Industry Foundation Class STEP Files (IFC) Reader

The IFC Reader allows the Feature Manipulation Engine (FME) to read Industry Foundation Classes (IFC) Standard for the Exchange of Product model data Files (STEP-Files). IFC is a vendor neutral Building Information Modeling data model and the ISO 10303 STEP-File standard is its primary exchange format.

The FME format keyword is IFC.

Overview

The IFC specification is promoted and published by International Alliance for Interoperability (IAI). The IFC model specification is published in the ISO 10303 EXPRESS data modelling language. Data is exchanged through the ISO 10303 STEP-File plain-text format.

The IFC Reader module support IFC specification version 2x, 2x2, and 2x3.

All class instances that descend from IfcRoot are mapped to features in FME. There are three fundamental class types in the IFC model:

- Descendants of IfcObject stands for all physically tangible and existing items, and conceptual items, such as processes and resources. IfcProduct is a subtype of IfcObject and descendants of IfcProduct are the only classes that may have a geometric representation.
- Descendants of IfcRelationship describe relationships between objects.
- Properties are descendants of IfcPropertyDefinition and are characteristics that may be assigned to objects.

Instances are uniquely identified by an instance name inside a STEP-File dataset. Instance names appear in attributes that reference other instances.

The attributes of IFC classes are fixed. However, objects can be extended by properties. Properties may have predefined structures defined by the IFC model, or they can be dynamically defined inside a dataset.

A collection of properties forms a property set, and the set is assigned to an object through a relationship instance. In FME, dynamic property set instances are identified by the *Name* attribute, and they form feature types according to this attribute. Properties assigned to these dynamic property sets appear as attributes of feature types.

IFC Quick Facts

Format Type Identifier	IFC
Reader/Writer	Reader
Licensing Level	Professional
Dependencies	None
Dataset Type	File
Feature Type	IfcRoot classes
Typical File Extensions	IFC
Automated Translation Support	Yes
User-Defined Attributes	Yes
Coordinate System Support	No
Generic Color Support	No
Spatial Index	Never
Schema Required	Yes
Transaction Support	Never
Rich Geometry	Yes
Geometry Type	ifc_type

Geometry Support			
Geometry	**Supported?**	**Geometry**	**Supported?**
aggregate	yes	point	yes
circles	yes	polygon	yes
circular arc	yes	raster	no
donut polygon	yes	solid	yes
elliptical arc	yes	surface	yes
ellipses	yes	text	yes
line	yes	z values	yes
none	yes		

Reader Overview

The IFC reader will automatically detect the IFC specification version of the data file by analyzing its header.

To generate the source schema, the IFC Reader will scan through the source file. Each non-abstract entity descendant from IfcRoot will appear as a source feature type. The source schema also has feature types for history and identification related entities: IfcOwnerHistory, IfcPerson, IfcApplication, IfcPersonAndOrganization, and IfcOrganization. The source schema will only contain feature types for entities that are instantiated in the source data file.

Reader Directives

The directives that are processed by the IFC reader are listed below. The suffixes shown are prefixed by the current <ReaderKeyword>_ in a mapping file. By default, the <ReaderKeyword> for the IFC reader is IFC.

DATASET

Required/Optional: *Required*

The value for this directive is the path to the source data file. If the data file does not exist or if the file is unrecognized by the reader, then the process will fail.

SPLIT_REPRESENTATIONS

Required/Optional: *Optional*

This directive specifies whether IfcProduct objects associated with multiple IfcShapeRepresentation objects will be read as a single FME feature. If the value is NO and the IfcProduct object is associated with multiple IfcShapeRepresentation objects, then the geometry of the feature will be a collection of all the geometric representations. If the value is YES, then the IfcProduct will be split among multiple FME features with each feature geometrically represented by a single IfcShapeRepresentation object. All the split features will have the same attributes that are on the IfcProduct object. The default value of this directive is YES.

```
IFC_SPLIT_REPRESENTATIONS YES
```

