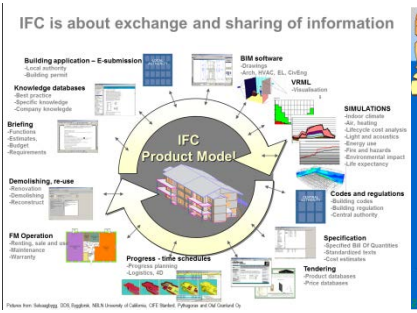
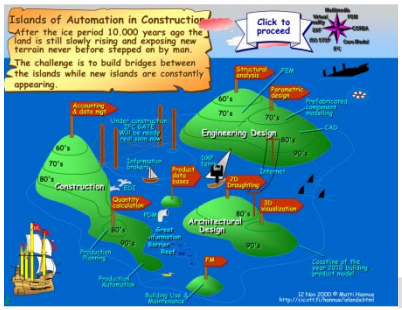
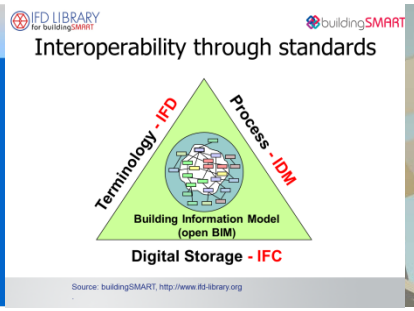
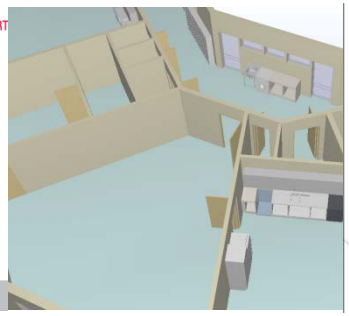
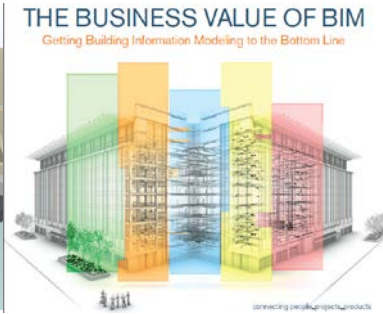






buildingSMART-standarder

- IFC, BCF, bSDD, IDM och MVD

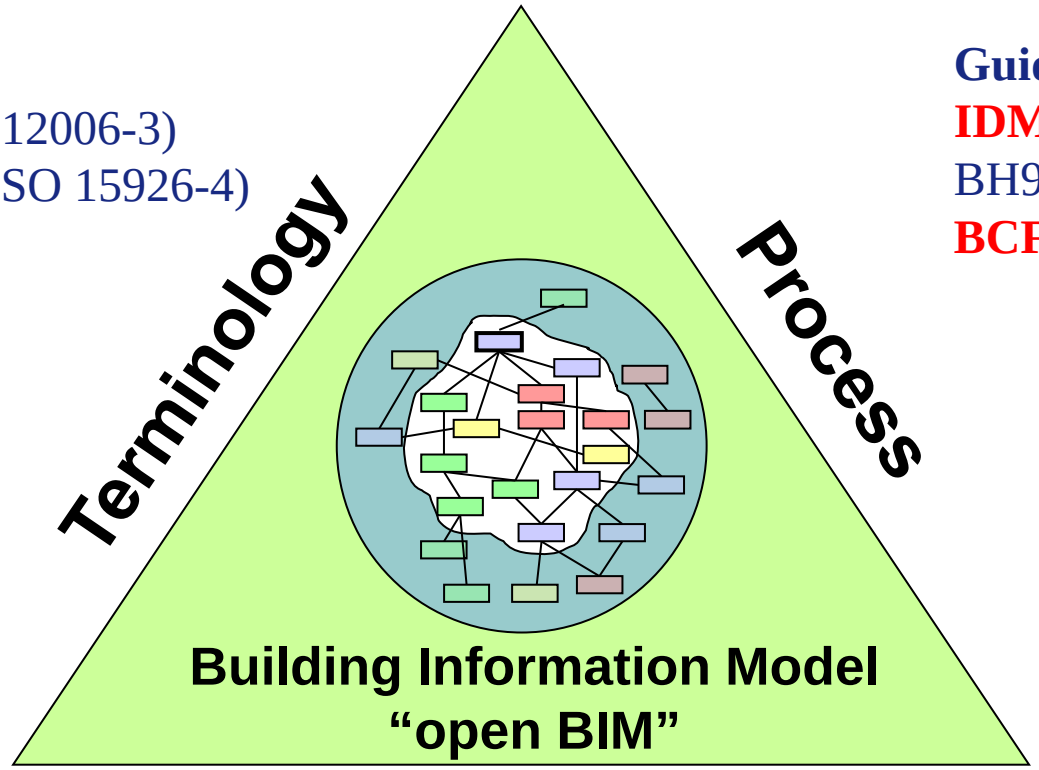
Professor Väino Tarandi

Stockholm, 2016-11-24

Overview of selected standards

Dictionaries
bSDD (IFD) (ISO 12006-3)
Oil & Gas: RDL (ISO 15926-4)

Codes
BSAB – Swe
OMNI class –US
ISO 12006-2



Guidelines
IDM (ISO 29481-1)
BH90 – Swe
BCF – BIM Collaboration Format

Digital Storage

Buildings
IFC (ISO 16739)
gbXML
fi2XML

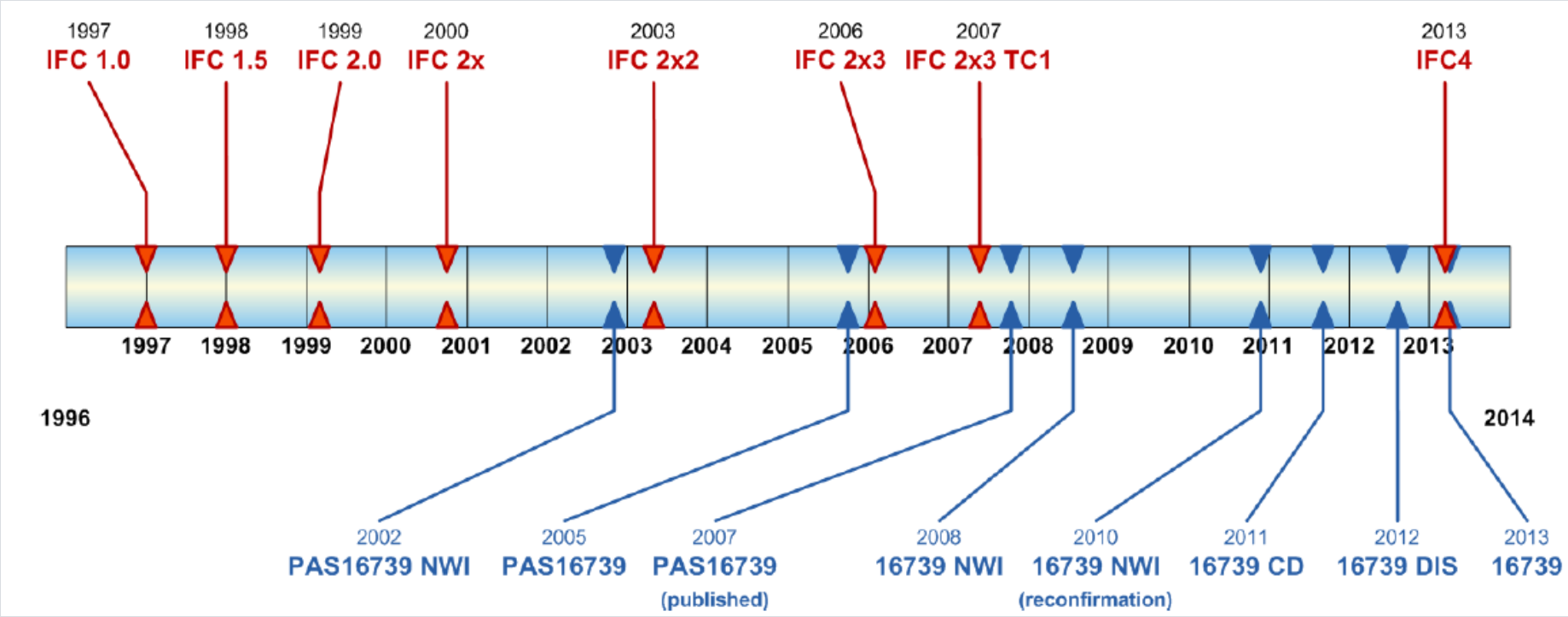
Generic – Lifecycle
PLCS (ISO 10303-239)
CityGML

GIS / Infra
Transmodel
GML

IFC – the standard

KTH Architecture and the Built Environment

IFC development history



Information for a building element

Identification

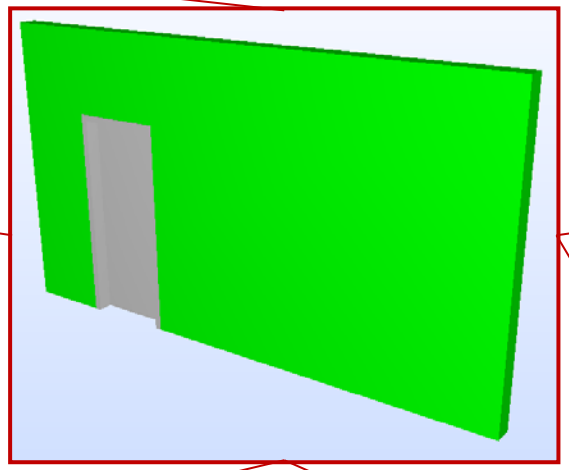
IfcWall: Basiswand:MW 17.5:98046
GUID: 3G_7N62zbD$BUYR_Q8WHAt

Locations

Identification | Location | Quantities | Profile | Relations | Classification

Property	Value
Building	Building.b1.1
Floor	Erdgeschoss
Top Elevation	2.80 m
Bottom Elevation	0 mm
Distance to Next Floor	3.00 m
Global Top Elevation	2.80 m
Global Bottom Elevation	0 mm
Global X	4.08 m
Global Y	6.29 m

Documents(link)



Properties

Identification | Location | Quantities | Profile | Relations | Classification
PSet_Revit_Type_Konstruktion | Pset_WallCommon

Property	Value
Reference	Basiswand:MW 17.5
ThermalTransmittance	2.28

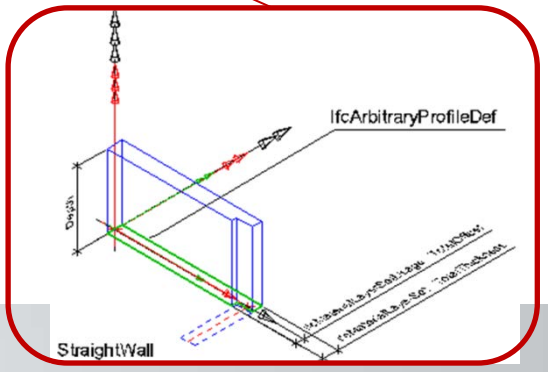
Relations

Wall.0.5

PSet_Revit_Type_Konstruktion | Pset_WallCommon
Hyperlinks | PSet_Revit_Abhängigkeiten | PSet_Revit_Bemaßungen
Identification | Location | Quantities | Profile | Relations | Classification

- Containment
  - Erdgeschoss
- Provides
  - Space Boundary.1
  - Space Boundary.44
  - Space Boundary.48
- Referencing
  - Space.0.2 : Wohnen[0.001]
  - Space.0.5 : Flur Eingang[0.003]
- Void
  - Opening.0.4

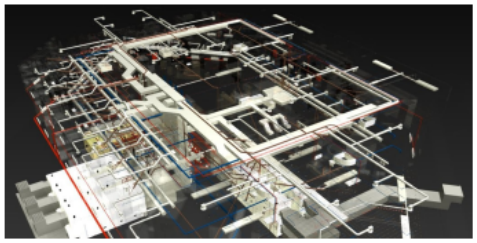
Geometry



IFC, http://www.buildingsmart.org/

IFC4 Add1 Release

Filed under: IFC Release, Specifications



IFC4 Addendum 1

Official landing page to publish the official IFC4 Addendum 1 release. it is a buildingSMART Final Standard.

Quick link for developer

- IFC4 Add1 Specification

IFC4 Addendum 1 Final

»access EXPRESS file«					»online access to HTML documentation«
»access XSD file«					»download of HTML documentation (90MB)«

What is new in IFC4 Addendum 1 ?

The main purposes of the IFC4 Addendum 1 are the improvement of the specification documentation and the necessary enhancements of the schema that resulted from the pilot implementations and the first Model View definitions. All changes made are downward compatible.

