



Document Code	Title	Organization/Author	Date	Status
ISG-2008-001	Implementation Guide for IFC	IAI Implementation Support Group	01/08/08	final
MSG-2008-001	exchange file header	IAI Model Support Group		

Implementation Guide for IFC Header Section

Version 1.0.2

05.08.2008

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Document history

1.0.	01.08.2008	Release of version 1.0 of the IFC header implementation guide
1.0.1	05.08.2008	Minor editorial changes
1.0.2	30.01.2010	Minor improvement in describing the view definitions [Table 2]

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1 Introduction

Each IFC exchange file, using the STEP physical file format (or ISO10303-21 structure), consists of a header and a data section.

1.1 History

The definition of the header section has been taken over from the ISO10303-21 STEP specification without any changes. This also meant, that no particular usage guide has been provided on how to fill-in the information into the IFC header section. It resulted into a variety of different ways on how information has been written, and IFC exchange files generated by different application sometime had the same information written into different fields.

Other information, such as the underlying IFC view definition for this IFC exchange file, was missing. This leads to a need to agree exactly on each field in the header section and to adapt the meaning of some attributes to the particular needs of IFC data exchange. The EXPRESS specification as provided by ISO10303-21 for the header section will however not be changed.

2 IFC Header Data Definition Guide

The following example gives an overview on how the header section should be populated:

FILE_DESCRIPTION	Example	Explanation
description	ViewDefinition[CoordinationView]	formal definition of the underlying view definition
implementation_level	2;1	see ISO10303-21, currently always 2;1 for IFC files
FILE_NAME	Example	Explanation
name	C:\IAI_Test_Building.ifc	local path and file name of the IFC export file
time_stamp	2007-02-06T10:28:37	time of creation of the IFC export file
author	Andreas Geiger, Andreas.Geiger@iai.fzk.de	user defined field to capture the author/creator of the IFC file
organization	Forschungszentrum Karlsruhe	user defined field to capture the organization of the author
preprocessor_version	ECCO Toolkit Version V 3.2.1	name of the toolbox used to create the IFC file
originating_system	IfcExplorer Version 2.2a (Build 437)	name of the application (including built number)
authorization	Karl-Heinz Haefele	user defined field to capture the authorizer of the IFC file
FILE_SCHEMA	Example	Explanation
schema_identifiers	IFC2X3	name of the IFC schema

Table 1: Example of an IFC header section

Example as shown in the IFC STEP exchange file:

```
ISO-10303-21;
  HEADER;
    FILE_DESCRIPTION((' ViewDefinition[CoordinationView]'),'2;1');
    FILE_NAME('C:\IAI_Test_Building.ifc',
      '2008-02-11T11:35:07',
      ('Andreas Geiger','AndreasGeiger@iai.fzk.de'),
      ('Forschungszentrum Karlsruhe '),
      'ECCO Toolkit Version V 3.2.1',
      'IfcExplorer Version 2.2a (Build 437)',
      'Karl-Heinz Haefele');
    FILE_SCHEMA('IFC2X3');
  ENDSEC;
  DATA;
    #1 =(); ...
  ENDSEC;
END-ISO-10303-21;
```

2.1 Agreement on using the description field

The description field of the FILE_DESCRIPTION entities is used to exchange information about:

1. View Definition supported by the exporting application that is reflected in the IFC file
 - a. this is a mandatory field providing formal information, the values for the View Definition keyword have to be formally agreed upon and accepted by buildingSMART International
2. Option being used by the exporting application for e.g. quality control and debugging
 - a. this is an optional field providing informal information, the values for the Option keyword reflect the export settings of the exporting software application, those settings may be specific to the exporting software
3. Exchange Requirements supported by the exporting application
 - a. this is an optional field foreseen for future usage, no guidelines are provided within this document

In order to exchange this within a simple list of strings (the data format of the description field) a formal syntax needs to be agreed upon:

1. To standardize the format in a very simple manner that allows the information is read accurately
2. To address currently known information that are important, see above
3. To allow additional information to be added in future

