



# **National BIM Standard - United States® Version 3**

## **4 Information Exchange Standards**

### **4.6 Building Programming information exchange (BPie) – Version 1.0**

#### **CONTENTS**

4.6.1 Scope.....	6
4.6.1.1 Business case description .....	6
4.6.1.1.1 Life-cycle phase list .....	6
4.6.1.1.2 Business case description .....	6
4.6.1.1.3 Business case analysis .....	6
4.6.1.2 Participants and stakeholders .....	6
4.6.1.2.1 Participants list.....	6
4.6.1.2.2 Stakeholders list .....	7
4.6.1.2.3 Stakeholders coverage analysis.....	7
4.6.2 Normative references .....	7
4.6.2.1 References and standards .....	7
4.6.2.1.1 Reference standards list.....	8
4.6.2.1.2 Reference standards list.....	8
4.6.2.1.3 Reference program and project list .....	8
4.6.3 Terms, definitions, symbols and abbreviated terms .....	8
4.6.4 Business process documentation.....	8
4.6.4.1 Process models provided .....	8
4.6.4.1.1 Business process list .....	9

4.6.4.1.2 Business process descriptions .....	9
4.6.4.1.3 Business process model diagrams.....	9
4.6.4.2 Representative process models .....	9
4.6.4.2.1 Stakeholder coverage analysis.....	9
4.6.4.2.2 Process coverage analysis.....	9
4.6.4.2.3 Contract documentary deliverable list .....	9
4.6.4.2.4 Contract documentary deliverable analysis.....	9
4.6.4.3 Process models formatting .....	10
4.6.4.3.1 BPMN usage description .....	10
4.6.5 Exchange requirements.....	10
4.6.5.1 Exchange requirements legibility .....	10
4.6.5.1.1 Exchange requirements list .....	11
4.6.5.1.2 Exchange requirement classification list .....	11
4.6.5.1.3 Exchange requirement coverage analysis .....	11
4.6.5.2 Exchange requirements detail .....	11
4.6.5.2.1 Exchange requirements definition .....	11
4.6.5.2.2 Business rule list.....	11
4.6.5.2.3 Business rule definition.....	13
4.6.5.3 Exchange requirements reusability .....	13
4.6.5.3.1 Related business process list .....	13
4.6.5.3.2 Related exchange requirement list.....	13
4.6.5.3.3 Related exchange requirement reuse analysis .....	14
4.6.6 Model View Definition .....	15
4.6.6.1 Data definition.....	15
4.6.6.1.1 Data definitions list.....	15

4.6.6.1.2 Data definitions .....	16
4.6.6.1.3 Data definition reference schema list .....	43
4.6.6.2 (not used).....	43
4.6.6.2.1 Concept list .....	44
4.6.6.2.2 Concept definitions .....	44
4.6.6.2.3 Concept attributes list .....	53
4.6.6.2.4 Concept relationship description .....	57
4.6.6.2.5 Concept requirements applicability.....	58
4.6.6.3 (not used).....	60
4.6.6.3.1 Concept list .....	60
4.6.6.3.2 Related existing concept list .....	61
4.6.6.3.3 (not used).....	62
4.6.6.3.4 Concept business rule list.....	62
4.6.6.3.5 Concept business rule description.....	70
4.6.6.4 (not used).....	77
4.6.6.4.1 MVD schema listing .....	77
4.6.6.4.2 MVD format description .....	77
4.6.6.4.3 MVD dynamic schema analysis.....	79
4.6.6.4.4 Non-applicable entity exclusion analysis .....	93
4.6.7 Conformance Testing Procedures .....	99
4.6.7.1 Format and content requirements .....	99
4.6.7.1.1 Test rule list .....	100
4.6.7.1.2 Test rule definition .....	100
4.6.7.1.3 Test rules formatting.....	100
4.6.7.1.4 Test rule coverage analysis.....	100

4.6.7.2	Examples and mapping requirements .....	100
4.6.7.2.1	Example file list .....	100
4.6.7.2.2	Example file description .....	100
4.6.8.2.3	Common BIM file reuse .....	100
4.6.7.2.4	Implementers' agreements .....	100
4.6.7.2.5	Transformations/mapping allowed .....	100
4.6.7.2.6	Transformation/mapping documentation .....	100
4.6.7.3	Testing tools and procedures .....	100
4.6.7.3.1	Testing tool list .....	101
4.6.7.3.2	Testing tool algorithm .....	101
4.6.7.3.3	Testing tools sample files .....	101
4.6.7.3.4	Testing tool software availability .....	101
4.6.8	Implementation Resources .....	101
4.6.8.1	Implementation resources list .....	101
4.6.8.1.1	Implementation guides .....	101
4.6.8.2	Implementation resources completeness .....	101
4.6.8.2.1	Workflow coverage methodology .....	101
4.6.8.2.2	Workflow coverage analysis .....	101
4.6.9	Revision plans .....	101
4.6.9.1	Revision plans list .....	101
4.6.9.1.1	Revision management process .....	102
4.6.9.1.2	Revision management notification .....	102
4.6.9.2	Proposed revision deployment methods: .....	102
4.6.9.2.1	Revision management process .....	102
4.6.9.2.2	Revision management notification .....	102

Annexes ..... 103

Bibliography ..... 103

## 4.6.1 Scope

### 4.6.1.1 Business case description

In current AEC practice client requirements are typically recorded in a building program/Brief Depending on the building type, it covers various aspects of client requirements from the overall goals, activities and spatial needs to very detailed material and condition requirements. The requirements documentation is usually not updated accordingly. In the worst case the changes are recorded just in the memory of the participants, and in the best case in meeting or personal notes. Finding the latest updates and evolution of the requirements from the documentation is very difficult, if not impossible. This process can lead to an end result which is significantly different from the documented client requirements.

#### 4.6.1.1.1 Life-cycle phase list

The client's requirements are usually expressed in a building program (also called "client brief") prior to design. The requirements should carry through design development and construction as they are managed/maintained. The initial requirements and intended use of the rooms/functions is also relevant information in the M&O/FM stage.

One could therefore argue that the exchange is relevant for the entire life cycle of a facility.

#### 4.6.1.1.2 Business case description

The objective of this project is to standardize a Requirement Model Specification with sufficient flexibility to make it internationally robust. A standard requirements model will enable automated comparison between the required facility performance and the designed solution, i.e. continuous validation though design development. The designed and constructed building should continuously be compared with the client's requirements and deviations should trigger either an update of the requirements or an update of the design. The proposed solution is based on a registration of the client's needs in a computer interpretable format based on BuildingSMART standards. By identifying specific requirements it is both possible to store the information in a structured way, monitor changes and automate validation.

The proposed solution will provide benefits in many different areas. It will:

- Streamline identification of client's requirements in an open format
- Stimulate the market to develop software tools to capture and share client's requirements in relation to buildings, departments, spaces, FF&E and systems.
- Stimulate design tools to handle client's requirements as an integrated part of design.
- Create the possibility to automate validation of designed and constructed building with the client's requirements.
- Enable client requirements management and thereby earlier get an estimate of the impact of cost.
- Avoid costly rework due to mismatch between the requirements and the constructed building.
- Provide the freedom to select the best tool for the job.

#### 4.6.1.1.3 Business case analysis

### 4.6.1.2 Participants and stakeholders

#### 4.6.1.2.1 Participants list

The Building Programming information exchange development project since the early beginning in 2007 has involved several organizations and stakeholders. The project team includes:

- U.S. Army Corps of Engineers, Dr. Bill East
- Statsbygg, Msc. Frode Mohus
- Salford University, Dr. Arto Kiviniemi. (Ph.D. dissertation: “Requirements Management Interface to Building Product Models”, CIFE, Stanford University, USA, 2005)
- Granlund Oy: Reijo Hänninen (CEO), Tuomas Laine (Director Innovation and Development)
- Nosyko/dRofus: Rolf Jerving, Håkon Clausen Ole Kristian Kvarsvik
- AEC3: Late Dr. Jeffrey Wix, Dr. Thomas Liebich
- Condustrivity, Tim Chipman

#### **4.6.1.2.2 Stakeholders list**

Initially the key stakeholders identified were the repetitive public clients, as they were considered to both have the overall interest of capturing, maintaining and documenting requirements over the facilities lifecycle. They would also be in position to reuse the standard, and “good requirements” over a portfolio of projects and enable automated validation mechanisms.

Design teams will be in a position to say what kind of information they would need to do their job, and also for QA, i.e. that their design is according to client needs and specifications. A standard requirements schema means that the design tools in use will also be able to present the client requirements in the designers interface independent of the client.

A standard schema for client requirements will enable automated validation; hence software providers will also be stakeholders.

Stakeholders list:

- Owners
- Owner Representatives
- Architects
- Engineers
- Planners
- Software providers
- Consultants

#### **4.6.1.2.3 Stakeholders coverage analysis**

None

### **4.6.2 Normative references**

#### **4.6.2.1 References and standards**

There have been several buildingSMART and related projects aimed at the capture of architectural programming information to support both the architectural programming effort, delivery of standard Request for Proposal documents to more clearly communicate owners' requirements, and to perform the automated assessment of spatial compliance of later design documents. These projects include the Portfolio and Asset management – Performance Requirements (PAMPeR), International Alliance for Interoperability's AR-5 Project, the buildingSMART international Room Data Sheet “aquarium” project, the United States General Services Administration project CDB 2010, the buildingSMART alliance® Spatial Compliance information exchange (SCie, pronounced “ski”) project, and the Norwegian effort IDM for Building programming . While each of these projects have explored some aspects of the contracted information exchanges needed to create an open standard for architectural programming, none of these projects have achieved a critical mass to be recognized as national standards and be widely implemented internationally.

The above mentioned projects reviewed in the BPie project, and none were found to be directly overlapping or in conflict with the suggested BPie standard. See attached report, *2011-03-14-BPie\_previous\_BS\_programming – Annex I*

#### **4.6.2.1.1 Reference standards list**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

#### **4.6.2.1.2 Reference standards list (Other)**

See above mentioned 4.6.2.1.1

#### **4.6.2.1.3 Reference program and project list**

See above mentioned 4.6.2.1.1

### **4.6.3 Terms, definitions, symbols and abbreviated terms**

None

### **4.6.4 Business process documentation**

#### **4.6.4.1 Process models provided**

The process model for BPie was published on buildingSMART international, IUG website in December 2011:

[http://iug.buildingsmart.org/idms/information-delivery-manuals/idm-for-building-programming/IDM\\_process\\_map\\_building\\_programming\\_161111.pdf/view](http://iug.buildingsmart.org/idms/information-delivery-manuals/idm-for-building-programming/IDM_process_map_building_programming_161111.pdf/view)

With the intention to address-, and support an international robust programming process, it was made rather flexible to support the iterative processes of programming. I.e. processes and exchanges are not described sequential, but as processes that can happen in parallel or in any order dependent of needed approach. Since publication, we have not received any comments that the process described is not applicable to any organization.



The process map identifies five Exchange Requirements:

- Pre-program requirements
- Program functions (R1)
- Program space requirements (R2)
- *Program system requirements (R3)*
- *Program equipment requirements (R4)*

[The two latter ER's are not completed at the time of this submission and thus are not included.]

Traditionally the programming process happens prior to design. However this PM describes the relation between requirements and the designed solution more as an iterative process, because one aims for client requirements management. Hence one needs to compare/validate though design development, and when deviations are identified, one needs to either update the requirements or the solution (or as a minimum be able to present delta). The exchanges in this process map will therefore not only be the starting point of the design process, but also have a strong relation to design throughout design development.

The process map is attached as Annex II

#### **4.6.4.1.1 Business process list**

See Annex II

#### **4.6.4.1.2 Business process descriptions**

See Annex II

#### **4.6.4.1.3 Business process model diagrams**

See Annex II

#### **4.6.4.2 Representative process models**

As stated in chapter 4.6.4.1 and Annex II

##### **4.6.4.2.1 Stakeholder coverage analysis**

See Annex II

##### **4.6.4.2.2 Process coverage analysis**

See Annex II

##### **4.6.4.2.3 Contract documentary deliverable list**

See Annex II

##### **4.6.4.2.4 Contract documentary deliverable analysis**

See Annex II

#### 4.6.4.3 Process models formatting

##### 4.6.4.3.1 BPMN usage description

The process model has been provided with the BPMN notation as defined in the IDM – BPMN guide ISO 16739

#### 4.6.5 Exchange requirements

Exchange requirement Models were published as draft documents on the buildingSMART international, IUG website in December 2011:

[http://iug.buildingsmart.org/idms/information-delivery-manuals/idm-for-building-programming/IDM\\_exchange\\_req\\_building\\_programming\\_161111.pdf/view](http://iug.buildingsmart.org/idms/information-delivery-manuals/idm-for-building-programming/IDM_exchange_req_building_programming_161111.pdf/view)

In these documents the ER have been mapped to be exchanged using the BuildingSMART IFC schema.

Comments and suggested extensions have been received through the review period and also from the implementation process through the COBie challenge 2013. Updated documentation will be distributed as the IDM is published on the BuildingSMART IUG website.

The Exchange requirement is Annex V in this submission.

##### 4.6.5.1 Exchange requirements legibility

The included exchange requirements in this submission are:

- Pre-program requirements
- Program functions (R1)
- Program space requirements (R2)

These three exchanges address requirements set to project, site, building, building stories, rooms/spaces and zones. In the MVD documentation, they have been organized in two exchanges, basic and advanced. Where the basic exchange only requires a room list, while the “advanced” requires that it should be technically possible to exchange room data sheet as requirements properties set to rooms and zones and equipment lists.

*Note: Pre-program requirements contain all strategic, portfolio and feasibility questions as they are described in the PAMPeR project (Portfolio and Asset Management: Performance Requirements).*

Exchange requirements attached as distributed for review;

“er\_exchange\_requirement\_space\_program” and

“er\_exchange\_requirement\_spatial\_requirements”

Comments and suggested extensions have been received through the review period and also from the implementation process through the COBie challenge 2013. Updated documentation will be distributed as the IDM is published on the buildingSMART IUG website.

The Exchange requirements are Annex III & IV in this submission

#### 4.6.5.1.1 Exchange requirements list

Each exchange is listed by name as follows.

- Facility criteria
- Discipline specifications

#### 4.6.5.1.2 Exchange requirement classification list

Each phase classification used by this model view is listed by Omniclass™ notation and title as follows.

- 31-20 00 00 Conceptualization Phase
- 31-30 00 00 Criteria Definition Phase

#### 4.6.5.1.3 Exchange requirement coverage analysis

Each exchange is listed by name and corresponding classifications for the process undertaken, the sender of the information, and the receiver of the information.

Exchange	Process	Sender	Receiver
Facility Criteria	31-20 00 00 Conceptualization Phase	34-10 11 00 Owner	34-20 11 11 Architect
Discipline Specifications	31-30 00 00 Criteria Definition Phase	34-10 11 00 Owner	34-20 11 11 Architect

#### 4.6.5.2 Exchange requirements detail

##### 4.6.5.2.1 Exchange requirements definition

Each exchange is listed by name and a description of the information contained.

##### Facility criteria

The Basic exchange delivers a simple room list identifying each space, net planned area, and any functional dependencies.

##### Discipline specifications

The Advanced exchange contains detailed information for spaces suitable for generating Room Data Sheets (RDS).

##### 4.6.5.2.2 Business rule list

Each exchange consists of a set of entity data definitions with usage defined according to business rule concepts. An entity describes an object class having one or more attributes, where each attribute may refer to values, collections, or references to other objects. A concept describes usage of object classes, where allowable values and object types are indicated for specific attributes. Each heading that follows

refers to an exchange, where each table row corresponds to an entity, each table column corresponds to an exchange, and each cell indicates whether the concept is used for the entity within the exchange.

## Facility Criteria

Entity	Identity	Descriptions	Project Declaration	Project Classification Information	Classification	Object Typing	Properties for Occurrences	Properties on Occurrences	Quantity Sets	Spatial Composition	Spatial Naming
IfcProject	R	O	O	O						R	
IfcBuilding	R	O			O		O	R	O		R
IfcBuildingStorey	R	O					O		O	R	O
IfcSite							O			O	
IfcSpace	R	O			O	O	R	O		O	R
IfcZone	O						O				

## Discipline Specifications

Entity	Identity	Descriptions	Project Declaration	Project Classification Information	Classification	Tabular Constraints	Object Typing	Properties for Occurrences	Properties on Occurrences	Properties for Types	Assigned Actor	Control Assignment	Actor Assignment	Quantity Sets	Spatial Naming
IfcProject	R	O	O	O											
IfcWorkCalendar	O											O	O		
IfcBuilding	R	O			O			O		R				O	R
IfcBuildingStorey	R	O						O						O	O
IfcSite								O				O			
IfcSpace	R	R			O	O	O	R		R		O			R
IfcSpaceType	O									O					

IfcZone	R							R											
IfcOccupant	R										O								

#### 4.6.5.2.3 Business rule definition

Business rule definitions are all defined as re-usable templates as indicated in Clause 4.6.6.3.5.

#### 4.6.5.3 Exchange requirements reusability

Names and classifications of exchanges are intended to be consistent across other model views where applicable, while the content of a particular exchange is intended to be unique.

##### 4.6.5.3.1 Related business process list

Business processes within this model view are correlated with those used in other model views as follows.

Process	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
31-20 00 00 Conceptualization Phase		X	X				
31-30 00 00 Criteria Definition Phase		X	X			X	X

##### 4.6.5.3.2 Related exchange requirement list

Exchange requirements within this model view are correlated with those used in other model views as follows.

	Plumbing System Design	Electrical System Design	Mechanical System Design	Building Automation	Building Programming	Facilities Management Handover	Common Use Definitions	Exchange
Facility Criteria	X	X				X	X	
Discipline Specifications	X	X				X	X	

#### 4.6.5.3.3 Related exchange requirement reuse analysis

Exchange requirements across other model views are correlated as follows.

	Plumbing System Design	Electrical System Design	Mechanical System Design	Building Automation	Building Programming	Facilities Management Handover	Common Use Definitions	Exchange
Facility Criteria	X	X				X	X	
Discipline Specifications	X	X				X	X	
Project Definition	X	X				X		
Space Program	X	X	X			X		
Product Program	X	X	X			X		
Design Early	X	X				X		
Design Schematic	X	X				X		
Design Coordinated	X	X				X		
Design Issue						X		
Product Type Template	X	X	X			X		
Product Template	X	X	X	X		X		
Bid Issue						X		
Product Type Selection	X	X				X		

	Exchange	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
System Layout			X		X	X	X	X
Product Installation			X		X			
Product Inspection			X					
Construction Issue			X					
Product Type Parts			X					
Product Type Warranty			X					
Product Type Maintenance			X					
System Operation			X		X	X	X	X
Space Condition			X					
Product Parts Replacement			X					
Space Occupancy			X		X			
Space Activity Renovation			X					
Remodel			X					
Expand			X					
Demolish			X					

#### 4.6.6 Model View Definition

##### 4.6.6.1 Data definition

###### 4.6.6.1.1 Data definitions list

Each entity data definition is listed by schema and entity name as follows.

- IfcKernel
- IfcProject
- IfcProcessExtension
- IfcWorkCalendar
- IfcProductExtension

- IfcBuilding
- IfcBuildingStorey
- IfcSite
- IfcSpace
- IfcSpaceType
- IfcZone
- IfcSharedFacilitiesElements
- IfcOccupant

#### 4.6.6.1.2 Data definitions

Each entity data definition is described within subsections as follows, with electronic representations provided in EXPRESS and XSD formats.

### IfcProject

*IfcProject* indicates the undertaking of some design, engineering, construction, or maintenance activities leading towards a product. The project establishes the context for information to be exchanged or shared, and it may represent a construction project but does not have to. The *IfcProject*'s main purpose in an exchange structure is to provide the root instance and the context for all other information items included.

The context provided by the *IfcProject* includes:

- the default units
- the geometric representation context for exchange structures including shape representations
- the world coordinate system
- the coordinate space dimension
- the precision used within the geometric representations, and
- optionally the indication of the true north relative to the world coordinate system

**HISTORY** New entity in IFC1.0

**IFC4 CHANGE** The attributes *RepresentationContexts* and *UnitsInContext* are made optional and are promoted to supertype *IfcContext*.

#### Informal Propositions:

1. There shall only be one project within the exchange context. This is enforced by the global rule *IfcSingleProjectInstance*.

#### EXPRESS Specification:

**ENTITY** IfcProject



**SUBTYPE OF** (IfcContext);**WHERE**

HasName	: EXISTS(SELf\IfcRoot.Name);
CorrectContext	: NOT(EXISTS(SELf\IfcContext.RepresentationContexts)) OR (SIZEOF(QUERY(Temp < * SELf\IfcContext.RepresentationContexts 'IFCREPRESENTATIONRESOURCE.IFCGEOMETRICREPRESENTATIONSUBCONTEXT' IN TYPEOF(Temp ) = 0);
NoDecomposition	: SIZEOF(SELf\IfcObjectDefinition.Decomposes) = 0;
HasOwnerHistory	: EXISTS(SELf\IfcRoot.OwnerHistory);

**END\_ENTITY;**Formal Propositions:

<b>HasName</b>	: The <i>Name</i> attribute has to be provided for IfcProject. It is the short name for the project.
<b>CorrectContext</b>	: If a <i>RepresentationContexts</i> relation is provided then there shall be no instance of <i>IfcGeometricRepresentationSubContext</i> directly included in the set of <i>RepresentationContexts</i> .
<b>NoDecomposition</b>	: The IfcProject represents the root of the any decomposition tree. It shall therefore not be used to decompose any other object definition.
<b>HasOwnerHistory</b>	: The <i>OwnerHistory</i> attribute has to be provided for IfcProject. It provides the minimum of owner information for the project data set and the last change action, that applied to the whole data set. NOTE Each individual data item, that derives from IfcRoot may have an individual <i>OwnerHistory</i> . It then overrides the common ownership and chance action information provided at the single IfcProject instance in an IFC data set.

IFC4 CHANGE New where rule.

Inheritance Graph:**ENTITY** IfcProject**ENTITY** IfcRoot

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: <b>OPTIONAL</b> IfcStrippedOptional;
Name	: <b>OPTIONAL</b> IfcLabel;
Description	: <b>OPTIONAL</b> IfcText;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments	: <b>SET OF</b> IfcRelAssigns <b>FOR</b> RelatedObjects;
HasContext	: <b>SET</b> [0:1] OF IfcRelDeclares <b>FOR</b> RelatedDefinitions;
IsDecomposedBy	: <b>SET OF</b> IfcRelAggregates <b>FOR</b> RelatingObject;
Decomposes	: <b>SET</b> [0:1] OF IfcRelAggregates <b>FOR</b> RelatedObjects;
HasAssociations	: <b>SET OF</b> IfcRelAssociates <b>FOR</b> RelatedObjects;

**ENTITY** IfcContext

ObjectType : **OPTIONAL** IfcStrippedOptional;  
 LongName : **OPTIONAL** IfcStrippedOptional;  
 Phase : **OPTIONAL** IfcStrippedOptional;  
 RepresentationContexts : **OPTIONAL SET [1:?] OF** IfcStrippedOptional;  
 UnitsInContext : **OPTIONAL** IfcStrippedOptional;

## INVERSE

IsDefinedBy : **SET [0:?] OF** IfcRelDefinesByProperties **FOR** RelatedObjects;  
 Declares : **SET OF** IfcRelDeclares **FOR** RelatingContext;

## ENTITY IfcProject

### END\_ENTITY;

```

<xs:element name="IfcProject" type="ifc:IfcProject" substitutionGroup="ifc:IfcContext" nillable="true"/>
<xs:complexType name="IfcProject">
  <xs:complexContent>
    <xs:extension base="ifc:IfcContext"/>
  </xs:complexContent>
</xs:complexType>

```

## IfcWorkCalendar

An *IfcWorkCalendar* defines working and non-working time periods for tasks and resources. It enables to define both specific time periods, such as from 7:00 till 12:00 on 25th August 2009, as well as repetitive time periods based on frequently used recurrence patterns, such as each Monday from 7:00 till 12:00 between 1st March 2009 and 31st December 2009.

### [HISTORY New entity in IFC4.](#)

A work calendar is a subtype of *IfcControl* and thus inherits the feature for controlling other objects through *IfcRelAssignsToControl*, which is used to define a work calendar for tasks (*IfcTask*) and resources (*IfcResource*). It also inherits a name and description attribute, whereas a name shall be given and a description may be given as an indication of its content and usage.

The definition of time periods can be derived from a base calendar and/or modified/defined by a set of working times and non-working exception times. All time periods defined by *IfcWorkCalendar.ExceptionTimes* override the time periods inherited from the base calendar (base calendar is defined as the next applicable calendar for the task or resource). Thus, exception times replace the working times from the base calendar.

Figure 87 shows the definition of a work calendar, which is defined by a set of work times and exception times. The work times are defined as recurring patterns with optional boundaries (applying from and/or to a specific date). The shown example defines a simple work calendar with working times Monday to Thursday 8:00 to 12:00 and 13:00 to 17:00, Friday 8:00 to 14:00 and as exception every 1st Monday in a month the work starts one hour later - i.e. the working time on every 1st Monday in a month is overridden to be 9:00 to 12:00 and 13:00 to 17:00. Both the working time and the exception time are valid for the period of 01.09.2010 till 30.08.2011.