- The documentation format has been further improved for readability. A language independent section to describe the entities and types with their attributes and relationships is now available and separate to the EXPRESS and XSD code;
- The use of concept templates (chapter 4) and concepts is greatly enhanced, based on the mvdXML specification to enable better MVD developments and validation;
- Minor schema enhancements reflect the experience from pilot implementations of the IFC4 enhancements;
- One additional schema enhancement has been added after intensive discussions and considerations, a simplified and far more compact definition of poly lines with arc segments
  - See the following »summary« of the rationale behind adding this additional geometry definition
- An overview of all changes is provided »here«
- A detailed listing of all issues resolved for the beta release is shown »here«

IFC4 Add 1 for MVD development

- the first official Model View Definition for IFC4 will be based on the Addendum 1. Therefore all upcoming buildingSMART International IFC Certification are based on IFC4 Addendum 1.
- see IFC4 Reference View and IFC4 Design Transfer View as the first two bSI

IFC4 Add 1 under ISO16739

- it is planned to create a new work item for a first Amendment of

Specifications

- IFC Overview
- IFC Releases
  - IFC4 Add2 Release
  - **IFC4 Add1 Release**
  - IFC4 Release
  - IFC2x3 TC1 Release
  - IFC2x3 Release
  - IFC2x2 Release
  - IFC2x Release
- ifcXML Overview
- mvdXML Overview
- MVD Releases
- Pset Releases
- BCF Releases
- Related Specifications
- Specification tools

Search

Search Site

Search

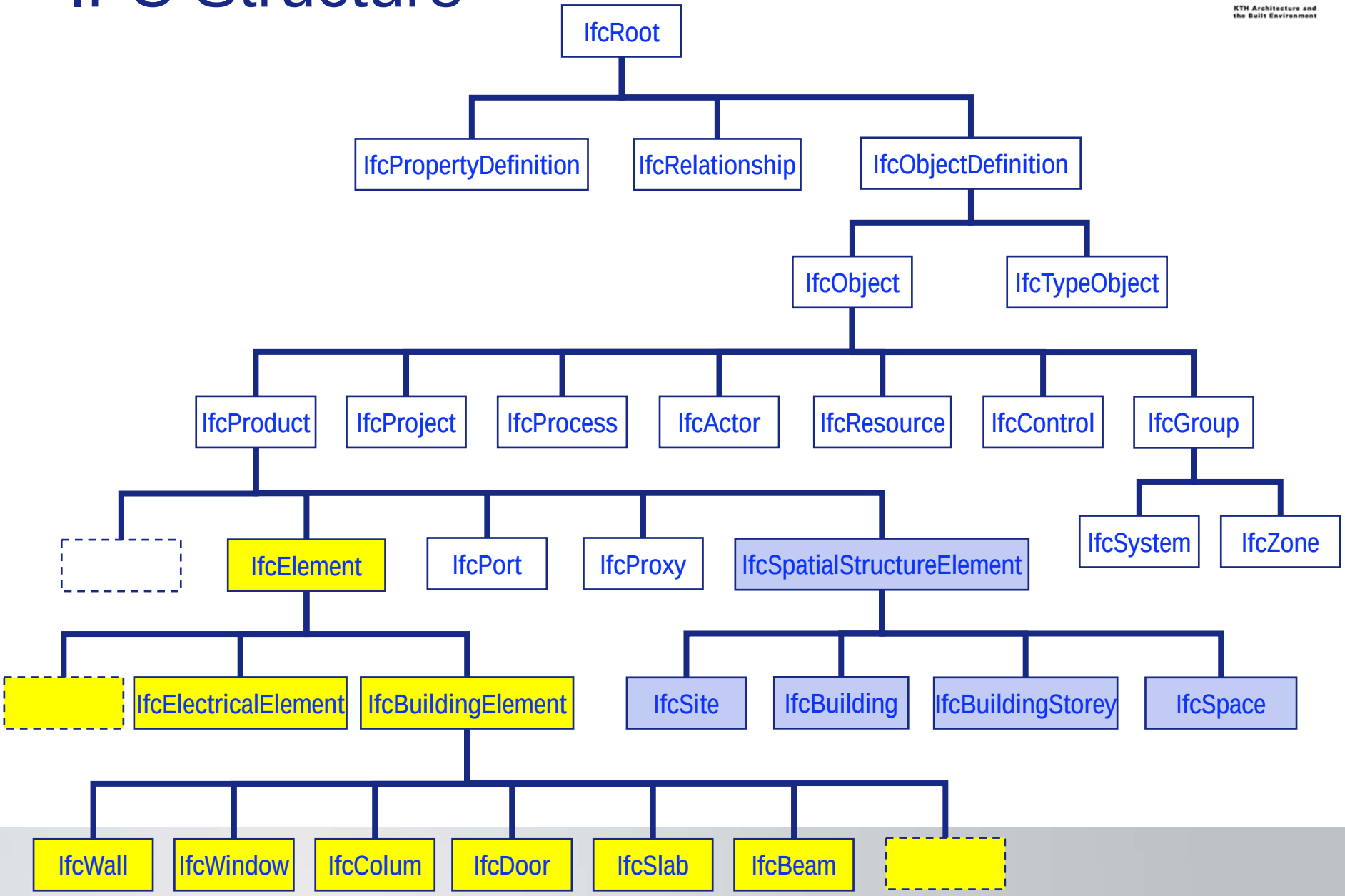
Advanced Search...

News

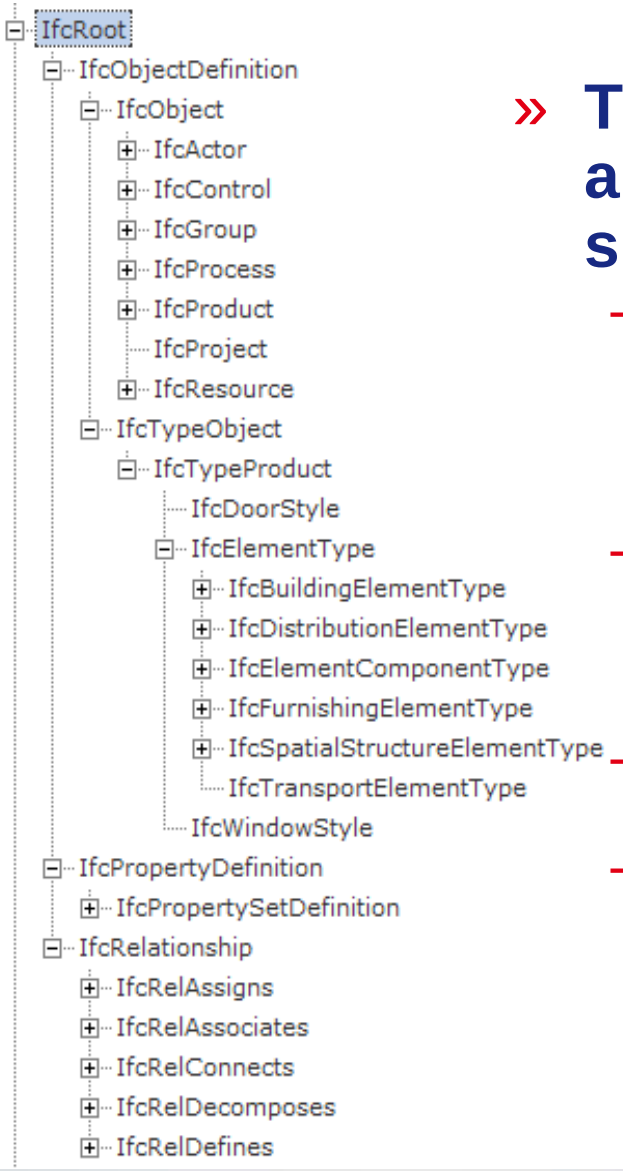
IFC4 Add2 published
Jul 15, 2016

More news...

IFC Structure

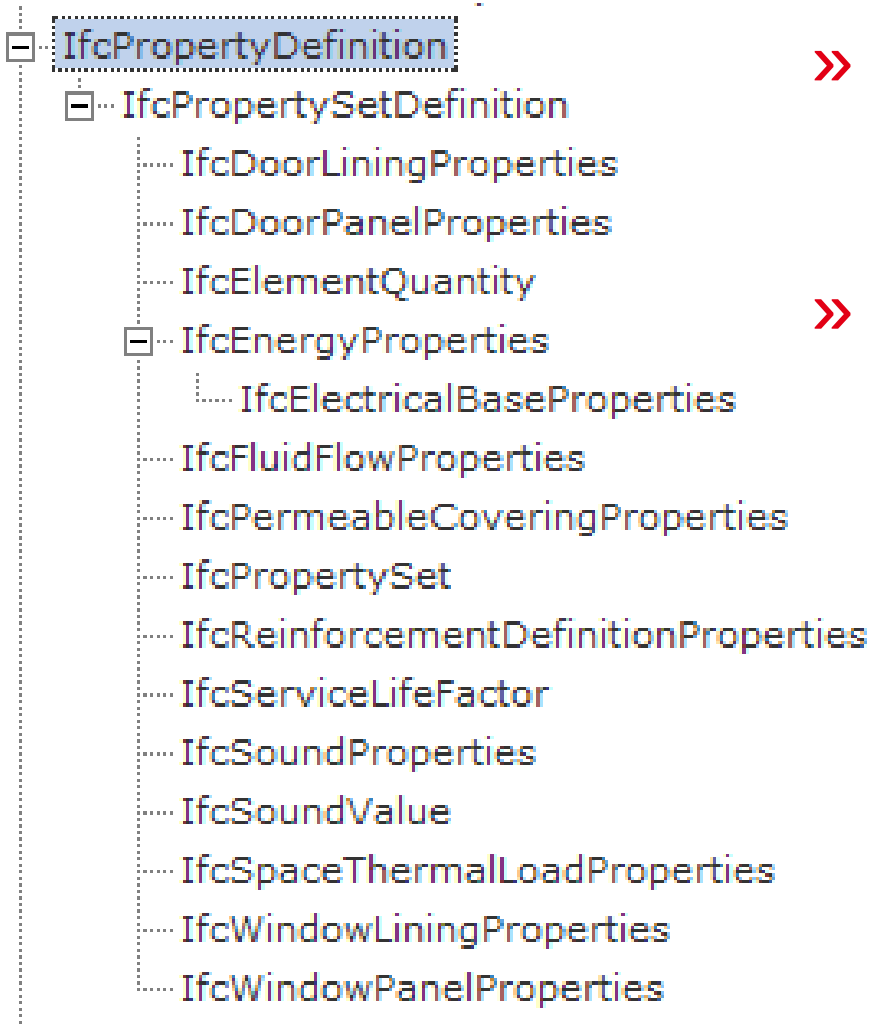


IFC schema brief (1)



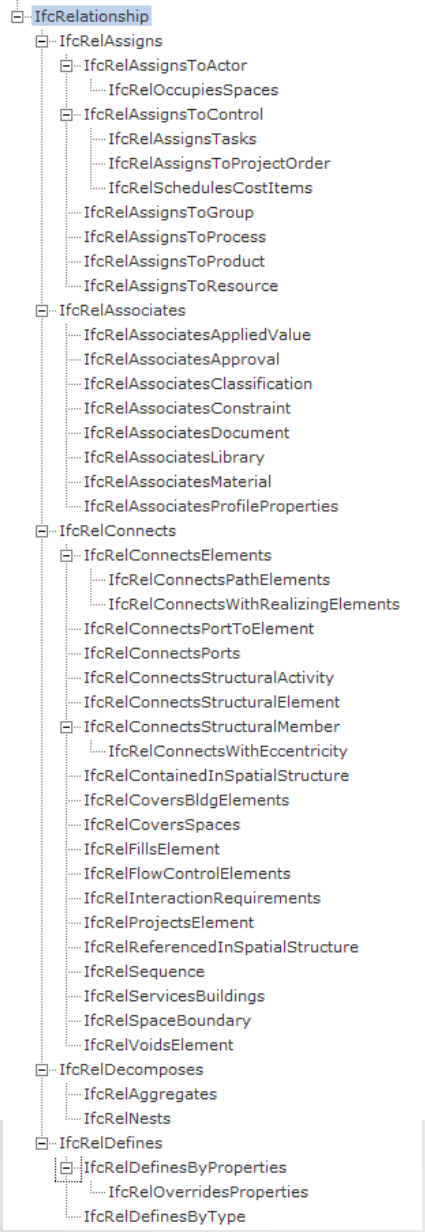
- **The main business objects, relationships and properties in the IFC schema are subclasses of IfcRoot**
  - ***IfcRoot holds***
    - The global ID (unique), name and description of the business object
    - The owner history which can be used for consolidation and versioning in SAs
  - ***IfcObjectDefinition holds*** inverse information to
    - Assignment relationships
    - Decomposition relationships (aggregations/nesting)
    - Association relationships (classifications/documents/libraries)
  - ***IfcObject (supertype of all business objects) holds***
    - Inverse information to Definition relationship (properties and types)
  - ***IfcTypeObject (supertype of all type objects) holds***
    - Properties for the type
    - Inverse relationship to the IfcObject

IFC schema brief (2)



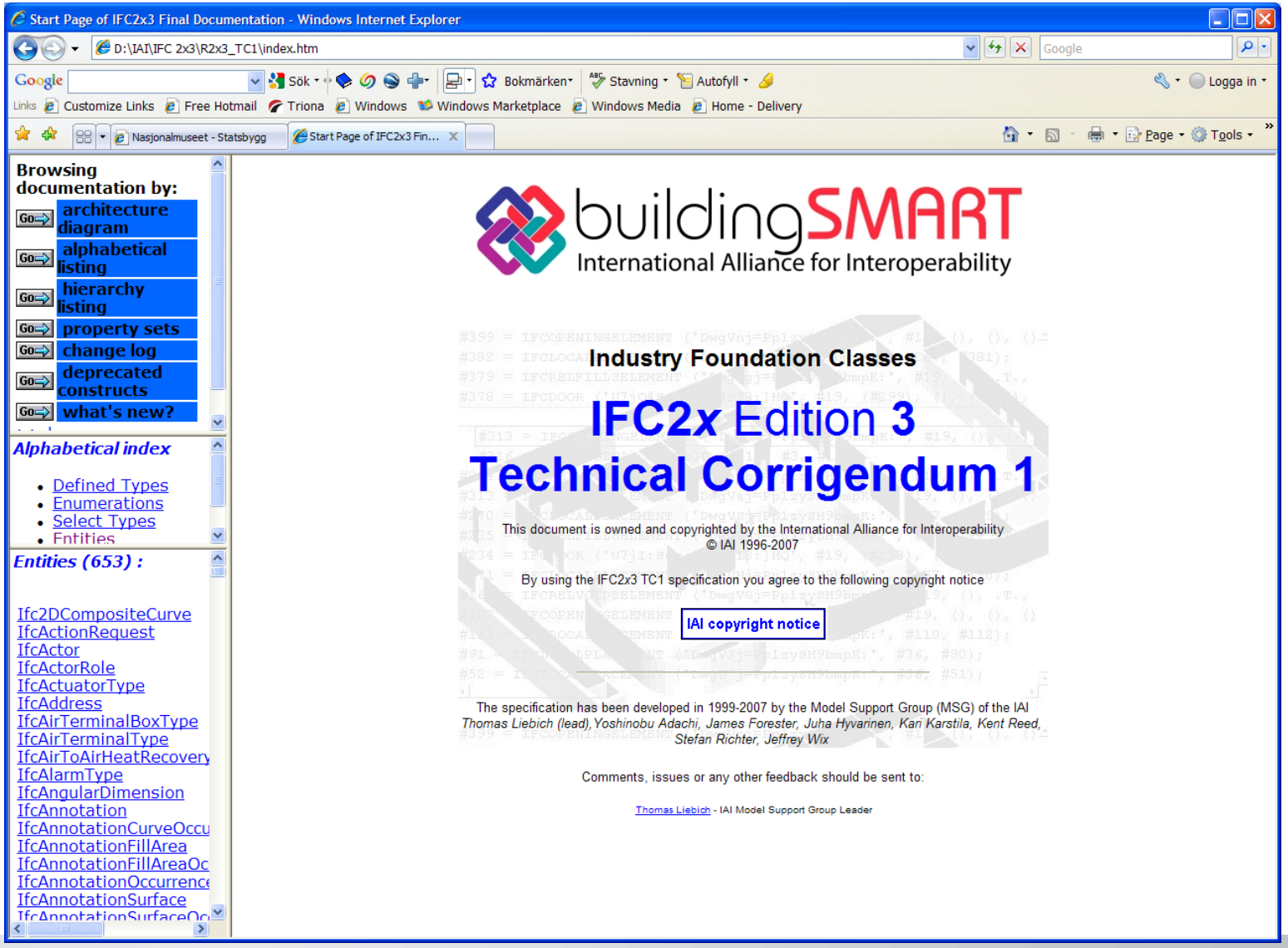
- ***IfcPropertyDefinition has***
  - inverse relationships to object to which the properties are assigned
- ***IfcPropertySetDefinition***
  - are basically groups of properties for business objects and object types

IFC schema brief (3)



- ***IfcRelationship*** *(supertypes of all kind of relationships)*
  - ***Assignments*** (semantically object client/supplier relationship)
  - ***Associations*** (classification/documents/libraries relationships)
  - ***Connections*** (mainly topological relationships between objects which might have constraints associated to)
  - ***Decompositions*** (mainly structural relationships)
  - ***Definitions*** (properties / types relationships)

IFC 2x3 specification



Start Page of IFC2x3 Final Documentation - Windows Internet Explorer
C:\IAI\IFC 2x3\R2x3_TC1\index.htm
Bing
Favorites
Suggested Sites
Web Slice Gallery
8A i Källängens blogg
Dexter - Logga in
Free Hotmail
Home - Delivery
LogOn
Start Page of IFC2x3 Final Documenta...
Page
Safety
Tools

IfcBuilding

Definition from ISO 6707-1:1989: Construction work that has the provision of shelter for its occupants or contents as one of its main purpose and is normally designed to stand permanently in one place.