The following syntax is agreed to allow for extending the agreement of the header section description entity. It has to follow a simple format as followed (in BNF notation):

```
<keyword_set> ::= <keyword> "[" <value_list_set> "]"
                | <keyword> "|" <simple_value_list> "]"
                | "ViewDefinition" "[" <simple_value_list> "]"
```

```
,* general format is <keyword> followed by simple list
,* of values, or a set of sub-list, each preceded with name
,* except for ViewDefinition that will only take simple list
```

```

<keyword> ::= "Option"
           | "ExchangeRequirement"
           | <other_keyword>

<value_list_set> ::= <value_list_set> ";" <value_set>
                  | <value_set>

                ;* set of <value_set> separated by semi colon (;)

<value_set> ::= <set_name> ":" <simple_value_list>

                ;* comma separated list preceded with a name

<simple_value_list> ::= <simple_value_list> "," <value>
                    | <value>

                ;* is a simple comma separated values

<value> ::= <predefined_name> | <any_name>

<predefined_name> ::= "CoordinationView"
                   | "PresentationView"
                   | "StructuralAnalysisView"
                   | "FMHandOverView"
                   | "QuantityTakeOffAddOnView"
                   | "SpaceBoundary1stLevelAddOnView"
                   | "SpaceBoundary2ndLevelAddOnView"

                ;* This is a list of predefined View Definition
                ;* any other View Definition can be added without violating the syntax
                ;* because it is defined as part of <value> ::= <any_name> above

<any_name>      )
<other_keyword> ) any word/string
<set_name>      )

restriction: for keyword "ViewDefinition" only <value_list> is
applicable

```

Each keyword_set shall be written into a separate string (as part of the LIST OF STRING which is the data type of the description field). Multiple keyword_set's, having the same keyword are allowed.

Examples following this agreement are:

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView]'),'2;1');
```

(each keyword set has to be given in a separate string within the list of strings.)

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView,
QuantityTakeOffAddOnView]'),'2;1');
```

(more then one View Definition can be used, e.g for base view and add-on view.)

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView]', 'ViewDefinition
[QuantityTakeOffAddOnView]'),'2;1');
```

(keyword sets having the same keyword can be repeated, it is identical to the example above.)

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView,
SpaceBoundary1stLevelAddOnView, QuantityTakeOffAddOnView ]', 'Option [
ExcludedObjects: Stair, Ramp, Space; SplitLevel: On]'),'2;1');
```

(Option is a reversed keyword to capture the export options chosen for creating the file, the meaning of the value list set is unique to the exporting application.)

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView,
SpaceBoundary1stLevelAddOnView, QuantityTakeOffAddOnView ]', 'Option [
ExcludedObjects: Stair, Ramp, Space; SplitLevel: On]', 'Comment [This
export contains Boolean Operation geometry that may not be fully
supported by other application]'),'2;1');
```

(Additional comments can be added)

Invalid examples are:

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView,
SpaceBoundary1stLevelAddOnView, QuantityTakeOffAddOnView ] Option [
ExcludedObjects: Stair, Ramp, Space; SplitLevel: On]'),'2;1');
```

(each keyword has to be given in a separate string within the list of strings.)

```
FILE_DESCRIPTION('ViewDefinition [CoordinationView,
SpaceBoundary1stLevelAddOnView, QuantityTakeOffAddOnView ]', 'Option [
ExcludedObjects: Stair, Ramp, Space; SplitLevel: On]', 'Comment [This
export contains Boolean Operation geometry that may not be fully
supported by other application and this export contains no bounding
box geometry that would provide a fall back for such applications -
this and other lengthy descriptions may extend the maximum string
length of 256 characters for each string field.]'),'2;1');
```

(the last string has more than 256 characters.)

The predefined names, i.e. the name of agreed view definitions, are explained in the Appendix, see table 2 for currently agreed or proposed view definition keywords.

3 Detailed overview of header section definition

The IFC header section is based on the STEP definition ISO/FDIS 10303-21, called Part 21 (STEP physical file). This part of an IFC file contains information of the entire exchange structure and data.

3.1 Header Data Entities

Each header of IFC and STEP files should contain the following instances:

- file_description,
- file_name,
- file_schema.

It is important that the entities appear in the order above. The following section explains the entities following their original STEP definition and the additional agreements for IFC exchange files.

3.1.1 Entity file_description

The **file_description** specifies the version of this part of ISO 10303 used to create the exchange structure as well as its contents.

EXPRESS Specification:

```
ENTITY file_description;  
  description : LIST [1:?] OF STRING (256);  
  implementation_level : STRING (256);  
END_ENTITY;
```

Attribute: **description**

STEP Definition:

An **informal** description of the contents of this exchange structure.

