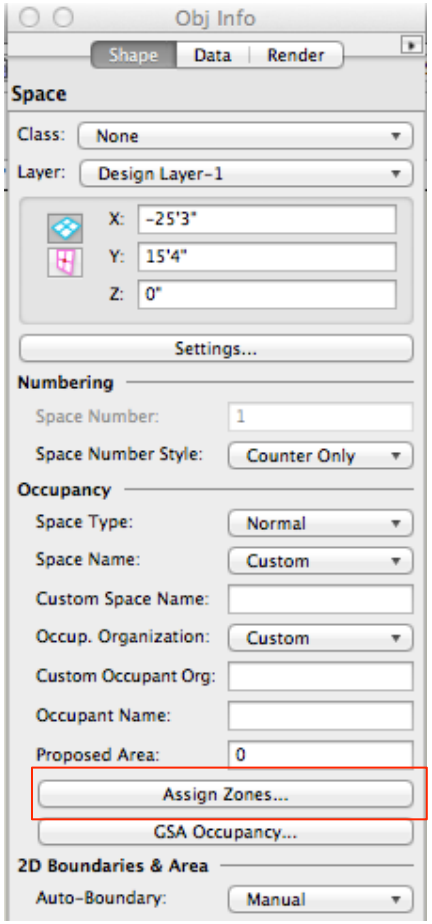

Figure 9 – Assigning Space Zones through the OIP.

Custom Property Sets

When to Use Custom IFC Property Sets

Property sets (or Pset) are used to assign groups of data fields, or properties, to IFC objects. Property sets can be very specific to an IFC object, such as Pset_WallCommon to IfcWall, or they can be more general and applied to any IFC object, such as Pset_ManufacturerTypeInformation. The naming convention Pset_Xxx also applies to these property sets.

Because IFC is extensible, any *user-defined* data can be assigned to an IFC object, even if it is not in the predefined list of pSets in the IFC Data dialog box. These are called "custom property sets." Custom property sets need to follow technical encoding conventions. They must have unique and allowable names. This means that the names cannot duplicate specified property set names or begin with "Pset_".

Custom property sets are captured and exchanged in the IFC format through Vectorworks' record formats.

Creating IFC-Compatible Record Formats

To use a custom property set, you must first create a record format to define the data to be captured and exchanged in IFC format. To learn how to create a custom record format, please visit Vectorworks 2016 Help online.

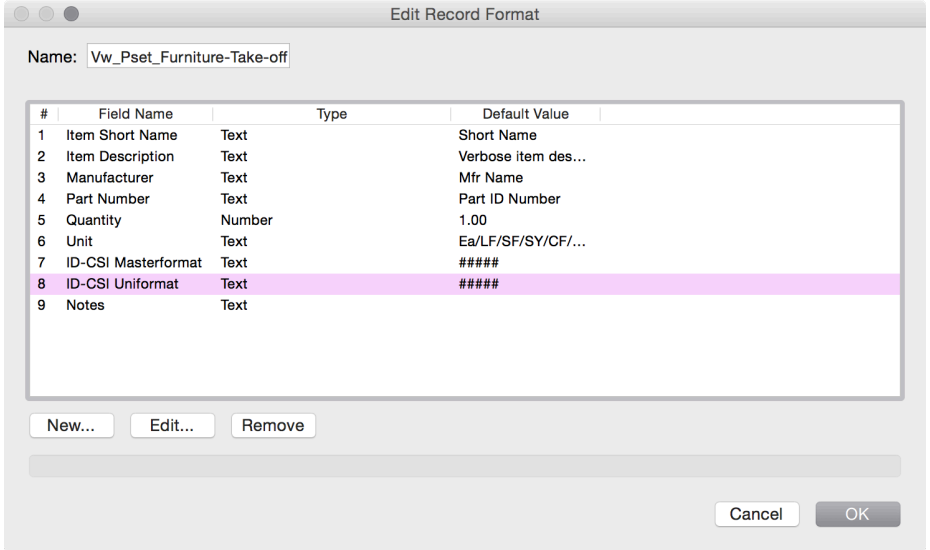

Figure 10 – "Field Name" and "Type" definitions of a "record format" in Vectorworks.