Workbench Parameter: Split multiple representations

SUBTRACT_OPENINGS

Required/Optional: *Optional*

This directive specifies whether the reader will subtract IfcOpeningElement representations from IfcProduct representations that are related together by an IfcRelVoidsElement object. If the value is YES then the IfcOpeningElement objects will have no geometry, and IfcProduct representations will have openings as determined by the IfcRelVoidsElement relationship. If the value is NO then the opening will not be calculated, and IfcOpeningElement objects will retain their representations. The default value of this directive is YES.

```
IFC_SUBTRACT_OPENINGS YES
```

Workbench Parameter: Subtract Openings

IFCSPACE_GEOMETRY

Required/Optional: *Optional*

This directive specifies whether the reader will preserve or remove the representations of IfcSpace features. IfcSpace geometries are virtual areas or volumes that provide for certain functions within a building. When physical entities are most important, visualizing these volumes of space may not be desirable.

If the value is YES then IfcSpace features will have their defined representations. If the value is NO, then IfcSpace features will have no geometry. The default value for this directive is NO.

```
IFC_IFCSPACE_GEOMETRY NO
```

Workbench Parameter: Read IfcSpace geometries

CONTEXT_TYPES

Required/Optional: *Optional*

This directive specifies which geometric representation will be processed by the reader according to the associated IfcRepresentationContext object's ContextType attribute. If this directive is not specified, then all representations will be processed. The format for values for this directive is a comma-delimited list of ContextType values. If at least one ContextType value is specified for this directive, then the reader will only process the representations that are associated with IfcRepresentationContext objects that have ContextType values that appear in the list specified for this directive. However, if a '!' character appears by itself in the comma-delimited string, then the reader will not process the representations associated with representation contexts that matches a value in the list. If the only value for this directive is '!', then all context types will be processed.

For example, this mapping file statement will direct the reader to only read geometric representations that are associated with 'Design' and 'Sketch' representation contexts:

```
IFC_CONTEXT_TYPES Design,Sketch
```

This mapping file statement will direct the reader to read all geometric representations that are not associated with the 'Sketch' representation context:

```
IFC_CONTEXT_TYPES !,Sketch
```

Workbench Parameter: Representation context types to read

REPRESENTATION_IDENTIFIERS

Required/Optional: *Optional*

This directive specifies which geometric representation will be processed by the reader according to the IfcRepresentation object's RepresentationIdentifier attribute. If this directive is not specified, then all representations will be processed. The format for values for this directive is a comma-delimited list of RepresentationIdentifier values. If at least one RepresentationIdentifier value is specified for this directive, then the reader will only process the representations that have RepresentationIdentifier values that appear in the list specified for this directive. However, if a '!' character appears by itself in the comma-delimited string, then the reader will not process the representations that matches a value in the list. If the only value for this directive is '!', then all representation identifiers will be processed.

For example, this mapping file statement will direct the reader to only read geometric representations with 'Axis' and 'Body' representation identifiers:

```
IFC_REPRESENTATION_IDENTIFIERS Axis,Body
```

This mapping file statement will direct the reader to read all geometric representations except for the ones with an 'Axis' representation identifier:

```
IFC_REPRESENTATION_IDENTIFIERS !,Axis
```

Workbench Parameter: Representation identifiers to read

REPRESENTATION_TYPES

Required/Optional: *Optional*

This directive specifies which geometric representation will be processed by the reader according to the IfcRepresentation object's RepresentationType attribute. If this directive is not specified, then all representations except for the `BoundingBox` representation type will be processed. The format for values for this directive is a comma-delimited list of RepresentationType values. If at least one RepresentationType value is specified for this directive, then the reader will only process the representations that have RepresentationType values that appear in the list specified for this directive. However, if a '!' character appears by itself in the comma-delimited string, then the reader will not process the representations that matches a value in the list. If the only value for this directive is '!', then all representation types will be processed.

Representations can have multiple representation types: specifically, the MappedRepresentation type can coexist with other representation types. In this case, all representation types applicable to the representation must be specified for that representation to be read.