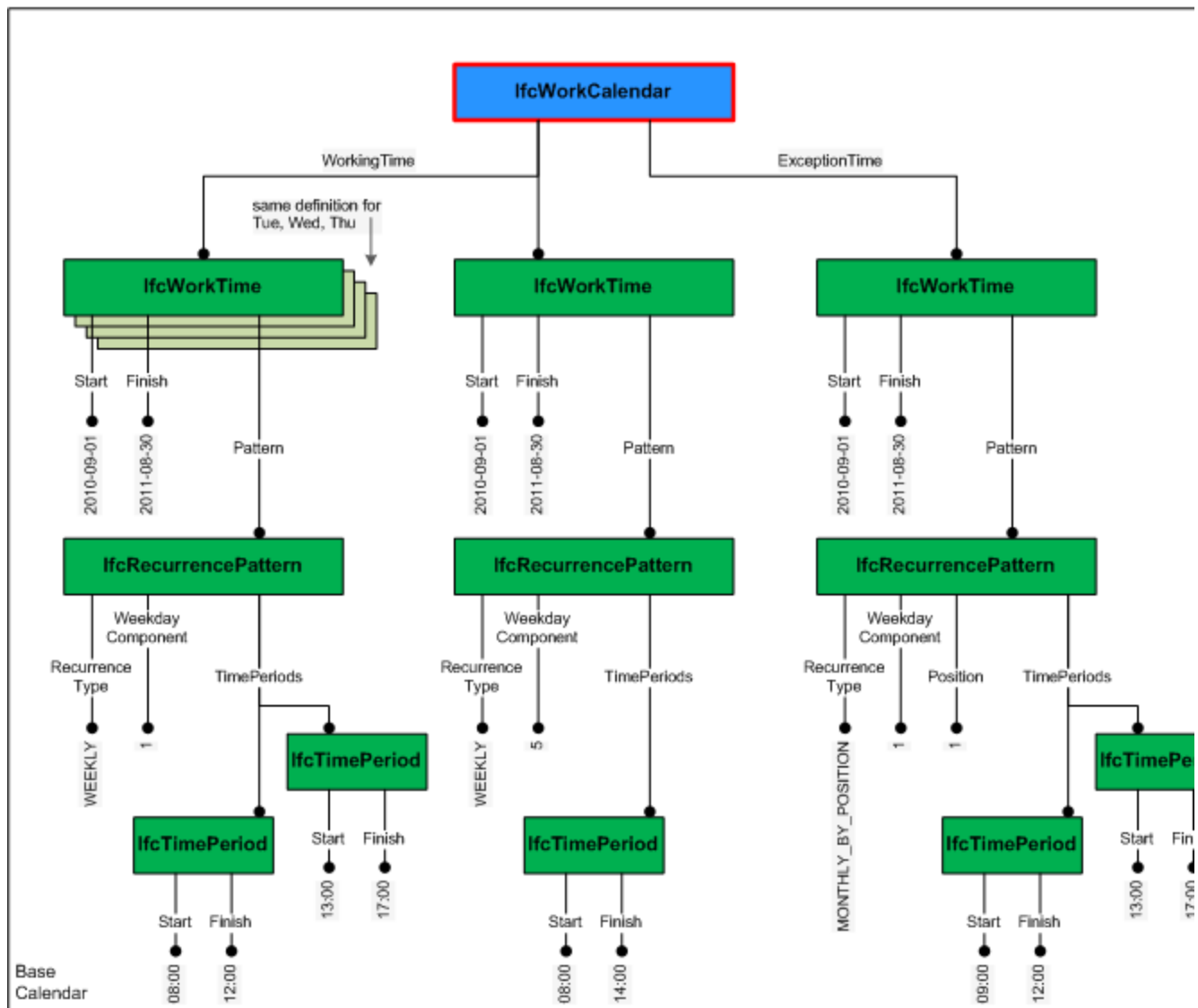


Figure 87 — Work calendar instantiation

EXPRESS Specification:

ENTITY IfcWorkCalendar

SUBTYPE OF (IfcControl);

WorkingTimes : OPTIONAL SET [1:?] OF IfcWorkTime;  
 ExceptionTimes : OPTIONAL SET [1:?] OF IfcStrippedOptional;  
 PredefinedType : OPTIONAL IfcStrippedOptional;

**WHERE**

CorrectPredefinedType : NOT(EXISTS(PredefinedType)) OR (PredefinedType <> IfcWorkCalendarTypeEnum.USERDEFINED)  
 OR ((PredefinedType = IfcWorkCalendarTypeEnum.USERDEFINED) AND  
 EXISTS(SELF\IfcObject.ObjectType));

**END\_ENTITY;****Attribute Definitions:**

**WorkingTimes** : Set of times periods that are regarded as an initial set-up of working times. Exception times can then further restrict these working times.  
**ExceptionTimes** : Set of times periods that define exceptions (non-working times) for the given working times including the base calendar, if provided.

**Formal Propositions:**

**CorrectPredefinedType** : The attribute ObjectType must be asserted when the value of the IfcWorkCalendarTypeEnum is set to USERDEFINED.

**Inheritance Graph:**

**ENTITY** IfcWorkCalendar

**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
 OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
 Name : **OPTIONAL** IfcLabel;  
 Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition

**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
 HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
 IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
 Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
 HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcControl

Identification : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

Controls : **SET OF** IfcRelAssignsToControl **FOR** RelatingControl;

**ENTITY** IfcWorkCalendar

WorkingTimes : **OPTIONAL SET** [1:?] **OF** IfcWorkTime;

ExceptionTimes : **OPTIONAL SET** [1:?] **OF** IfcStrippedOptional;

PredefinedType : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

```
<xs:element name="IfcWorkCalendar" type="ifc:IfcWorkCalendar" substitutionGroup="ifc:IfcControl" nillable="true"/>
<xs:complexType name="IfcWorkCalendar">
  <xs:complexContent base="ifc:IfcControl">
    <xs:sequence>
      <xs:element name="WorkingTimes" nillable="true" minOccurs="0">
        <xs:complexType>
          <xs:sequence>
            <xs:element ref="ifc:IfcWorkTime" maxOccurs="unbounded"/>
          </xs:sequence>
          <xs:attribute ref="ifc:itemType" fixed="ifc:IfcWorkTime"/>
          <xs:attribute ref="ifc:cType" fixed="set"/>
          <xs:attribute ref="ifc:arraySize" use="optional"/>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexContent>
</xs:complexType>
```

**IfcBuilding**

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).

**NOTE** Definition from ISO 6707-1: 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.

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

The *IfcBuilding* is used to build the spatial structure of a building (that serves as the primary project breakdown and is required to be hierarchical). The spatial structure elements are linked together by using the objectified relationship *IfcRelAggregates*.

**HISTORY** New entity in IFC1.0.

Figure 27 shows the *IfcBuilding* as part of the spatial structure. It also serves as the spatial container for building and other elements.

NOTE Detailed requirements on mandatory element containment and placement structure relationships are given in view definitions and implementer agreements.

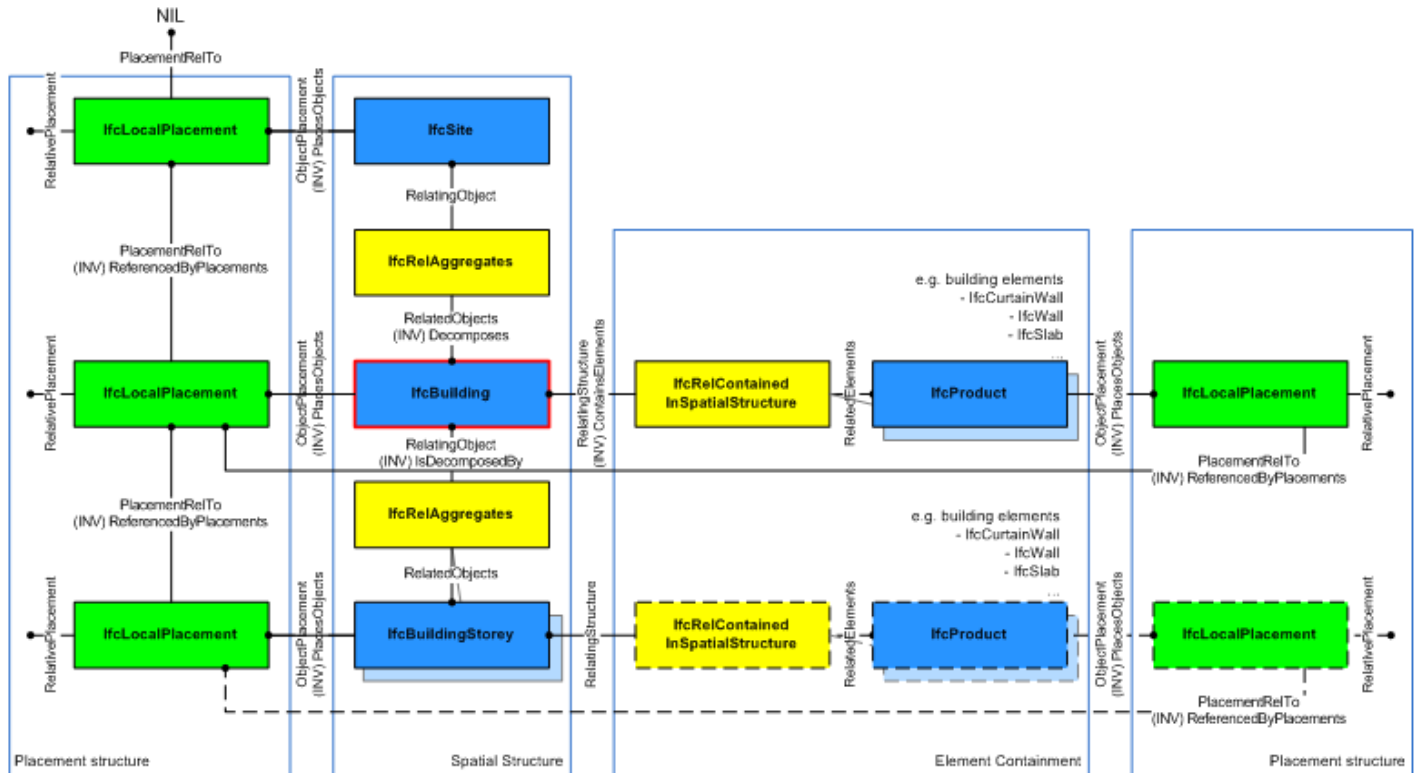


Figure 27 — Building composition

Systems, such as building service or electrical distribution systems, zonal systems, or structural analysis systems, relate to *IfcBuilding* by using the objectified relationship *IfcRelServicesBuildings*.

#### Attribute Use Definition

Figure 28 describes the heights and elevations of the *IfcBuilding*. It is used to provide the height above sea level of the project height datum for this building, that is, the internal height 0.00. The height 0.00 is often used as a building internal reference height and equal to the floor finish level of the ground floor.

- base elevation of building provided by: *IfcBuilding.ElevationOfRefHeight*, it is usually the top of construction slab
- base elevation of terrain at the perimeter of the building provided by: *IfcBuilding.ElevationOfTerrain*, it is usually the minimum elevation is sloped terrain
- total height of building, also referred to as ridge height (top of roof structure, e.g. the ridge against terrain): provided by BaseQuantity with Name="TotalHeight"
- eaves height of building (base of roof structure, e.g. the eaves against terrain): provided by BaseQuantity with Name="EavesHeight"

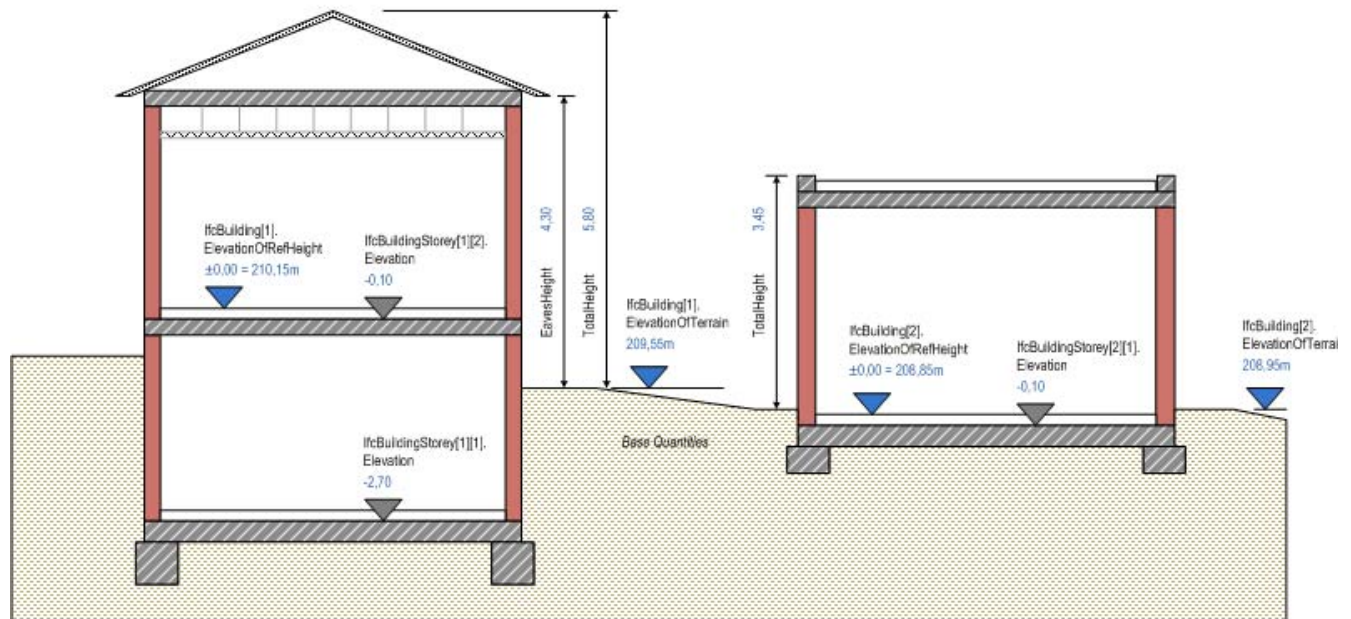


Figure 28 — Building elevations

### EXPRESS Specification:

**ENTITY** IfcBuilding

**SUBTYPE OF** (IfcSpatialStructureElement);

ElevationOfRefHeight : **OPTIONAL** IfcStrippedOptional;  
 ElevationOfTerrain : **OPTIONAL** IfcStrippedOptional;  
 BuildingAddress : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

### Attribute Definitions:

**ElevationOfRefHeight** : Elevation above sea level of the reference height used for all storey elevation measures, equals to height 0.0. It is usually the ground floor level.  
**ElevationOfTerrain** : Elevation above the minimal terrain level around the foot print of the building, given in elevation above sea level.

### Inheritance Graph:

**ENTITY** IfcBuilding

**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
Name : **OPTIONAL** IfcLabel;  
Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcProduct

ObjectPlacement : **OPTIONAL** IfcStrippedOptional;  
Representation : **OPTIONAL** IfcProductRepresentation;

**INVERSE****ENTITY** IfcSpatialElement

LongName : **OPTIONAL** IfcLabel;

**INVERSE****ENTITY** IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;



**ENTITY** IfcBuilding

ElevationOfRefHeight : **OPTIONAL** IfcStrippedOptional;  
 ElevationOfTerrain : **OPTIONAL** IfcStrippedOptional;  
 BuildingAddress : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

```
<xs:element name="IfcBuilding" type="Ifc:IfcBuilding" substitutionGroup="Ifc:IfcSpatialStructureElement" nillable="true"/>
<xs:complexType name="IfcBuilding">
  <xs:complexContent base="Ifc:IfcSpatialStructureElement">
    <xs:extension base="Ifc:IfcSpatialStructureElement"/>
  </xs:complexContent>
</xs:complexType>
```

**IfcBuildingStorey**

The building storey has an elevation and typically represents a (nearly) horizontal aggregation of spaces that are vertically bound.

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

- **COMPLEX:** building storey complex
- **ELEMENT:** building storey
- **PARTIAL:** partial building storey

**EXAMPLE** In split level houses, a storey is split into two or more partial storeys, each with a different elevation. It can be handled by defining a storey, which includes two or more partial storeys with the individual elevations.

The *IfcBuildingStorey* is used to build the spatial structure of a building (that serves as the primary project breakdown and is required to be hierarchical). The spatial structure elements are linked together by using the objectified relationship *IfcRelAggregates*.

Figure 29 shows the *IfcBuildingStorey* as part of the spatial structure. It also serves as the spatial container for building and other elements.

**NOTE** Detailed requirements on mandatory element containment and placement structure relationships are given in view definitions and implementer agreements.

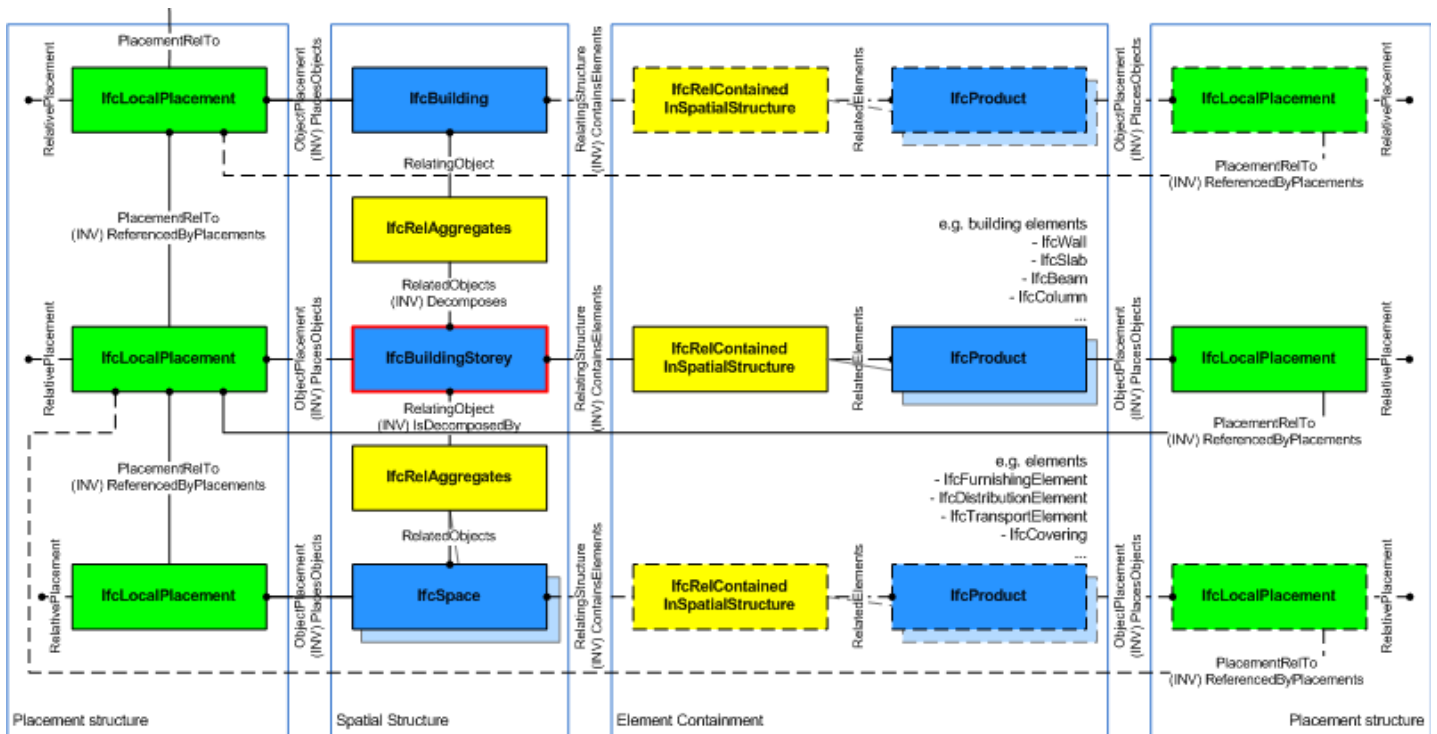


Figure 29 — Building storey composition

HISTORY New entity in IFC1.0

#### Attribute Use Definition

Figure 30 describes the heights and elevations of the *IfcBuildingStorey*.

- elevation of storey provided by: *IfcBuildingStorey.Elevation* as a local height value relative to *IfcBuilding.ElevationOfRefHeight*, it is usually the top of construction slab
- net height of storey, also referred to as total height or system height (top of construction slab to top of construction slab above): provided by BaseQuantity with Name="GrossHeight"
- net height of storey (top of construction slab to bottom of construction slab above): provided by BaseQuantity with Name="NetHeight"

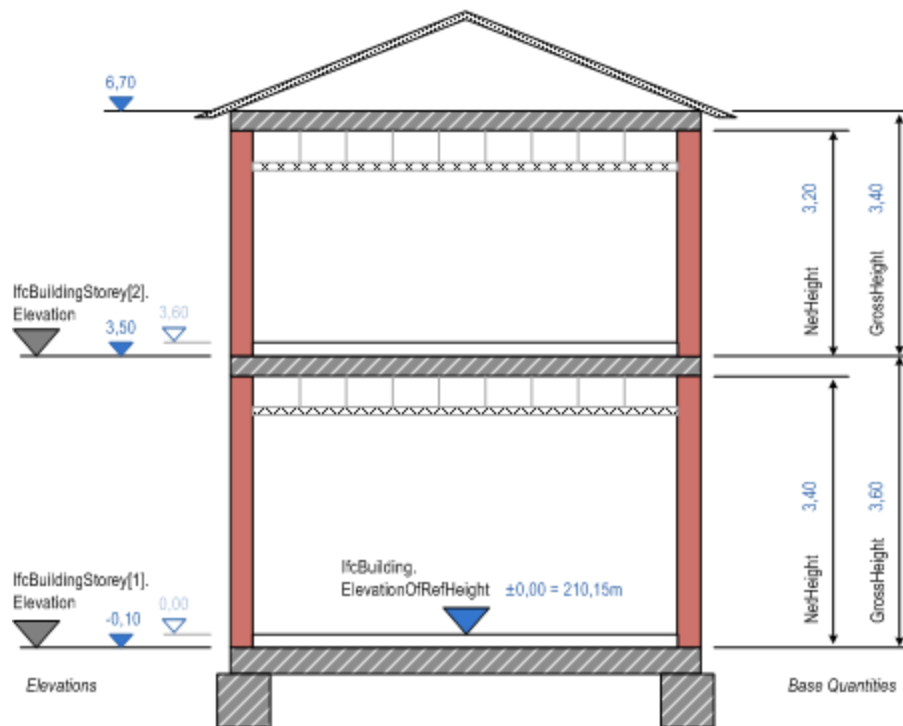


Figure 30 — Building storey elevations

[EXPRESS Specification:](#)**ENTITY** IfcBuildingStorey**SUBTYPE OF** (IfcSpatialStructureElement);Elevation : **OPTIONAL** IfcStrippedOptional;**END\_ENTITY;**[Attribute Definitions:](#)

**Elevation** : Elevation of the base of this storey, relative to the 0,00 internal reference height of the building. The 0.00 level is given by the absolute above sea level height by the ElevationOfRefHeight attribute given at IfcBuilding.

[Inheritance Graph:](#)**ENTITY** IfcBuildingStorey**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;

OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
Name : **OPTIONAL** IfcLabel;  
Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
HasContext : **SET** [0: 1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
Decomposes : **SET** [0: 1] OF IfcRelAggregates **FOR** RelatedObjects;  
HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

IsTypedBy : **SET** [0: 1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcProduct

ObjectPlacement : **OPTIONAL** IfcStrippedOptional;  
Representation : **OPTIONAL** IfcProductRepresentation;

**INVERSE****ENTITY** IfcSpatialElement

LongName : **OPTIONAL** IfcLabel;

**INVERSE****ENTITY** IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

**ENTITY** IfcBuildingStorey

Elevation : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

```
<xs:element name="IfcBuildingStorey" type="ifc:IfcBuildingStorey" substitutionGroup="ifc:IfcSpatialStructureElement"
nillable="true"/>
<xs:complexType name="IfcBuildingStorey">
  <xs:complexContent base="ifc:IfcSpatialStructureElement">
    <xs:extension base="ifc:IfcSpatialStructureElement"/>
  </xs:complexContent>
</xs:complexType>
```

**IfcSite**

A site is a defined area of land, possibly covered with water, on which the project construction is to be completed. A site may be used to erect, retrofit or turn down building(s), or for other construction related developments.

NOTE Term according to ISO6707-1 vocabulary "area of land or water where construction work or other development is undertaken".

A site may include a definition of the single geographic reference point for this site (global position using WGS84 with *Longitude*, *Latitude* and *Elevation*). The precision is provided up to millionth of a second and it provides an absolute placement in relation to the real world as used in exchange with geospatial information systems. If asserted, the *Longitude*, *Latitude* and *Elevation* establish the point in WGS84 where the point 0.,0.,0. of the *LocalPlacement* of *IfcSite* is situated.

The geometrical placement of the site, defined by the *IfcLocalPlacement*, shall be always relative to the spatial structure element, in which this site is included, or absolute, i.e. to the world coordinate system, as established by the geometric representation context of the project. The world coordinate system, established at the *IfcProject.RepresentationContexts*, may include a definition of the true north within the XY plane of the world coordinate system, if provided, it can be obtained at *IfcGeometricRepresentationContext.TrueNorth*.

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

- COMPLEX = site complex
- ELEMENT = site
- PARTIAL = site section

The *IfcSite* is used to build the spatial structure of a building (that serves as the primary project breakdown and is required to be hierarchical).

Figure 32 shows the *IfcSite* as part of the spatial structure. In addition to the logical spatial structure, also the placement hierarchy is shown. In this example the spatial structure hierarchy and the placement hierarchy are identical.

NOTE Detailed requirements on mandatory element containment and placement structure relationships are given in view definitions and implementer agreements.

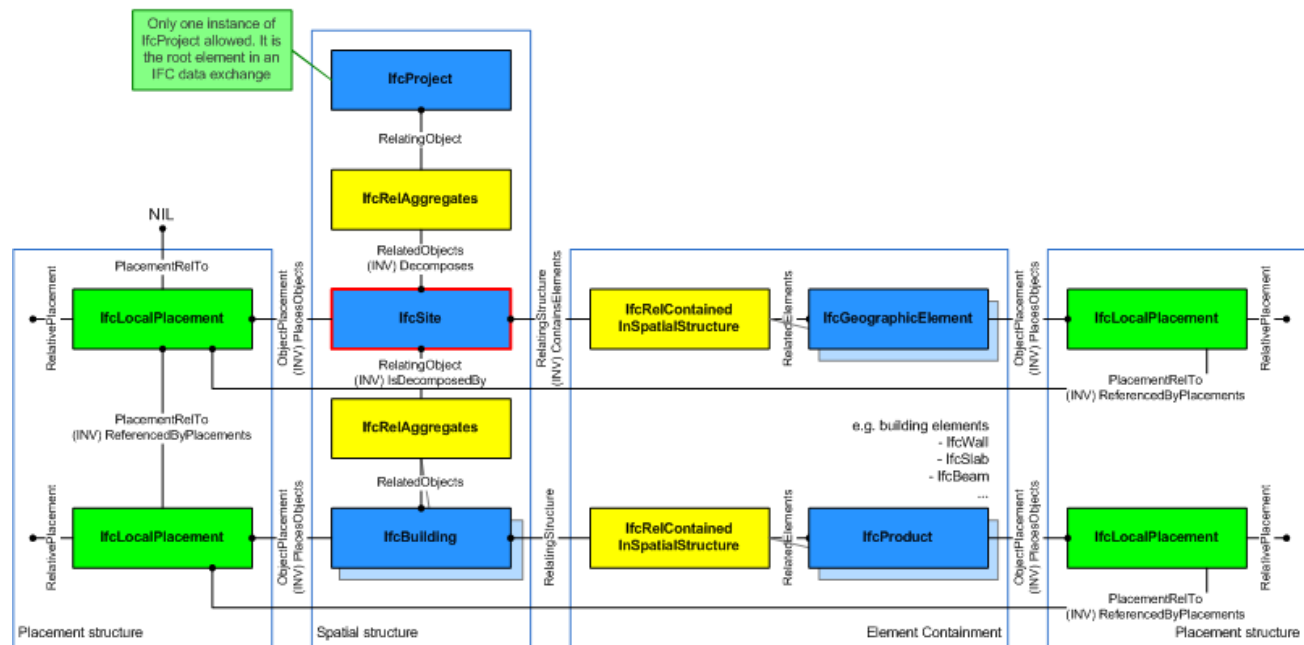


Figure 32 — Site composition

HISTORY New entity in IFC1.0.