The record format name defines the name of the IFC custom property set. Therefore, it is recommended that record formats designated for IFC export should be named with a "VwPset_" or "ePset_" prefix. This will give the record a unique name and easily recognizable. Record format names are case sensitive, and cannot contain blank spaces. If necessary, use an underscore. For example, a record format can be named "ePset_MyDataExchange."

As with any custom record, the record format can consist of any number of fields, designated by a "Field Name" and a "Field Type" (see Figure 10).

When all field data pairs have been completed, click OK to create the record format.

The record format appears in the Resource Browser, under the Record Format category (Figure 12). Like any resource, it can be shared between files using the export or import functionality of the Resource Browser. This is especially useful for custom PSets that will be used repeatedly for multiple projects.

NOTE: The custom record format created *does not* need to be attached to the object in order to get a successful export of an IFC custom Pset. Instead, the custom record will be converted to an IFC Custom Property Set. For this reason, any IFC data that is attached to an object by way of the record format in the OIP *will not* be reflected in the IFC custom Pset. Data must be entered in the "IFC Data" dialog.

CAUTION: If the record format created for the custom property set is deleted, the Custom PSet and *all* associated data will be deleted as well! It is recommended to not delete any record formats within a file. Be watchful of this when conducting a "purge objects" command.

NOTE: With previous versions of Vectorworks, it was necessary to create "corresponding" IFC value fields within the custom record format. This is no longer necessary. However, if you have a custom record format in your resources that *is* formatted this way, it can still be converted into an IFC custom property set.

Converting a Record Format to an IFC Custom Property Set

Once the record format has been created, it is converted to an IFC Property Set and attached to an object, group, symbol definition, or symbol instance.

To assign the custom IFC data:

1. Select the object, group, or symbol for assignment of IFC data.
2. Through the "Select IFC Entity" dialog box, select the IFC object type as described in "Assigning IFC Data to Objects"
3. Click OK.

   The IFC Data dialog box opens.
4. Click "Manage Custom Property Sets."

   The Manage Custom Property Sets dialog box opens (Figure 13).
5. Click in the Use column to include a record format. Selected record formats display with a check mark. You can select multiple record formats if they are present in the document.
6. Click OK to return to the IFC Data dialog box (Figure 14).

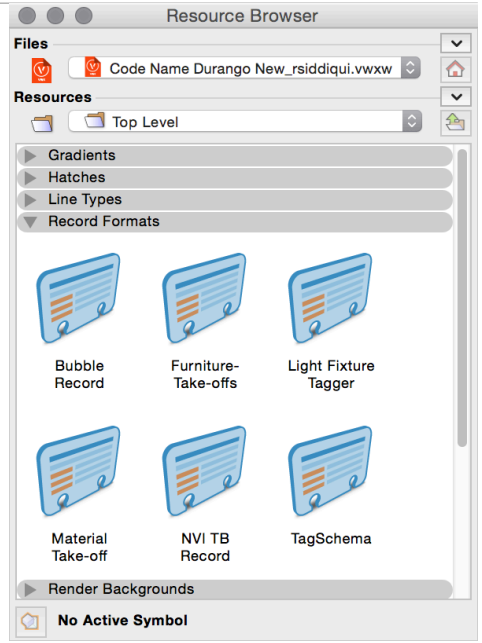

Figure 12 – IFC Custom Property Set saved as a resource.