Definition from IAI: A building represents a structure that provides shelter for its occupants or contents and stands in one place. The building is also used to provide a basic element within the spatial structure hierarchy for the components of a building project (together with site, storey, and space).

A building is (if specified) associated to a site. A building may span over several connected or disconnected buildings. Therefore building complex provides for a collection of buildings included in a site. A building can also be decomposed in (vertical) parts, where each part defines a building section. This is defined by the composition type attribute of the supertype *IfcSpatialStructureElements* which is interpreted as follow:

- COMPLEX = building complex
- ELEMENT = building
- PARTIAL = building section

HISTORY New entity in IFC Release 1.0.

Property Set Use Definition:

The property sets relating to the *IfcBuilding* are defined by the *IfcPropertySet* and attached by the *IfcRelDefinesByProperties* relationship. It is accessible by the inverse *IsDefinedBy* relationship. The following property set definitions specific to the *IfcBuilding* are part of this IFC release:

- Pset_BuildingCommon: common property set for all types of buildings
- Pset_BuildingWaterStorage: specific property set for buildings to capture the water supply requirements
- Pset_BuildingUse: specific property set for buildings to capture the current and anticipated real estate context.
- Pset_BuildingUseAdjacent: specific property set for buildings to capture the use information about the adjacent buildings.

Quantity Use Definition:

The quantities relating to the *IfcBuilding* are defined by the *IfcElementQuantity* and attached by the *IfcRelDefinesByProperties*. The following quantities are foreseen, but will be subjected to the local standard of measurement:

Name	*Description*	*Value Type*
NominalHeight	Calculated height of the building, measured from the level of terrain to the top part of the building. The exact definition and calculation rules depend on the method of measurement used.	*IfcQuantityLength*
NominalArea	Calculated coverage of the site area that is occupied by the building	*IfcQuantityArea*

Browsing documentation by:

- Go ⇨ architecture diagram
- Go ⇨ alphabetical listing
- Go ⇨ hierarchy listing
- Go ⇨ property sets
- Go ⇨ change log
- Go ⇨ deprecated constructs

Alphabetical index

- Defined Types
- Enumerations
- Select Types
- Entities

IfcAxis2Placement3D
IfcBSplineCurve
IfcBeam
IfcBeamType
IfcBezierCurve
IfcBlobTexture
IfcBlock
IfcBoilerType
IfcBooleanClippingResult
IfcBooleanResult
IfcBoundaryCondition
IfcBoundaryEdgeCondition
IfcBoundaryFaceCondition
IfcBoundaryNodeCondition
IfcBoundaryNodeConditionW
IfcBoundedCurve
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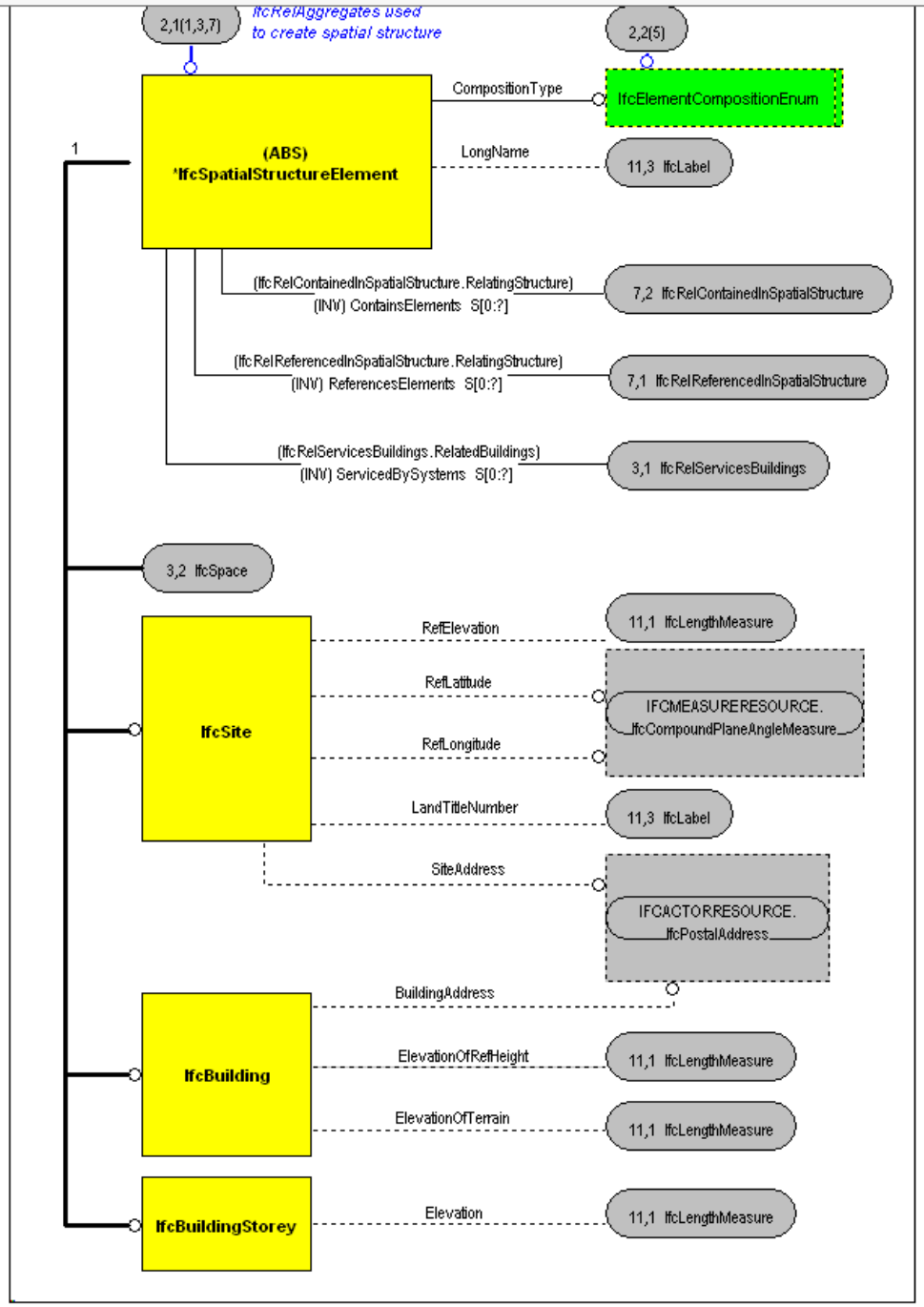
IfcBuildingElementProxy
IfcBuildingElementProxyType



KTH Architecture and the Built Environment

Geometry - example

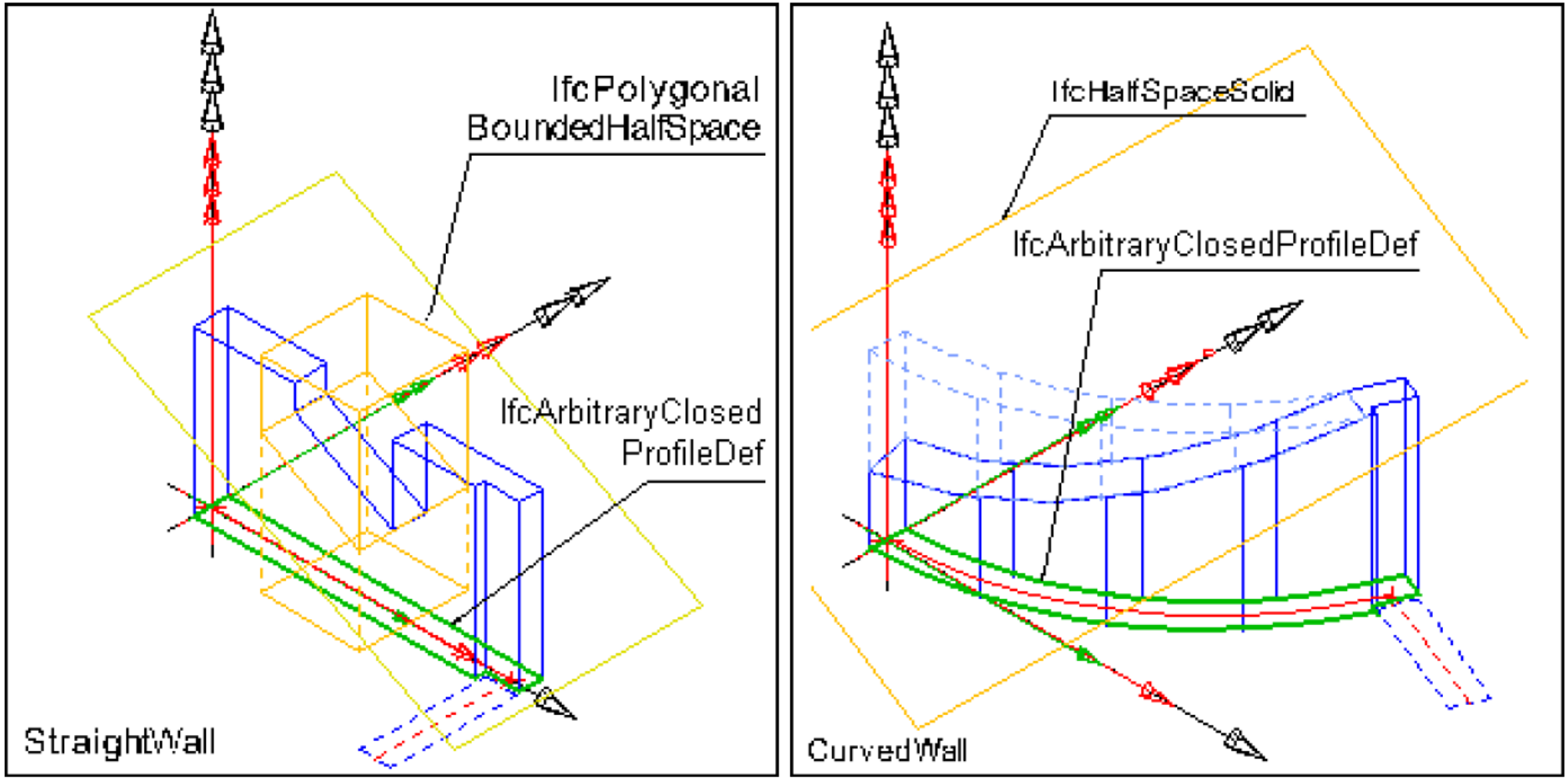
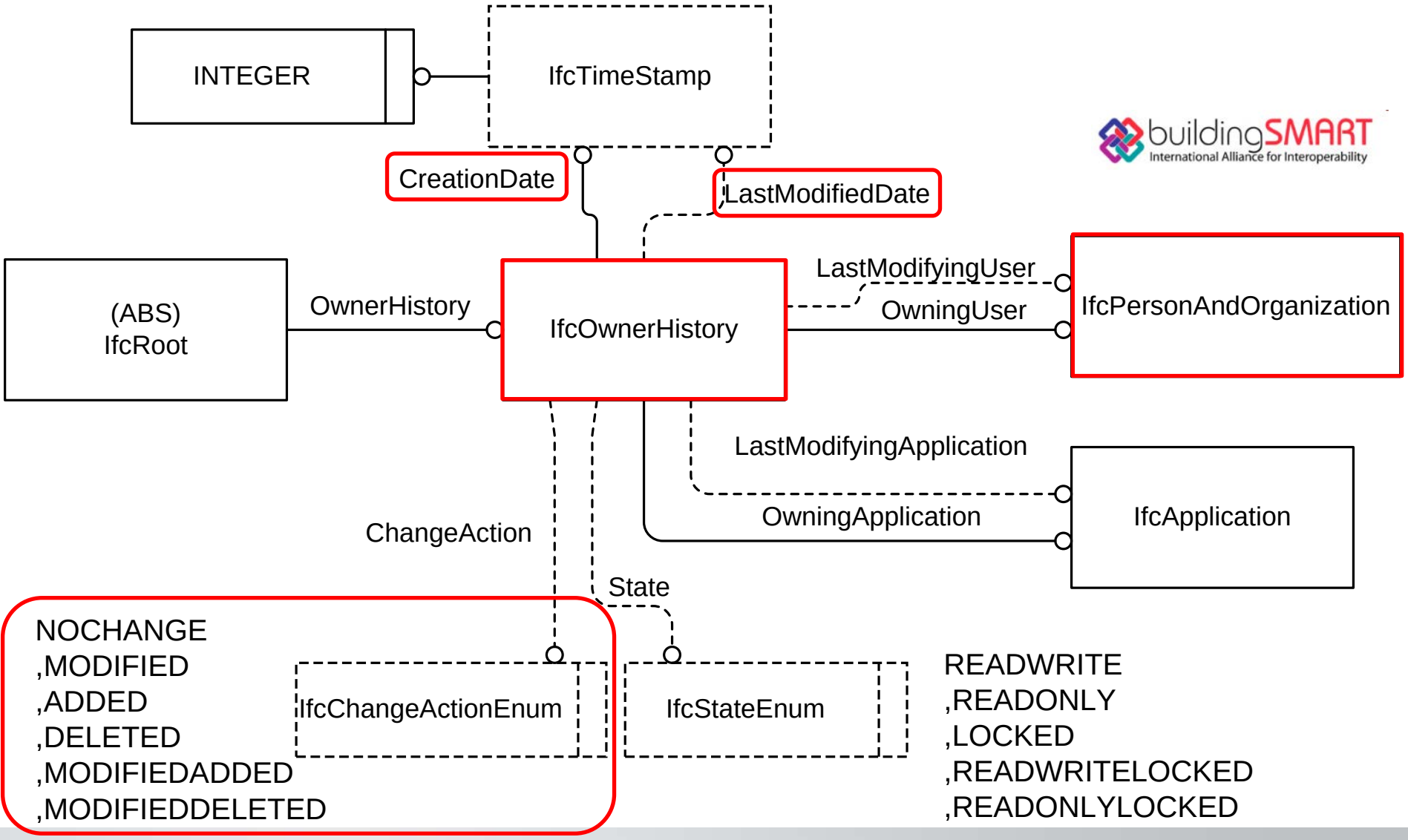
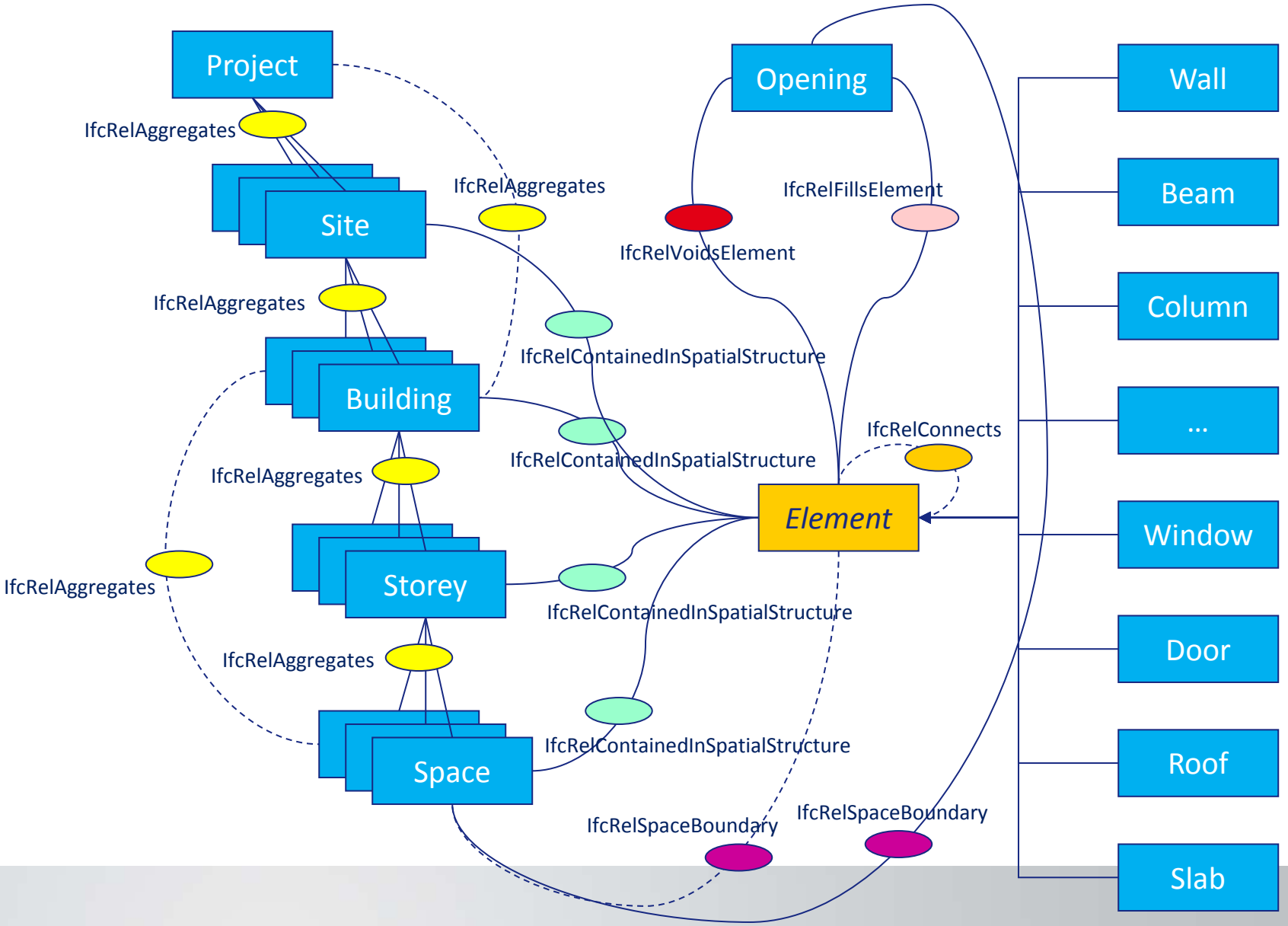