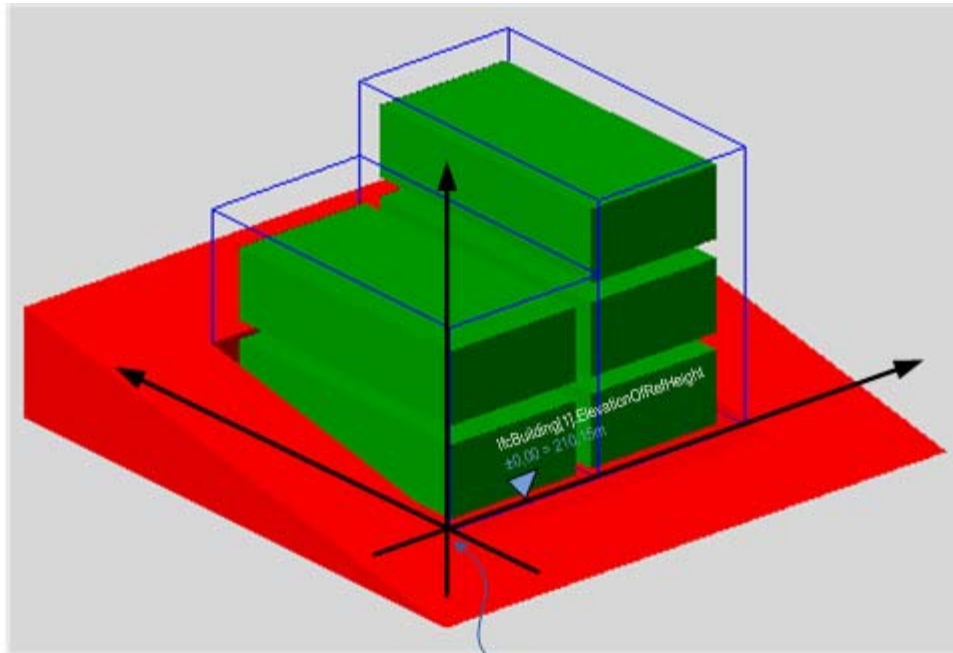
#### Attribute Use Definition

Figure 33 describes the heights and elevations of the *IfcSite*. It is used to provide the geographic longitude, latitude, and height above sea level for the origin of the site. The origin of the site is the local placement.

The provision of longitude, latitude, height at the *IfcSite* for georeferencing is provided for upward compatibility reasons. It requires a single instance of *IfcSite* and WGS84 as coordinate reference system.

For exact georeferencing (or referencing to any other geographic coordinate system other than WGS84) the entities *IfcCoordinateReferenceSystem* and *IfcMapConversion* have to be used to define an exact mapping of the project engineering coordinate system to the geographic (or map) coordinate system.

- reference height of site is provided by: *IfcSite.RefElevation*, it is given according to the height datum used at this location.
- the reference height of each building situated at the site is given against the same height datum used at this location.
- the elevations of each storey belonging to each building are given as local height relative to the reference height of the building.



IfcSite.ObjectPlacement = IfcLocalPlacement

for information purpose equal to: RefLongitude, RefLatitude, RefHeight

Referring to degree, minute, seconds (with fractions) given in WGS84: 15° 52' 23.34"; 53° 21' 12.34"; 210.15m

Figure 33 — Site elevations

## EXPRESS Specification:

**ENTITY** IfcSite

**SUBTYPE OF** (IfcSpatialStructureElement);

RefLatitude	: <b>OPTIONAL</b> IfcStrippedOptional;
RefLongitude	: <b>OPTIONAL</b> IfcStrippedOptional;
RefElevation	: <b>OPTIONAL</b> IfcStrippedOptional;
LandTitleNumber	: <b>OPTIONAL</b> IfcStrippedOptional;
SiteAddress	: <b>OPTIONAL</b> IfcStrippedOptional;

**END\_ENTITY;**

## Attribute Definitions:

<b>RefElevation</b>	: Datum elevation relative to sea level.
<b>LandTitleNumber</b>	: The land title number (designation of the site within a regional system).

## Inheritance Graph:

**ENTITY** IfcSite

**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
Name : **OPTIONAL** IfcLabel;  
Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcProduct

ObjectPlacement : **OPTIONAL** IfcStrippedOptional;  
Representation : **OPTIONAL** IfcProductRepresentation;

**INVERSE****ENTITY** IfcSpatialElement

LongName : **OPTIONAL** IfcLabel;

**INVERSE****ENTITY** IfcSpatialStructureElement



CompositionType : **OPTIONAL** IfcStrippedOptional;

## ENTITY IfcSite

RefLatitude : **OPTIONAL** IfcStrippedOptional;

RefLongitude : **OPTIONAL** IfcStrippedOptional;

RefElevation : **OPTIONAL** IfcStrippedOptional;

LandTitleNumber : **OPTIONAL** IfcStrippedOptional;

SiteAddress : **OPTIONAL** IfcStrippedOptional;

## END\_ENTITY;

```
<xs:element name="IfcSite" type="ifc: IfcSite" substitutionGroup="ifc: IfcSpatialStructureElement" nillable="true"/>
<xs:complexType
  <xs:complexContent>
    <xs:extension base="ifc: IfcSpatialStructureElement"/>
  </xs:complexContent>
</xs:complexType>
```

## IfcSpace

A space represents an area or volume bounded actually or theoretically. Spaces are areas or volumes that provide for certain functions within a building.

A space is associated to a building storey (or in case of exterior spaces to a site). A space may span over several connected spaces. Therefore a space group provides for a collection of spaces included in a storey. A space can also be decomposed in parts, where each part defines a partial space. This is defined by the *CompositionType* attribute of the supertype *IfcSpatialStructureElement* which is interpreted as follow:

- COMPLEX = space group
- ELEMENT = space
- PARTIAL = partial space

NOTE View definitions and implementation agreements may restrict spaces with *CompositionType*=ELEMENT to be non-overlapping.

The *IfcSpace* is used to build the spatial structure of a building (that serves as the primary project breakdown and is required to be hierarchical). The spatial structure elements are linked together by using the objectified relationship *IfcRelAggregates*.

Figure 34 shows the *IfcSpace* as part of the spatial structure. It also serves as the spatial container for space related elements.

NOTE Detailed requirements on mandatory element containment and placement structure relationships are given in view definitions and implementer agreements.

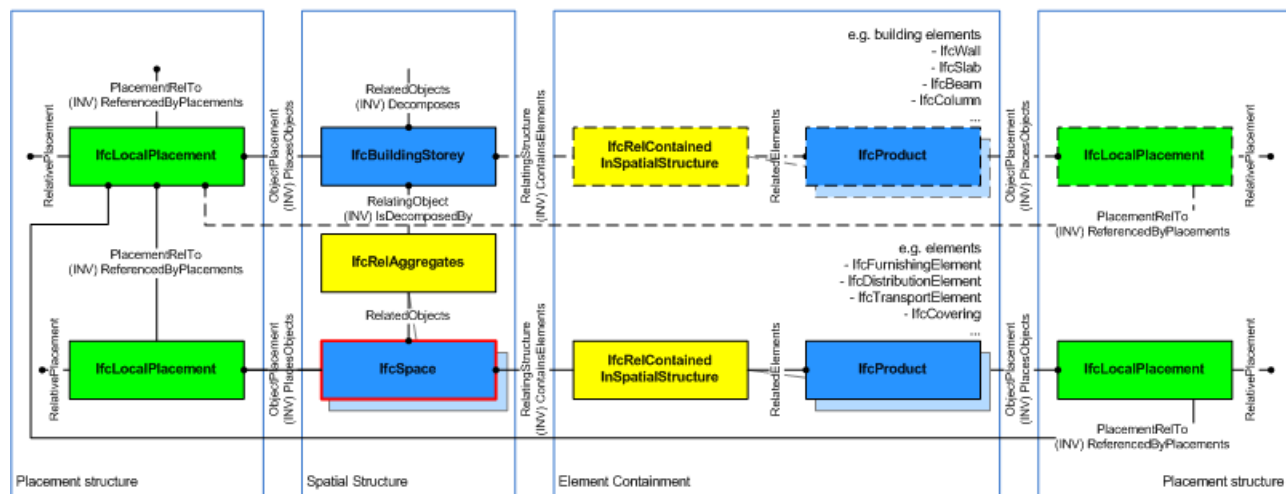


Figure 34 – Space composition

The following guidelines should apply for using the *Name*, *Description*, *LongName* and *ObjectType* attributes.

- *Name* holds the unique name (or space number) from the plan.
- *Description* holds any additional information field the user may have specified, there are no further recommendations.
- *LongName* holds the full name of the space, it is often used in addition to the *Name*, if a number is assigned to the room, then the descriptive name is exchanged as *LongName*.
- *ObjectType* holds the space type, i.e. usually the functional category of the space.

NOTE In cases of inconsistency between the geometric representation of the *IfcSpace* and the combined geometric representations of the surrounding *IfcRelSpaceBoundary*, the geometric representation of the space should take priority over the geometric representation of the surrounding space boundaries.

## HISTORY New entity in IFC1.0

### Attribute Use Definition

Figure 35 describes the heights and elevations of the *IfcSpace*.

- elevation of the space (top of construction slab) equals elevation of storey: provided by *IfcBuildingStorey.Elevation* relative to *IfcBuilding.ElevationOfRefHeight*
- elevation of the space flooring (top of flooring on top of slab): provided by *IfcSpace.ElevationWithFlooring* relative to *IfcBuilding.ElevationOfRefHeight*
- height of space (top of slab below to bottom of slab above): provided by BaseQuantity with Name="Height"
- floor height of space (top of slab below to top of flooring): provided by BaseQuantity with Name="FinishFloorHeight"
- net height of space (top of flooring to bottom of suspended ceiling): provided by BaseQuantity with Name="FinishCeilingHeight"

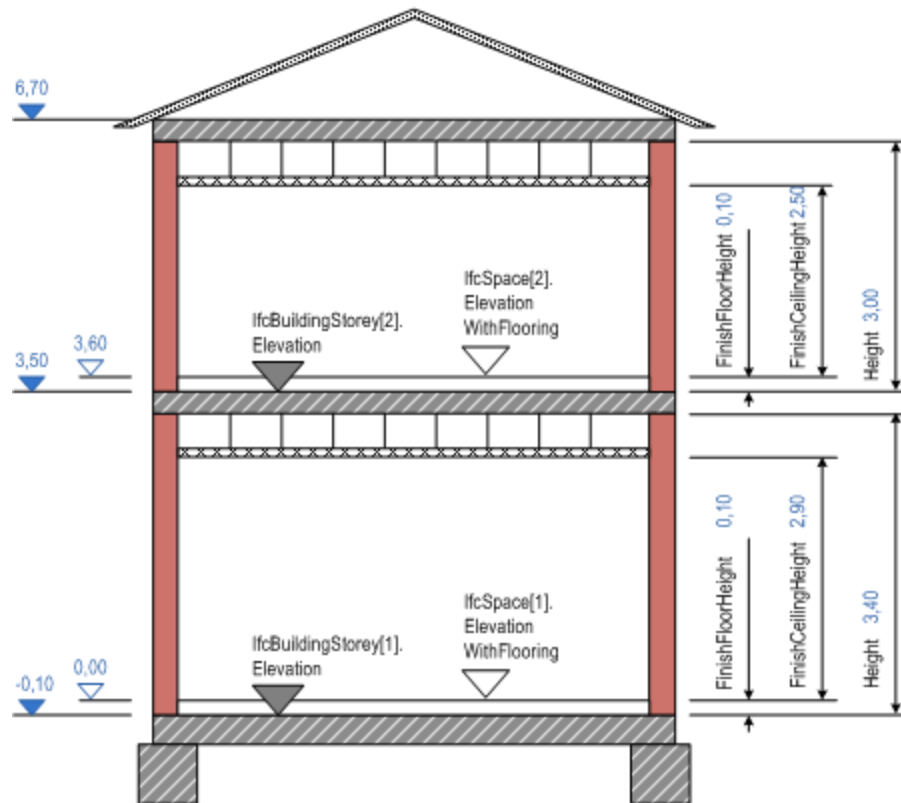


Figure 35 — Space elevations

## EXPRESS Specification:

**ENTITY** IfcSpace

**SUBTYPE OF** (IfcSpatialStructureElement);

PredefinedType : **OPTIONAL** IfcStrippedOptional;  
 ElevationWithFlooring : **OPTIONAL** IfcStrippedOptional;

## INVERSE

## WHERE

CorrectPredefinedType : NOT(EXISTS(PredefinedType)) OR (PredefinedType <> IfcSpaceTypeEnum.USERDEFINED) OR ((PredefinedType = IfcSpaceTypeEnum.USERDEFINED) AND EXISTS (SELF\IfcObject.ObjectType));  
 CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCPRODUCTEXTENSION.IFCSPACETYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

**END\_ENTITY;**

## Attribute Definitions:

**PredefinedType** : Predefined generic types for a space that are specified in an enumeration. There might be property sets defined specifically for each predefined type.  
 NOTE Previous use had been to indicate whether the IfcSpace is an interior space by value INTERNAL, or an exterior space by value EXTERNAL. This use is now deprecated, the property 'IsExternal' at 'Pset\_SpaceCommon' should be used instead.

**IFC4 CHANGE** The attribute has been renamed from *ExteriorOrInteriorSpace* with upward compatibility for file based exchange.

**ElevationWithFlooring** : Level of flooring of this space; the average shall be taken, if the space ground surface is sloping or if there are level differences within this space.

## Formal Propositions:

**CorrectPredefinedType** : Either the *PredefinedType* attribute is unset (e.g. because an IfcSpaceType is associated), or the inherited attribute *ObjectType* shall be provided, if the *PredefinedType* is set to USERDEFINED.

**CorrectTypeAssigned** : Either there is no space type object associated, i.e. the *IsTypedBy* inverse relationship is not provided, or the associated type object has to be of type IfcSpaceType.

## Inheritance Graph:

**ENTITY** IfcSpace

**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
 OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
 Name : **OPTIONAL** IfcLabel;  
 Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition

### INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
 HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
 IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
 Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
 HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

### INVERSE

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcProduct

ObjectPlacement : **OPTIONAL** IfcStrippedOptional;  
 Representation : **OPTIONAL** IfcProductRepresentation;

## INVERSE

### ENTITY IfcSpatialElement

LongName : **OPTIONAL** IfcLabel;

## INVERSE

### ENTITY IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

### ENTITY IfcSpace

PredefinedType : **OPTIONAL** IfcStrippedOptional;  
 ElevationWithFlooring : **OPTIONAL** IfcStrippedOptional;

## INVERSE

### END\_ENTITY;

```
<xs:element name="IfcSpace" type="Ifc: IfcSpace" substitutionGroup="Ifc: IfcSpatialStructureElement" nillable="true"/>
<xs:complexType
  <xs:complexContent>
    <xs:extension base="Ifc: IfcSpatialStructureElement"/>
  </xs:complexContent>
</xs:complexType>
```

## IfcSpaceType

A space represents an area or volume bounded actually or theoretically. Spaces are areas or volumes that provide for certain functions within a building.

The *IfcSpaceType* defines a list of commonly shared defines commonly shared information for occurrences of spaces. The set of shared information may include:

- common properties within shared property sets
- common shape representations

It is used to define a space specification (i.e. the specific space information, that is common to all occurrences of that space type. Space types may be exchanged without being already assigned to occurrences.

NOTE The space types are often used to represent space catalogues, less so for sharing a common representation map. Space types in a space catalogue share same space classification and a common set of space requirement properties.

The occurrences of *IfcSpaceType* are represented by instances of *IfcSpace*.

**HISTORY** New entity in IFC2x3.

**IFC4 CHANGE** The attribute *LongName* has been added to the end of the entity definition.

### Geometry Use Definition

The *IfcSpaceType* may define the shared geometric representation for all space occurrences. The *RepresentationMaps* attribute refers to a list of *IfcRepresentationMap*'s, that allow for multiple geometric representations (e.g. with *IfcShaperepresentation*'s having an *RepresentationIdentifier* 'Box', 'FootPrint', or 'Body').

NOTE The product representations are defined as representation maps (at the level of the supertype *IfcTypeProduct*, which gets assigned by an element occurrence instance through the *IfcShapeRepresentation.Item[1]* being an *IfcMappedItem*. However view definitions and implementer agreements may prevent the usage of shared geometry for spaces.

## EXPRESS Specification:

**ENTITY** *IfcSpaceType*

**SUBTYPE OF** (*IfcSpatialStructureElementType*);

*PredefinedType* : *IfcSpaceTypeEnum*;  
*LongName* : **OPTIONAL** *IfcStrippedOptional*;

### WHERE

*CorrectPredefinedType* : (*PredefinedType* <> *IfcSpaceTypeEnum.USERDEFINED*) OR ((*PredefinedType* = *IfcSpaceTypeEnum.USERDEFINED*) AND EXISTS(*SELF*\(*IfcSpatialElementType.ElementType*)));

**END\_ENTITY;**

## Attribute Definitions:

**PredefinedType** : Predefined types to define the particular type of space. There may be property set definitions available for each predefined type.  
**LongName** : Long name for a space type, used for informal purposes. It should be used, if available, in conjunction with the inherited *Name* attribute.  
 NOTE In many scenarios the *Name* attribute refers to the short name or number of a space type, and the *LongName* refers to the full descriptive name.

**IFC4 CHANGE** New attribute added at the end of entity definition.

## Formal Propositions:

**CorrectPredefinedType** : The inherited attribute *ElementType* shall be provided, if the *PredefinedType* is set to *USERDEFINED*.

## Inheritance Graph:

**ENTITY** *IfcSpaceType*

**ENTITY** *IfcRoot*

*GlobalId* : *IfcGloballyUniqueId*;  
*OwnerHistory* : **OPTIONAL** *IfcStrippedOptional*;  
*Name* : **OPTIONAL** *IfcLabel*;  
*Description* : **OPTIONAL** *IfcText*;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
 HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
 IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
 Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
 HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcTypeObject

ApplicableOccurrence : **OPTIONAL** IfcStrippedOptional;  
 HasPropertySets : **OPTIONAL SET** [1:?] **OF** IfcPropertySetDefinition;

**INVERSE**

Types : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatingType;

**ENTITY** IfcTypeProduct

RepresentationMaps : **OPTIONAL LIST** [1:?] **OF UNIQUE** IfcStrippedOptional;  
 Tag : **OPTIONAL** IfcStrippedOptional;

**INVERSE****ENTITY** IfcSpatialElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

**ENTITY** IfcSpatialStructureElementType**ENTITY** IfcSpaceType

PredefinedType : IfcSpaceTypeEnum;  
 LongName : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

```
<xs:element name="IfcSpaceType" type="ifc:IfcSpaceType" substitutionGroup="ifc:IfcSpatialStructureElementType"
nillable="true"/>
<xs:complexType name="IfcSpaceType">
  <xs:complexContent>
```

```

<xs:extension
  <xs:attribute
    name="PredefinedType"
    type="ifc: IfcSpaceTypeEnum"
    base="ifc: IfcSpatialStructureElementType">
  </xs:extension>
</xs:complexContent>
</xs:complexType>

```

## IfcZone

A zone is a group of spaces, partial spaces or other zones. Zone structures may not be hierarchical (in contrary to the spatial structure of a project - see *IfcSpatialStructureElement*), i.e. one individual *IfcSpace* may be associated with zero, one, or several *IfcZone*'s. *IfcSpace*'s are grouped into an *IfcZone* by using the objectified relationship *IfcRelAssignsToGroup* as specified at the supertype *IfcGroup*.

NOTE Certain use cases may restrict the freedom of non-hierarchical relationships. In some building service use cases the zone denotes a view based delimited volume for the purpose of analysis and calculation. This type of zone cannot overlap with respect to that analysis, but may overlap otherwise.

### HISTORY New entity in IFC1.0

**IFC4 CHANGE** The entity is now subtyped from *IfcSystem* (not its supertype *IfcGroup*) with upward compatibility for file based exchange.

## EXPRESS Specification:

**ENTITY** IfcZone

**SUBTYPE OF** (IfcSystem);

LongName : **OPTIONAL** IfcStrippedOptional;

## WHERE

WR1 : (SIZEOF(SELF\IfcGroup.IsGroupedBy) = 0) OR (SIZEOF (QUERY (temp < \*  
SELF\IfcGroup.IsGroupedBy[1].RelatedObjects | NOT(('IFCPRODUCTEXTENSION.IFCZONE' IN  
TYPEOF(temp)) OR ('IFCPRODUCTEXTENSION.IFCSPACE' IN TYPEOF(temp)) OR  
(('IFCPRODUCTEXTENSION.IFCSPATIALZONE' IN TYPEOF(temp)) ))) = 0);

**END\_ENTITY;**

## Attribute Definitions:

**LongName** : Long name for a zone, used for informal purposes. It should be used, if available, in conjunction with the inherited *Name* attribute.  
NOTE In many scenarios the *Name* attribute refers to the short name or number of a zone, and the *LongName* refers to the full name.

**IFC4 CHANGE** The attribute has been added at the end of the entity definition.

## Formal Propositions:

**WR1** : An IfcZone is grouped by the objectified relationship *IfcRelAssignsToGroup*. Only objects of type IfcSpace, IfcZone and *IfcSpatialZone* are allowed as *RelatedObjects*.

## Inheritance Graph:

**ENTITY** IfcZone



**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
 OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
 Name : **OPTIONAL** IfcLabel;  
 Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
 HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
 IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
 Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
 HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

**ENTITY** IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

**INVERSE**

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

**ENTITY** IfcGroup**INVERSE****ENTITY** IfcSystem**INVERSE****ENTITY** IfcZone

LongName : **OPTIONAL** IfcStrippedOptional;

**END\_ENTITY;**

```
<xs:element name="IfcZone" type="ifc:IfcZone" substitutionGroup="ifc:IfcSystem" nillable="true"/>
```

```

<xs:complexType                                name="IfcZone">
  <xs:complexContent>
    <xs:extension                                base="ifc: IfcSystem"/>
  </xs:complexContent>
</xs:complexType>

```

## IfcOccupant

An occupant is a type of actor that defines the form of occupancy of a property.

The principal purpose of **IfcOccupant** is to determine the nature of occupancy of a property for a particular actor. All characteristics relating to the actor (name and organization details) are inherited from the *IfcActor* entity.

**HISTORY** New entity in IFC2x

### EXPRESS Specification:

**ENTITY** IfcOccupant

**SUBTYPE OF** (IfcActor);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

#### WHERE

WR31 : NOT(PredefinedType = IfcOccupantTypeEnum.USERDEFINED) OR EXISTS(SELF\IfcObject.ObjectType);

**END\_ENTITY;**

### Attribute Definitions:

### Formal Propositions:

**WR31** : The attribute ObjectType must be asserted when the value of the IfcOccupantTypeEnum is set to USERDEFINED.

### Inheritance Graph:

**ENTITY** IfcOccupant

**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;  
 OwnerHistory : **OPTIONAL** IfcStrippedOptional;  
 Name : **OPTIONAL** IfcLabel;  
 Description : **OPTIONAL** IfcText;

**ENTITY** IfcObjectDefinition

**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;  
 HasContext : **SET** [0:1] OF IfcRelDeclares **FOR** RelatedDefinitions;  
 IsDecomposedBy : **SET OF** IfcRelAggregates **FOR** RelatingObject;  
 Decomposes : **SET** [0:1] OF IfcRelAggregates **FOR** RelatedObjects;  
 HasAssociations : **SET OF** IfcRelAssociates **FOR** RelatedObjects;

#### ENTITY IfcObject

ObjectType : **OPTIONAL** IfcStrippedOptional;

#### INVERSE

IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;  
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

#### ENTITY IfcActor

TheActor : IfcActorSelect;

#### INVERSE

IsActingUpon : **SET OF** IfcRelAssignsToActor **FOR** RelatingActor;

#### ENTITY IfcOccupant

PredefinedType : **OPTIONAL** IfcStrippedOptional;

#### END\_ENTITY;

```

<xs:element name="IfcOccupant" type="ifc:IfcOccupant" substitutionGroup="ifc:IfcActor" nillable="true"/>
<xs:complexType name="IfcOccupant">
  <xs:complexContent>
    <xs:extension base="ifc:IfcActor"/>
  </xs:complexContent>
</xs:complexType>
  
```

#### 4.6.6.1.3 Data definition reference schema list

Each referenced schema is listed by standards body notation and official title.