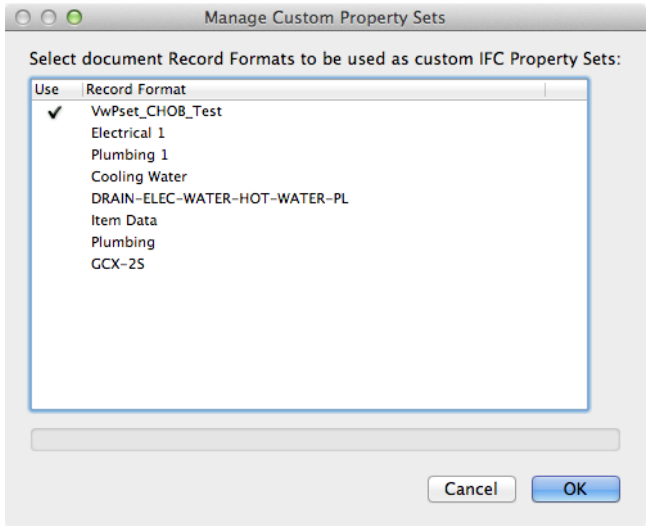

Figure 13 – Selecting your custom PSet from the "Manage Custom Property Sets" dialog.

The selected custom record formats are listed as data sets in the IFC Entities/Psets list under "Object Properties."

NOTE: If there are any errors in the naming, formatting, or pairing of any field in the record format, the custom property set does not appear in the IFC Entities/Pset list. Internal checks ensure the integrity of the data and automatically reject any errors. Correct the errors by editing the record format from the Resource Browser, and try again.

7. Select the custom Pset and click in the Use column. A check mark indicates that the Pset is enabled and attached to the object.
8. Select the custom Pset properties and assign values to the selected properties through the "String value for selected property" field (Figure 14).

It is important to remember that any values added to the object via the data pane in the OIP for this custom record, will not carry through to the IFC Data dialog box. They have to be entered in the IFC Data dialog directly.

9. Click OK to assign the IFC data to the object.

The IFC data can be reviewed or edited by clicking IFC Data from the Object Info palette of a selected IFC object or entity, or by selecting the object or entity and selecting AEC > IFC Data.

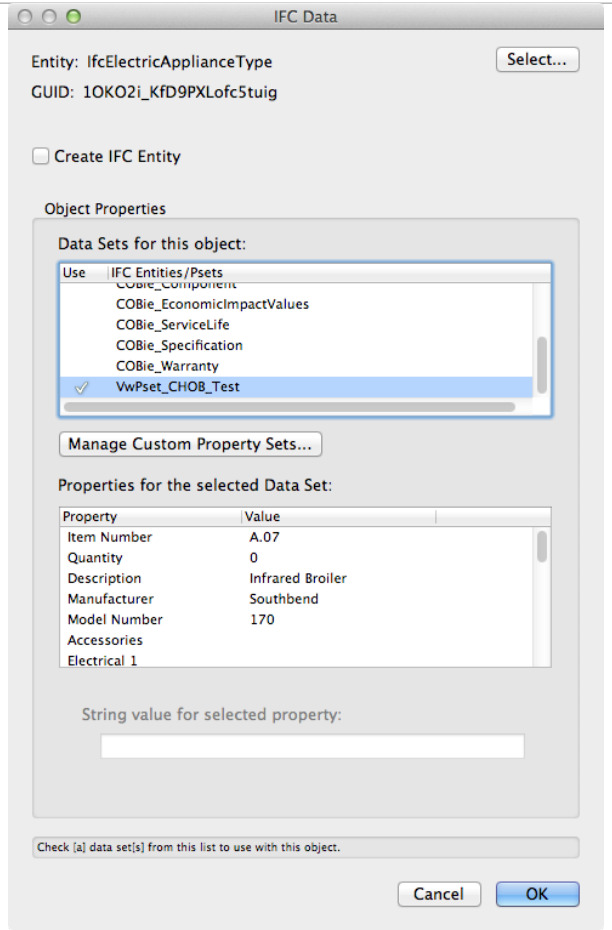

Figure 14 – IFC Data dialog with a Custom Property Set selected.