IFC Specific Addition to the Definition:

It is a **formal** description and should be used to define one or more model view definitions used in the context of this exchange structure. Full list of supported model view definitions can be found in the appendix.

Additional to the keywords of the view definitions, export options, comments and exchange requirement information can be included. Examples for additional information stored as options are:

- Information on partial model exchange
- Filter information used for export
- Additional options used for export

The syntax for the description attribute is described in 2.1.

Attribute: **implementation_level**

STEP Definition:

An identification of the specification to which the encoding in this exchange structure conforms and any conformance options employed in that encoding. The value of this attribute shall indicate conformance to this version of this part of ISO 10303 by having either the value "3;1" or the value "3;2". The value for exchange structures adhering to conformance class 1 shall be "3;1". The value for exchange structures adhering to conformance class 2 shall be "3;2".

If the following restrictions on the encoding are met, the value "2;1" or the value "2;2" may be used to indicate conformance to this version of this part of ISO 10303:

- the exchange structure shall contain a single data section, and the "DATA" keyword shall not be followed by a parenthesized PARAMETER_LIST;
- the exchange structure header section shall not contain FILE_POPULATION entities;
- the exchange structure header section shall not contain SECTION_LANGUAGE entities;
- the exchange structure header section shall not contain SECTION_CONTEXT entities;
- the enumerated values of an EXPRESS ENUMERATION shall not be encoded using short names.

If used, the value "2;1" shall designate exchange structures adhering to conformance class 1, and the value "2;2" shall designate exchange structures adhering to conformance class 2.

NOTE 1 Conformance classes 1 and 2 are defined in 10.2.5. ISO/FDIS 10303-21:2001(E)

NOTE 2 The general form for the value is "v;cc", where v is the version number of this part of ISO 10303, as specified in annex C, and cc is the encoding of conformance

class. Future versions of this part of ISO 10303 may specify additional values for v and cc.

NOTE 3 The use of "2;1" and "2;2" is provided to support upward compatibility with implementations based on the previous version of this part of ISO 10303.

IFC Specific Addition to the Definition:

No changes to the STEP definition.

Currently IFC exchange files are based on Version 1 of Part 21, i.e. ISO10303-21:1994, and IFC does not use complex entities that would require using conformance class 2. Therefore all IFC files should have the **implementation_level: 2;1**

3.1.2 Entity file_name

The **file_name** provides human readable information about the exchange structure. With the exception of the time_stamp attribute, the contents of the attributes of this entity are not defined by this part of ISO 10303-21.

EXPRESS Specification:

```
ENTITY file_name;
  name : STRING (256);
  time_stamp : time_stamp_text;
  author : LIST [ 1 : ? ] OF STRING (256);
  organization : LIST [ 1 : ? ] OF STRING (256);
  preprocessor_version : STRING (256);
  originating_system : STRING (256);
  authorization : STRING (256);
END_ENTITY;

TYPE time_stamp_text = STRING(256);
END_TYPE;
```

Attribute: **name**

STEP Definition:

The string of graphic characters used to name this particular instance of an exchange structure.

NOTE: The name is intended to be used as human to human communication between sender and receiver.

IFC Specific Addition to the Definition:

No changes to the STEP definition.

Attribute: **time_stamp:**

STEP Definition:

The date and time specifying when the exchange structure was created. The contents of the string shall correspond to the extended format for the complete calendar date as specified in 4.2.1.1 of ISO 8601 concatenated to the extended format for the time of the day as specified either in 4.3.1.1 or in 4.3.3 of ISO 8601. The date and time shall be separated by the capital letter T as specified in 4.4.1 of ISO 8601. The alternate formats of 4.3.1.1 and 4.3.3 permit the optional inclusion of a time zone specifier.

EXAMPLE

Time stamp element	Complete extended format
Calendar Date 12 April 1993	1993-04-12
Time of the Day 27 minutes 46 seconds past 15 hours	15:27:46
Time Zone (field is optional) 5 hours west of Greenwich	-05:00
Above date and time encoded within the time_stamp field	1993-04-12T15:27:46-05:00

IFC Specific Addition to the Definition:

No changes to the STEP definition.

Attribute: **author:**

STEP Definition:

The name and mailing address of the person responsible for creating the exchange structure.