Reference	Description
ISO 16739:2013	Industry Foundation Classes (IFC) for data sharing in the construction and facilities management industries

#### 4.6.6.2 (not used)

#### 4.6.6.2.1 Concept list

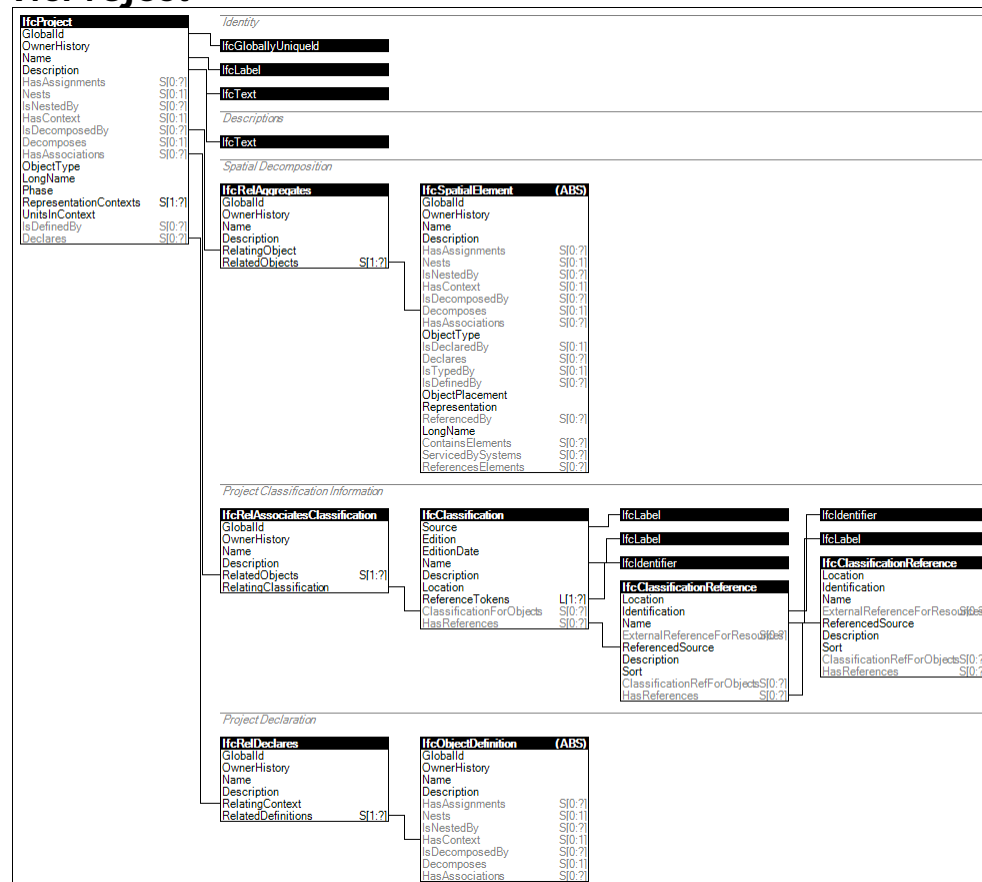
Each concept is listed by entity name and concept template within the following table. Each row corresponds to an entity, each column corresponds to a concept template, and each cell indicates usage of a concept template for an entity.

Entity	Identity	Project Classification Information	Spatial Decomposition	Descriptions	Project Declaration	Calendar	Control Assignment	Assigned Actor	Spatial Naming	Classification	Properties for Occurrences	Quantity Sets	Properties on Occurrences	Spatial Composition	Object Typing	FootPrint GeomSet Geometry	Body SweptSolid Geometry	Assigned Control	Tabular Constraints	Properties for Types	Actor Assignment
IfcProject	X	X	X	X	X																
IfcWorkCalendar	X					X	X	X													
IfcBuilding	X			X					X	X	X	X	XX								
IfcBuildingStorey	X		X	X					X		X	X									
IfcSite			X								X			X							
IfcSpace	X		X	X					X	X	X		X		X	X	X	X	X		
IfcSpaceType	X																		X	X	
IfcZone	X										X										
IfcOccupant	X																				X

#### 4.6.6.2.2 Concept definitions

Each entity is described within subsections, with diagrams indicating the graph of attributes and objects representing the combination of all concepts applied to instances of the entity. Each block in the diagram represents an entity, where the entity name is shown at the top of the block with background in black. Each attribute within the entity is shown in order, where black is used to indicate a direct attribute and grey is used to indicate an inverse attribute. Notation to the right of each attribute indicates aggregation, where S indicates a SET (unordered unique objects) and L indicates a LIST (ordered objects), the first number in brackets indicates the minimum count, and the second number in brackets indicates the maximum count or “?” for unlimited. Lines connecting blocks indicates attributes that point to objects of other data definitions.

## IfcProject



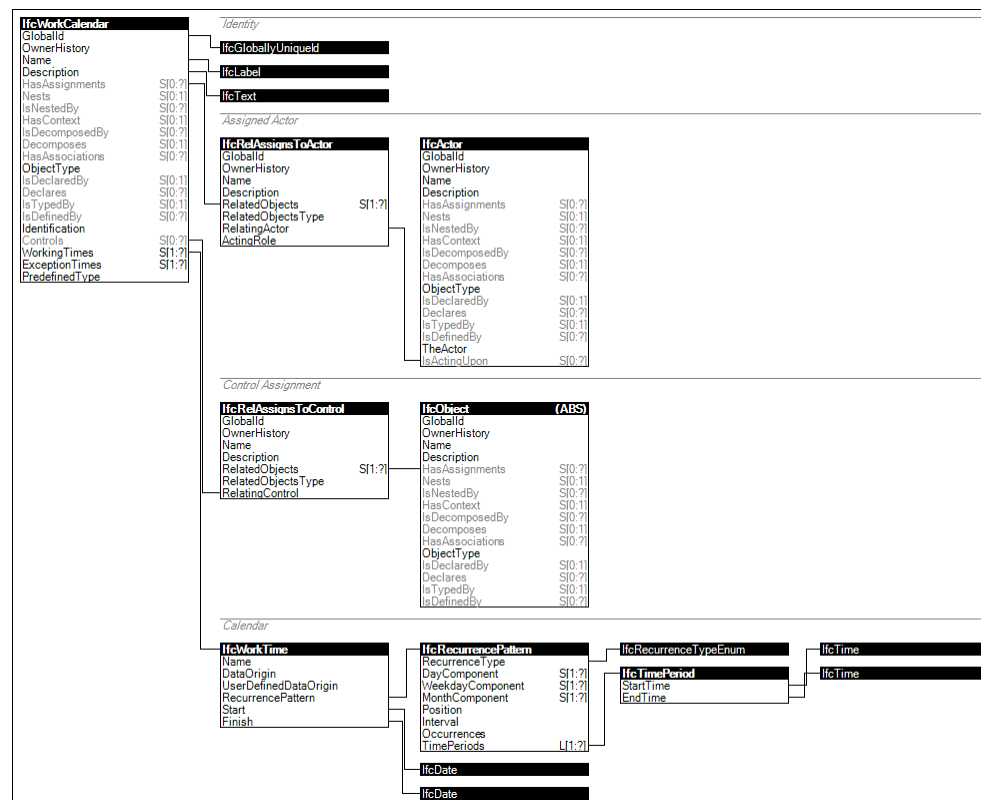
## Spatial Decomposition

The *IfcProject* is used to reference the root of the spatial structure of a building (that serves as the primary project breakdown and is required to be hierarchical). The spatial structure elements are linked together, and to the *IfcProject*, by using the objectified relationship *IfcRelAggregates*. The *IfcProject* references them by its inverse relationship:

- *IfcProject.Decomposes* — it shall be NIL, i.e. *IfcProject* shall not be part of a decomposition as it is the root element of the spatial structure.
- *IfcProject.IsDecomposedBy* — referencing (*IfcSite* || *IfcBuilding*) by *IfcRelAggregates.RelatingObject*. The *IfcSite* or *IfcBuilding* referenced shall be the root of the spatial structure.

## IfcWorkCalendar

This entity is used to indicate occupancy schedules. It may be used to indicate recurring intervals such as Monday-Friday 08:00-16:00 with optional exceptions for holidays. Such information may be used in building programming to determine space allocation and energy requirements.



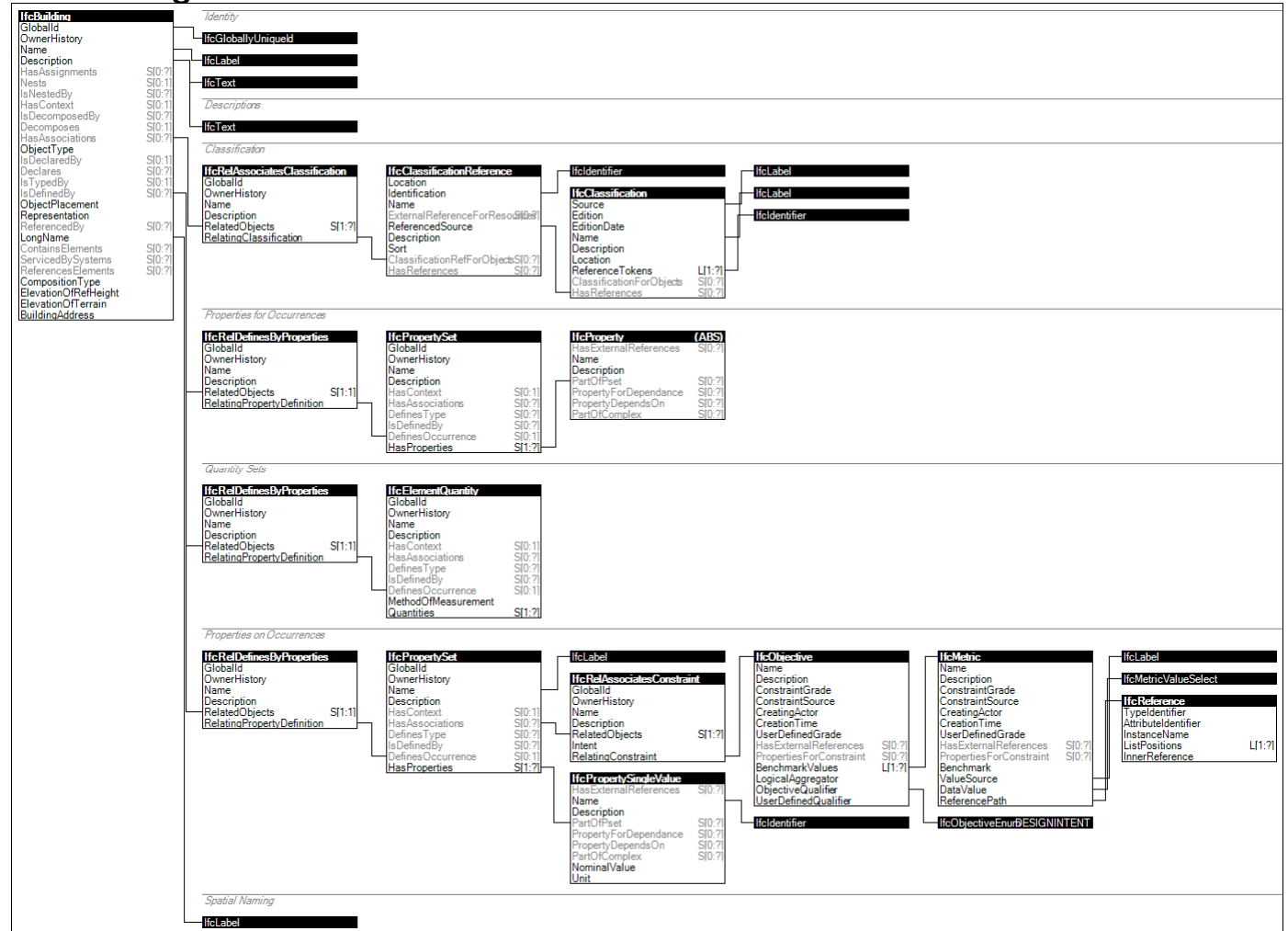
## Control Assignment

Spaces may be assigned to calendars to indicate specific locations to be occupied.

## Assigned Actor

Calendars may be assigned to a specific occupant indicating times when the occupant is planned to occupy any assigned spaces.

## IfcBuilding



## Identity

The *Name* refers to a short name or a building number used for reference purposes.

## Descriptions

The *Description* refers to general information about the building.

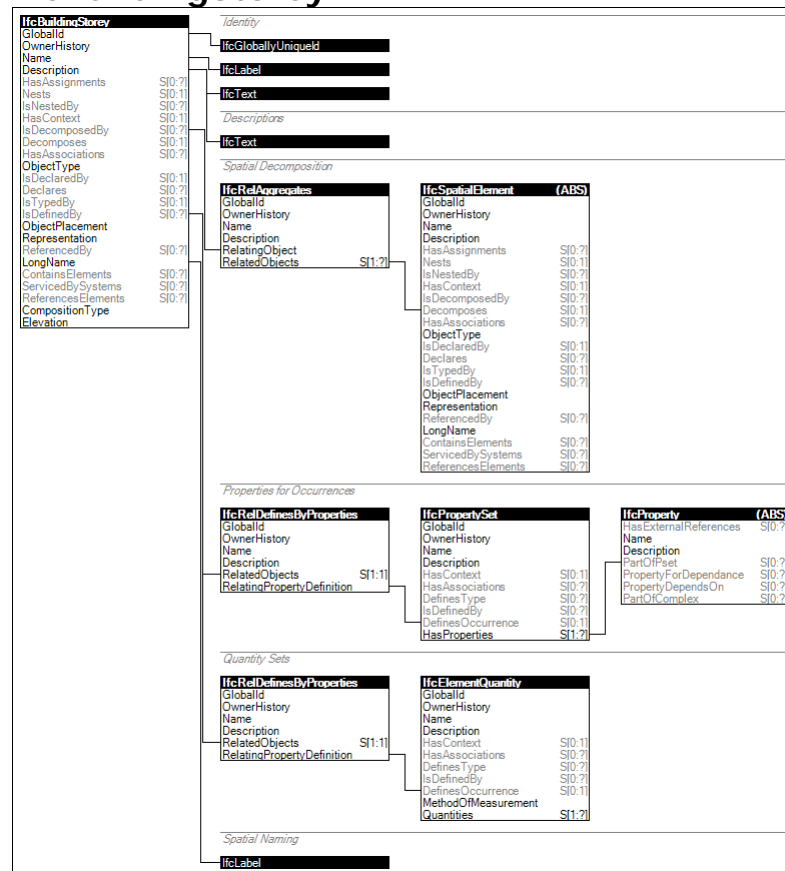
## Spatial Naming

The *LongName* refers to a short or long name for reference purposes.

## Classification

The building can be classified using a reference library or any national, standard or project specific classification. Multiple classifications can be used.

## IfcBuildingStorey



## Identity

The *Name* refers to a short name or a level number used for reference purposes. It should correspond to level numbering as used in elevators and stairways.

## Descriptions

The *Description* refers to general information about the building.

## Spatial Naming

The *LongName* refers to a short or long name for reference purposes.

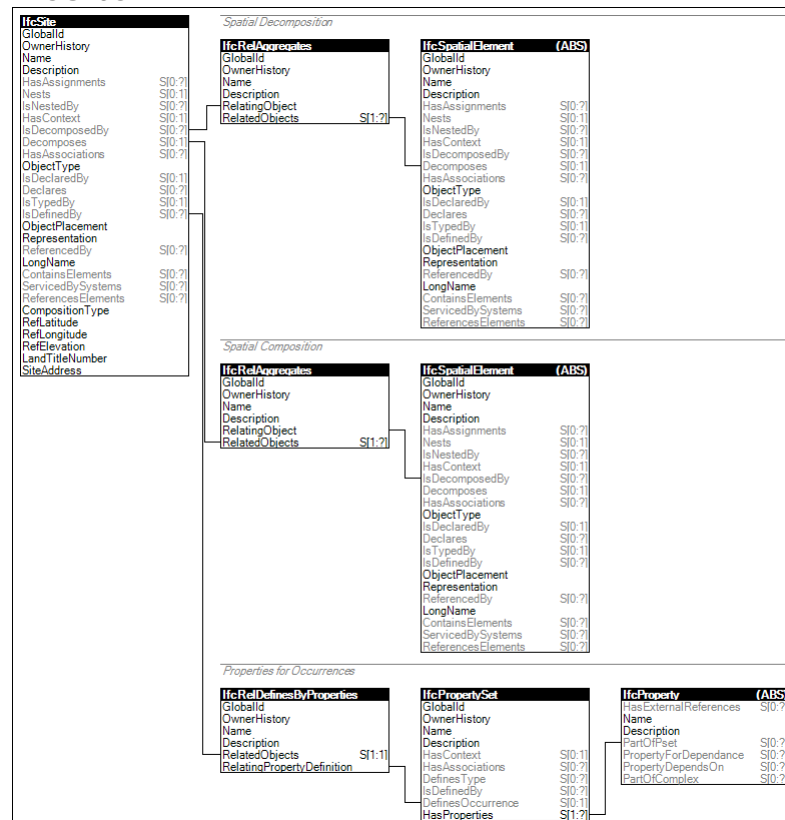
## Spatial Decomposition

By using the inverse relationship *IfcBuildingStorey.Decomposes* it references (*IfcBuilding* || *IfcBuildingStorey*) through *IfcRelAggregates.RelatingObjectIfcBuildingStorey*, the referenced *IfcBuildingStorey* needs to have a different and higher



*CompositionType*, i.e. COMPLEX (if the other *IfcBuildingStorey* has ELEMENT), or ELEMENT (if the other *IfcBuildingStorey* has PARTIAL).

## IfcSite



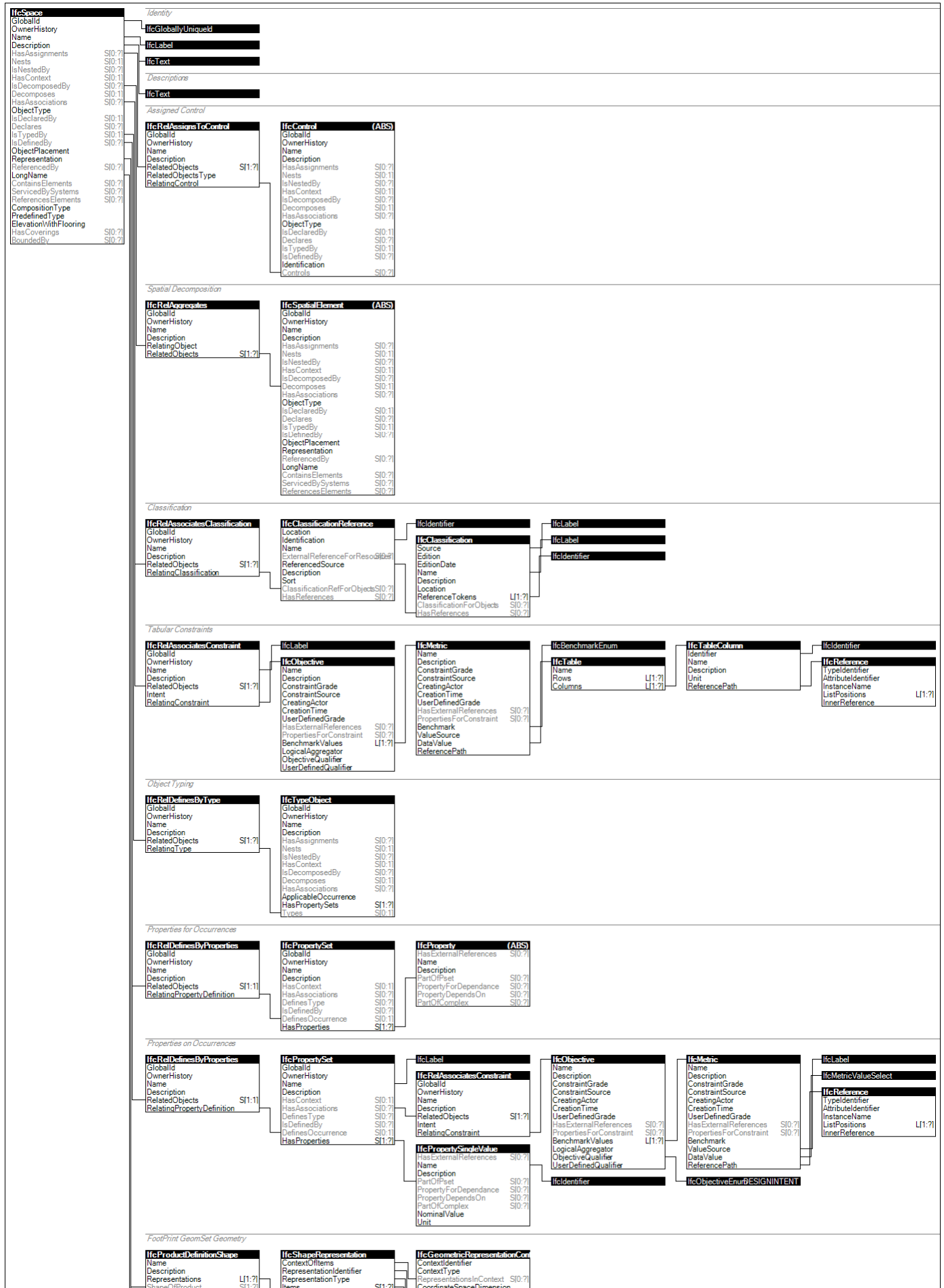
## Spatial Decomposition

By using the inverse relationship *IfcSite.Decomposes* it references *IfcProject* || *IfcSite* through *IfcRelAggregates.RelatingObject*, If it refers to another instance of *IfcSite*, the referenced *IfcSite* needs to have a different and higher *CompositionType*, i.e. COMPLEX (if the other *IfcSite* has ELEMENT), or ELEMENT (if the other *IfcSite* has PARTIAL).

## Spatial Composition

By using the inverse relationship *IfcSite.IsDecomposedBy* it references (em>*IfcSite* || *IfcBuilding* || *IfcSpace* by *IfcRelAggregates.RelatedObjects*. If it refers to another instance of *IfcSite*, the referenced *IfcSite* needs to have a different and lower *CompositionType*, i.e. ELEMENT (if the other *IfcSite* has COMPLEX), or PARTIAL (if the other *IfcSite* has ELEMENT).

## IfcSpace



## Identity

The *GlobalId* should not change as long as the function for the room is the same (even if the location of the room is changed in the model).

The *Name* refers to an alphanumeric number unique to the building, based on location, corresponding to signage for room numbers.

## Descriptions

The *Description* refers to the activities and functions that the space is expected to serve.

## Object Typing

The *Name* on the *IfcSpaceType* refers to a standard naming convention (acronym) for room types used, and is usually a client or company specific code for room templates shared for multiple rooms in a project and/or across projects.

## Classification

The space should be classified by activity (functional category) using a reference library or any national, standard or project specific classification. A single space can have more than one classification assigned.

## Properties on Occurrences

Specific properties identified within this concept are mandatory, and may be automatically enforced via constraints, where *IfcMetric.ReferencePath* maps to specific instances or attributes that may be compared with the specified property value.

## Spatial Decomposition

By using the inverse relationship *IfcSpace.Decomposes* it references *IfcSite* || *IfcBuildingStorey* || *IfcSpace* by *IfcRelAggregates.RelatingObject*. If it refers to another instance of *IfcSpace*, the referenced *IfcSpace* needs to have a different and higher *CompositionType*, i.e. COMPLEX (if the other *IfcSpace* has ELEMENT), or ELEMENT (if the other *IfcSpace* has PARTIAL).

## FootPrint GeomSet Geometry

The following constraints apply to the 2D representation:

- An *IfcBoundedCurve* is required, using *IfcPolyline* for faceted space contours or *IfcCompositeCurve* for space contours with arc segments. For spaces with inner boundaries, a set of *IfcBoundedCurve*'s is used, that should be grouped into an *IfcGeometricCurveSet*.

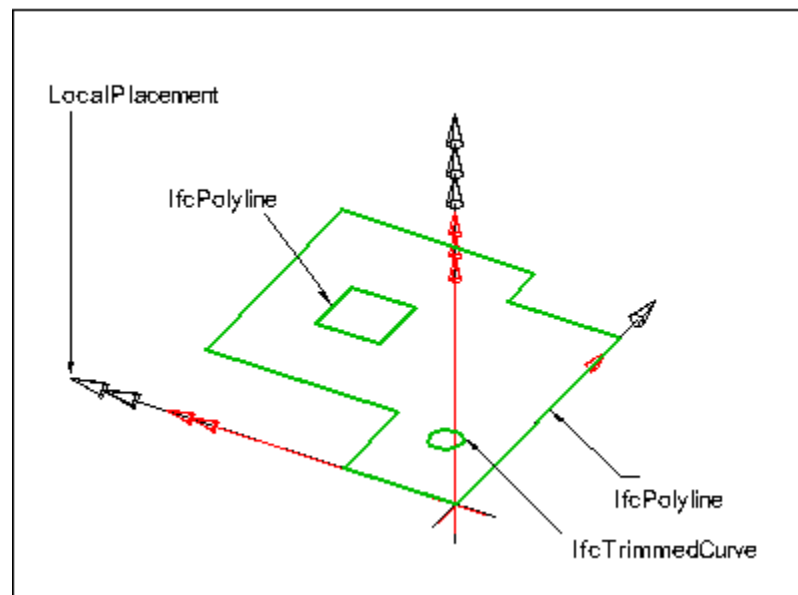


Figure 186 — Space footprint

EXAMPLE Figure 186 shows a two-dimensional bounded curve representing the foot print of *IfcSpace*.

## Body SweptSolid Geometry

The following constraints apply to the standard representation:

- Solid: *IfcExtrudedAreaSolid* is required,
- Profile: *IfcArbitraryClosedProfileDef* is required, *IfcArbitraryProfileDefWithVoids* shall be supported.
- Extrusion: The extrusion direction shall be vertically, i.e., along the positive Z Axis of the co-ordinate system of the containing spatial structure element.

Figure 187 shows an extrusion of an arbitrary profile definition with voids into the swept area solid of *IfcSpace*.