PROXY ELEMENTS AND OTHER SPECIAL CASES

Proxy Elements

The "proxy element" tag is reserved for model elements that do not have a semantic definition in the current IFC release. IfcBuildingElementProxy should be used to export special types of building elements that do not have a defined meaning for the element type. This means any object that does not fit any of the IFC semantic types found in the "Select IFC Entity" dialog box's full list, it should be tagged as a proxy element. This will include any site elements that are incorporated in the model that may not have an IFC type equivalent.

Proxy elements have generic property sets associated with them that include basic information such as object name, description, and object type (see Figure 15).

Special Cases

Stairs

When using the Stair Tool to create stair objects, it is advisable to not mirror a stair object when creating additional stair elements. The best course is to duplicate the stair and then enter the stair object's dialog and change the "handedness" rather than using the mirror command.

You may find that other geometry within symbols will display the same type of behavior. If so, place the symbol again without using the mirror tool.

Column Grid

A column grid can be exported from Vectorworks by using 2D linework as the grid instead of the default "Grid Bubble" tool found in the "Dims/Notes" palette. Use lines, arcs or circles to draw your grid. Each line of the grid must be individually tagged with IFC data by selecting IfcGridAxis from the list in the IFC Entity dialog box.

Lines drawn for the vertical grid need a tag prefix of "V" and lines drawn for the horizontal grid need a tag prefix of "U."

For a third part of the grid that may include column lines at an angle the prefix "W" will be used. This prefix is reserved for only if you have a 3-grid axis. The IFC Grid can only support these 3 axes and nothing more. If necessary, you may need to create a "primary grid" and a "secondary grid."

For example:

1. For lines drawn vertically, select a line, Select AEC > IFC data, click on the IfcGridAxis selection,
2. Under "Object Properties" select the IfcGridAxis Pset to see the properties below.
3. Choose AxisTag, enter the prefix "V" and the letter of the grid in the field for "String Value for Selected Property" (Figure 16). Click OK.

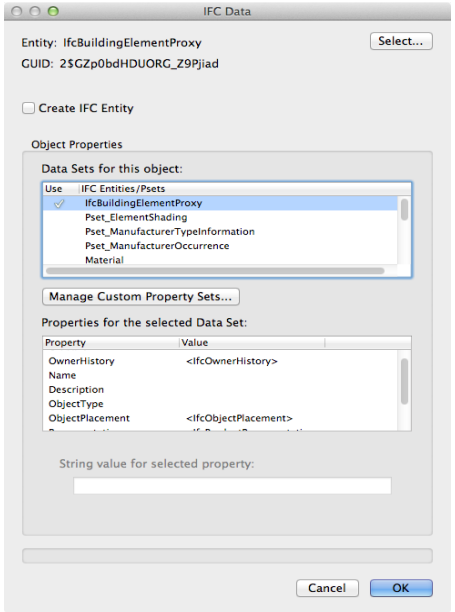

Figure 15 – Basic property set of IFC Proxy Elements.

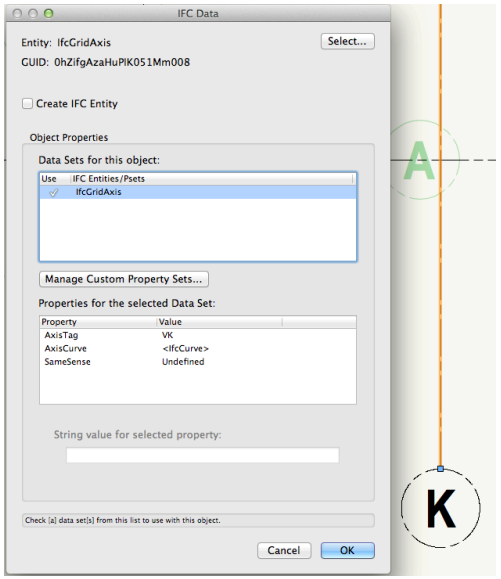

Figure 16 – String Value for IFC Grid Axis.