Figure 27 : Example of bounded and unbounded clipping planes

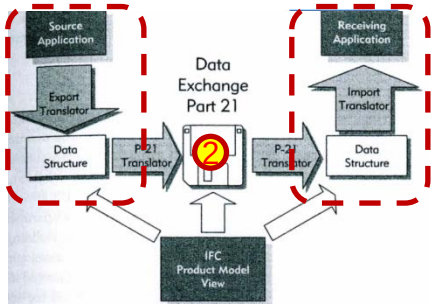
Owner History



Typical IFC data exchange file structure



Export the IFC file



IFCExample1-2IFCExport.ifc - Notepad

File Edit Format View Help

```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION(('ViewDefinition [CoordinationView, QuantityTakeOffAddOnView]','Option [Filter:
VisibleElements]'),'2;1');
FILE_NAME('C:\\Users\\NenadB\\Documents\\CGI\\Projekti\\CITA\\CAD\\IFCExample1-2IFCExport.ifc','2010-
05-17T11:44:37',('Architect'),('Building Designer Office'),'PreProc - EDM 5.0','ArchiCAD 13.00 Release
1. Windows Build Number of the Ifc 2x3 interface: 64125 (21-07-2009)\X\0A','The authorising person');
FILE_SCHEMA(('IFC2X3'));
ENDSEC;

DATA;
#1= IFCORGANIZATION('GS','Graphisoft','Graphisoft',$,$);
#5= IFCAPPLICATION(#1,'13.0','ArchiCAD 13.0','ArchiCAD');
#6= IFCPERSON('','','',$,$,$,$,$);
#8= IFCORGANIZATION('','','',$,$);
#12= IFCPERSONANDORGANIZATION(#6,#8,$);
#13= IFCOWNERHISTORY(#12,#5,$,.ADDED.,$,$,$,1274089476);
#14= IFCSIUNIT(*,.LENGTHUNIT.,.MILLI.,.METRE.);
#15= IFCSIUNIT(*,.AREAUNIT.,$,.SQUARE_METRE.);
#16= IFCSIUNIT(*,.VOLUMEUNIT.,$,.CUBIC_METRE.);
#17= IFCSIUNIT(*,.PLANEANGLEUNIT.,$,.RADIAN.);
#18= IFCMEASUREWITHUNIT(IFCPLANEANGLEMEASURE(0.017453293),#17);
#19= IFCDIMENSIONALEXPONENTS(0,0,0,0,0,0,0);
#20= IFCCONVERSIONBASEDUNIT(#19,.PLANEANGLEUNIT.,'DEGREE',#18);
#21= IFCSIUNIT(*,.SOLIDANGLEUNIT.,$,.STERADIAN.);
#22= IFCSIUNIT(*,.MASSUNIT.,$,.GRAM.);
#23= IFCSIUNIT(*,.TIMEUNIT.,$,.SECOND.);
#24= IFCSIUNIT(*,.THERMODYNAMICTEMPERATUREUNIT.,$,.DEGREE_CELSIUS.);
#25= IFCSIUNIT(*,.LUMINOUSINTENSITYUNIT.,$,.LUMEN.);
#26= IFCUNITASSIGNMENT((#14,#15,#16,#20,#21,#22,#23,#24,#25));
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#32= IFCDIRECTION((0.,1.,0.));
#36= IFCDIRECTION((0.,0.,1.));
#40= IFCCARTESIANPOINT((0.,0.,0.));
#44= IFCAXIS2PLACEMENT3D(#40,#36,#28);
#47= IFCDIRECTION((6.1232340E-17,1.));
#51= IFCGEOMETRICREPRESENTATIONCONTEXT('Plan','Design',3,1.0000000E-5,#44,#47);
#54= IFCPROJECT('2HT2nJiIT08A2IhpvNb9sW',#13,'D                                    206),#26);
#61= IFCPROPERTYSET('03FnQt2TbALgDt6WbsDs1Z',#1
#66= IFCPROPERTYSINGLEVALUE('GS_TimeStamp',$,IFC
#70= IFCRELDEFINESBYPROPERTIES('05l5OWhdr02gflBc
#72= IFCLOCALPLACEMENT($,#44);
#75= IFCSITE('25j2mdBRT0sPjnZ3xTMA6H',#13,'Defau                                  ,28,0),(54,25,0),$,
$,$);
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#88= IFCBUILDING('3m1fgA4Hn6IQ_7595zbBLn',#13,'D                                  ENT.,$,$,$);
#98= IFCAXIS2PLACEMENT3D(#40,#36,#28);
#101= IFCLOCALPLACEMENT(#85,#98);
#104= IFCBUILDINGSTOREY('3R_UY84BP0XgG_TENPVnYW'                                  01-0000-0000-0000-
000000000000',.ELEMENT.,0.);
#114= IFCMATERIAL('Masonry Block');
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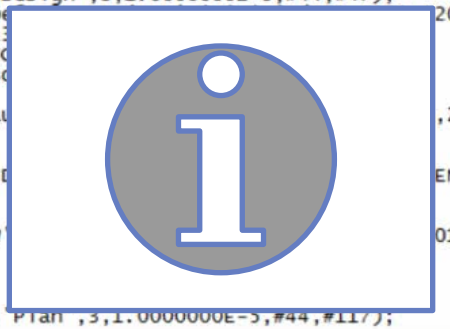
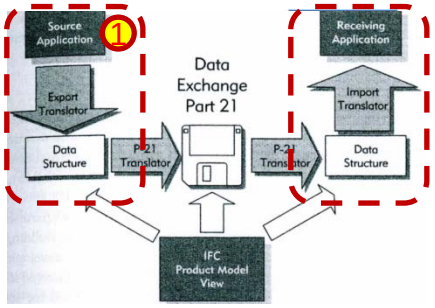


file