IFC Specific Addition to the Definition:

No changes to the STEP definition. Name of the person who created the IFC file. It is a user defined data field, i.e. it should be a name coming from some UI field, a default value this could be for example the login or user name from the operating system.

Attribute: **organization**

STEP Definition:

The group or organization with whom the author is associated.

IFC Specific Addition to the Definition:

No changes to the STEP definition. It is a user defined data field, i.e. it should be a name coming from some UI field, a default value this could be for example the organization or group name from the operating system.

Attribute: **preprocessor_version**

STEP Definition:

The system used to create the exchange structure, including the system product name and version.

IFC Specific Addition to the Definition:

Name and version of the toolbox used to create the IFC file, NOT the name of the application itself.

Attribute: **originating_system**

STEP Definition:

The system from which the data in this exchange structure originated.

IFC Specific Addition to the Definition:

Name and version and/or build number of the application which generates the IFC file, this is the name of the application. Note: The version and/or build number should be as specific as possible.

Attribute: authorization**STEP Definition:**

The name and mailing address of the person who authorized the sending of the exchange structure.

IFC Specific Addition to the Definition:

No changes to the STEP definition. It is a user defined field, i.e. it should be a name coming from some UI field.

3.1.3 Entity file_schema

The **file_schema** entity identifies the EXPRESS schemas that specify the entity instances in the data sections. The attribute **schema_identifiers** shall consist of a list of strings, each of which shall contain the name of the schema optionally followed by the object identifier assigned to that schema.

If the name of a schema contains *small letters*, such *small letters* shall be converted to the corresponding *capital letters*. Only *capital letters* shall occur in strings of the **schema_name**.

If an object identifier is provided, it shall have the form specified in ISO/IEC 8824-1. The use of object identifiers within this International Standard is described in clause 3 of ISO 10303-1. When available, the use of the object identifier is recommended as it provides unambiguous identification of the schema.

NOTE The general form of an object identifier is a sequence of space-delimited integers. The sequence is enclosed within *braces* ("{" , "}").

EXPRESS Specification:

```
ENTITY file_schema;
  schema_identifiers : LIST [1:?] OF UNIQUE schema_name;
END_ENTITY;

TYPE schema_name = STRING(1024);
END_TYPE;
```

Attribute schema_identifiers**STEP Definition:**

The schemas that specify the entity instances in the data section.

IFC Specific Addition to the Definition:

No changes to the STEP definition. Currently no object identifiers are used.

Appendix

The following predefined names for the “ViewDefinition” Keyword for the attribute description of entity file_description are currently agreed. More can be defined, if other model view definitions are defined and authorized.

View name	View keyword	Description
Extended coordination view	CoordinationView (agreed)	Basic BIM models with shape representations, including parametric shape for a range of standard building elements and non parametric shape for all elements. It is used to share BIM between the major disciplines of architecture, structural engineering, and building services, during design and construction phase. The shared BIM is supposed to be re-editable by the receiving application.
Presentation view	PresentationView (proposed)	Basic BIM model with no parametric shape description (all element geometry is provided as surface or brep models). It is used in visualization, visual checking and clash detection. The exchanged BIM is not supposed to be re-editable by the receiving application, but meant to be used in a reference mode.
Structural analysis view, or (<i>structural modeling to structural analysis view</i>)	StructuralAnalysisView (proposed)	Sharing a single structural analysis model (as created by the structural modeler) by many (FEM or other) structural calculation packages.
FM Hand-over view, or (<i>as-built information to facility management view</i>)	FMHandOverView (proposed)	Handover of building and building service data from an as-built (or as designed) BIM or from an survey of existing buildings into a computer-aided facility management tool.
Quantity Take-Off using base quantities	QuantityTakeOffAddOnView (proposed)	Additional provision of base quantities with the basic BIM, the underlying view can be either the CoordinationView, or the PresentationView.
Space Boundaries using 1st level space boundary definition	SpaceBoundary1stLevel AddOnView (proposed)	Additional provision of 1st level space boundaries used for many use cases with the basic BIM. the underlying view can be either the CoordinationView (or the PresentationView ???)
Space Boundaries using 2nd level space boundary definition	SpaceBoundary2ndLevel AddOnView (proposed)	Additional provision of 2nd level space boundaries used as thermal boundary surfaces in addition to the basic BIM. the underlying view can be either the CoordinationView (or the PresentationView ???)

Table 2: Table of predefined names for ViewDefinition keyword