4. Select the next grid line and repeat. Use the prefix “U” for horizontally drawn grid lines. Use the prefix “W” for any angled axes or other, tertiary types of axes.
5. Once all the axes are labeled as IfcGridAxis, group all of the lines, arcs, or circles together.
6. Select the group, select AEC > IFC data, and click on IfcGrid to attach the IfcGrid tag to the group.

NOTE: You can setup a name for the grid in cases where multiple grid groups exist.

To create a “secondary grid,” follow the same steps, but create a separate group with the same, IfcGrid tag.

HOW TO SHARE AND USE YOUR IFC MODEL

Exporting

Generally, Vectorworks files are exported as entire projects (sites with buildings consisting of stories), to be exchanged or analyzed with other IFC-compatible applications. When you use the "Export IFC Project" command, you assign design layers to building stories. For a project initially set up with Vectorworks' story organization, this assignment, called "layer mapping", is done automatically. This means that the layers assigned to the building stories are automatically included in the Mapped Layers list and are mapped to an appropriately named IFC Story. Mapping can also be controlled manually, letting you override or edit the automated process. The manual process is also used if you have chosen to not use Vectorworks' story organization. Keep in mind that when the layers are mapped manually, the last mapping settings are retained by Vectorworks. You will only need to map layers again if any new layers are added.

The following guidelines may be useful when preparing your model for export:

- Set up the project with stories from the beginning. Though not completely necessary, it does automate part of the export process.
- Take care to set up the elevation values of layers correctly, and verify that all the objects in the drawing are vertically aligned as necessary.
- If you are using standard Vectorworks plug-in objects, it is best to use those listed in the "Default Vectorworks Objects Tagged as IFC Objects" portion of this guide.
- Use the IFC Data command to attach IFC data to custom symbols and objects, so that they will be recognized at IFC export.
- Use the "VA Create Schedule" command to generate IFC schedules for default objects, or create your own schedules to verify and correct the IFC data attached to objects.
- Before exporting, set 3D Conversion Resolution lower to optimize the file size - Vectorworks Preferences > 3D > 3D Conversion Resolution > Low
- Select only the layers you want exported by using the "Export Visible Objects Only" option.
- Set the model to Top/Plan view before exporting.
- If you are exporting the model specifically for energy analysis, many energy analysis programs require a unique element called a 1st Level Space Boundary - File > Export > Export IFC Project > Add-on Views > 1st Level Space Boundaries
- Test the quality of the IFC export file by verifying it in an IFC model browser. Almost all IFC browsers can view and validate the model. Some examples of IFC browsers available at this time include:
  - Solibri Model Viewer (Macintosh or Windows)
  - FZKViewer (Windows)
  - DDS-CAD Viewer (Windows)
  - Tekla BIMsight (Windows)
  - Constructivity Model Viewer (Windows)
  - RDF IFC Viewer (Windows, Macintosh and Linux versions planned)
  - Field3D (iOS)
  - IFC WebServer (web browser)
  - xBIM Xplorer (Windows)
  - IfcPlusPlus (Windows)

For more information regarding IFC viewers and other IFC-compatible applications, visit the buildingSMART IFC-Compatible Implementations Database or IfcWiki.org websites.

Vectorworks project files can be exported to .ifc, .ifczip, and .ifcxml formats.

Export to IFC Versions 2x2 or 2x3 is supported, but version 2x3 is most commonly used in current practice. The export of a project to an IFC file is based on specifying the geometry and associated data needed for the use of the exported file. This specification is called a Model View Definition (MVD). Vectorworks software supports the use of MVDs to automate the export, or allows the user to manually define a custom set of geometry and data to be exported.