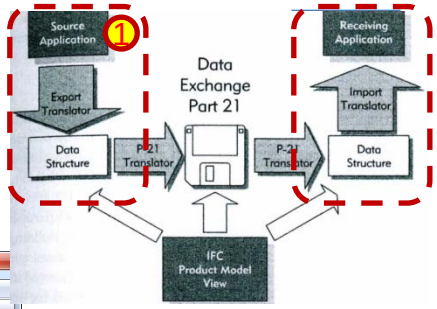
Starting Solibri Model Viewer

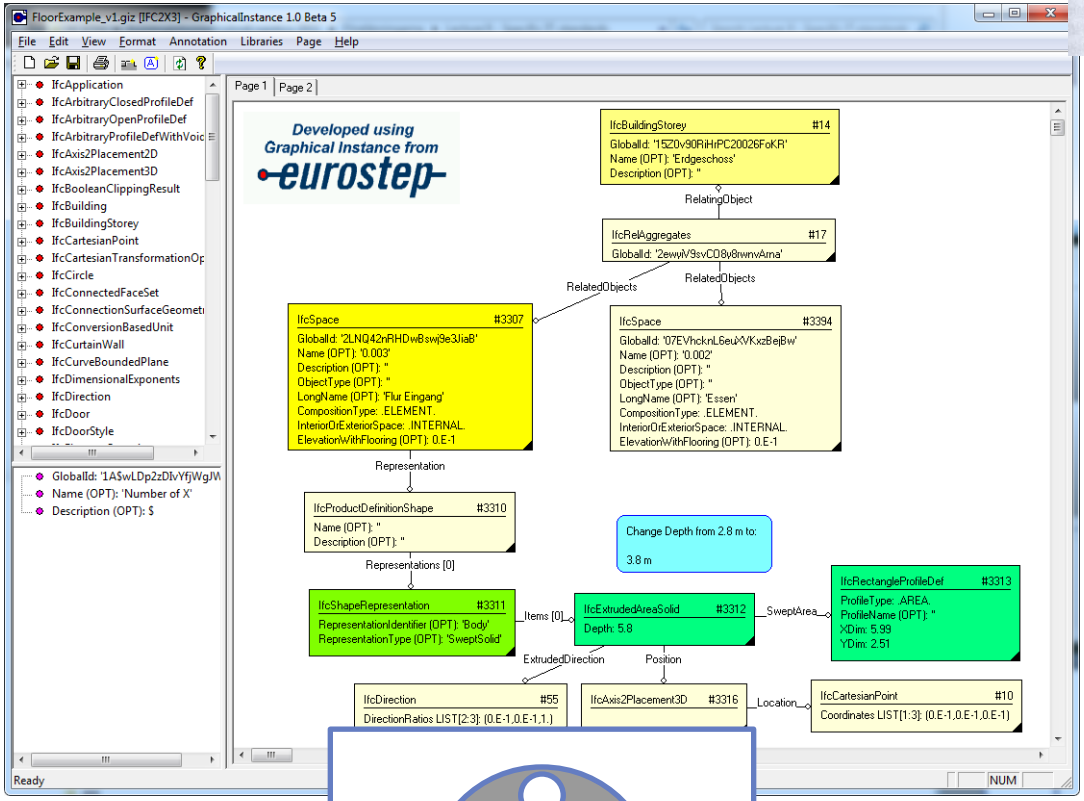
Changing the IFC information



- You can create and change the building objects in an authoring tool, like a CAD-system
- You can do it in other tools too, like Graphical Instance – you only need to know the standard, i.e. IFC
- In Graphical Instance you can access the IFC file, modify it and export a new version

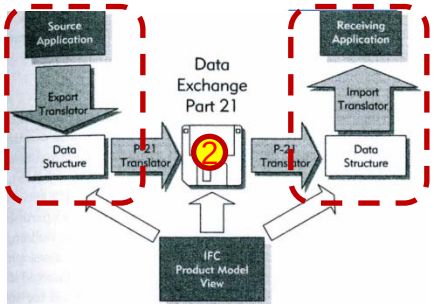
Changing the IFC information

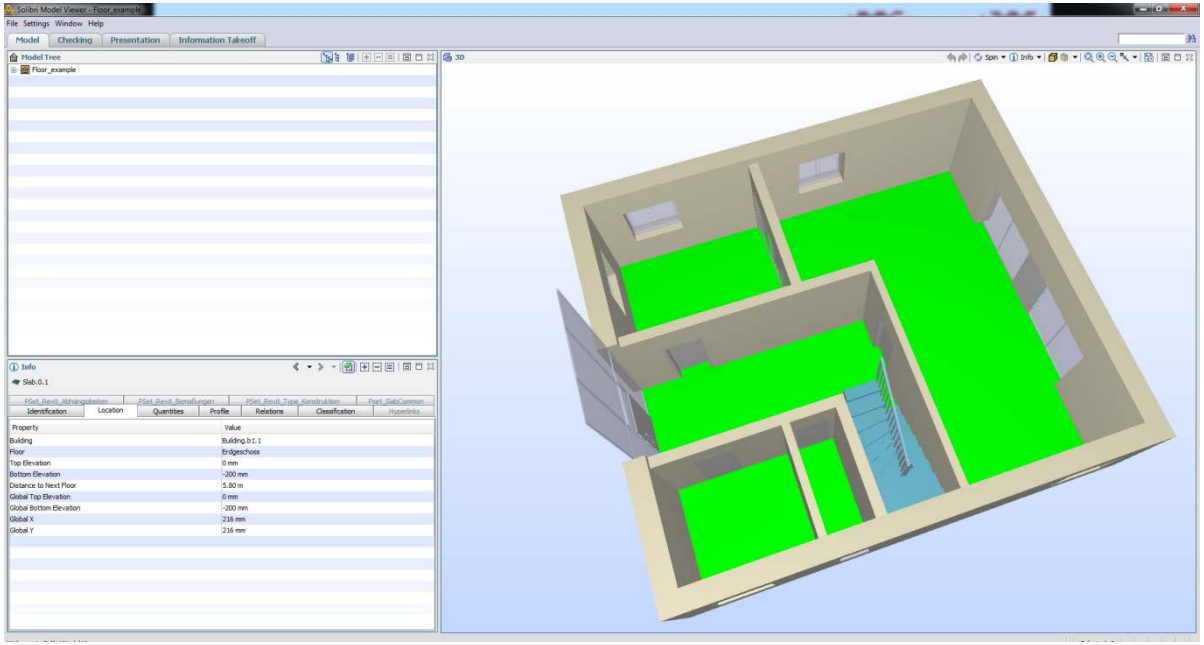




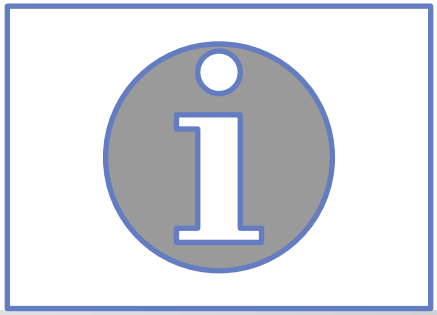
Starting Graphical Instance

Export the IFC file





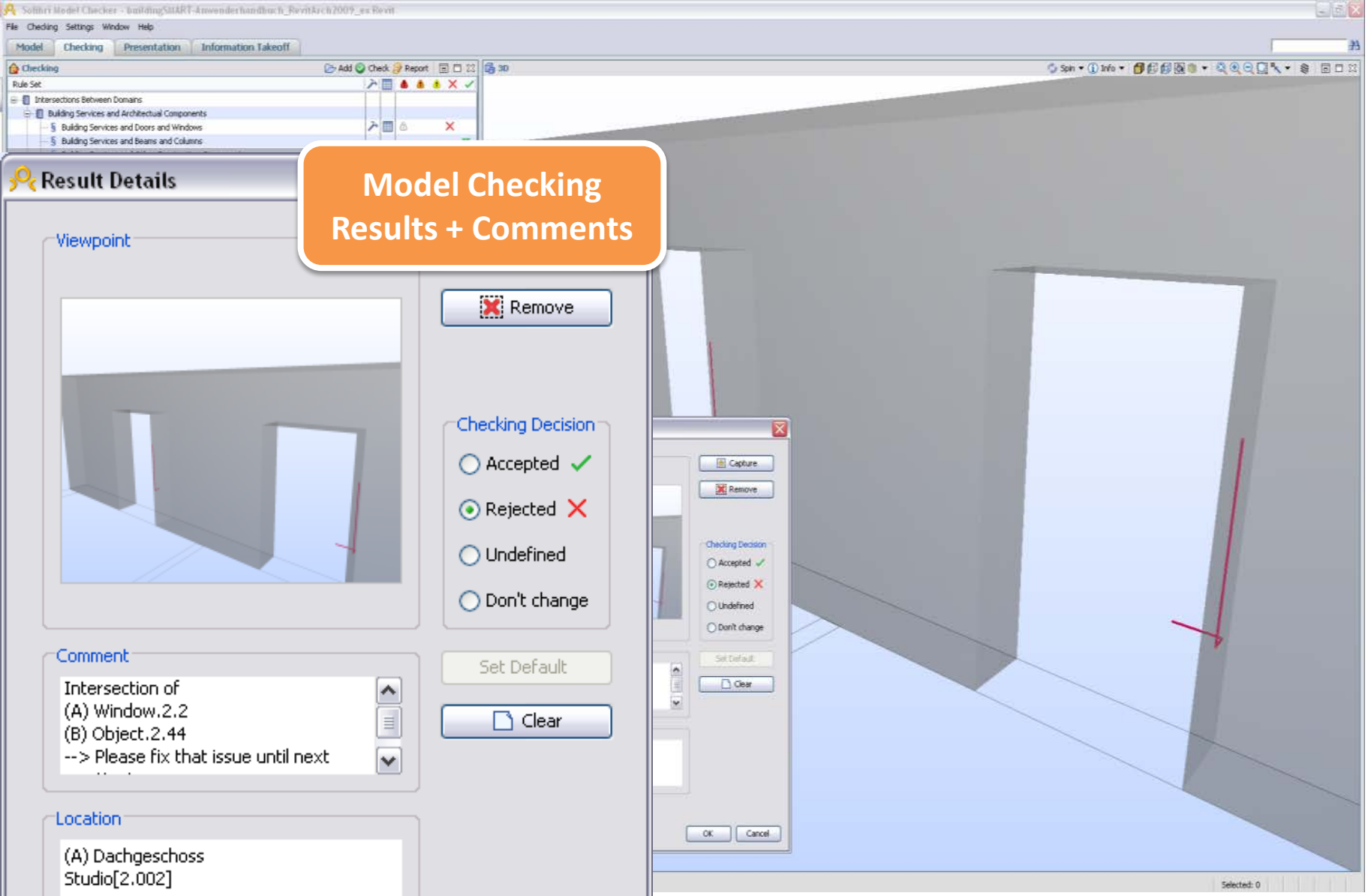
file



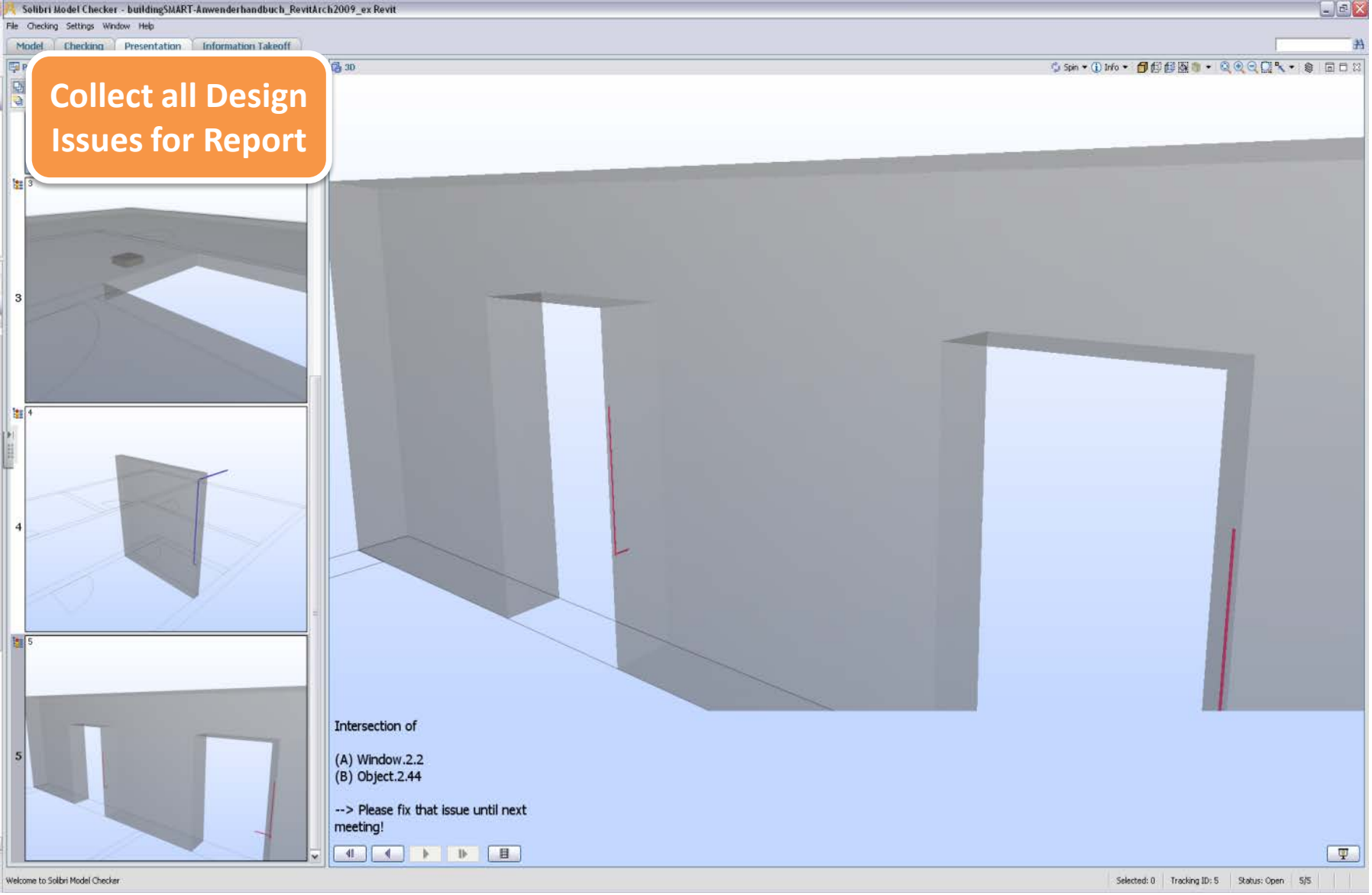
Starting Solibri Model Checker

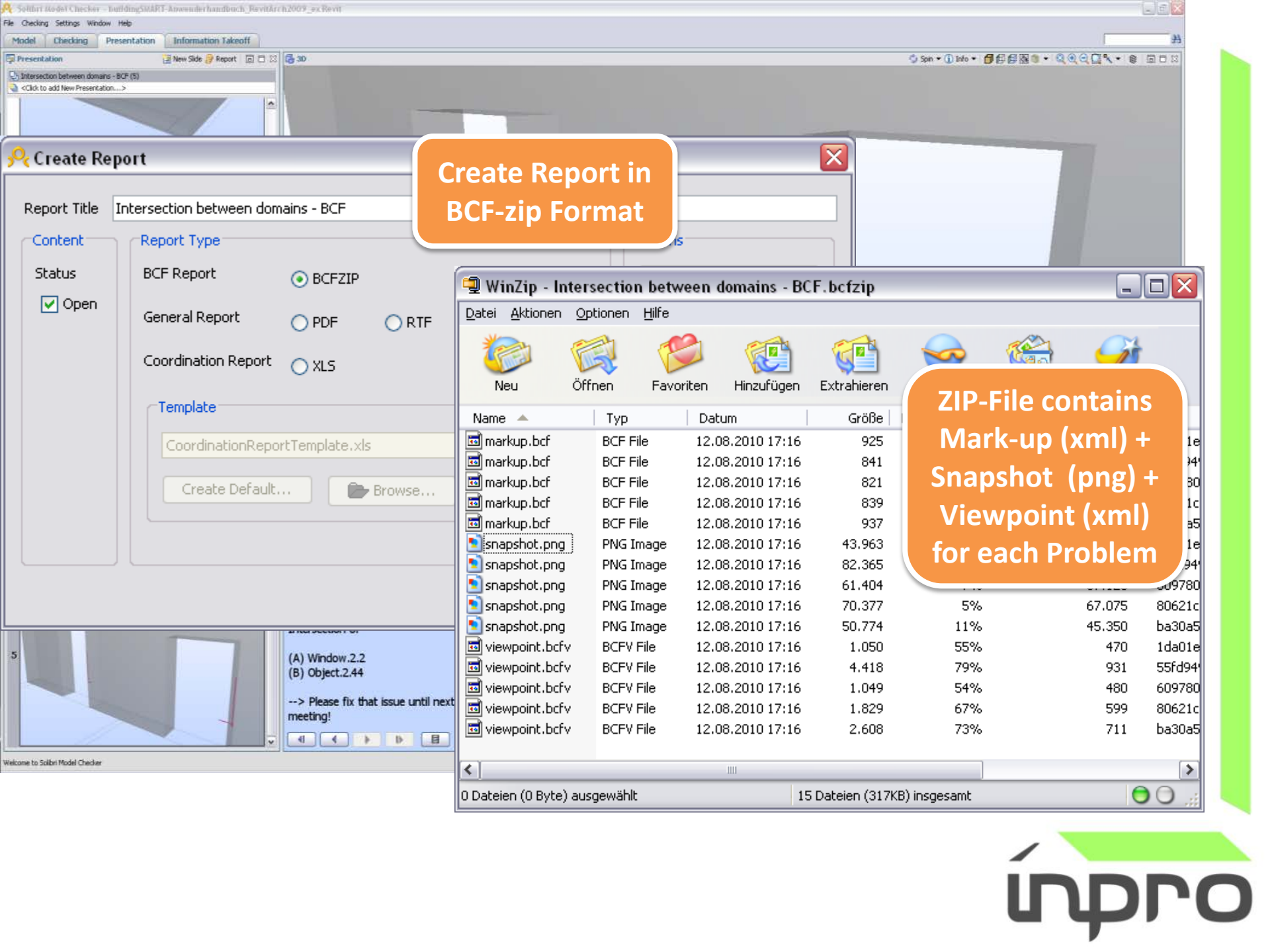
BIM Collaboration Format

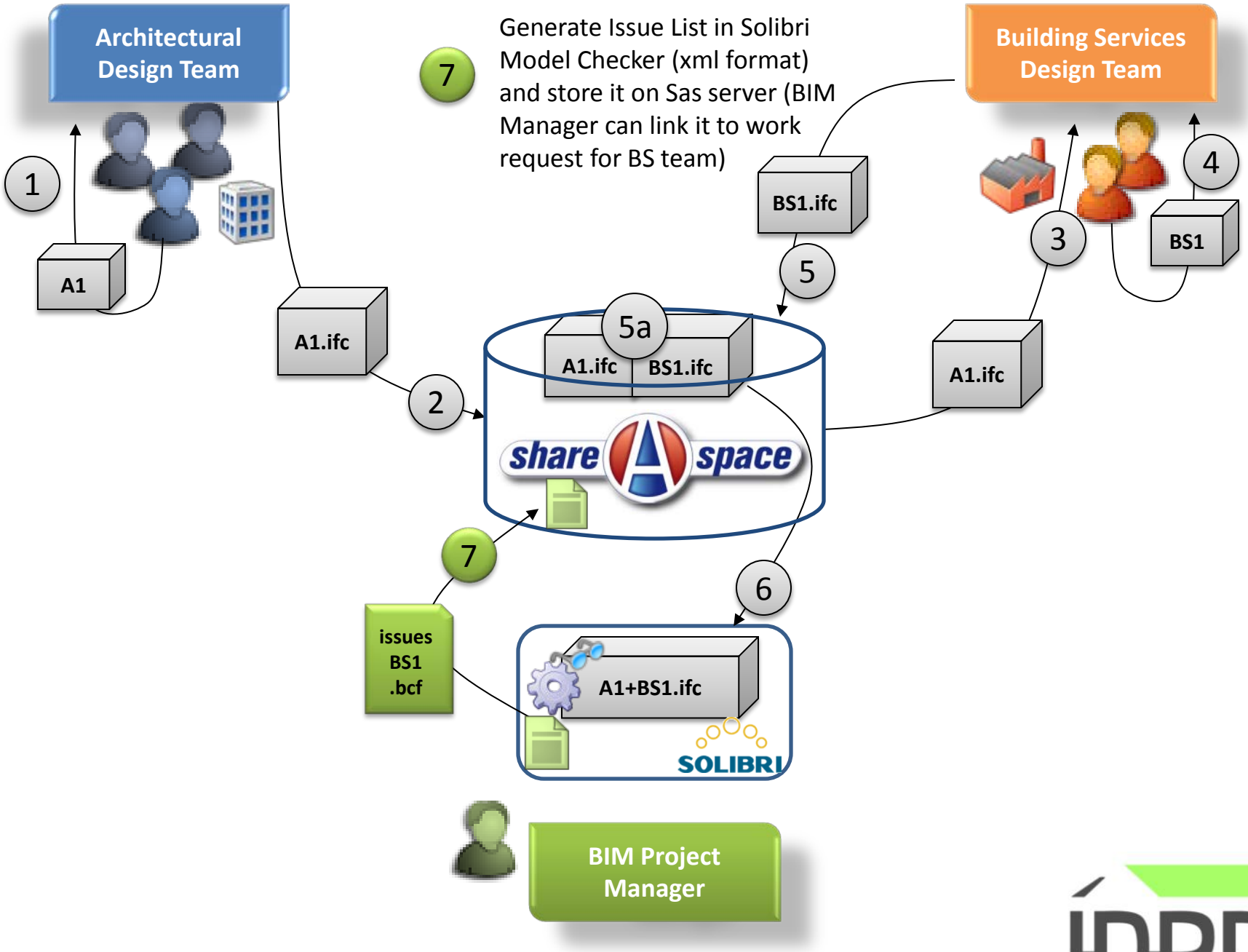
KTH Architecture and the Built Environment

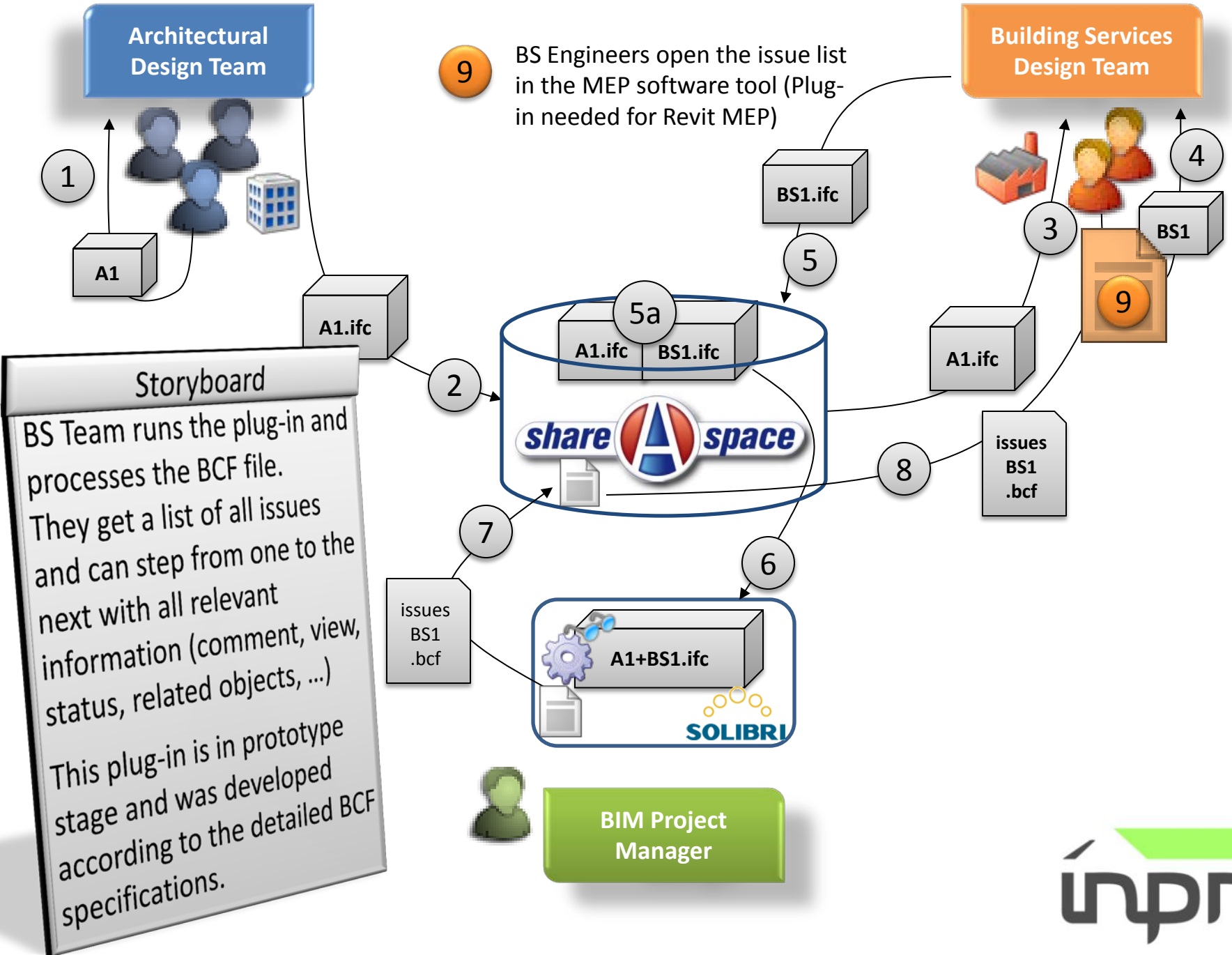

Model Checking
Results + Comments
Result Details
Viewpoint
Remove
Checking Decision
Accepted
Rejected
Undefined
Don't change
Comment
Intersection of
(A) Window.2.2
(B) Object.2.44
--> Please fix that issue until next
Set Default
Clear
Location
(A) Dachgeschoss
Studio[2.002]
Use in presentation
OK
Cancel

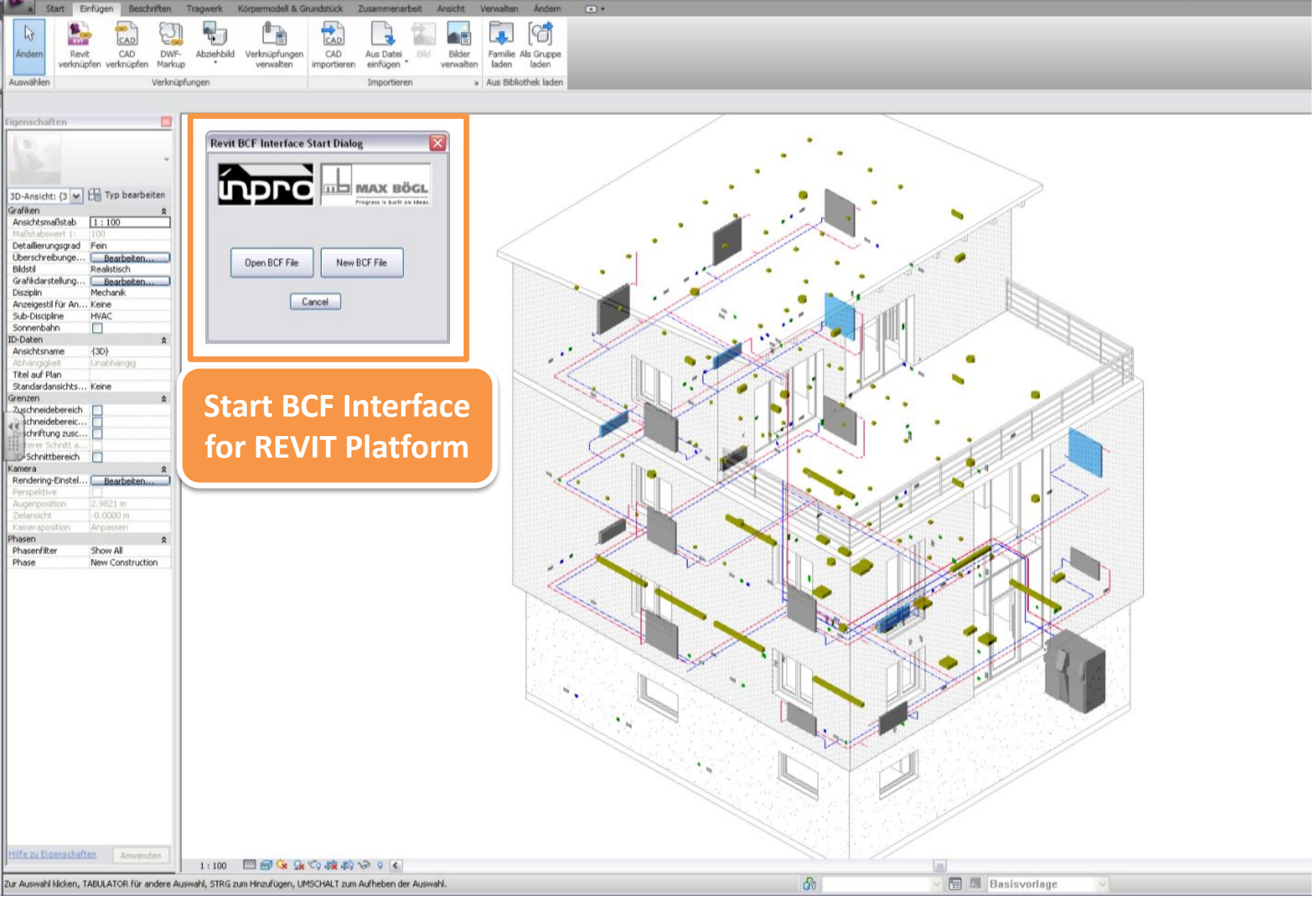
Collect all Design Issues for Report

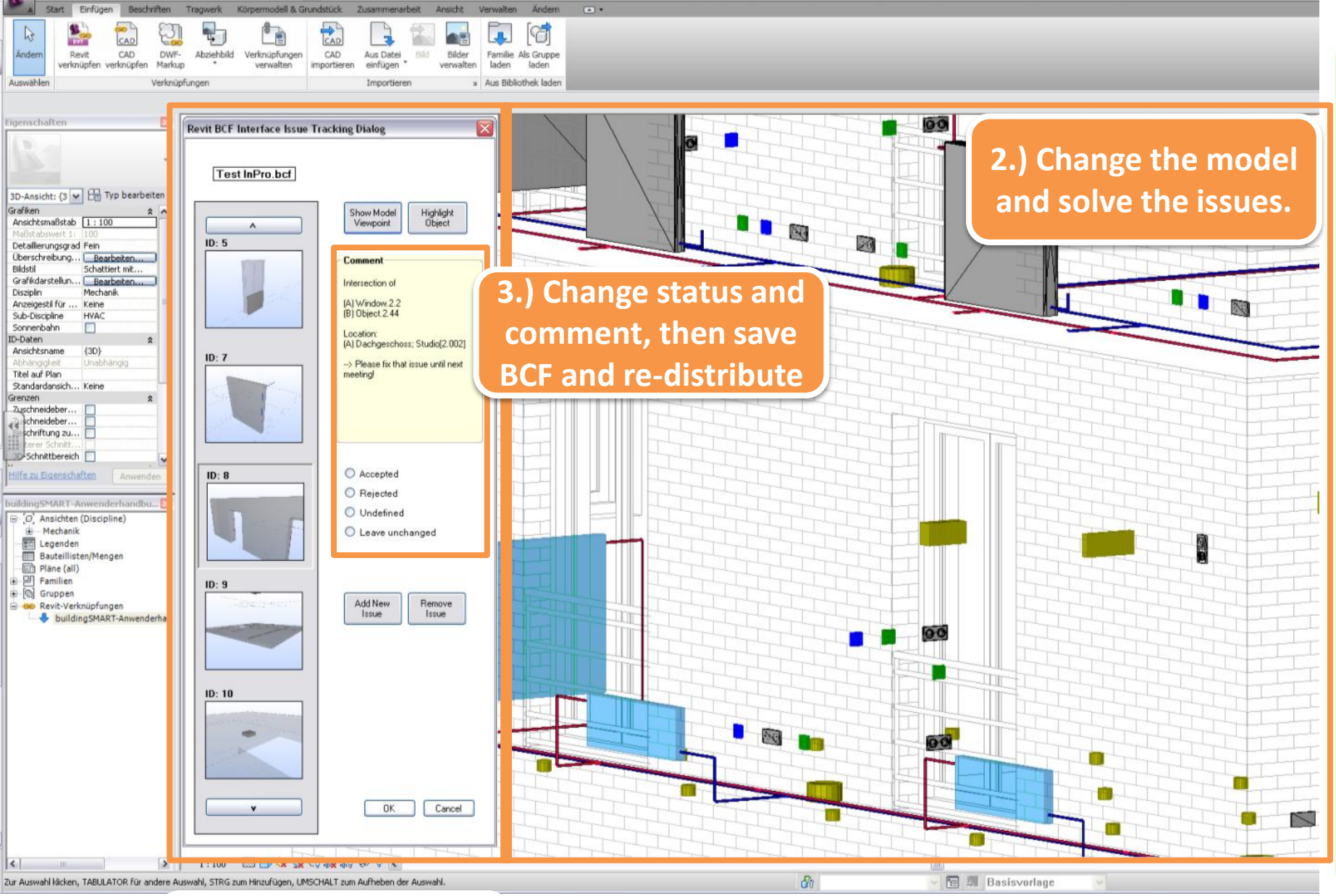



Create Report
Report Title
Intersection between domains - BCF
Content
Status
Open
Report Type
BCF Report
BCFZIP
General Report
PDF
RTF
Coordination Report
XLS
Template
CoordinationReportTemplate.xls
Create Default...
Browse...
Create Report in BCF-zip Format
WinZip - Intersection between domains - BCF.bcfzip
Datei Aktionen Optionen Hilfe
Neu
Öffnen
Favoriten
Hinzufügen
Extrahieren
Name
Typ
Datum
Größe
markup.bcf BCF File 12.08.2010 17:16 925
markup.bcf BCF File 12.08.2010 17:16 841
markup.bcf BCF File 12.08.2010 17:16 821
markup.bcf BCF File 12.08.2010 17:16 839
markup.bcf BCF File 12.08.2010 17:16 937
snapshot.png PNG Image 12.08.2010 17:16 43.963
snapshot.png PNG Image 12.08.2010 17:16 82.365
snapshot.png PNG Image 12.08.2010 17:16 61.404
snapshot.png PNG Image 12.08.2010 17:16 70.377 5% 67.075 80621c
snapshot.png PNG Image 12.08.2010 17:16 50.774 11% 45.350 ba30a5
viewpoint.bcfv BCFV File 12.08.2010 17:16 1.050 55% 470 1da01e
viewpoint.bcfv BCFV File 12.08.2010 17:16 4.418 79% 931 55fd94
viewpoint.bcfv BCFV File 12.08.2010 17:16 1.049 54% 480 609780
viewpoint.bcfv BCFV File 12.08.2010 17:16 1.829 67% 599 80621c
viewpoint.bcfv BCFV File 12.08.2010 17:16 2.608 73% 711 ba30a5
0 Dateien (0 Byte) ausgewählt
15 Dateien (317KB) insgesamt
ZIP-File contains Mark-up (xml) + Snapshot (png) + Viewpoint (xml) for each Problem
(A) Window.2.2
(B) Object.2.44
--> Please fix that issue until next meeting!


Architectural Design Team
Building Services Design Team
7
Generate Issue List in Solibri Model Checker (xml format) and store it on Sas server (BIM Manager can link it to work request for BS team)