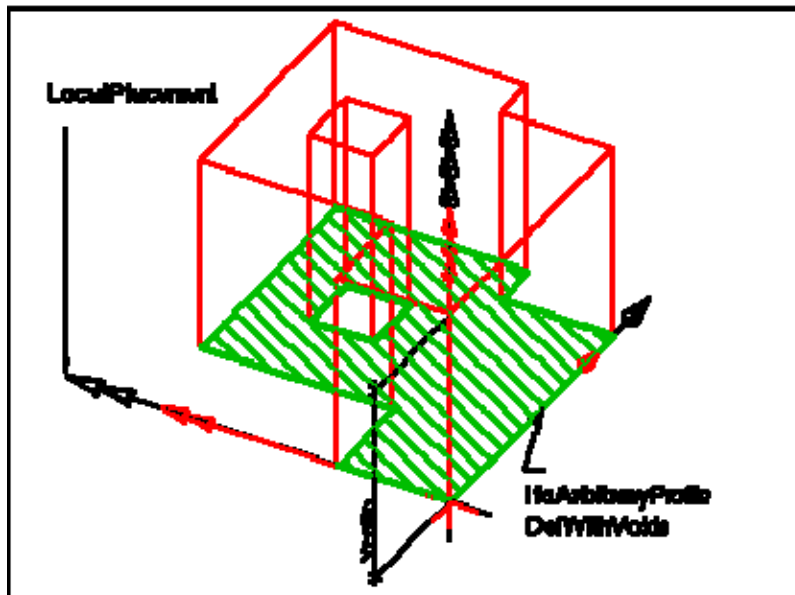


Figure 187 — Space body swept solid

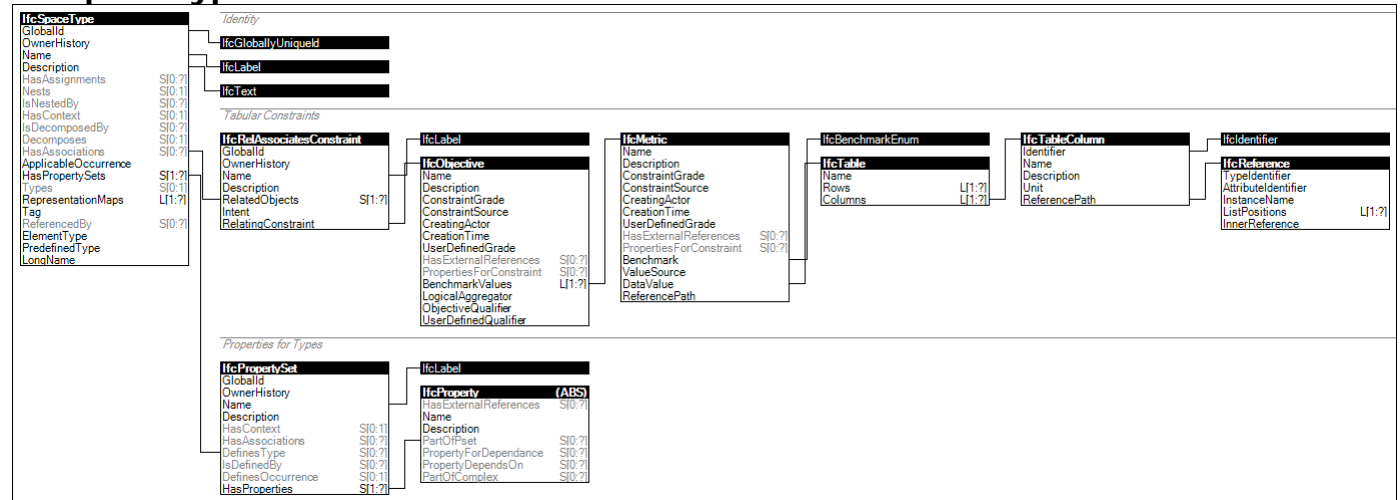
## Assigned Control

Spaces may be assigned to calendars indicating occupancy schedules. Such calendars may in turn be assigned to occupants identifying the organization and population.

## Tabular Constraints

Furniture, Fixtures, and Equipment (FF&E) schedules may be defined using tabular constraints. Software observing the IFC constraint model may validate such schedules as any other tabular constraint. Implementing software may enable direct viewing and/or editing of such schedules, automatically generate such schedules based on building model data, automatically generate building model data according to schedules, or a combination thereof.

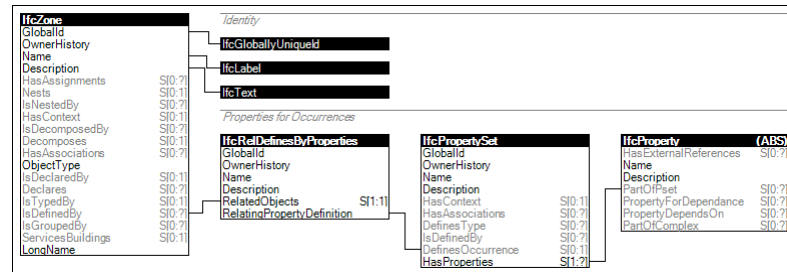
## IfcSpaceType



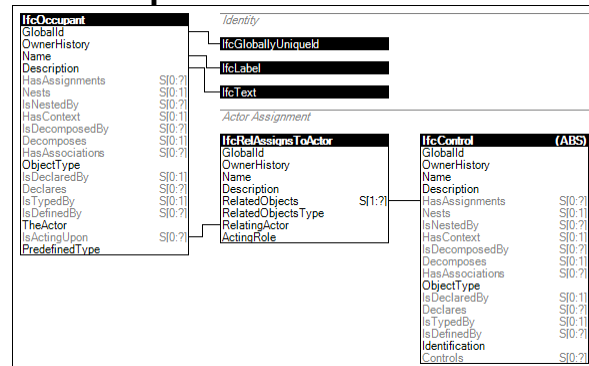
## Tabular Constraints

Furniture, Fixtures, and Equipment (FF&E) schedules may be defined using tabular constraints. Software observing the IFC constraint model may validate such schedules as any other tabular constraint. Implementing software may enable direct viewing and/or editing of such schedules, automatically generate such schedules based on building model data, automatically generate building model data according to schedules, or a combination thereof.

## IfcZone



## IfcOccupant



### 4.6.6.2.3 Concept attributes list

Concepts may be defined that use parameters to indicate applicable values. For example, plumbing objects may make use of ports to enable connectivity to other objects for distribution of water, and a specific entity such as a hot water heater may have specific ports such as “ColdWaterIn” and

“HotWaterOut”. Defining attributes at concepts enables re-use of concepts where the data structures are the same, but applicable values may differ. Each concept is shown in a subsection as follows, with rows corresponding to entities and rule instances, columns corresponding to template parameters, and cells corresponding to values applied to rules.

## Project Classification Information

Entity	Source	Name	ReferenceTokens
IfcProject			

## Spatial Decomposition

Entity	Spatial Parts
IfcProject	IfcSite
	IfcBuilding
IfcBuildingStorey	IfcSpace
IfcSite	IfcProject
	IfcSite
IfcSpace	

## Project Declaration

Entity	Type
IfcProject	IfcOccupant
	IfcSystem
	IfcZone
	IfcWorkCalendar
	IfcSpace
	IfcSpaceType

## Control Assignment

Entity	Type
IfcWorkCalendar	IfcSpace

## Assigned Actor

Entity	Type
IfcWorkCalendar	IfcOccupant

## Classification

Entity	Source	Name	Tokens
IfcBuilding			
IfcSpace			

## Properties for Occurrences

Entity	PredefinedType	Name
IfcBuilding		Pset_BuildingCommon
IfcBuildingStorey		Pset_BuildingStoreyCommon
IfcSite		Pset_SiteCommon
IfcSpace		Pset_SpaceCommon
		Pset_SpaceOccupancyRequirements
		Pset_SpaceLightingRequirements
		Pset_SpaceThermalRequirements
		Pset_SpaceFireSafetyRequirements
		ePset_SpaceDimensionalRequirements
		ePset_SpaceOccupancyRequirements
		ePset_SpaceStructuralRequirements
		ePset_SpaceCoveringRequirements
		ePset_SpaceDoorRequirements
		ePset_SpaceWindowRequirements
		ePset_SpaceLightingRequirements
		ePset_SpaceThermalRequirements
		ePset_SpaceElectricalRequirements
		ePset_SpaceCommunicationsRequirements
		Pset_SpaceFireSafetyRequirements
		ePset_SpaceSecurityRequirements
		ePset_SpaceSensorRequirements
		ePset_SpaceEmergencyRequirements
		ePset_SpaceSignalingRequirements
		ePset_SpaceAudiovisualRequirements
		ePset_SpaceAcousticRequirements
		ePset_SpaceWaterRequirements
		ePset_SpaceExhaustRequirements
		ePset_SpaceGasProvisionRequirements
		ePset_SpaceMaintenanceRequirements
		ePset_SpaceCustomRequirements
IfcZone		Pset_ZoneCommon

## Properties on Occurrences

Entity	Pset	Property	Type	ReferencePath
IfcBuilding	Pset_BuildingCommon	Category	IfcLabel	
IfcBuilding	Pset_BuildingCommon	GrossPlannedArea	IfcAreaMeasure	
IfcBuilding	Pset_BuildingCommon	Category	IfcLabel	
IfcBuilding	Pset_BuildingCommon	GrossPlannedArea	IfcAreaMeasure	

Entity	Pset	Property	Type	ReferencePath
IfcSpace	ePset_SpaceStructuralRequirements	FloorLoad	IfcPlanarForceMeasure	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcSlab.HasAssignments[*]\IfcRelAssignsToProduct.RelatedObjects[*]\IfcStructuralSurfaceMember.AssignedStructuralActivity[*]\IfcRelConnectsStructuralActivity.RelatingStructuralActivity\IfcStructuralSurfaceAction.AppliedLoad\IfcStructuralLoadPlanarForce.PlanarForceZ
	Pset_SpaceCoveringRequirements	FloorCovering	IfcLabel	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.HasCoverings[*]\IfcRelCoverSpaces.RelatedCoverings[*]\IfcCovering/FLOORING.HasAssociations[*]\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers['Fill']\IfcMaterialLayer.Material\IfcMaterial.Name
	Pset_SpaceCoveringRequirements	WallCovering	IfcLabel	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.HasCoverings[*]\IfcRelCoverSpaces.RelatedCoverings[*]\IfcCovering/CLADDING.HasAssociations[*]\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers['Fill']\IfcMaterialLayer.Material\IfcMaterial.Name
	Pset_SpaceCoveringRequirements	CeilingCovering	IfcLabel	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.HasCoverings[*]\IfcRelCoverSpaces.RelatedCoverings[*]\IfcCovering/CEILING.HasAssociations[*]\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers['Fill']\IfcMaterialLayer.Material\IfcMaterial.Name
	Pset_SpaceLightingRequirements	NoArtificialLighting	IfcBoolean	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcLightFixture
	ePset_SpaceElectricalRequirements	OutletsMains	IfcInteger	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcOutlet
	ePset_SpaceWaterRequirements	FloorDrain	IfcBoolean	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcWasteTerminal
	ePset_SpaceCommunicationsRequirements	OutletsICT	IfcInteger	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcOutlet/DATAOUTLET
	ePset_SpaceCommunicationsRequirements	OutletsTelephone	IfcInteger	\IfcPropertySet.DefinesOccurrence[*]\IfcRelDefinesByProperties.RelatedObjects[*]\IfcSpace.ContainsElements[*]\IfcRelContainedInSpatialStructure.RelatedElements[*]\IfcOutlet/TELEPHONEOUTLET

## Spatial Composition

Entity	Spatial Composite
IfcSite	IfcBuilding
	IfcSpace

## Object Typing

Entity	Type
IfcSpace	IfcSpaceType



## FootPrint GeomSet Geometry

Entity	Identifier	Type	Items
IfcSpace	FootPrint	Curve2D	IfcBoundedCurve

## Body SweptSolid Geometry

Entity	Identifier	Type	Items
IfcSpace			

## Assigned Control

Entity	Type
IfcSpace	IfcWorkCalendar

## Tabular Constraints

Entity	Identifier	ReferencePath
IfcSpace	Identification	\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.GlobalId
	Count	\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.GlobalId
	Name	\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.Name
IfcSpaceType	Identification	\\IfcSpaceType.DefinesOccurrences[*]\\IfcRelDefinesByType.RelatedObjects[*]\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.GlobalId
	Count	\\IfcSpaceType.DefinesOccurrences[*]\\IfcRelDefinesByType.RelatedObjects[*]\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.GlobalId
	Name	\\IfcSpaceType.DefinesOccurrences[*]\\IfcRelDefinesByType.RelatedObjects[*]\\IfcSpace.ContainsElements[*]\\IfcRelContainedInSpatialStructure.RelatedElements[*]\\IfcElement.IsTypedBy[*]\\IfcRelDefinesByType.RelatingType\\IfcElementType.Name

## Properties for Types

Entity	Name
IfcSpaceType	

## Actor Assignment

Entity	Type
IfcOccupant	IfcWorkCalendar

### 4.6.6.2.4 Concept relationship description

Concepts may inherit from other concepts such that more generic rules may be defined at a higher level and more specific rules at a lower level. For example, geometry may be defined for a distribution segment (e.g. ducts, pipes, cables) that indicate permitted use of an extruded area solid (IfcExtrudedAreaSolid) which defines a 2D cross section extruded along a 3D linear segment. Such rule may be further refined for ducts to indicate that the cross-sections are further restricted to shapes such as hollow rectangles (IfcRectangleHollowProfileDef) or hollow circles (IfcCircleHollowProfileDef). Concepts are shown in a hierarchy as follows where inner concepts inherit from outer concepts.

- Roots
  - Identity
  - Descriptions
- Project
  - Project Declaration
  - Project Classification Information
- Association
  - Classification
  - Constraint
    - Tabular Constraints
- Definition
  - Object Typing
  - Property Sets
    - Properties for Occurrences
    - Properties for Types
    - Properties on Occurrences
  - Quantity Sets
    - Quantity Sets for Occurrences
    - Quantities on Occurrences
- Assignment
  - Actor Assignment
  - Control Assignment
  - Assigned Actor
  - Assigned Control
- Composition
  - Aggregation
    - Spatial Composition
    - Spatial Decomposition
- Control
  - Calendar
- Product
  - Geometry
    - Footprint Geometry
      - FootPrint GeomSet Geometry
    - Body Geometry
      - Body SweptSolid Geometry
  - Spatial Naming

#### 4.6.6.2.5 Concept requirements applicability

Each entity is shown in subsections as follows, with rows corresponding to concepts, columns corresponding to exchanges, and cells indicating requirements where 'R' indicates required and 'O' indicates optional.

## IfcProject

Concept	Facility Criteria	Discipline Specifications
Identity	R	R
Project Classification Information	O	O
Spatial Decomposition	R	R
Descriptions	O	O
Project Declaration	O	O

## IfcWorkCalendar

Concept	Facility Criteria	Discipline Specifications
Identity		O
Calendar		O
Control Assignment		O
Assigned Actor		O

## IfcBuilding

Concept	Facility Criteria	Discipline Specifications
Identity	R	R
Descriptions	O	O
Spatial Naming	R	R
Classification	O	O
Properties for Occurrences	O	O
Quantity Sets	O	O
Properties on Occurrences	R	R
Properties on Occurrences	R	R

## IfcBuildingStorey

Concept	Facility Criteria	Discipline Specifications
Identity	R	R
Descriptions	O	O
Spatial Naming	O	O
Spatial Decomposition	R	R
Properties for Occurrences	O	O
Quantity Sets	O	O

## IfcSite

Concept	Facility Criteria	Discipline Specifications
Properties for Occurrences	O	O
Spatial Decomposition	O	O
Spatial Composition	O	O

## IfcSpace

Concept	Facility Criteria	Discipline Specifications
Identity	R	R
Descriptions	O	R
Spatial Naming	R	R
Object Typing	O	O
Classification	O	O
Properties for Occurrences	R	R
Properties on Occurrences	O	R
Spatial Decomposition	O	O
FootPrint GeomSet Geometry	O	O
Body SweptSolid Geometry	O	O
Assigned Control		O
Tabular Constraints		O

## IfcSpaceType

Concept	Facility Criteria	Discipline Specifications
Identity		O
Properties for Types		O
Tabular Constraints		O

## IfcZone

Concept	Facility Criteria	Discipline Specifications
Identity	O	R
Properties for Occurrences	O	R

## IfcOccupant

Concept	Facility Criteria	Discipline Specifications
Identity		R
Actor Assignment		O

### 4.6.6.3 (not used)

#### 4.6.6.3.1 Concept list

Each concept used within this model view is listed as follows.

- Identity
- Project Classification Information
- Spatial Decomposition
- Descriptions
- Project Declaration

- Calendar
- Control Assignment
- Assigned Actor
- Spatial Naming
- Classification
- Properties for Occurrences
- Quantity Sets
- Properties on Occurrences
- Spatial Composition
- Object Typing
- FootPrint GeomSet Geometry
- Body SweptSolid Geometry
- Assigned Control
- Tabular Constraints
- Properties for Types
- Actor Assignment

#### 4.6.6.3.2 Related existing concept list

In the following table, each row corresponds to a concept used within this model view, each column corresponds to another model view, and each cell indicates usage of the concept within the corresponding model view.

Concept	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
Identity	X	X	X	X	X	X	X
Project Classification Information	X		X				
Spatial Decomposition	X		X	X	X	X	X
Descriptions			X		X	X	X
Project Declaration	X	X	X	X	X	X	X
Calendar			X			X	X

Concept	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
Control Assignment	X	X	X	X		X	X
Assigned Actor			X				
Spatial Naming			X				
Classification	X	X	X	X	X	X	X
Properties for Occurrences	X	X	X	X		X	X
Quantity Sets	X		X				X
Properties on Occurrences			X				
Spatial Composition	X	X	X				
Object Typing	X	X	X	X	X	X	X
FootPrint GeomSet Geometry	X		X				
Body SweptSolid Geometry	X		X				
Assigned Control			X				
Tabular Constraints			X				
Properties for Types		X	X	X		X	X
Actor Assignment	X		X			X	X

#### 4.6.6.3.3 (not used)

#### 4.6.6.3.4 Concept business rule list

Each concept template is defined in a subsection as follows, with rows corresponding to each business rule. The *Reference* column identifies the path to the entity and attribute. The *Cardinality* column indicates whether the number of permitted instances is restricted differently than the underlying schema, using [N:M] notation where N indicates the minimum number of instances, M indicates the maximum number of instances, where '?' indicates unbounded. The *Parameter* column indicates the name of a substitutable parameter, if applicable, defined at each usage of the business rule.

#### Identity

Reference	Cardinality	Parameter
\IfcRoot.GlobalId		
\IfcRoot.GlobalId\IfcGloballyUniqueId		

Reference	Cardinality	Parameter
\IfcRoot.Name		
\IfcRoot.Name\IfcLabel		
\IfcRoot.Description		
\IfcRoot.Description\IfcText		

## Project Classification Information

Reference	Cardinality	Parameter
\IfcContext.HasAssociations		
\IfcContext.HasAssociations\IfcRelAssociatesClassification		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.HasReferences		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.HasReferences\IfcClassificationReference		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.Identification		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.Identification\IfcIdentifier		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.Name		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.HasReferences\IfcClassificationReference.Name\IfcLabel		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.Source		Source
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.Source\IfcLabel		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.Name		Name
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.Name\IfcLabel		
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.ReferenceTokens		ReferenceTokens
\IfcContext.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassification.ReferenceTokens\IfcIdentifier		

## Spatial Decomposition

Reference	Cardinality	Parameter
\IfcObjectDefinition.IsDecomposedBy		
\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates		
\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates.RelatedObjects		Spatial Parts

\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates.RelatedObjects\IfcSpatialElement		
---	--	--

## Descriptions

Reference	Cardinality	Parameter
\IfcRoot.Description		
\IfcRoot.Description\IfcText		

## Project Declaration

Reference	Cardinality	Parameter
\IfcContext.Declares		
\IfcContext.Declares\IfcRelDeclares		
\IfcContext.Declares\IfcRelDeclares.RelatedDefinitions		Type
\IfcContext.Declares\IfcRelDeclares.RelatedDefinitions\IfcObjectDefinition		

## Calendar

Reference	Cardinality	Parameter
\IfcWorkCalendar.WorkingTimes		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.RecurrenceType		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.RecurrenceType\IfcRecurrenceTypeEnum		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods\IfcTimePeriod		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods\IfcTimePeriod.StartTime		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods\IfcTimePeriod.StartTime\IfcTime		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods\IfcTimePeriod.EndTime		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.RecurrencePattern\IfcRecurrencePattern.TimePeriods\IfcTimePeriod.EndTime\IfcTime		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.Start		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.Start\IfcDate		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.Finish		
\IfcWorkCalendar.WorkingTimes\IfcWorkTime.Finish\IfcDate		

## Control Assignment

Reference	Cardinality	Parameter
-----------	-------------	-----------



\IfcControl.Controls		
\IfcControl.Controls\IfcRelAssignsToControl		
\IfcControl.Controls\IfcRelAssignsToControl.RelatedObjects		Type
\IfcControl.Controls\IfcRelAssignsToControl.RelatedObjects\IfcObject		

## Assigned Actor

Reference	Cardinality	Parameter
\IfcObject.HasAssignments		
\IfcObject.HasAssignments\IfcRelAssignsToActor		
\IfcObject.HasAssignments\IfcRelAssignsToActor.RelatingActor		Type
\IfcObject.HasAssignments\IfcRelAssignsToActor.RelatingActor\IfcActor		

## Spatial Naming

Reference	Cardinality	Parameter
\IfcSpatialElement.LongName		
\IfcSpatialElement.LongName\IfcLabel		

## Classification

Reference	Cardinality	Parameter
\IfcObjectDefinition.HasAssociations		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.Identification		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.Identification\IfcIdentifier		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.Source		Source
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.Source\IfcLabel		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.Name		Name
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.Name\IfcLabel		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.ReferenceTokens		Tokens

\IfcObjectDefinition.HasAssociations\IfcRelAssociatesClassification.RelatingClassification\IfcClassificationReference.ReferencedSource\IfcClassification.ReferenceTokens\IfcIdentifier		
--	--	--

## Properties for Occurrences

Reference	Cardinality	Parameter
\IfcObject.PredefinedType		PredefinedType
\IfcObject.IsDefinedBy		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.Name		Name
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcProperty		

## Quantity Sets

Reference	Cardinality	Parameter
\IfcObject.IsDefinedBy		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcElementQuantity		

## Properties on Occurrences

Reference	Cardinality	Parameter
\IfcObject.IsDefinedBy		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.Name		Pset
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.Name\IfcLabel		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertySingleValue		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertySingleValue.Name		Property
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertySingleValue.Name\IfcIdentifier		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertySingleValue.NominalValue		Type
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio		

Reference	Cardinality	Parameter
ns		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.ObjectiveQualifier		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.ObjectiveQualifier\IfcObjectiveEnum		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.ValueSource		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.ValueSource\Ifc Label		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.DataValue		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.DataValue\IfcM etricValueSelect		
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.ReferencePath		ReferencePa th
\IfcObject.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasAssociatio ns\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.ReferencePath\ IfcReference		

## Spatial Composition

Reference	Cardinality	Parameter
\IfcSpatialElement.Decomposes		
\IfcSpatialElement.Decomposes\IfcRelAggregates		
\IfcSpatialElement.Decomposes\IfcRelAggregates.RelatingObject		Spatial Composite
\IfcSpatialElement.Decomposes\IfcRelAggregates.RelatingObject\IfcSpatialElement		

## Object Typing

Reference	Cardinality	Parameter
\IfcObject.IsTypedBy		
\IfcObject.IsTypedBy\IfcRelDefinesByType		
\IfcObject.IsTypedBy\IfcRelDefinesByType.RelatingType		Type
\IfcObject.IsTypedBy\IfcRelDefinesByType.RelatingType\IfcTypeObject		

## FootPrint GeomSet Geometry

Reference	Cardinality	Parameter
\IfcProduct.Representation		
\IfcProduct.Representation\IfcProductDefinitionShape		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier	[1:1]	Identifier
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems\IfcGeometricRepresentationContext		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		Type
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Items
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet		

## Body SweptSolid Geometry

Reference	Cardinality	Parameter
\IfcElement.Representation		
\IfcElement.Representation\IfcProductDefinitionShape		
\IfcElement.Representation\IfcProductDefinitionShape.Representations		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems\IfcGeometricRepresentationContext		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier	[1:1]	Identifier
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Body		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		Type
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Items
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcExtrudedAreaSolid		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcRevolvedAreaSolid		

## Assigned Control

Reference	Cardinality	Parameter
\IfcObject.HasAssignments		
\IfcObject.HasAssignments\IfcRelAssignsToControl		
\IfcObject.HasAssignments\IfcRelAssignsToControl.RelatingControl		Type
\IfcObject.HasAssignments\IfcRelAssignsToControl.RelatingControl\IfcControl		

## Tabular Constraints

Reference	Cardinality	Parameter
\IfcObjectDefinition.HasAssociations		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.Benchmark		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.Benchmark\IfcBenchmarkEnum		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.Identifier		Identifier
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.Identifier\IfcIdentifier		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath		ReferencePath
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference.TypeIdentifier		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.Benchmark Values\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference.AttributeIdentifier		

\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference.InstanceName		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference.ListPositions		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.RelatingConstraint\IfcObjective.BenchmarkValues\IfcMetric.DataValue\IfcTable.Columns\IfcTableColumn.ReferencePath\IfcReference.InnerReference		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.Name		
\IfcObjectDefinition.HasAssociations\IfcRelAssociatesConstraint.Name\IfcLabel		

## Properties for Types

Reference	Cardinality	Parameter
\IfcTypeObject.HasPropertySets		
\IfcTypeObject.HasPropertySets\IfcPropertySet		
\IfcTypeObject.HasPropertySets\IfcPropertySet.Name		Name
\IfcTypeObject.HasPropertySets\IfcPropertySet.Name\IfcLabel		
\IfcTypeObject.HasPropertySets\IfcPropertySet.HasProperties		
\IfcTypeObject.HasPropertySets\IfcPropertySet.HasProperties\IfcProperty		

## Actor Assignment

Reference	Cardinality	Parameter
\IfcActor.IsActingUpon		
\IfcActor.IsActingUpon\IfcRelAssignsToActor		
\IfcActor.IsActingUpon\IfcRelAssignsToActor.RelatedObjects		Type
\IfcActor.IsActingUpon\IfcRelAssignsToActor.RelatedObjects\IfcControl		

### 4.6.6.3.5 Concept business rule description

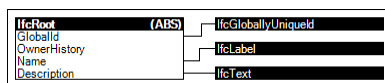
Each concept template is described in a subsection as follows, with diagrams indicating usage of attributes and entities reflecting defined business rules.

## Identity

An object needs to be identifiable for accurate processing by both human and automated processes. Identification may be through several attributes such as Identification, Name, or GUID. The GUID is compressed for the purpose of being exchanged within an IFC data set - the compressed GUID is referred to as "IFC-GUID". While the IFC-GUID is normally generated automatically and has to be persistent, the Identification may relate to other informal registers but should be unique within the set of objects of the same type. The Name and Description should allow any object to be identified in the context of the project or facility being modelled.