To export a Vectorworks file to IFC

1. Select File > Export > Export IFC Project.

   The Export IFC Project dialog box opens (Figure 17). Under the "Data" tab, you'll see a number of options for specifying the export options as well as the overall project information such as project data, author data, site data, and building data. Any required field within this tab will be automatically filled based on the existing Vectorworks project information.

   For "Export Options," select IFC version 2x3 (the default) and the "CV 2.0 – Architecture" Model View (also a default). This particular Model View is an official buildingSMART international view for exporting architectural models for coordination with structural *and* MEP models.

   If you have created any "custom property sets," make sure that the "Export Custom Property Sets" box is checked (this should also be checked by default).

   To better understand all the parameters within the "Data" tab of the dialog, please visit Vectorworks 2016 Help online.

2. Click the "Layer Mapping" tab to specify which layers to export, and the Story Name to assign to them at export (Figure 18). If a site model is set to a "site layer" and has

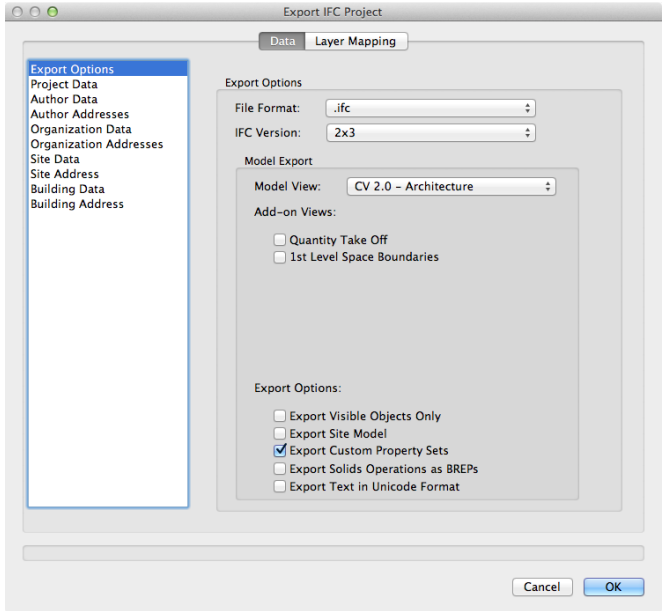

Figure 17 – IFC Project Export window – Data tab.

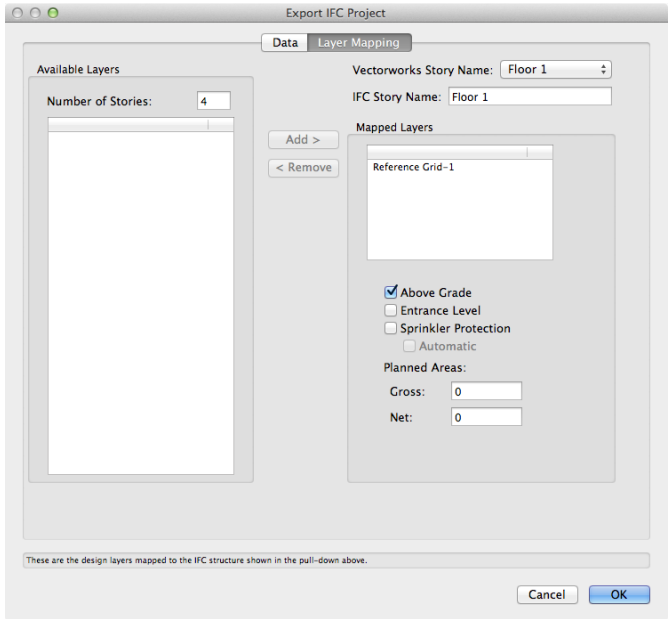

Figure 18 – IFC Project Export window – Layer Mapping tab.

been tagged for IFC, it will also be included.