1
A1
A1.ifc
2
BS1.ifc
5
5a
A1.ifc
BS1.ifc
shareAspace
3
4
BS1
A1.ifc
7
issues BS1 .bcf
6
A1+BS1.ifc
SOLIBRI
BIM Project Manager


Architectural Design Team
Building Services Design Team
9
BS Engineers open the issue list in the MEP software tool (Plug-in needed for Revit MEP)
1
A1
A1.ifc
BS1.ifc
5
3
4
BS1
9
5a
A1.ifc
BS1.ifc
2
shareAspace
A1.ifc
8
issues BS1 .bcf
7
6
issues BS1 .bcf
A1+BS1.ifc
SOLIBRI
BIM Project Manager
Storyboard
BS Team runs the plug-in and processes the BCF file. They get a list of all issues and can step from one to the next with all relevant information (comment, view, status, related objects, ...)
This plug-in is in prototype stage and was developed according to the detailed BCF specifications.
inpro

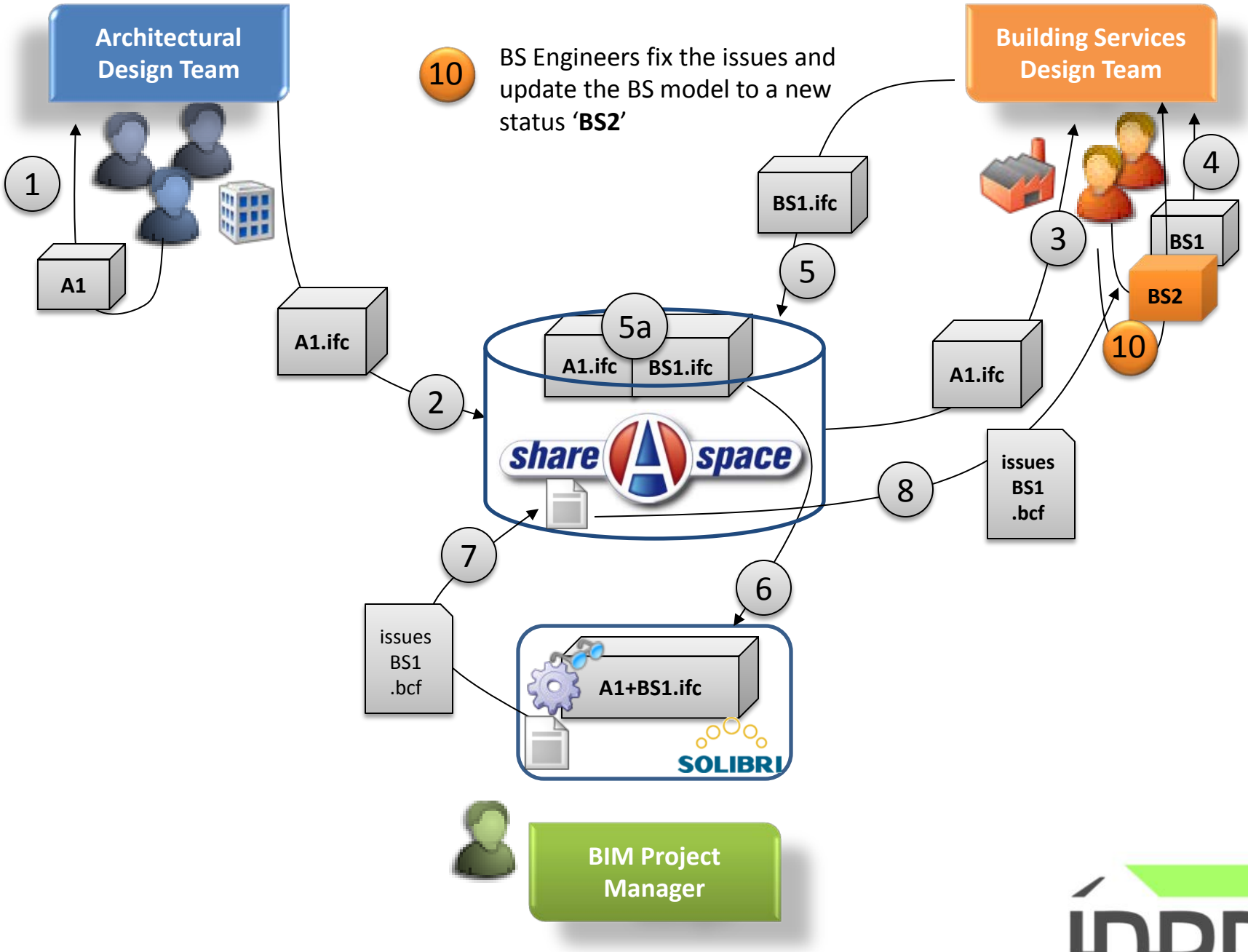

Start
Einfügen
Beschriften
Tragwerk
Körpermodell & Grundstück
Zusammenarbeit
Ansicht
Verwalten
Ändern
Ändern
Revit verknüpfen
CAD verknüpfen
DWF-Markup
Abziehbild
Verknüpfungen verwalten
CAD importieren
Aus Datei einfügen
Bild
Bilder verwalten
Familie laden
Als Gruppe laden
Auswählen
Verknüpfungen
Importieren
Aus Bibliothek laden
Eigenschaften
3D-Ansicht: {3
Typ bearbeiten
Grafiken
Ansichtsmaßstab 1 : 100
Maßstabswert 1: 100
Detaillierungsgrad Fein
Überschreibunge... Bearbeiten...
Bildstil Realistisch
Grafikdarstellung... Bearbeiten...
Disziplin Mechanik
Anzeigestil für An... Keine
Sub-Discipline HVAC
Sonnenbahn
ID-Daten
Ansichtsname {3D}
Abhängigkeit Unabhängig
Titel auf Plan
Standardansichts... Keine
Grenzen
Zuschneidebereich
Schnittbereich
Kamera
Rendering-Einstel... Bearbeiten...
Perspektive
Augenposition 2.9821 m
Zielansicht 0.0000 m
Kameraposition Anpassen
Phasen
Phasenfilter Show All
Phase New Construction
Hilfe zu Eigenschaften
Anwenden
Revit BCF Interface Start Dialog
inpro
MAX BÖGL
Progress is built on ideas.
Open BCF File
New BCF File
Cancel
Start BCF Interface for REVIT Platform
1 : 100
Zur Auswahl klicken, TABULATOR für andere Auswahl, STRG zum Hinzufügen, UMSCHALT zum Aufheben der Auswahl.
Basisvorlage



1.) Open BCF File and step through all issues and comments

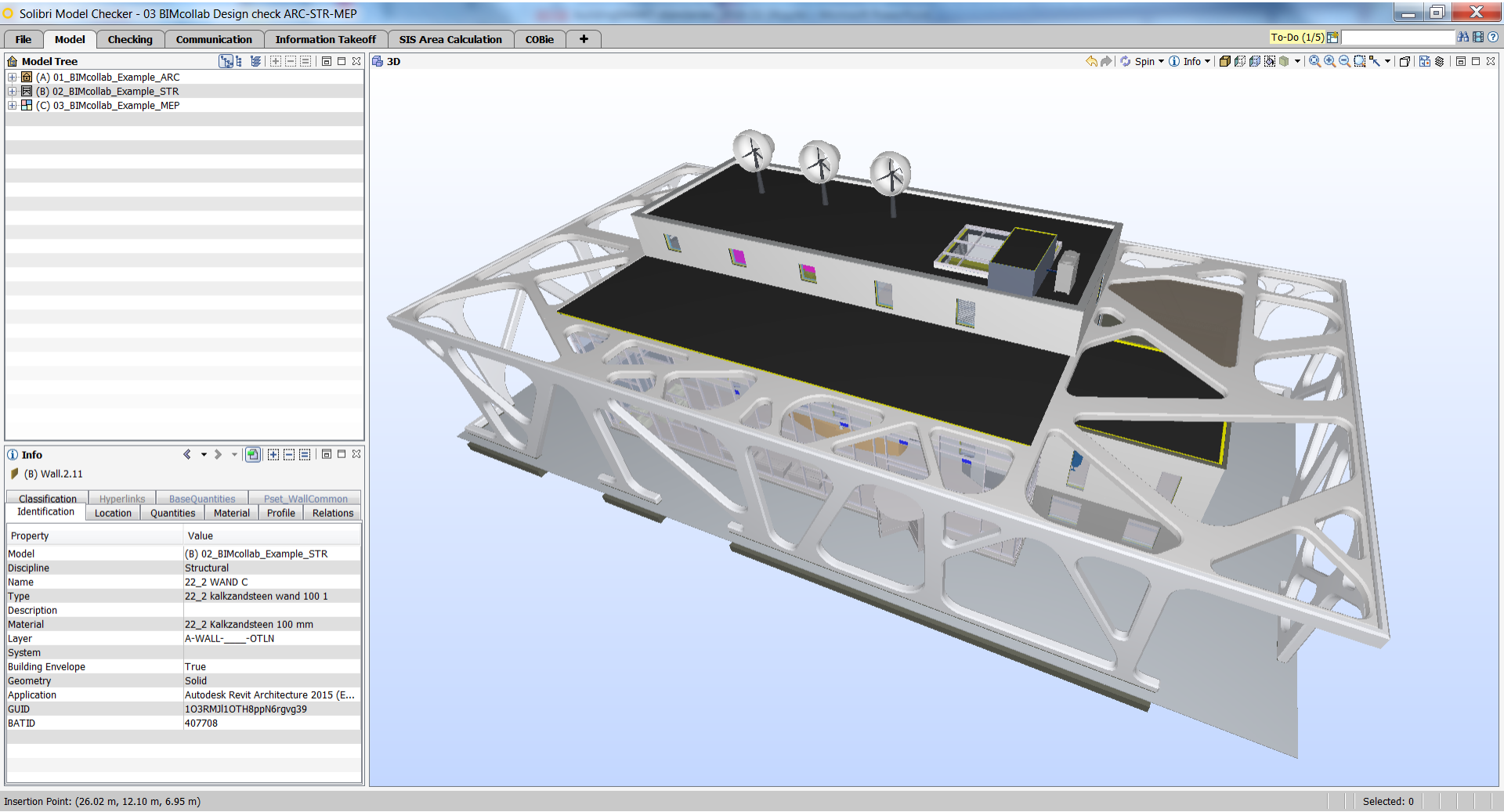
Revit ‚jumps' to the right camera position and linked objects

inpro


Architectural Design Team
Building Services Design Team
10
BS Engineers fix the issues and update the BS model to a new status '**BS2**'
1
A1
A1.ifc
2
BS1.ifc
5
5a
A1.ifc
BS1.ifc
shareAspace
A1.ifc
3
4
BS1
BS2
10
8
issues BS1 .bcf
7
6
issues BS1 .bcf
A1+BS1.ifc
SOLIBRI
BIM Project Manager

BCF - exempel

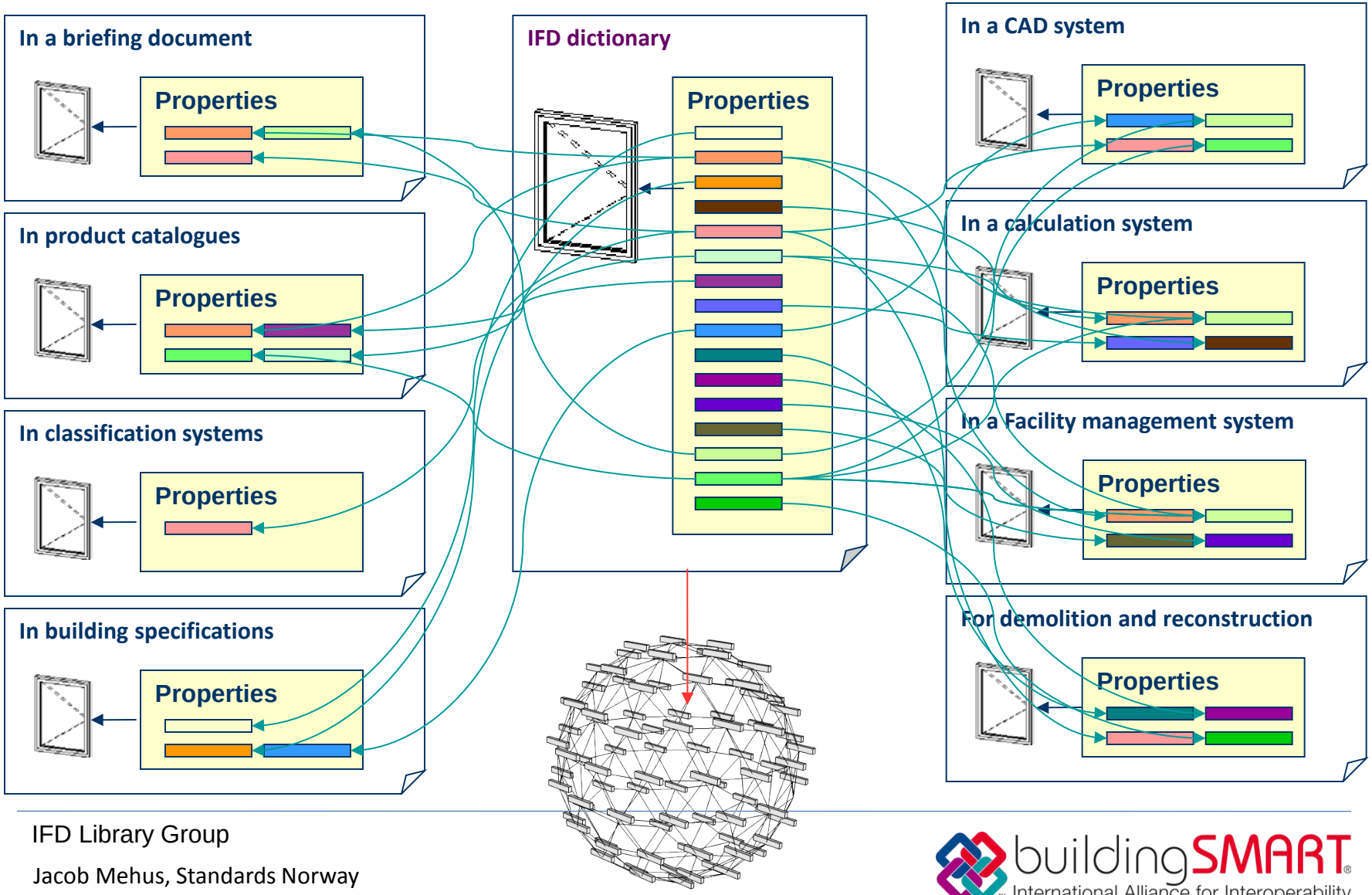
KTH Architecture and the Built Environment



bSDD buildingSMART Data Dictionary (IFD Library)

KTH Architecture and the Built Environment

bSData Dictionary – a mapping mechanism



bSData Dictionary

Product

Generic door set

- Thickness → 92 millimeter
- Hand of door → Right
- Width → 890 millimeter
- Height → 2090 millimeter
- Material → MDF
- Surface finishing → Painted