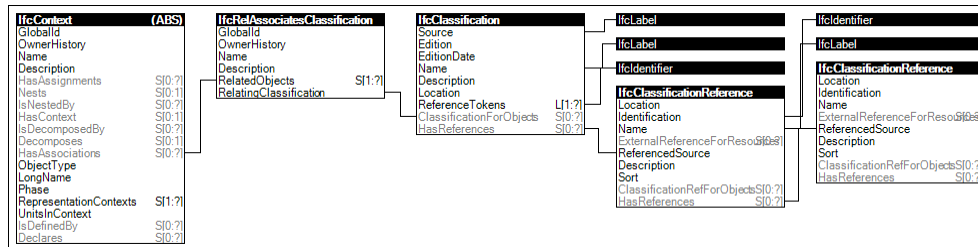
Various objects may have additional identifications that may be human-readable and/or may be structured through classification association.

Various file formats may use additional identifications of instances for serialization purposes, however there is no requirement or guarantee for such identifications to remain the same between revisions or across applications. For example, the IFC-SPF file format lists each instance with a 64-bit integer that is unique within the particular file.



## Project Classification Information

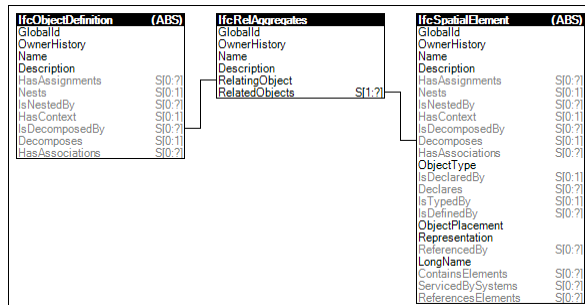
Projects may define classification structures, which may be used to classify objects contained within the same project, or other referencing projects (incorporating the current project as *IfcProjectLibrary*).



## Spatial Decomposition

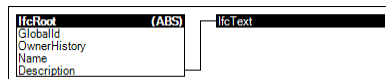
Provision of a spatial structure of the project by aggregating spatial structure elements. The spatial structure is a hierarchical tree of spatial structure elements (site, building, storey, space) ultimately assigned to the project. Decomposition refers to the relationship to lower level elements (e.g. this storey has spaces).

The order of spatial structure elements being included in the concept are from high to low level: *IfcProject*, *IfcSite*, *IfcBuilding*, *IfcBuildingStorey*, *IfcSpace*. Therefore an spatial structure element can only have parts of an element at the same or lower level.



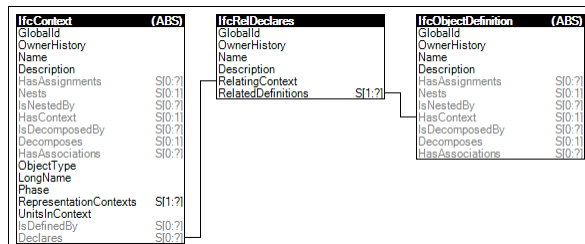
## Descriptions

Objects may have descriptions included to aid in human identification of the object.



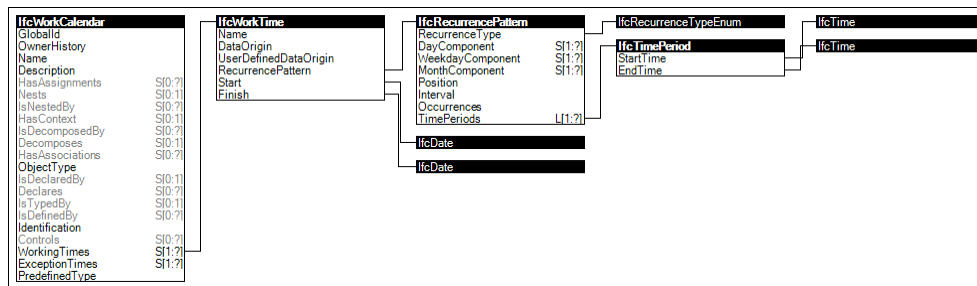
## Project Declaration

The project provides a directory of objects contained within using declaration relationships.



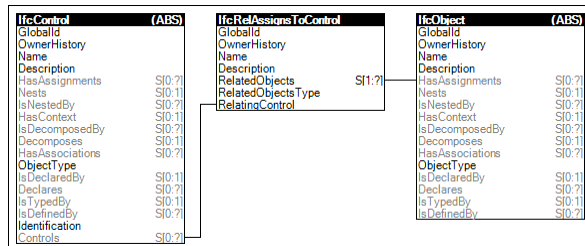
## Calendar

Calendar information is used to filter other objects to indicate time periods during which the control applies.



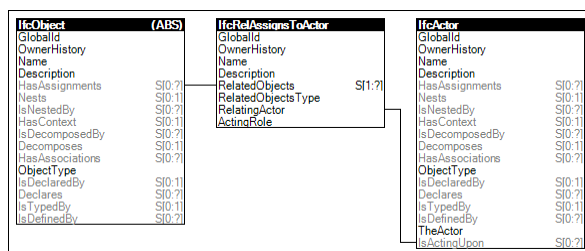
## Control Assignment

Controls may have assignments indicating objects that must observe the established requirements. An example of such assignment is a labor resource assigned to a calendar.



## Assigned Actor

Objects may be assigned to actors indicating the actor demands services of the object. Specific semantics are defined at concepts.



## Spatial Naming

Spatial elements may have both identifier-based names and descriptive names, each of which should correspond with building signage.

For spatial elements, the *Name* attribute is intended to be unique and indexable within a building for purposes of identifying by location. This attribute typically corresponding to a room number, floor number, or building number.

For spatial elements, the *LongName* attribute is intended to be descriptive of function, such as 'Small Conference Room'.



IfcSpatialElement (ABS)	IfcLabel
GlobalId	
OwnerHistory	
Name	
Description	
HasAssignments	S10..71
Nests	S10..11
IsNestedBy	S10..71
HasContext	S10..11
IsDecomposedBy	S10..71
Decomposes	S10..11
HasAssociations	S10..71
ObjectType	
IsDeclaredBy	S10..11
Declares	S10..71
IsTypedBy	S10..11
IsDefinedBy	S10..71
ObjectPlacement	
Representation	
ReferencedBy	S10..71
LongName	
ContainsElements	S10..71
ServedBySystems	S10..71
ReferencesElements	S10..71

## Classification

Objects, type objects, properties, and some resource schema entities can be further described by associating references to external sources of information. The source of information can be:

- a classification system;
- a dictionary server;
- any external catalogue that classifies the object further;
- a service that combine the above features.

An individual item within the external source of information can be selected. It then applies the inherent meaning of the item to the object or property.

IfcObjectDefinition (ABS)	IfcRelAssociatesClassification	IfcClassificationReference	IfcIdentifier	IfcLabel
GlobalId	GlobalId	Location	IfcClassification	IfcLabel
OwnerHistory	OwnerHistory	Identification	Source	IfcLabel
Name	Name	ExternalReferenceForResources	Edition	IfcIdentifier
Description	Description	ReferencedSource	EditionDate	
HasAssignments	RelatedObjects	Description	Name	
Nests	RelatingClassification	Sort	Description	
IsNestedBy		ClassificationRefForObjects	Location	
HasContext		HasReferences	ReferenceTokens	
IsDecomposedBy			ClassificationForObjects	
Decomposes			HasReferences	
HasAssociations				

## Properties for Occurrences

Any specialization of *object* can be related to multiple *property set occurrences*. A property set contains multiple *property occurrences*. The data types of property occurrences are single value, enumerated value, bounded value, table value, reference value, list value, and combination of property occurrences.

IfcObject (ABS)	IfcRelDefinesByProperties	IfcPropertySet	IfcProperty (ABS)
GlobalId	GlobalId	GlobalId	HasExternalReferences
OwnerHistory	OwnerHistory	OwnerHistory	S10..71
Name	Name	Name	Name
Description	Description	Description	Description
HasAssignments	RelatedObjects	HasContext	PartOfPset
Nests	RelatingPropertyDefinition	HasAssociations	PropertyForDependence
IsNestedBy		Defines Type	Property Depends On
HasContext		IsDefinedBy	PartOfComplex
IsDecomposedBy		Defines Occurrence	
Decomposes		HasProperties	
HasAssociations			
ObjectType			
IsDeclaredBy			
Declares			
IsTypedBy			
IsDefinedBy			

## Quantity Sets

Any specialization of *object* can be related to multiple *quantity set occurrences*. A quantity set contains multiple *quantity occurrences*. The data type of quantity occurrence are count, length, area, volume, weight, time, and combination of quantity occurrences.

IfcObject (ABS)	IfcRelDefinesByProperties	IfcElementQuantity
GlobalId	GlobalId	GlobalId
OwnerHistory	OwnerHistory	OwnerHistory
Name	Name	Name
Description	Description	Description
HasAssignments	RelatedObjects	HasContext
Nests	RelatingPropertyDefinition	HasAssociations
IsNestedBy		Defines Type
HasContext		IsDefinedBy
IsDecomposedBy		Defines Occurrence
Decomposes		MethodOfMeasurement
HasAssociations		Quantities
ObjectType		
IsDeclaredBy		
Declares		
IsTypedBy		
IsDefinedBy		

## Properties on Occurrences

Properties on occurrences may be required to be present for specific information exchanges.

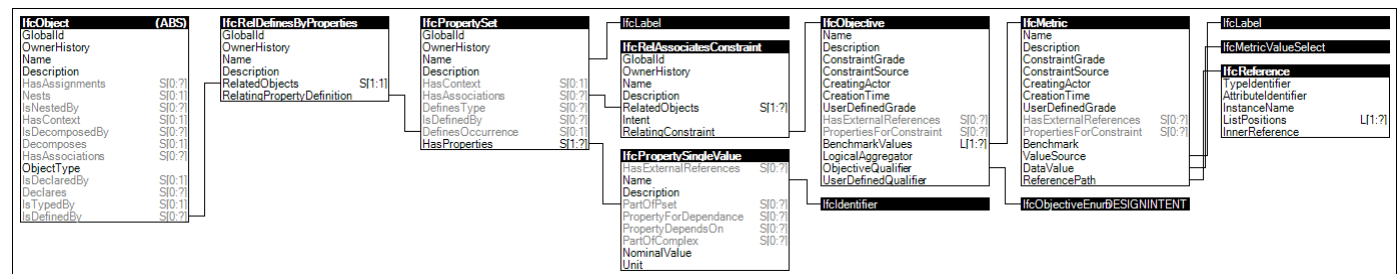
Constraints may be attached to property sets to enforce conformance of the building model to indicated values. The associated *IfcObjective* has its type set to DESIGNINTENT to indicate that any nonconforming value should be flagged accordingly but not necessarily automatically updated as is done for other types such as PARAMETRIC. The *IfcObjective* contains one or more *IfcMetric* items corresponding to each *IfcProperty* that is constrained, where *IfcMetric.ValueSource* corresponds to *IfcProperty.Name*. The *IfcMetric.ReferencePath* identifies the attribute on related objects (*IfcRelDefinesByProperties.RelatedObjects*) that is to be checked, where the reference path is relative to the associated object, in this case the *IfcPropertySet*.

Within this document, attribute paths (as used for *IfcReference*) are encoded using syntax in the form 'IfcSpace.OwnerHistory\IfcOwnerHistory.CreationDate' with the following conventions:

- The period character (".") dereferences an attribute from an entity.
- The back slash character ("\") casts an entity into a subtype, where a backslash without a subtype indicates mapping to the type itself.
- The forward slash character ("/") filters an entity according to its PredefinedType.
- A bracket sequence with an asterisk ("[\*]") dereferences a collection into each member.
- A bracket sequence with an encoded string (e.g. "[\"\"\"\"SerialNumber\"]") dereferences a collection into a specific member by name.

Constrained values are interpreted as follows:

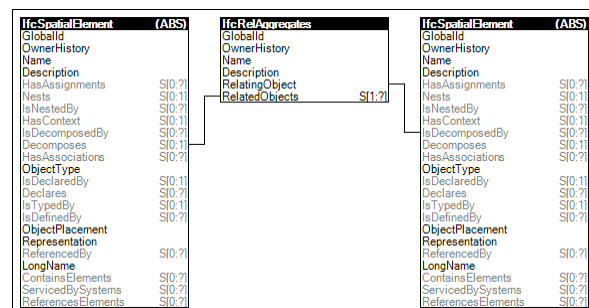
- *IfcBoolean*: checks for the presence of one or more matching elements, where True indicates one or more exist, and False indicates none exist.
- *IfcInteger*: checks for the count of elements, where the number indicates the quantity of matching elements found.
- *IfcValue*: for all other value types such as labels or measure values, checks for matching value.



## Spatial Composition

Provision of a spatial structure of the project by aggregating spatial structure elements. The spatial structure is a hierarchical tree of spatial structure elements (site, building, storey, space) ultimately assigned to the project. Composition refers to the relationship to a higher level element (e.g. this storey is part of a building).

The order of spatial structure elements being included in the concept are from high to low level: *IfcProject*, *IfcSite*, *IfcBuilding*, *IfcBuildingStorey*, *IfcSpace*. Therefore an spatial structure element can only be part of an element at the same or higher level.



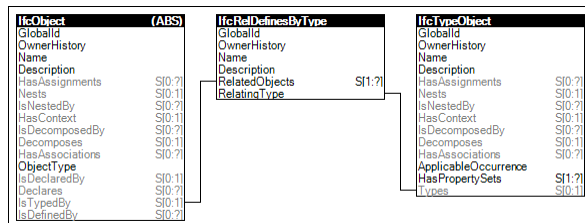
## Object Typing

*Object Occurrences* may be defined by a particular *Object Type*, where such type describes common characteristics. Such characteristics include common properties, shapes, materials, composition, and other concepts described at particular entities. An object occurrence may have similar state as its object type, overridden state for particular characteristics, or have no defined type object.

A pair of *entities* are defined for various object occurrences and object types, where such object occurrence entity may only be defined using a particular object type entity. For example, the *IfcTank* occurrence object entity has a corresponding *IfcTankType* type object entity.

Many object occurrence and object type entities have an *attribute* named *PredefinedType* consisting of a specific *enumeration*. Such predefined type essentially provides another level of inheritance to further differentiate objects without the need for additional *entities*. Predefined types are not just informational; various rules apply such as applicable *property sets*, part composition, and distribution ports.

For scenarios of object types having part compositions, such parts may be reflected at object occurrences having separate state. For example, a *wall type* may define a particular arrangement of studs, a *wall occurrence* may reflect the same arrangement of studs, and studs within the wall occurrence may participate in specific relationships that do not exist at the type such as being connected to an electrical junction box.

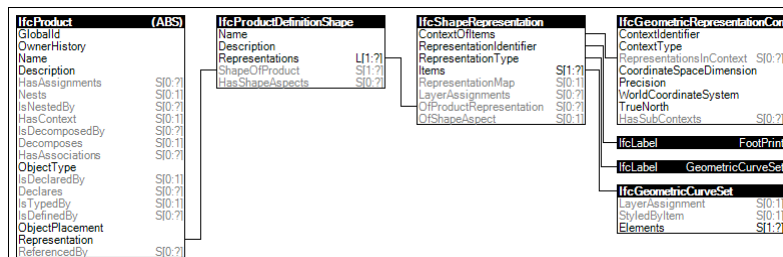


## FootPrint GeomSet Geometry

The 'FootPrint GeomSet Geometry' is the standard representation for the floor plan projection of the geometric representation of elements, comprising of mainly 2D curves

The following attribute values for the *IfcShapeRepresentation* holding this geometric representation are used:

- *IfcShapeRepresentation.RepresentationIdentifier* : 'FootPrint'
- *IfcShapeRepresentation.RepresentationType* : 'GeometricCurveSet'
- *IfcShapeRepresentation.Items* : *IfcGeometricCurveSet*

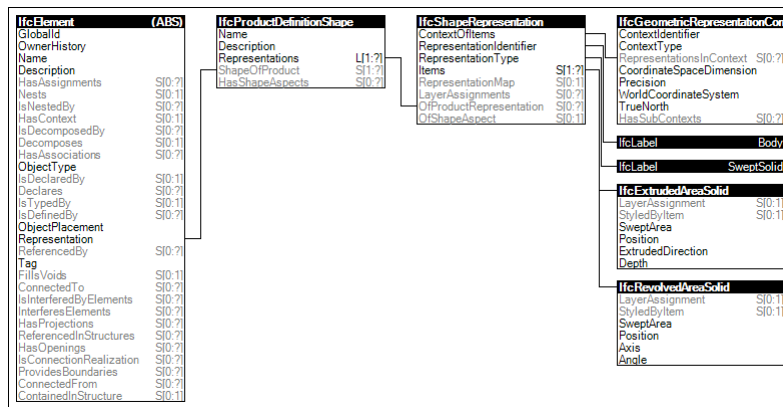


## Body SweptSolid Geometry

The *Body SweptSolid Geometry* is the representation of the 3D shape of a product by swept solid models, only allowing for the basic extruded area solids and revolved area solids.

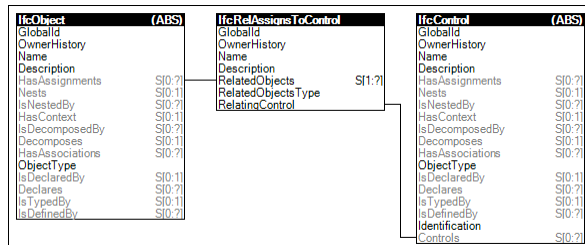
The following attribute values for the *IfcShapeRepresentation* holding this geometric representation shall be used:

- *IfcShapeRepresentation.RepresentationIdentifier* = 'Body'
- *IfcShapeRepresentation.RepresentationType* = 'SweptSolid'
- *IfcShapeRepresentation.Items* = *IfcExtrudedAreaSolid*, *IfcRevolvedAreaSolid*



## Assigned Control

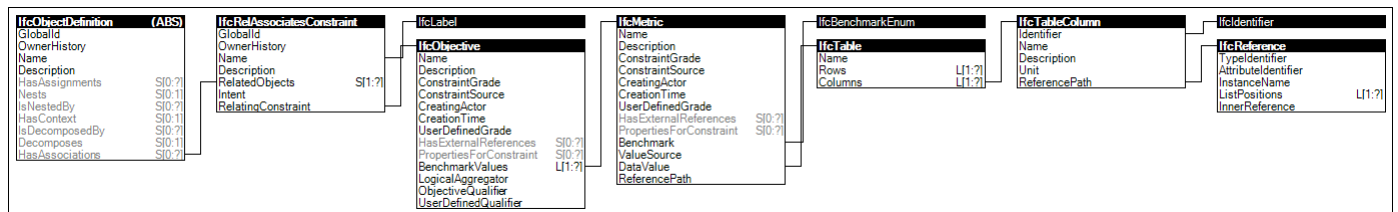
Objects may be assigned to controls indicating the control demands services of the object. Specific semantics are defined at concepts.



## Tabular Constraints

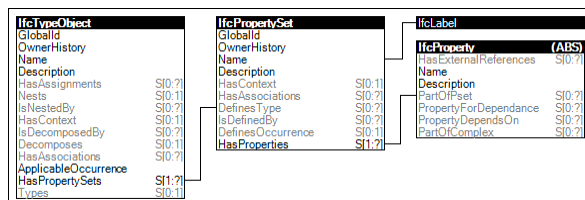
This template enables a tabular representation of items that may be used to validate the building model and/or automatically generate requirement elements within the building model.

Tables may be used for various scenarios, such as available configurations of product types, equipment schedules, and mappings to tabular data formats.



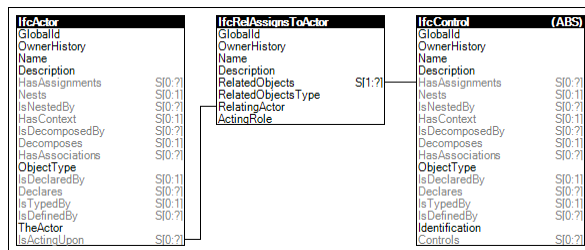
## Properties for Types

For object types, property sets are defined directly.



## Actor Assignment

Actors may have assignments indicating objects for which they have responsibility. An example of such assignment is a work order assigned to an organization.



#### 4.6.6.4 (not used)

##### 4.6.6.4.1 MVD schema listing

The schema encapsulating the data definitions for this model view is published in multiple representations.

An MVDXML file defines the referenced entities and rules for this model view. This file may be used to validate instance data (in IFC-SPF or IFC-XML files), filter instance data to include entities and attributes within scope of this model view, or generate sub-schemas (including the EXP and XSD representations).

An EXP file represents the schema in EXPRESS format (ISO 10303-11) which adapts the referenced Industry Foundation Classes schema (ISO 16739) by including a subset of data definitions and a subset of attributes within each data definition. The EXP file may be used by software development tools for generating programming languages schemas (e.g. C++, C#, Java), database definitions (e.g. SQL DDL), and data transport schema definitions (e.g. XSD).

An XSD file represents the schema in XML Data Definition Language (XSD) which adapts the referenced subset of data definitions. The XSD file may be used by software development tools (e.g. Eclipse, Microsoft Visual Studio) to validate XML files and generate language-specific classes.

An IFC file represents the dynamic portions of the schema in the form of property sets within an SPF (ISO 10303-21) instance file.

The rationale for publishing multiple representations is to provide the richest level of integration for different implementations; while XSD is often used in defining web standards replacing document-based exchanges (e.g. invoices), it lacks data model information needed for type safety, data integrity, indexing, and optimization; all of which may be derived from the EXPRESS representation.

File	Format
BPie.exp	EXPRESS schema definition
BPie.xsd	XML schema definition (XSD)
BPie.mvdxml	MVDXML schema transform
BPie.ifc	IFC dynamic schema definition

##### 4.6.6.4.2 MVD format description

Implementations of this model view may publish instance data in various formats. Such format indicates the data encoding and does not necessarily imply that data may only be exchanged using physical files on computers; formats may be transmitted over the Internet as the “presentation layer” (OSI Layer 6) of

any API. As the IFC data model supports both full and partial data models where all objects can be tagged to indicate merge directives (Create/Update/Delete using `IfcOwnerHistory.ChangeAction`), data may be transmitted in whole or in part, such as indicating only data changes.

As other OSI layers are already standardized, a full web API may be defined by referencing each layer as follows:

OSI Layer	OSI Layer Name	Protocol	Description
7	Application	WebDav	Defines valid operations such as GET, PUT, POST, DELETE, MKCOL, LOCK, UNLOCK
6	Presentation	IFC-SPF/IFC-XML	Defines data encoding
5	Session	HTTP/HTTPS	Defines establishment of sessions, compression, authentication, requests, responses, and errors
4	Transport	TCP	Defines message delivery
3	Network	IP	Defines network paths across multiple nodes
2	Data Link	MAC	Defines data frame communications between two nodes
1	Physical	(undefined)	Defines physical connectivity

Each supported format is listed by name, with Extension indicating the default file extension to use on applicable platforms (e.g. Windows), MIME type for indicating the HTTP header when transmitting over the Internet, and Reference standard indicating the presentation layer encoding format.

Format	Extension	MIME	Reference
IFC-SPF	.ifc	application/step	ISO 10303-21
IFC-XML	.ifcxml	application/xml	ISO 10303-28

IFC-SPF (ISO 10303-21) is a text format optimized to carry data with complex relationships, supporting human readability yet more compact representation (typically around 10% of size of equivalent XML).

IFC-HDF (ISO 10303-26) is a binary file format encapsulating data in a compact, indexable encoding optimized for quick retrieval and minimal memory usage.

NOTE As this file type is not yet widely implemented, it is not officially part of this model view, however implementations may prefer such format for internal use.

IFC-XML (ISO 10303-28) is a hierarchical markup format with wide support from software development tools and platforms, supporting greater human readability at the expense of larger representation.

NOTE As typical buildings contain millions of elements with graphs of relationships resulting in gigabytes of data, XML is not yet suitable for representing complete buildings from a pragmatic standpoint of data size, transmission cost, and loading time. However, using derived formats along with MVDXML to filter data sets may enable more efficient exchanges to take place.

IFC-ZIP (ISO 21320-1) is a compressed file format encapsulating one of the above formats to minimize data size.

NOTE As this model view is primarily intended for web-based exchange, zip compression may be selected by other means according to the client and server; therefore, the IFC-ZIP format is not officially part of this model view.

#### 4.6.6.4.3 MVD dynamic schema analysis

Portions of data definitions are defined dynamically, to allow software applications to support extensible definitions while minimizing implementation overhead. Each property set is shown within a subsection as follows, with rows corresponding to properties. See *IfcPropertySet* for usage information.

#### Pset\_BuildingCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'). Used to store the non-classification driven internal project type.
BuildingID	P_SINGLEVALUE	IfcIdentifier	A unique identifier assigned to a building. A temporary identifier is initially assigned at the time of making a planning application. This temporary identifier is changed to a permanent identifier when the building is registered into a statutory buildings and properties database.
IsPermanentID	P_SINGLEVALUE	IfcBoolean	Indicates whether the identity assigned to a building is permanent (= TRUE) or temporary (=FALSE).
ConstructionMethod	P_SINGLEVALUE	IfcLabel	The type of construction action to the building, the project deals with, e.g. new construction, renovation, refurbishment, etc.
FireProtectionClass	P_SINGLEVALUE	IfcLabel	Main fire protection class for the building which is assigned from the fire protection classification table as given by the relevant national building code.
SprinklerProtection	P_SINGLEVALUE	IfcBoolean	Indication whether this object is sprinkler protected (TRUE) or not (FALSE).
SprinklerProtectionAutomatic	P_SINGLEVALUE	IfcBoolean	Indication whether this object has an automatic sprinkler protection (TRUE) or not (FALSE).
OccupancyType	P_SINGLEVALUE	IfcLabel	Occupancy type for this object. It is defined according to the presiding national building code.
GrossPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned gross area for the building Used for programming the building.
NetPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned net area for the building Used for programming the building.
NumberOfStoreys	P_SINGLEVALUE	IfcInteger	The number of storeys within a building. Captured for those cases where the IfcBuildingStorey entity is not used. Note that if IfcBuildingStorey is asserted and the number of storeys in a building can be determined from it, then this approach should be used in preference to setting a property for the number of storeys.
YearOfConstruction	P_SINGLEVALUE	IfcLabel	Year of construction of this building, including expected year of completion.
YearOfLastRefurbishment	P_SINGLEVALUE	IfcLabel	Year of last major refurbishment, or reconstruction, of the building (applies to reconstruction works).
IsLandmarked	P_SINGLEVALUE	IfcLogical	This building is listed as a historic building (TRUE), or not (FALSE), or unknown.