For a project initially set up with stories, mapping is done automatically so that the layers assigned to the building stories are automatically included in the "Mapped Layers" list and are mapped to an appropriately named story. Mapping can also be controlled manually.

Specify the associated building or site data for each of the mapped layers.

To better understand all the parameters within this tab of the dialog, please visit Vectorworks 2016 Help online.

3. Click OK to export the project.

   Indicate the file name and location in the Save As dialog box.

Importing IFC Files

An IFC project, including one containing multiple buildings or large information sets, can be imported into a Vectorworks file. The units of the imported file are determined by the Vectorworks file settings. An important thing to understand is that the files original presentation layers or CAD layers from an imported IFC file are assigned to corresponding Vectorworks *classes*. Also, the "Import IFC command" automatically assigns IFC building stories to their own design layers.

To import an IFC file:

1. Select File > Import > Import IFC.
2. Select the .ifc, .ifczip, or .ifcxml file to open, and click Open. The IFC import can be filtered based on elements or stories.

   Alternatively, click the file to import and drag it into a window where a Vectorworks document is open.

Reference Model Workflow

When considering the reference model workflow, think of the process as a "one way" data exchange. This means that your model, when exported via IFC, will be received by your consultants and used as base information. The IFC file should not be used with the expectation that upon receipt, the model can be edited and manipulated as objects created natively within your software. Instead, the IFC models will be used in a file-sharing environment called the Reference Model Workflow.

In a Reference Model workflow, IFC models generated by the various consultants are collected by the project BIM manager who creates a federated model within an IFC browser application such as Solibri Model Checker for the purposes of clash detection, model validation, quantity takeoffs, and other necessary tasks. Once a model is validated within the IFC browser, it is shared among the consultants with relevant comments regarding the model. The consultants will then reference the validated IFC model into their own application to make the necessary additions and edits to their model.

This workflow helps facilitate an iterative process involving discussion and exchange between all project participants. It also addresses questions about model ownership and responsibility by eliminating the possibility of editing parts of the model that you are not responsible for.

OTHER RESOURCES AND INFORMATION

There are multiple places online to access more detailed information regarding IFC and BuildingSMART International, the entity that oversees IFC.

You can visit the IFC Wiki page here.

You can also access a full list of the different software that are IFC certified by BuildingSMART here.

Information regarding Model View Definitions and the standardization of Exchange Requirements by buildingSMART can be found here.

TERMINOLOGY

IFC – Industry Foundation Classes is a platform neutral, open file format that is not controlled by a single software vendor or a group of vendors. It is an object-based file format with a data model developed by buildingSMART to facilitate interoperability in the AEC industry. It is a commonly used collaboration format in BIM based projects.

Open Source File Format – a format whose technology is freely available to the public for development.

Standardized File Format – a format that follows a standard way that information is encoded for storage in a computer file. It specifies how bits are used to encode information in a digital storage medium.

Semantic Object – a representation of a collection of attributes that describe an identifiable object. This means that the model describes the meaning of instance. The support of semantic objects is what makes IFC ideal for an open BIM exchange.

Extensibility – a design or coding principle that takes future growth into consideration. Extensions can be through the addition of new information or through modification of existing functionality. IFC is an extensible file format in that new information can be added to existing information or existing information can be modified.

Dynamically Extensible – the principle of being able to dynamically change or load in new information without changing the existing information. Adding new IFC information to an existing Record Format is a good example of this.

IFC Object Tag – a label or tag that helps identify an IFC object.

IFC Object Type – an object that has been identified as building element with the corresponding IFC tag.

Property Set – attributes that define a particular type of object. IFCPropertySet are a collection of predefined attributes that are used to define an object. Property Sets are also referred to as "PSets."

Custom Property Set – user created/defined property sets.

Model View Definition (MVD) – also called an IFC View Definition, a Model View Definition defines the IFC information needed to satisfy any of the Exchange Requirements defined by buildingSMART for collaboration.