For example, this mapping file statement will direct the reader to only read geometric representations with 'Brep' and 'SweptSolid' representation types:

```
IFC_REPRESENTATION_TYPES Brep,SweptSolid
```

This mapping file statement will direct the reader to read all geometric representations except for the ones with an 'BoundingBox' representation type. This is the default value for this directive and this value will be used if the directive was not specified in the mapping file:

```
IFC_REPRESENTATION_TYPES !,BoundingBox
```

Workbench Parameter: Representation types to read

Feature Representation

IFC features will have attributes that corresponds to the explicit attributes listed in the EXPRESS entity definitions. Derived attributes and inverse attributes will not appear on features. However, some inverse attributes are mapped to format specific attributes for convenience and are listed in the following table.

For IfcProduct objects, the attributes `ObjectPlacement` and `Representation` are mapped to the format specific attributes `ifc_object_placement` and `ifc_representation`, respectively.

Attributes with attribute type `instance` are references to other instances. These values will always start with a '#' character followed by a number. They will match the value of the `ifc_instance_name` attribute of some feature.

In addition to the generic FME feature attributes that FME Workbench adds to all features (see *About Feature Attributes* on page 7), this format adds the following format-specific attributes:

Attribute Name	Contents
ifc_instance_name	This attribute contains the unique instance name that corresponds to the feature.
ifc_entity_type	This attribute contains the name of the entity of which the feature is an instance. The value is equivalent to the feature type name for most features.
ifc_representation_identifier	This attribute contains the value of the RepresentationIdentifier attribute of the IfcRepresentation object by which this feature is represented. This attribute is only applicable when the feature has only one representation. (See the ifc_representations attribute)
ifc_context_type	This attribute contains the value of the ContextType attribute of the IfcRepresentationContext object with which the feature's representation is associated. This attribute is only applicable when the feature has only one representation. (See the ifc_representations attribute)
ifc_context_dimension	This attribute contains the value of the CoordinateSpaceDimension attribute of the IfcGeometricRepresentationContext object with which the feature's representation is associated.
ifc_context_precision	This attribute contains the value of the Precision attribute of the IfcGeometricRepresentationContext object with which the feature's representation is associated.
ifc_is_decomposed_by{}	This list attribute contains the instance names of objects that decomposes the feature according to an IfcRelDecomposes relationship instance.
ifc_decomposes	This attribute contains the instance name of the object that the feature decomposes according to an IfcRelDecomposes relationship instance.
ifc_contains{}	This list attribute contains the instance names of objects that is spatially contained in the feature according to an IfcRelContainedInSpatialStructure relationship instance.
ifc_is_contained_in	This attribute contains the instance name of the object in which the feature is spatially contained according to an IfcRelContainedInSpatialStructure relationship instance.
ifc_representations{}.type	This structured list attribute contains the IFC geometry type of each representation associated with the feature.
ifc_representations{}.identifier	This structured list attribute contains the representation identifier (see ifc_representation_identifier) of each representation associated with the feature.

Attribute Name	Contents
ifc_object_placement	This attribute contains the instance name of the IfcObjectPlacement object which determines the placement of the feature's representation in world coordinates. The IFC Reader will have processed this object when generating the geometry for the feature.
ifc_representation	This attribute contains the instance name of the IfcRepresentation object which determines the representation of the feature. The IFC Reader will have processed this object when generating the geometry for the feature.

The geometry of IFC features are identified by the ifc_type attribute. The valid values for this attribute are listed and described in the following sections.

Points

ifc_type: ifc_point

The geometry is represented by a single point.

Lines

ifc_type: ifc_line

The geometry is represented by a path. Path segments can be linear or elliptical.

Currently, IfcTrimmedCurve is not supported.

These attributes are common to features with ifc_type of ifc_line, but the attributes may also appear in features with different ifc_type values.