- Color → NCS S0502
- Hinge → 2465 snap-in

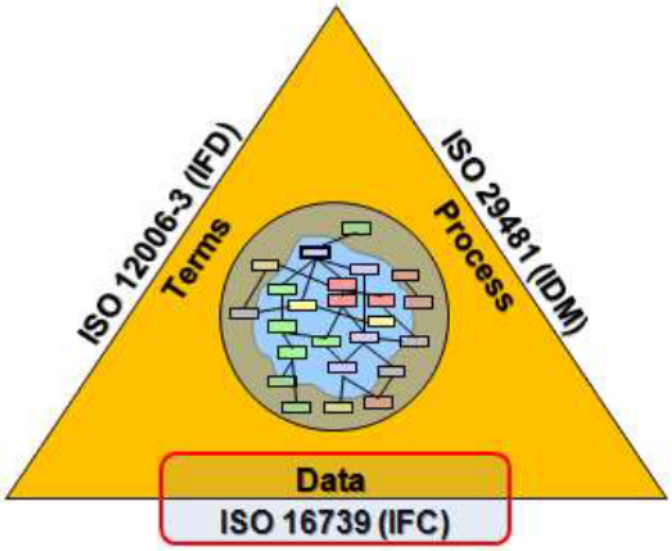
\+ =

Definite door set

IDM och MVD

KTH Architecture and the Built Environment

IFC•IDM•MVD



IDM (Information Delivery Manual):

The ISO 29481-1:2010 "Building information modelling - Information delivery manual - Part 1: Methodology and format" standard has been developed by buildingSMART in order to have a methodology to capture and specify processes and information flow during the lifecycle of a facility.

MVD (Model View Definition):

An IFC View Definition, or **Model View Definition, MVD**, defines a subset of the IFC schema, that is needed to satisfy one or many **Exchange Requirements** of the AEC industry. The method used and propagated by buildingSMART to define such Exchange Requirements is the **Information Delivery Manual**, IDM (also ISO 29481).

From: http://www.buildingsmart-tech.org/

Development Process

by Jan Karlshøj — last modified Jul 30, 2011 06:16 PM

Creation of an Information Delivery Manual is the first step in development process starting from identifying users' need to a useful solution is developed.

The development process starts with identifying user needs in Information Delivery Manuals, which are used to create an more technical specification called Model View Definition. The requirement specification is now used to implement a solution in software products that preferable should be certified before they are released for use.

Steps in development of an Information Delivery Manuals

1. Identify high value and preferable repeatable business processes
2. Check if an existing IDM can be used
3. Before starting development of an IDM the involved parties shuold make sure that if a new IDM is developed it will be implemented in software products that are used by the parties.
4. Collaborate as much as possible with other organisations that have a common interest in the same IDM.
5. Verify that the IDM is working with real world data and projects.
6. Continue the development process by develop a MVD
7. Provide feedback loops to continually improve the IDM and the related software implementations.

IDM

Roadmap
Overview
Information Delivery Manuals
Approval of IDM
Development
Development Process
Methods and Guides
Training Material
Contact
Template

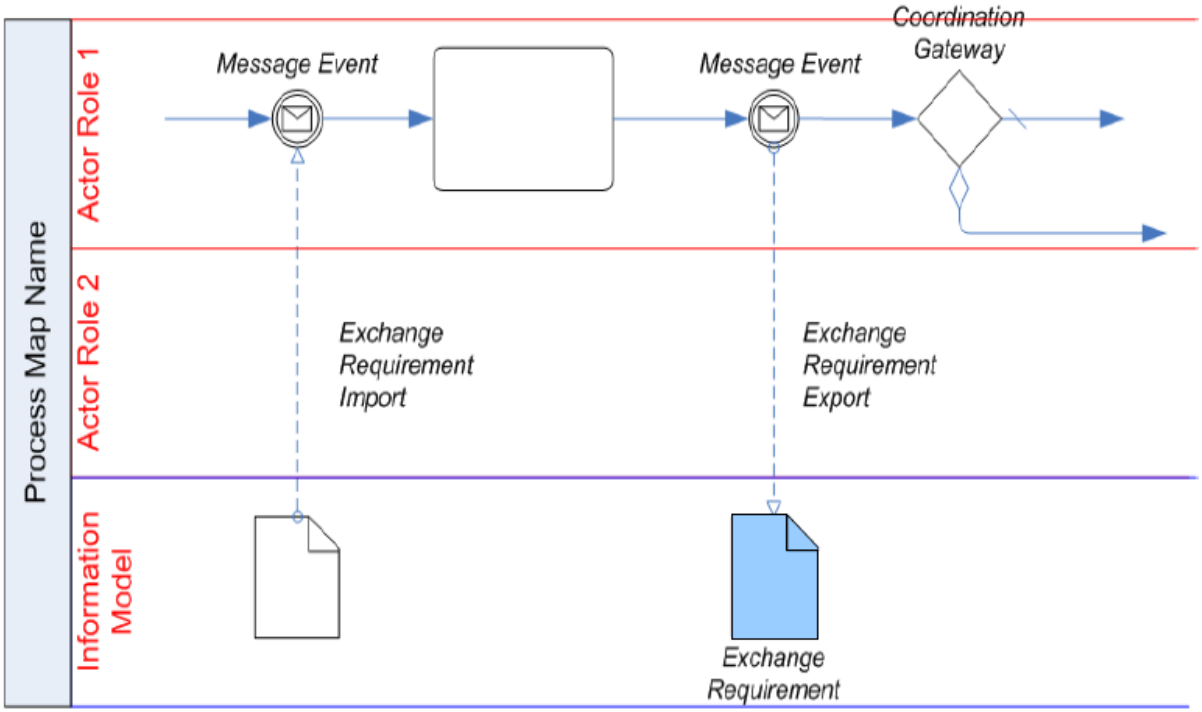
Search

Search Site
Search
Advanced Search...

Upcoming events

For a list of

Showing an Exchange Requirement



An 'Exchange Requirement' is always shown in a process map as a data object within the Information Model swimlane.

IDM example from buildingSMART

Information Delivery Manual (IDM)

for

BIM Based Energy Analysis

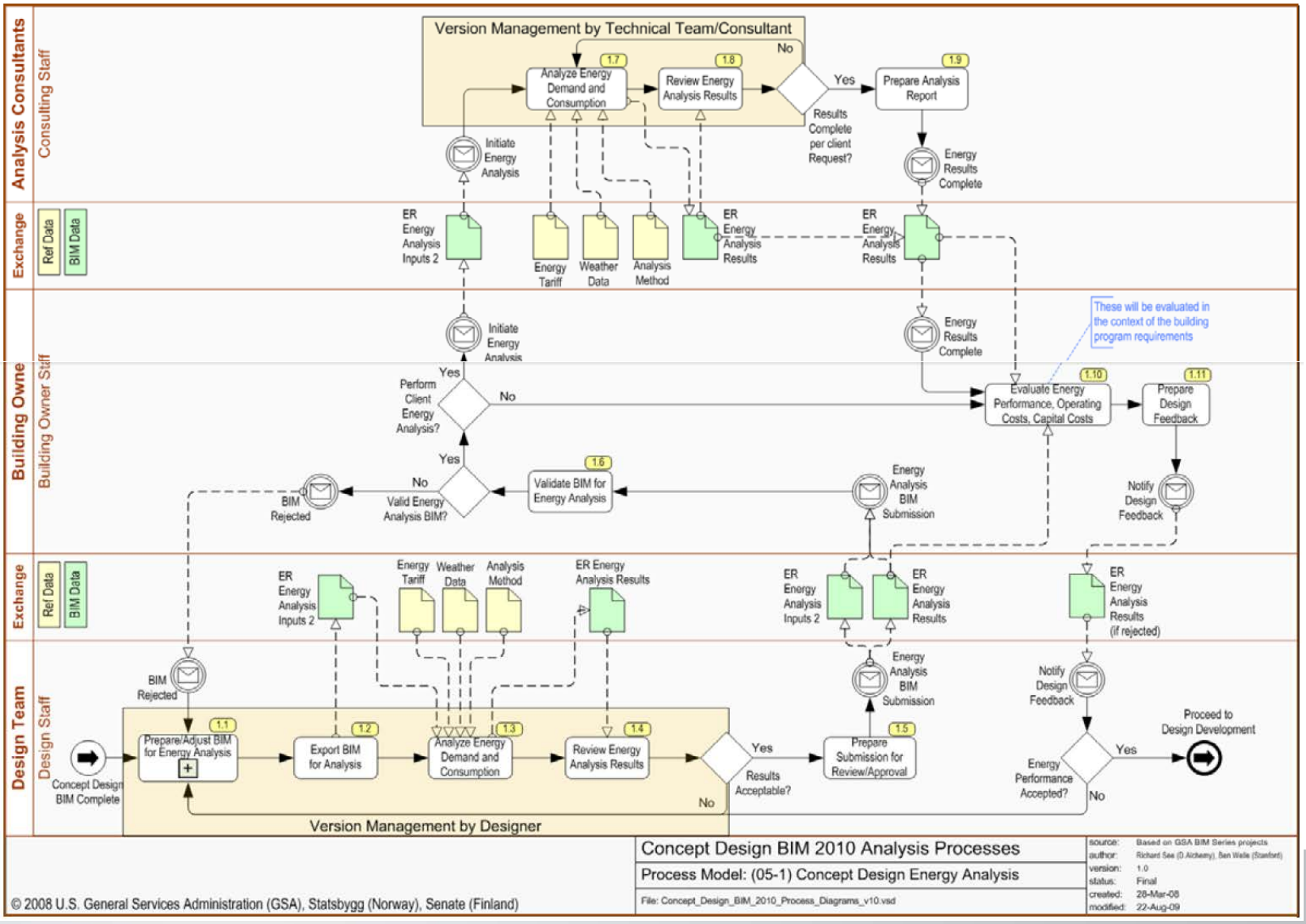
as part of the

Concept Design BIM 2010

Version: 1.0 -- August 2009

1.2 Specification of Process

1.2.1 Concept Design Phase Energy Analysis



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Type	Initial Concept BIM