#### Pset\_BuildingStoreyCommon

Property	Property Type	Data Type	Description
----------	---------------	-----------	-------------

Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'). Used to store the non-classification driven internal project type.
EntranceLevel	P_SINGLEVALUE	IfcBoolean	Indication whether this building storey is an entrance level to the building (TRUE), or (FALSE) if otherwise.
AboveGround	P_SINGLEVALUE	IfcLogical	Indication whether this building storey is fully above ground (TRUE), or below ground (FALSE), or partially above and below ground (UNKNOWN) - as in sloped terrain.
SprinklerProtection	P_SINGLEVALUE	IfcBoolean	Indication whether this object is sprinkler protected (TRUE) or not (FALSE).
SprinklerProtectionAutomatic	P_SINGLEVALUE	IfcBoolean	Indication whether this object has an automatic sprinkler protection (TRUE) or not (FALSE). It should only be given, if the property "SprinklerProtection" is set to TRUE.
LoadBearingCapacity	P_SINGLEVALUE	IfcPlanarForceMeasure	Maximum load bearing capacity of the floor structure throughout the storey as designed.
GrossPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned area for the building storey. Used for programming the building storey.
NetPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned net area for the building storey. Used for programming the building storey.

### Pset\_SiteCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'). Used to store the non-classification driven internal project type.
BuildableArea	P_SINGLEVALUE	IfcAreaMeasure	The area of site utilization expressed as a maximum value according to local building codes.
SiteCoverageRatio	P_SINGLEVALUE	IfcPositiveRatioMeasure	The ratio of the utilization, TotalArea / BuildableArea, expressed as a maximum value. The ratio value may be used to derive BuildableArea.
FloorAreaRatio	P_SINGLEVALUE	IfcPositiveRatioMeasure	The ratio of all floor areas to the buildable area as the maximum floor area utilization of the site as a maximum value according to local building codes.
BuildingHeightLimit	P_SINGLEVALUE	IfcPositiveLengthMeasure	Allowed maximum height of buildings on this site - according to local building codes.
TotalArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned area for the site. Used for programming the site space.

### Pset\_SpaceCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'). Used to store the non-classification driven internal project type.
IsExternal	P_SINGLEVALUE	IfcBoolean	Indication whether the element is designed for use in the exterior (TRUE) or not (FALSE). If (TRUE) it is an external element and faces the outside of the building.
GrossPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned gross area for the space. Used for programming the space.
NetPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned net area for the space. Used for programming the space.
PubliclyAccessible	P_SINGLEVALUE	IfcBoolean	Indication whether this space (in case of e.g., a toilet) is designed to serve as a publicly accessible space, e.g., for a public toilet (TRUE) or not (FALSE).



HandicapAccessible	P_SINGLEVALUE	IfcBoolean	Indication whether this space (in case of e.g., a toilet) is designed to serve as an accessible space for handicapped people, e.g., for a public toilet (TRUE) or not (FALSE). This information is often used to declare the need for access for the disabled and for special design requirements of this space.
--------------------	---------------	------------	--

## Pset\_SpaceCoveringRequirements

Property	Property Type	Data Type	Description
FloorCovering	P_SINGLEVALUE	IfcLabel	Label to indicate the material or finish of the space flooring. The label is used for room book information and often displayed in room stamp. The material information is provided in absence of an IfcCovering (type=FLOORING) object with own shape representation and material assignment. In case of inconsistency the material assigned to IfcCovering elements takes precedence.
FloorCoveringThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	Thickness of the material layer(s) for the space flooring. The thickness information is provided in absence of an IfcCovering (type=FLOORING) object with own shape representation. In cases of inconsistency between the geometric parameters of an assigned IfcCovering and this attached property, the geometric parameters take precedence.
WallCovering	P_SINGLEVALUE	IfcLabel	Label to indicate the material or finish of the space flooring. The label is used for room book information and often displayed in room stamp. The material information is provided in absence of an IfcCovering (type=CLADDING) object with own shape representation and material assignment. In case of inconsistency the material assigned to IfcCovering elements takes precedence.
WallCoveringThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	Thickness of the material layer(s) for the space cladding. The thickness information is provided in absence of an IfcCovering (type=CLADDING) object with own shape representation. In cases of inconsistency between the geometric parameters of an assigned IfcCovering and this attached property, the geometric parameters take precedence.
CeilingCovering	P_SINGLEVALUE	IfcLabel	Label to indicate the material or finish of the space flooring. The label is used for room book information and often displayed in room stamp. The material information is provided in absence of an IfcCovering (type=CEILING) object with own shape representation and material assignment. In case of inconsistency the material assigned to IfcCovering elements takes precedence.
CeilingCoveringThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	Thickness of the material layer(s) for the space ceiling. The thickness information is provided in absence of an IfcCovering (type=CEILING) object with own shape representation. In cases of inconsistency between the geometric parameters of an assigned IfcCovering and this attached property, the geometric parameters take precedence.
SkirtingBoard	P_SINGLEVALUE	IfcLabel	Label to indicate the material or construction of the skirting board around the space flooring. The label is used for room book information. The material information is provided in absence of an IfcCovering (type=SKIRTINGBOARD) object with own shape representation and material assignment. In case of inconsistency the material assigned to IfcCovering elements takes precedence.
SkirtingBoardHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	Height of the skirting board. The height information is provided in absence of an IfcCovering (type=SKIRTINGBOARD) object with own shape

Property	Property Type	Data Type	Description
			representation and material assignment. In case of inconsistency the height assigned to IfcCovering elements takes precedence.
Molding	P_SINGLEVALUE	IfcLabel	Label to indicate the material or construction of the molding around the space ceiling. The label is used for room book information. The material information is provided in absence of an IfcCovering (type=MOLDING) object with own shape representation and material assignment. In case of inconsistency the material assigned to IfcCovering elements takes precedence.
MoldingHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	Height of the molding. The height information is provided in absence of an IfcCovering (type=MOLDING) object with own shape representation and material assignment. In case of inconsistency the height assigned to IfcCovering elements takes precedence.
ConcealedFlooring	P_SINGLEVALUE	IfcBoolean	Indication whether this space is designed to have a concealed flooring space (TRUE) or not (FALSE). A concealed flooring space is normally meant to be the space beneath a raised floor.
ConcealedCeiling	P_SINGLEVALUE	IfcBoolean	Indication whether this space is designed to have a concealed flooring space (TRUE) or not (FALSE). A concealed ceiling space is normally meant to be the space between a slab and a ceiling.

### Pset\_SpaceFireSafetyRequirements

Property	Property Type	Data Type	Description
FireRiskFactor	P_SINGLEVALUE	IfcLabel	Fire Risk factor assigned to the space according to local building regulations. It defines the fire risk of the space at several levels of fire hazard.
FlammableStorage	P_SINGLEVALUE	IfcBoolean	Indication whether the space is intended to serve as a storage of flammable material (which is regarded as such by the presiding building code. (TRUE) indicates yes, (FALSE) otherwise.
FireExit	P_SINGLEVALUE	IfcBoolean	Indication whether this object is designed to serve as an exit in the case of fire (TRUE) or not (FALSE). Here whether the space (in case of e.g., a corridor) is designed to serve as an exit space, e.g., for fire escape purposes.
SprinklerProtection	P_SINGLEVALUE	IfcBoolean	Indication whether the space is sprinkler protected (TRUE) or not (FALSE).
SprinklerProtectionAutomatic	P_SINGLEVALUE	IfcBoolean	Indication whether the space has an automatic sprinkler protection (TRUE) or not (FALSE). It should only be given, if the property "SprinklerProtection" is set to TRUE.
AirPressurization	P_SINGLEVALUE	IfcBoolean	Indication whether the space is required to have pressurized air (TRUE) or not (FALSE).

### Pset\_SpaceLightingRequirements

Property	Property Type	Data Type	Description
ArtificialLighting	P_SINGLEVALUE	IfcBoolean	Indication whether this space requires artificial lighting (as natural lighting would be not sufficient). (TRUE) indicates yes (FALSE) otherwise.
Illuminance	P_SINGLEVALUE	IfcIlluminanceMeasure	Required average illuminance value for this space.

## Pset\_SpaceOccupancyRequirements

Property	Property Type	Data Type	Description
OccupancyType	P_SINGLEVALUE	IfcLabel	Occupancy type for this object. It is defined according to the presiding national building code.
OccupancyNumber	P_SINGLEVALUE	IfcCountMeasure	Number of people required for the activity assigned to this space.
OccupancyNumberPeak	P_SINGLEVALUE	IfcCountMeasure	Maximal number of people required for the activity assigned to this space in peak time.
OccupancyTimePerDay	P_SINGLEVALUE	IfcTimeMeasure	The amount of time during the day that the activity is required within this space.
AreaPerOccupant	P_SINGLEVALUE	IfcAreaMeasure	Design occupancy loading for this type of usage assigned to this space.
MinimumHeadroom	P_SINGLEVALUE	IfcLengthMeasure	Headroom required for the activity assigned to this space.
IsOutlookDesirable	P_SINGLEVALUE	IfcBoolean	An indication of whether the outlook is desirable (set TRUE) or not (set FALSE)

## Pset\_SpaceThermalRequirements

Property	Property Type	Data Type	Description
SpaceTemperature	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Temperature of the space or zone, that is required from user/designer view point. If no summer or winter space temperature requirements are given, it applies all year, otherwise for the intermediate period. Provide this value, if no temperature range (Min-Max) is available.
SpaceTemperatureMax	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Maximal temperature of the space or zone, that is required from user/designer view point. If no summer or winter space temperature requirements are given, it applies all year, otherwise for the intermediate period.
SpaceTemperatureMin	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Minimal temperature of the space or zone, that is required from user/designer view point. If no summer or winter space temperature requirements are given, it applies all year, otherwise for the intermediate period.
SpaceTemperatureSummerMax	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Maximal temperature of the space or zone for the hot (summer) period, that is required from user/designer view point and provided as requirement for cooling.
SpaceTemperatureSummerMin	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Minimal temperature of the space or zone for the hot (summer) period, that is required from user/designer view point and provided as requirement for cooling.
SpaceTemperatureWinterMax	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Maximal temperature of the space or zone for the cold (winter) period, that is required from user/designer view point and provided as requirement for heating.
SpaceTemperatureWinterMin	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Minimal temperature of the space or zone for the cold (winter) period, that

Property	Property Type	Data Type	Description
			is required from user/designer view point and provided as requirement for heating.
SpaceHumidity	P_SINGLEVALUE	IfcRatioMeasure	Humidity of the space or zone that is required from user/designer view point. If no summer or winter space humidity requirements are given, it applies all year, otherwise for the intermediate period. Provide this property, if no humidity range (Min-Max) is available.
SpaceHumidityMax	P_SINGLEVALUE	IfcRatioMeasure	Maximal permitted humidity of the space or zone that is required from user/designer view point. If no summer or winter space humidity requirements are given, it applies all year, otherwise for the intermediate period.
SpaceHumidityMin	P_SINGLEVALUE	IfcRatioMeasure	Minimal permitted humidity of the space or zone that is required from user/designer view point. If no summer or winter space humidity requirements are given, it applies all year, otherwise for the intermediate period.
SpaceHumiditySummer	P_SINGLEVALUE	IfcRatioMeasure	Humidity of the space or zone for the hot (summer) period, that is required from user/designer view point and provided as requirement for cooling.
SpaceHumidityWinter	P_SINGLEVALUE	IfcRatioMeasure	Humidity of the space or zone for the cold (winter) period that is required from user/designer view point and provided as requirement for heating.
DiscontinuedHeating	P_SINGLEVALUE	IfcBoolean	Indication whether discontinued heating is required/desirable from user/designer view point. (TRUE) if yes, (FALSE) otherwise.
NaturalVentilation	P_SINGLEVALUE	IfcBoolean	Indication whether the space is required to have natural ventilation (TRUE) or mechanical ventilation (FALSE).
NaturalVentilationRate	P_SINGLEVALUE	IfcCountMeasure	Indication of the requirement of a particular natural air ventilation rate, given in air changes per hour.
MechanicalVentilationRate	P_SINGLEVALUE	IfcCountMeasure	Indication of the requirement of a particular mechanical air ventilation rate, given in air changes per hour.
AirConditioning	P_SINGLEVALUE	IfcBoolean	Indication whether this space requires air conditioning provided (TRUE) or not (FALSE).
AirConditioningCentral	P_SINGLEVALUE	IfcBoolean	Indication whether the space requires a central air conditioning provided (TRUE) or not (FALSE). It should only be given, if the property "AirConditioning" is set to TRUE.

## Pset\_ZoneCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'). Used to store the non-classification driven internal project type.
IsExternal	P_SINGLEVALUE	IfcBoolean	Indication whether the element is designed for use in the exterior (TRUE) or not (FALSE). If (TRUE) it is an external zone at the outside of the building.
GrossPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned gross area for the zone. Used for programming the zone.
NetPlannedArea	P_SINGLEVALUE	IfcAreaMeasure	Total planned net area for the zone. Used for programming the zone.
PubliclyAccessible	P_SINGLEVALUE	IfcBoolean	Indication whether this space (in case of e.g., a toilet) is designed to serve as a publicly accessible space, e.g., for a public toilet (TRUE) or not (FALSE).
HandicapAccessible	P_SINGLEVALUE	IfcBoolean	Indication whether this space (in case of e.g., a toilet) is designed to serve as an accessible space for handicapped people, e.g., for a public toilet (TRUE) or not (FALSE). This information is often used to declare the need for access for the disabled and for special design requirements of this space.

### ePset\_SpaceDimensionalRequirements

Property	Property Type	Data Type	Description
MinimumPlenumHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	The plenum or air space between the suspended ceiling and the slab surface/deck above.
MinimumLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The minimum required length or width of the space
MinimumWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The minimum required width of the space

### ePset\_SpaceOccupancyRequirements

Property	Property Type	Data Type	Description
SharedUsage	P_SINGLEVALUE	IfcText	Describe the shared use of the space, if the space has different occupants
General	P_SINGLEVALUE	IfcText	Any verbal description of the Occupancy requirements from the client perspective
PermanentWorkSpace	P_SINGLEVALUE	IfcBoolean	The space is used as a permanent work space [TRUE] or not [FALSE]
HandicapAccessible	P_SINGLEVALUE	IfcBoolean	Stating if the room function must be handicap accessible.
OccupancySchedule	P_REFERENCEVALUE	IfcIrregularTimeSeries/IfcInteger	Indicates the number of people anticipated to occupy the space over a weekly period, starting on Monday and ending the following Sunday. If this space is assigned to an <i>IfcWorkCalendar</i> , then the scheduled occupants are governed by such calendar. NOTE: For mapping to WS-Calendar, this schedule property may map directly to the WS-Calendar 1.0 specification. The recurrence concepts of <i>IfcWorkCalendar</i> are not supported by WS-Calendar 1.0, however once such capability is available in a future version of WS-Calendar, then mappings are anticipated to be provided in a future edition of this model view.

### ePset\_SpaceStructuralRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Structural

			requirements from the client perspective
FloorLoad	P_SINGLEVALUE	IfcPlanarForceMeasure	Maximum load (e. g. through extra heavy equipment)
WallMountedEquipment	P_SINGLEVALUE	IfcBoolean	State if there is wall mounted equipment generating a load to the wall.
CeilingMountedEquipment	P_SINGLEVALUE	IfcBoolean	State if there is ceiling mounted equipment generating a load to the slab/deck above.
IncomingElectroMagneticProtection	P_SINGLEVALUE	IfcBoolean	Electromagnetic shielding of the space from outside EM sources
OutgoingElectroMagneticProtection	P_SINGLEVALUE	IfcBoolean	Electromagnetic shielding of outside spaces from EM sources inside the space
SuppressionIncomingVibration	P_SINGLEVALUE	IfcBoolean	Protection of space against vibration originating from source outside space
SuppressionOutgoingVibration	P_SINGLEVALUE	IfcBoolean	Protection of outside spaces against vibration originating from source inside the space

### ePset\_SpaceCoveringRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Covering requirements from the client perspective

### ePset\_SpaceDoorRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the door requirements from the client perspective
Material	P_REFERENCEVALUE	IfcMaterial/IfcMaterial:	Required or prohibited materials, with associated required minimum thickness
MinimumThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	Required or prohibited materials, with associated required minimum thickness
FireRating	P_SINGLEVALUE		Fire rating
MinimumWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Clear width (unobstructed clearance) for minimum one of the doors leading to the space. Unobstructed clearance refers to net inner dimensions of door frame.
MinimumHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	Clear height (unobstructed clearance) for minimum one of the doors leading to the space. Unobstructed clearance refers to net inner dimensions of door frame.
GlazedLight	P_SINGLEVALUE	IfcBoolean	Glazing within the door leaf
GlazedSideLight	P_SINGLEVALUE	IfcBoolean	Glazing within frame system, but adjacent to door
OperationType	P_SINGLEVALUE		Required operation type for doors required by the space function (swing door inwards, sliding door, revolving door, etc.)
LockingType	P_SINGLEVALUE	IfcBoolean	State if the doors to/from the space requires special locking types
Louvers	P_SINGLEVALUE	IfcBoolean	The space function requires louvers in the door(s)
TransitionThreshold	P_SINGLEVALUE	IfcBoolean	Lowered threshold or not
ContainmentThreshold	P_SINGLEVALUE	IfcPositiveLengthMeasure	Minimum height
AccessSystem	P_SINGLEVALUE	IfcBoolean	Access controlled door required, by means of magnetic stripe card reader, proximity reader, or some other means of controlled access through door.

DoorHolder	P_SINGLEVALUE	IfcBoolean	Door holders (part of fire alarm system) mounted on door/wall, for locking doors in normally open position.
------------	---------------	------------	---

### ePset\_SpaceWindowRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Window requirements from the client perspective
Openability	P_SINGLEVALUE	IfcBoolean	At least one of the windows in the outer wall(s) of the space permits manual opening/closing (e.g. a casement window or a sash window).
EmergencyEgress	P_SINGLEVALUE	IfcBoolean	Where required by code in residences
SillHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	
WindowControls	P_SINGLEVALUE		Manual or electronic operation
ThermalTransmittance	P_SINGLEVALUE	IfcThermalTransmittanceMeasure	Set the maximum heat transmission value according to local building codes

### ePset\_SpaceLightingRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Lighting requirements from the client perspective
DirectDaylight	P_SINGLEVALUE	IfcBoolean	If direct day lighting to the space (through glazing in outer wall etc) is required, or if indirect day lighting through mirror systems, fibre optic systems etc is also considered sufficient to fulfil requirement
ArtificialLighting	P_SINGLEVALUE	IfcBoolean	If artificial lighting to the space is not required.
LocalControlDaylightDensity	P_SINGLEVALUE	IfcBoolean	Control system for daylighting.
LocalControlArtificialLightDensity	P_SINGLEVALUE	IfcBoolean	Continuous adjustment/dimming of illumination level.
InternalShading	P_SINGLEVALUE	IfcBoolean	Various window blinds, shades, curtains, e.g. shutters, Venetian blinds, roller shades and curtain-like track blinds, enabling (a) limited darkening or (b) total darkening of the space from outside (sun) light.
Zoning	P_SINGLEVALUE	IfcBoolean	Separate lighting switch on/off function for individual zones in the space
ColorTemperature	P_SINGLEVALUE	IfcThermodynamicTemperatureMeasure	Color temperature of light source, expressed as Kelvin (K).
ColorRenderingIndex	P_SINGLEVALUE	IfcReal	The Color Rendering Index (CRI) is a measure of the ability of a light source to reproduce the colors of various objects being lit by the source
UnifiedGlareRating	P_SINGLEVALUE	IfcReal	Unified Glare Rating (UGR) tabular method according to CIE publication no. 117-1995.
Illuminance	P_SINGLEVALUE	IfcIlluminanceMeasure	Illuminance (illumination level), measured as Lux, according to CIE

Property	Property Type	Data Type	Description
			lux tables. local standards and recommendations.
SurfaceReflectance	P_SINGLEVALUE	IfcPositiveRatioMeasure	Reflectance values are critical in order to calculate lighting levels accurately.

### ePset\_SpaceThermalRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the thermal requirements from the client perspective
SpaceTemperatureWinter	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Acceptable temperatures during a defined winter period, that is required from a user/designer view point.
SpaceTemperatureSummer	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Acceptable temperatures during a defined summer period, that is required from a user/designer view point.
Zoning	P_SINGLEVALUE	IfcBoolean	Different thermal requirements for individual zones inside one space
LocalControlHeating	P_SINGLEVALUE	IfcBoolean	If space is temperature controlled from a centralized building automation system (BAS), the space can be controlled by the end user from a control switch or dial that locally overrides the BAS function within allowed temperature interval, e.g. +/- 3°C.
HeatingType	P_SINGLEVALUE		specific heating type required (e. g. floor heating)
CoolingType	P_SINGLEVALUE		specific cooling type required (e. g. cooling beam)
LocalControlVentilation	P_SINGLEVALUE	IfcBoolean	If space is ventilation controlled from a centralized building automation system (BAS), the space can be controlled by the end user from a control switch or dial that locally overrides the BAS function within allowed intervals.
VentilationGeneral	P_SINGLEVALUE	IfcText	Any verbal description of the Ventilation requirements from the client perspective
AirQualityGeneral	P_SINGLEVALUE	IfcText	Any verbal description of the Air quality requirements from the client perspective
MaxCO2Level	P_SINGLEVALUE	IfcMassDensityMeasure	

### ePset\_SpaceElectricalRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Electrical power supply requirements from the client perspective
OutletsMains	P_SINGLEVALUE	IfcInteger	Number of electrical power outlets (sockets)
OutletsBackup	P_SINGLEVALUE	IfcInteger	Number of electrical power outlets (sockets) in the space



			supplied from backup (interruptible for some seconds to a few minutes) generator power
OutletsUPS	P_SINGLEVALUE	IfcInteger	Number of electrical power outlets (sockets) in the space supplied from UPS (uninterruptible power supply) backup power
PermanentlyConnectedEquipment	P_LISTVALUE	IfcLabel	List of equipment to be permanently connected within the space.
CleanPower	P_SINGLEVALUE	IfcBoolean	Power filtering (ensure stable power frequency)

### ePset\_SpaceCommunicationsRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Telecommunication requirements from the client perspective
OutletsICT	P_SINGLEVALUE	IfcInteger	Number of outlets for normal Information and Communications Technology (ICT) supply in the space. Typically this is RJ-11 or RJ-45 outlets for copper cabling.
OutletsTelephone	P_SINGLEVALUE	IfcInteger	Number of outlets for traditional telephone supply in the space. Typically this is RJ-11 or RJ-45 outlets for copper cabling, the cabling often being lower rated than datacom cabling. IP-telephony within ICT solutions are not counted here.
WLANCoverate	P_SINGLEVALUE	IfcBoolean	WLAN coverage area
LocalSignaling	P_SINGLEVALUE	IfcBoolean	Local signaling requirements between spaces or functions that need separate cabling. Signaling type and affected spaces can be specified.
Fibers	P_SINGLEVALUE	IfcBoolean	In certain spaces connection speed and tolerance for disturbance require light fiber installations for telecommunication.

### ePset\_SpaceSensorRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Sensor requirements from the client perspective
Gas	P_SINGLEVALUE	IfcBoolean	State if there is a need for gas sensor
Temperature	P_SINGLEVALUE	IfcBoolean	State if there is a need for temperature sensor
AirPressure	P_SINGLEVALUE	IfcBoolean	State if there is a need for air pressure sensor
Radiation	P_SINGLEVALUE	IfcBoolean	State if there is a need for radiation sensor
Sound	P_SINGLEVALUE	IfcBoolean	State if there is a need for sound sensor
Humidity	P_SINGLEVALUE	IfcBoolean	State if there is a need for humidity sensor
CO2Sensor	P_SINGLEVALUE	IfcBoolean	State if there is a need for CO2 sensor
VentilationRate	P_SINGLEVALUE	IfcBoolean	State if there is a need for monitoring the ventilation rate in the room
SmokeDetection	P_SINGLEVALUE	IfcBoolean	State if there is a need for smoke detection sensor
SmokeDetectionType	P_SINGLEVALUE	IfcLabel	Define required type of smoke sensor
OccupancySensor	P_SINGLEVALUE	IfcBoolean	State if there is a need for occupancy sensor
RelatedAlarms	P_SINGLEVALUE	IfcText	Any verbal description for a combination of different alarms connected to sensors

### ePset\_SpaceSecurityRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Security requirements from the client perspective

CCTV	P_SINGLEVALUE	IfcBoolean	
ScreeningEquipment	P_SINGLEVALUE	IfcBoolean	
IntrusionDetection	P_SINGLEVALUE	IfcBoolean	
VehicularAccessControl	P_SINGLEVALUE	IfcBoolean	
ForcedEntryResistance	P_SINGLEVALUE	IfcBoolean	
BallisticResistance	P_SINGLEVALUE	IfcBoolean	
BlastResistance	P_SINGLEVALUE	IfcBoolean	
WindowGrilles	P_SINGLEVALUE	IfcBoolean	
ObjectSecurity	P_SINGLEVALUE	IfcBoolean	Object security in the space - protection against theft of valuable objects within the space.