Attribute Name	Contents
ifc_curve_style_name	This attribute specifies the name of the specific curve style assigned to the geometry.
ifc_curve_style_width	This attribute specifies the width of the curve.
ifc_curve_style_color	This attribute specifies the color of the curve as a string in the format "r,g,b" where 'r', 'g', and 'b' are the red, green, and blue components respectively specified in the inverval between 0 and 1.
ifc_curve_style_color.name	This attribute specifies the name of the color assigned to the curve.
ifc_curve_style_font_name	This attribute specifies the name of the curve font.
ifc_curve_style_font_pattern.visible	This attribute specifies the length of the visible portion of the curve. The curve will alternate between visible and invisible segments accordingly.
ifc_curve_style_font_pattern.invisible	This attribute specifies the length of the invisible portion of the curve. The curve will alternate between visible and invisible segments accordingly.

Attribute Name	Contents
ifc_curve_style_font_scaling	This attribute specifies the scaling factor applied to the curve font.

Polygon

ifc_type: ifc_polygon

The geometry is represented by an enclosed area.

These attributes are common to features with ifc_type of ifc_polygon, but the attributes also may appear in features with different ifc_type values.

Attribute Name	Contents
ifc_fill_area_style_name	This attribute specifies the name of the specific area fill style assigned to the geometry.
ifc_fill_area_style_color	This attribute specifies the color of the area fill as a string in the format "r,g,b" where 'r', 'g', and 'b' are the red, green, and blue components respectively specified in the inverval between 0 and 1.
ifc_fill_area_style_color.name	This attribute specifies the name of the color assigned to the fill area.
ifc_fill_area_style_external_reference.location	This attribute specifies the location of the external resource item.
ifc_fill_area_style_external_reference.item_reference	This attribute specifies the external resource identifier.
ifc_fill_area_style_external_reference.name	This attribute specifies the optional name of the external resource item.

Surface

ifc_type: ifc_surface

The geometry is represented by a 3D surface. The surface may consist of multiple faces.

These attributes are common to features with ifc_type of ifc_surface or ifc_solid, but the attributes may also appear in features with different ifc_type values.

Attribute Name	Contents
ifc_surface_style_name	This attribute specifies the name of the specific surface style assigned to the geometry.
ifc_surface_style_side	This attribute specifies the side of the surface geometry to which this style is assigned.
ifc_surface_style_shading_color	This attribute specifies the shading color of the surface.

Attribute Name	Contents
ifc_surface_style_diffuse_transmission_color	This attribute specifies the diffuse transmission color of the surface.
ifc_surface_style_diffuse_reflection_color	This attribute specifies the diffuse reflection color of the surface.
ifc_surface_style_transmission_color	This attribute specifies the transmission color of the surface.
ifc_surface_style_reflectance_color	This attribute specifies the reflectance color of the surface.

Solid

ifc_type: ifc_solid

The geometry is represented by a 3D solid. The outer boundary of the solid is represented by an enclosed surface.

Currently, for SweptSolid geometries, only IfcExtrudedAreaSolid is supported. The IfcRelVoidsElement relationship is not supported: IfcWall geometries may not have proper recesses and openings.

Text

ifc_type: ifc_text

The geometry is represented by a text literal.

These attributes are common to features with ifc_type of ifc_text, but the attributes may also appear in features with different ifc_type values.

Attribute Name	Contents
ifc_text_style_name	This attribute specifies the name of the specific text style assigned to the geometry.
ifc_text_style_font_name	This attribute specifies the name of the text font.
ifc_text_style_external_reference	This attribute specifies an externally defined text style.
ifc_text_style_foreground_color	This attribute specifies the foreground color of the text.
ifc_text_style_background_color	This attribute specifies the background color of the text.

Bounding Box

ifc_type: ifc_bounding_box

The geometry is represented by a 3D box which represents the bounding box of the physical representation of the feature. With the default setting for the REPRESENTATION_TYPES directive, bounding boxes will not be output by the IFC Reader.

Collection

ifc_type: ifc_collection

The geometry is represented by collection of geometry. Each member of the collection may have any geometric representation. This geometry type most frequently arises when the IFC feature has multiple geometric representations.