Documentation	It is assumed at this point the architect has defined a building concept design complete with all the required building elements and space objects. This design provides a proposed building layout including functional and non-functional space configuration and placement of other geometric elements. Non-functional spaces such as technical spaces, circulation spaces, shafts, etc. must be defined by a space objects and not left as unidentifiable voids surrounded by geometry. Spaces that represent multi-story spaces such as atria and vertical distribution routes such as shafts, stairways and elevator shafts should be represented as distinct spaces at each level of the building that are related to each other vertically (either via an opening in a slab or an element located at the opening for e.g. safety purposes). The Concept Design BIM should include: ○ the site and building location ○ the building orientation including its relationship to true north ○ the site and building elevation above a reference datum ○ the building story information ○ 3D geometry of adjacent buildings ○ 3D geometry of the building, including walls (exterior/interior), curtain walls, roofs, floors/slabs, ceilings, windows/skylights, doors, and shading devices ○ space objects, including those defined by virtual space boundaries At the end of this task, the following exchange requirements from **ER Energy Analysis Inputs 1** should be met: *Project, Site, Site Context, Building,* and *Building Stories*. The following exchange requirements from **ER Energy Analysis Inputs 1** should be partially met: *Spaces* and *Building Elements (General)*.

1.2.1.2 Prepare/Adjust BIM for Energy Analysis [1.1]

Type	Sub-Process
Documentation	At this point, the Concept Design BIM is passed to the appropriate designer to prepare the BIM for energy analysis. The designer may still be the architect, a mechanical engineer or energy consultant, or any combination of those three. Details of this sub-process are described in Section 1.2.2.

1.2.1.3 Export BIM for Analysis [1.2]

Type	Task
Documentation	Once the BIM has been prepared for energy analysis and validated in Task 1.1, it is exported to IFC for energy simulation. At this point, all the required exchange requirements in **ER Energy Analysis Inputs** 2 have been met. Prior to being able to use the IFC file for energy analysis, there may need to be some additional data reduction/transformation steps that need to take place. One approach is to use a series of preprocessors or middleware to make these changes, such as LBNL's Geometry Simplification Tool (GST), IDF Generator, and/or IDF Editor. This sequence of tools enables the designer to convert the IFC information into an input file for energy simulation, in this case EnergyPlus. In the future, such a sequence of steps may be combined into a single "Import IFC" function that building performance software vendors may implement.