### ePset\_SpaceEmergencyRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Emergency requirements from the client perspective
SOSTelephoneSupplies	P_SINGLEVALUE	IfcInteger	Number of emergency call supplies in the space. IP-based signaling within ICT solutions are not counted here
FireAlarmDescription	P_SINGLEVALUE	IfcText	Special fire alarm requirements (e.g. detector type or sensitivity) required in the space, beyond fire code, regulations etc.
FireExtinguisher	P_SINGLEVALUE	IfcText	Special fire extinguishing requirements (e.g. type) required in the space, beyond fire code, regulations etc.
MedicalSupplies	P_SINGLEVALUE	IfcBoolean	State if emergency medical supplies is required in the room
MassNotificationSystem	P_SINGLEVALUE	IfcBoolean	Ability to receive messages
DuressAlarm	P_SINGLEVALUE	IfcBoolean	

### ePset\_SpaceSignalingRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Signaling requirements from the client perspective
SignalingLamp	P_SINGLEVALUE	IfcBoolean	Office signaling (lamp) outside space entrance, indicating vacant or occupied space.
TrafficLights	P_SINGLEVALUE	IfcBoolean	Entrance call system
SynchronizedClocks	P_SINGLEVALUE	IfcBoolean	Number of (traditional) synchronized clock supplies in the space. IP-based time synchronization within ICT solutions are not counted here

### ePset\_SpaceAudioVisualRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Audiovisual requirements from the client perspective
MediaOutlets	P_SINGLEVALUE	IfcInteger	Number of (traditional) combined radio/TV outlets (e.g. coax RG-59) in

			the space (IP-based broadcasting within ICT solutions are not counted here).
HearingLoop	P_SINGLEVALUE	IfcBoolean	Induction loop supply (or similar functional solution) for hearing aid purposes in the space.
SpeechSystem	P_SINGLEVALUE	IfcBoolean	Audio system for amplification and distribution of human speech in the space.
SoundDistribution	P_SINGLEVALUE	IfcBoolean	Audio system for amplification and distribution of program source sound (e.g. from BRD or DVD) in the space.
AudiovisualSystem	P_SINGLEVALUE	IfcBoolean	Audiovisual (AV) control system for operating AV functions (audio, video, lighting, window shades, preset scenarios etc) in the space.
RemoteObservationSystem	P_SINGLEVALUE	IfcBoolean	Remote activity listening and/or observation in the space from activities in other spaces, through transfer of audio and/or video signals.

### ePset\_SpaceAcousticRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Acoustic requirements from the client perspective
AcousticPrivacy	P_SINGLEVALUE	IfcBoolean	
MaximumSoundLevel	P_SINGLEVALUE	IfcSoundPowerLevelMeasure	Maximum accepted sound level in the space in dBA in addition to national codes.
OutdoorNoiseSum	P_SINGLEVALUE	IfcSoundPowerMeasure	
NoiseSumdBA	P_SINGLEVALUE	IfcSoundPowerLevelMeasure	Contribution of noise from the sum of technical systems (dBA)
NoiseSumdBC	P_SINGLEVALUE	IfcSoundPowerLevelMeasure	Contribution of noise from the sum of technical systems (dBC)

### ePset\_SpaceWaterRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Water requirements from the client perspective
ColdWaterSupply	P_SINGLEVALUE	IfcInteger	Number of cold water supplies as pipe stubs, for sink/basin connection.
HotWaterSupply	P_SINGLEVALUE	IfcInteger	Number of hot water supplies as pipe stubs, for sink/basin connection.
FireHoseSupply	P_SINGLEVALUE	IfcInteger	Supply of cold water to the space, terminated in pipe stub and connected to fire hose with fittings and cabinet. Water supply is dimensioned for fire hose.
PurifiedWaterSupply	P_SINGLEVALUE	IfcInteger	Number of water supplies as pipe stubs to the space that is purified/treated according to specifications given to comply with purification requirements related to the space function/activity.
WaterTemperature	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Acceptable temperatures for hot water supply to space.
Basins	P_SINGLEVALUE	IfcInteger	Number of sinks, including cold and hot water supplies
Toilets	P_SINGLEVALUE	IfcInteger	Number of toilets, including cold water supplies and drainage
Showers	P_SINGLEVALUE	IfcInteger	Number of showers, including cold and hot

			water supplies for shower connection - and drainage
FloorDrain	P_SINGLEVALUE	IfcBoolean	Gully in floor, attached to water drain system.
DrainCleansing	P_SINGLEVALUE	IfcBoolean	State if there is a need for drain cleansing
DrainCleansingType	P_SINGLEVALUE	IfcLabel	Describe type (e.g. oil separator, grease traps)

### ePset\_SpaceExhaustRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Exhaust requirements from the client perspective
ExhaustVentilation	P_SINGLEVALUE	IfcBoolean	The removal of foul/contaminated/toxic air from a space by a mechanical means by a separate exhaust air system
KitchenExhaust	P_SINGLEVALUE	IfcBoolean	The removal of fatty/greasy/oily air from a food preparation space by a mechanical means by a separate exhaust air system.
RestroomExhaust	P_SINGLEVALUE	IfcBoolean	
WasteSuction	P_SINGLEVALUE	IfcBoolean	The removal of waste from space by means of an automatic vacuum based ducting system, for further collection and treatment.
FabricSuction	P_SINGLEVALUE	IfcBoolean	The removal of fabrics/clothes from space by means of an automatic vacuum based ducting system, for cleaning etc.
CentralVacuumSystem	P_SINGLEVALUE	IfcBoolean	If a central vacuum system

### ePset\_SpaceGasProvisionRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the Gas requirements from the client perspective
AirMedical	P_SINGLEVALUE	IfcInteger	Number of pressurized treated air outlets for medical purposes in the space.
AirTechnical	P_SINGLEVALUE	IfcInteger	Number of pressurized air outlets for technical purposes in the space.
Oxygen	P_SINGLEVALUE	IfcInteger	Number of Oxygen gas supply outlets in the space.
Helium	P_SINGLEVALUE	IfcInteger	Number of Helium gas supply outlets in the space.
Argon	P_SINGLEVALUE	IfcInteger	Number of Argon gas supply outlets in the space.
Nitrogen	P_SINGLEVALUE	IfcInteger	Number of Nitrogen gas supply outlets in the space.
Hydrogen	P_SINGLEVALUE	IfcInteger	Number of Hydrogen gas supply outlets in the space.
NitrousOxide	P_SINGLEVALUE	IfcInteger	Number of Nitrous oxide ('laughing gas') gas supply outlets in the space.
CarbonDioxide	P_SINGLEVALUE	IfcInteger	Number of Carbon dioxide gas supply outlets in the space.
PropaneGas	P_SINGLEVALUE	IfcInteger	Number of Propane gas supply outlets in the space.
Positioning	P_SINGLEVALUE	IfcText	Description of requirements for exact positioning on specific space surfaces of gas supply outlets

### ePset\_SpaceMaintenanceRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any verbal description of the FM and operation requirements from the client perspective
WasteSpecialTreatment	P_SINGLEVALUE	IfcText	Waste from running operations that needs special treatment for storage and

			transport, due to toxic or caustic substances, danger of infection etc.
CleaningAgents	P_SINGLEVALUE	IfcText	Special cleaning agents required in this space, different from project default.
CleaningMethods	P_SINGLEVALUE	IfcText	Special cleaning methods required in this space, different from project default.
CleaningIntervals	P_SINGLEVALUE	IfcText	Special cleaning intervals required in this space, different from project default.

## ePset\_SpaceCustomRequirements

Property	Property Type	Data Type	Description
General	P_SINGLEVALUE	IfcText	Any other requirements or properties that needs to be exchanged and is not covered by this ER. E.g. client specific requirements.

### 4.6.6.4.4 Non-applicable entity exclusion analysis

The referenced IFC schema is shown in the following table, with each row corresponding to a schema namespace, with data definitions listed within, where bold items indicate definitions within scope of this Model View Definition.

Namespace	Definitions	Usage
IfcKernel	<b>IfcActor</b> ; IfcComplexPropertyTemplate; <b>IfcContext</b> ; <b>IfcControl</b> ; <b>IfcGroup</b> ; <b>IfcObject</b> ; <b>IfcObjectDefinition</b> ; IfcPreDefinedPropertySet; IfcProcess; <b>IfcProduct</b> ; <b>IfcProject</b> ; IfcProjectLibrary; <b>IfcPropertyDefinition</b> ; <b>IfcPropertySet</b> ; <b>IfcPropertySetDefinition</b> ; IfcPropertySetTemplate; IfcPropertyTemplate; IfcPropertyTemplateDefinition; IfcProxy; <b>IfcQuantitySet</b> ; <b>IfcRelAggregates</b> ; <b>IfcRelAssigns</b> ; <b>IfcRelAssignsToActor</b> ; <b>IfcRelAssignsToControl</b> ; IfcRelAssignsToGroup; IfcRelAssignsToGroupByFactor; IfcRelAssignsToProcess; IfcRelAssignsToProduct; IfcRelAssignsToResource; <b>IfcRelAssociates</b> ; <b>IfcRelAssociatesClassification</b> ; IfcRelAssociatesDocument; IfcRelAssociatesLibrary; <b>IfcRelationship</b> ; IfcRelConnects; <b>IfcRelDeclares</b> ; <b>IfcRelDecomposes</b> ; <b>IfcRelDefines</b> ; IfcRelDefinesByObject; <b>IfcRelDefinesByProperties</b> ; IfcRelDefinesByTemplate; <b>IfcRelDefinesByType</b> ; IfcRelNests; IfcResource; <b>IfcRoot</b> ; IfcSimplePropertyTemplate; <b>IfcTypeObject</b> ; IfcTypeProcess; <b>IfcTypeProduct</b> ; IfcTypeResource; IfcPropertySetDefinitionSet; IfcComplexPropertyTemplateTypeEnum; IfcObjectTypeEnum; IfcPropertySetTemplateTypeEnum; IfcSimplePropertyTemplateTypeEnum; <b>IfcDefinitionSelect</b> ; IfcProcessSelect; IfcProductSelect; <b>IfcPropertySetDefinitionSelect</b> ; IfcResourceSelect;	29/60 (48%)
IfcControlExtension	IfcPerformanceHistory; IfcRelAssociatesApproval; <b>IfcRelAssociatesConstraint</b> ; IfcPerformanceHistoryTypeEnum;	1/4 (25%)
IfcProcessExtension	IfcEvent; IfcEventType; IfcProcedure; IfcProcedureType; IfcRelSequence; IfcTask; IfcTaskType; <b>IfcWorkCalendar</b> ; IfcWorkControl; IfcWorkPlan; IfcWorkSchedule; IfcEventTriggerTypeEnum; IfcEventTypeEnum; IfcProcedureTypeEnum; IfcSequenceEnum; IfcTaskTypeEnum; IfcWorkCalendarTypeEnum; IfcWorkPlanTypeEnum; IfcWorkScheduleTypeEnum;	1/19 (5%)
IfcProductExtension	IfcAnnotation; <b>IfcBuilding</b> ; IfcBuildingElement; IfcBuildingElementType; <b>IfcBuildingStorey</b> ; IfcCivilElement; IfcCivilElementType; IfcDistributionElement; IfcDistributionElementType; IfcElement; IfcElementAssembly; IfcElementAssemblyType; <b>IfcElementQuantity</b> ; IfcElementType; IfcExternalSpatialElement; IfcExternalSpatialStructureElement; IfcFeatureElement; IfcFeatureElementAddition; IfcFeatureElementSubtraction; IfcFurnishingElement; IfcFurnishingElementType; IfcGeographicElement; IfcGeographicElementType; IfcGrid; IfcOpeningElement; IfcOpeningStandardCase; IfcPort; IfcProjectionElement; IfcRelAssociatesMaterial; IfcRelConnectsElements; IfcRelConnectsPorts; IfcRelConnectsPortToElement; IfcRelConnectsWithRealizingElements; IfcRelContainedInSpatialStructure; IfcRelFillsElement; IfcRelInterferesElements; IfcRelProjectsElement; IfcRelReferencedInSpatialStructure; IfcRelServicesBuildings;	13/71 (18%)

Namespace	Definitions	Usage
	<p>IfcRelSpaceBoundary; IfcRelSpaceBoundary1stLevel;  IfcRelSpaceBoundary2ndLevel; IfcRelVoidsElement; <b>IfcSite</b>; <b>IfcSpace</b>;  <b>IfcSpaceType</b>; <b>IfcSpatialElement</b>; <b>IfcSpatialElementType</b>;  <b>IfcSpatialStructureElement</b>; <b>IfcSpatialStructureElementType</b>;  IfcSpatialZone; IfcSpatialZoneType; <b>IfcSystem</b>; IfcTransportElement;  IfcTransportElementType; IfcVirtualElement; <b>IfcZone</b>; IfcAssemblyPlaceEnum;  IfcElementAssemblyTypeEnum; IfcElementCompositionEnum;  IfcExternalSpatialElementTypeEnum; IfcGeographicElementTypeEnum;  IfcGridTypeEnum; IfcInternalOrExternalEnum; IfcOpeningElementTypeEnum;  IfcPhysicalOrVirtualEnum; IfcProjectionElementTypeEnum; <b>IfcSpaceTypeEnum</b>;  IfcSpatialZoneTypeEnum; IfcTransportElementTypeEnum;  IfcSpaceBoundarySelect;</p>	
IfcSharedBldgElements	<p>IfcBeam; IfcBeamStandardCase; IfcBeamType; IfcBuildingElementProxy;  IfcBuildingElementProxyType; IfcBuildingSystem; IfcChimney; IfcChimneyType;  IfcColumn; IfcColumnStandardCase; IfcColumnType; IfcCovering;  IfcCoveringType; IfcCurtainWall; IfcCurtainWallType; IfcDoor;  IfcDoorStandardCase; IfcDoorType; IfcMember; IfcMemberStandardCase;  IfcMemberType; IfcPlate; IfcPlateStandardCase; IfcPlateType; IfcRailing;  IfcRailingType; IfcRamp; IfcRampFlight; IfcRampFlightType; IfcRampType;  IfcRelConnectsPathElements; IfcRelCoversBldgElements; IfcRelCoversSpaces;  IfcRoof; IfcRoofType; IfcShadingDevice; IfcShadingDeviceType; IfcSlab;  IfcSlabElementedCase; IfcSlabStandardCase; IfcSlabType; IfcStair; IfcStairFlight;  IfcStairFlightType; IfcStairType; IfcWall; IfcWallElementedCase;  IfcWallStandardCase; IfcWallType; IfcWindow; IfcWindowStandardCase;  IfcWindowType; IfcBeamTypeEnum; IfcBuildingElementProxyTypeEnum;  IfcBuildingSystemTypeEnum; IfcChimneyTypeEnum; IfcColumnTypeEnum;  IfcConnectionTypeEnum; IfcCoveringTypeEnum; IfcCurtainWallTypeEnum;  IfcDoorTypeEnum; IfcDoorTypeOperationEnum; IfcMemberTypeEnum;  IfcPlateTypeEnum; IfcRailingTypeEnum; IfcRampFlightTypeEnum;  IfcRampTypeEnum; IfcRoofTypeEnum; IfcShadingDeviceTypeEnum;  IfcSlabTypeEnum; IfcStairFlightTypeEnum; IfcStairTypeEnum; IfcWallTypeEnum;  IfcWindowTypeEnum; IfcWindowTypePartitioningEnum;</p>	0/75 (0%)
IfcSharedBldgServiceElements	<p>IfcDistributionChamberElement; IfcDistributionChamberElementType;  IfcDistributionCircuit; IfcDistributionControlElement;  IfcDistributionControlElementType; IfcDistributionFlowElement;  IfcDistributionFlowElementType; IfcDistributionPort; IfcDistributionSystem;  IfcEnergyConversionDevice; IfcEnergyConversionDeviceType; IfcFlowController;  IfcFlowControllerType; IfcFlowFitting; IfcFlowFittingType; IfcFlowMovingDevice;  IfcFlowMovingDeviceType; IfcFlowSegment; IfcFlowSegmentType;  IfcFlowStorageDevice; IfcFlowStorageDeviceType; IfcFlowTerminal;  IfcFlowTerminalType; IfcFlowTreatmentDevice; IfcFlowTreatmentDeviceType;  IfcRelFlowControlElements; IfcDistributionChamberElementTypeEnum;  IfcDistributionPortTypeEnum; IfcDistributionSystemEnum; IfcFlowDirectionEnum;</p>	0/30 (0%)
IfcSharedComponentElements	<p>IfcBuildingElementPart; IfcBuildingElementPartType; IfcDiscreteAccessory;  IfcDiscreteAccessoryType; IfcElementComponent; IfcElementComponentType;  IfcFastener; IfcFastenerType; IfcMechanicalFastener; IfcMechanicalFastenerType;  IfcBuildingElementPartTypeEnum; IfcDiscreteAccessoryTypeEnum;  IfcFastenerTypeEnum; IfcMechanicalFastenerTypeEnum;</p>	0/14 (0%)
IfcSharedFacilitiesElements	<p>IfcAsset; IfcFurniture; IfcFurnitureType; IfcInventory; <b>IfcOccupant</b>;  IfcSystemFurnitureElement; IfcSystemFurnitureElementType;  IfcFurnitureTypeEnum; IfcInventoryTypeEnum; IfcOccupantTypeEnum;  IfcSystemFurnitureElementTypeEnum;</p>	1/11 (9%)
IfcSharedMgmtElements	<p>IfcActionRequest; IfcCostItem; IfcCostSchedule; IfcPermit; IfcProjectOrder;  IfcActionRequestTypeEnum; IfcCostItemTypeEnum; IfcCostScheduleTypeEnum;  IfcPermitTypeEnum; IfcProjectOrderTypeEnum;</p>	0/10 (0%)
IfcArchitectureDomain	<p>IfcDoorLiningProperties; IfcDoorPanelProperties; IfcDoorStyle;  IfcPermeableCoveringProperties; IfcWindowLiningProperties;  IfcWindowPanelProperties; IfcWindowStyle; IfcDoorPanelOperationEnum;  IfcDoorPanelPositionEnum; IfcDoorStyleConstructionEnum;  IfcDoorStyleOperationEnum; IfcPermeableCoveringOperationEnum;  IfcWindowPanelOperationEnum; IfcWindowPanelPositionEnum;  IfcWindowStyleConstructionEnum; IfcWindowStyleOperationEnum;</p>	0/16 (0%)

Namespace	Definitions	Usage
IfcBuildingControlsDomain	IfcActuator; IfcActuatorType; IfcAlarm; IfcAlarmType; IfcController; IfcControllerType; IfcFlowInstrument; IfcFlowInstrumentType; IfcSensor; IfcSensorType; IfcUnitaryControlElement; IfcUnitaryControlElementType; IfcActuatorTypeEnum; IfcAlarmTypeEnum; IfcControllerTypeEnum; IfcFlowInstrumentTypeEnum; IfcSensorTypeEnum; IfcUnitaryControlElementTypeEnum;	0/18 (0%)
IfcConstructionMgmtDomain	IfcConstructionEquipmentResource; IfcConstructionEquipmentResourceType; IfcConstructionMaterialResource; IfcConstructionMaterialResourceType; IfcConstructionProductResource; IfcConstructionProductResourceType; IfcConstructionResource; IfcConstructionResourceType; IfcCrewResource; IfcCrewResourceType; IfcLaborResource; IfcLaborResourceType; IfcSubContractResource; IfcSubContractResourceType; IfcConstructionEquipmentResourceTypeEnum; IfcConstructionMaterialResourceTypeEnum; IfcConstructionProductResourceTypeEnum; IfcCrewResourceTypeEnum; IfcLaborResourceTypeEnum; IfcSubContractResourceTypeEnum;	0/20 (0%)
IfcElectricalDomain	IfcAudioVisualAppliance; IfcAudioVisualApplianceType; IfcCableCarrierFitting; IfcCableCarrierFittingType; IfcCableCarrierSegment; IfcCableCarrierSegmentType; IfcCableFitting; IfcCableFittingType; IfcCableSegment; IfcCableSegmentType; IfcCommunicationsAppliance; IfcCommunicationsApplianceType; IfcElectricAppliance; IfcElectricApplianceType; IfcElectricDistributionBoard; IfcElectricDistributionBoardType; IfcElectricFlowStorageDevice; IfcElectricFlowStorageDeviceType; IfcElectricGenerator; IfcElectricGeneratorType; IfcElectricMotor; IfcElectricMotorType; IfcElectricTimeControl; IfcElectricTimeControlType; IfcJunctionBox; IfcJunctionBoxType; IfcLamp; IfcLampType; IfcLightFixture; IfcLightFixtureType; IfcMotorConnection; IfcMotorConnectionType; IfcOutlet; IfcOutletType; IfcProtectiveDevice; IfcProtectiveDeviceTrippingUnit; IfcProtectiveDeviceTrippingUnitType; IfcProtectiveDeviceType; IfcSolarDevice; IfcSolarDeviceType; IfcSwitchingDevice; IfcSwitchingDeviceType; IfcTransformer; IfcTransformerType; IfcAudioVisualApplianceTypeEnum; IfcCableCarrierFittingTypeEnum; IfcCableCarrierSegmentTypeEnum; IfcCableFittingTypeEnum; IfcCableSegmentTypeEnum; IfcCommunicationsApplianceTypeEnum; IfcElectricApplianceTypeEnum; IfcElectricDistributionBoardTypeEnum; IfcElectricFlowStorageDeviceTypeEnum; IfcElectricGeneratorTypeEnum; IfcElectricMotorTypeEnum; IfcElectricTimeControlTypeEnum; IfcJunctionBoxTypeEnum; IfcLampTypeEnum; IfcLightFixtureTypeEnum; IfcMotorConnectionTypeEnum; IfcOutletTypeEnum; IfcProtectiveDeviceTrippingUnitTypeEnum; IfcProtectiveDeviceTypeEnum; IfcSolarDeviceTypeEnum; IfcSwitchingDeviceTypeEnum; IfcTransformerTypeEnum;	0/66 (0%)
IfcHvacDomain	IfcAirTerminal; IfcAirTerminalBox; IfcAirTerminalBoxType; IfcAirTerminalType; IfcAirToAirHeatRecovery; IfcAirToAirHeatRecoveryType; IfcBoiler; IfcBoilerType; IfcBurner; IfcBurnerType; IfcChiller; IfcChillerType; IfcCoil; IfcCoilType; IfcCompressor; IfcCompressorType; IfcCondenser; IfcCondenserType; IfcCooledBeam; IfcCooledBeamType; IfcCoolingTower; IfcCoolingTowerType; IfcDamper; IfcDamperType; IfcDuctFitting; IfcDuctFittingType; IfcDuctSegment; IfcDuctSegmentType; IfcDuctSilencer; IfcDuctSilencerType; IfcEngine; IfcEngineType; IfcEvaporativeCooler; IfcEvaporativeCoolerType; IfcEvaporator; IfcEvaporatorType; IfcFan; IfcFanType; IfcFilter; IfcFilterType; IfcFlowMeter; IfcFlowMeterType; IfcHeatExchanger; IfcHeatExchangerType; IfcHumidifier; IfcHumidifierType; IfcMedicalDevice; IfcMedicalDeviceType; IfcPipeFitting; IfcPipeFittingType; IfcPipeSegment; IfcPipeSegmentType; IfcPump; IfcPumpType; IfcSpaceHeater; IfcSpaceHeaterType; IfcTank; IfcTankType; IfcTubeBundle; IfcTubeBundleType; IfcUnitaryEquipment; IfcUnitaryEquipmentType; IfcValve; IfcValveType; IfcVibrationIsolator; IfcVibrationIsolatorType; IfcAirTerminalBoxTypeEnum; IfcAirTerminalTypeEnum; IfcAirToAirHeatRecoveryTypeEnum; IfcBoilerTypeEnum; IfcBurnerTypeEnum; IfcChillerTypeEnum; IfcCoilTypeEnum; IfcCompressorTypeEnum; IfcCondenserTypeEnum; IfcCooledBeamTypeEnum; IfcCoolingTowerTypeEnum; IfcDamperTypeEnum; IfcDuctFittingTypeEnum; IfcDuctSegmentTypeEnum; IfcDuctSilencerTypeEnum; IfcEngineTypeEnum; IfcEvaporativeCoolerTypeEnum; IfcEvaporatorTypeEnum; IfcFanTypeEnum; IfcFilterTypeEnum; IfcFlowMeterTypeEnum; IfcHeatExchangerTypeEnum; IfcHumidifierTypeEnum; IfcMedicalDeviceTypeEnum; IfcPipeFittingTypeEnum; IfcPipeSegmentTypeEnum;	0/99 (0%)

Namespace	Definitions	Usage
	IfcPumpTypeEnum; IfcSpaceHeaterTypeEnum; IfcTankTypeEnum; IfcTubeBundleTypeEnum; IfcUnitaryEquipmentTypeEnum; IfcValveTypeEnum; IfcVibrationIsolatorTypeEnum;	
IfcPlumbingFireProtectionDomain	IfcFireSuppressionTerminal; IfcFireSuppressionTerminalType; IfcInterceptor; IfcInterceptorType; IfcSanitaryTerminal; IfcSanitaryTerminalType; IfcStackTerminal; IfcStackTerminalType; IfcWasteTerminal; IfcWasteTerminalType; IfcFireSuppressionTerminalTypeEnum; IfcInterceptorTypeEnum; IfcSanitaryTerminalTypeEnum; IfcStackTerminalTypeEnum; IfcWasteTerminalTypeEnum;	0/15 (0%)
IfcStructuralAnalysisDomain	IfcRelConnectsStructuralActivity; IfcRelConnectsStructuralMember; IfcRelConnectsWithEccentricity; IfcStructuralAction; IfcStructuralActivity; IfcStructuralAnalysisModel; IfcStructuralConnection; IfcStructuralCurveAction; IfcStructuralCurveConnection; IfcStructuralCurveMember; IfcStructuralCurveMemberVarying; IfcStructuralCurveReaction; IfcStructuralItem; IfcStructuralLinearAction; IfcStructuralLoadCase; IfcStructuralLoadGroup; IfcStructuralMember; IfcStructuralPlanarAction; IfcStructuralPointAction; IfcStructuralPointConnection; IfcStructuralPointReaction; IfcStructuralReaction; IfcStructuralResultGroup; IfcStructuralSurfaceAction; IfcStructuralSurfaceConnection; IfcStructuralSurfaceMember; IfcStructuralSurfaceMemberVarying; IfcStructuralSurfaceReaction; IfcActionSourceTypeEnum; IfcActionTypeEnum; IfcAnalysisModelTypeEnum; IfcAnalysisTheoryTypeEnum; IfcLoadGroupTypeEnum; IfcProjectedOrTrueLengthEnum; IfcStructuralCurveActivityTypeEnum; IfcStructuralCurveMemberTypeEnum; IfcStructuralSurfaceActivityTypeEnum; IfcStructuralSurfaceMemberTypeEnum; IfcStructuralActivityAssignmentSelect;	0/39 (0%)
IfcStructuralElementsDomain	IfcFooting; IfcFootingType; IfcPile; IfcPileType; IfcReinforcementDefinitionProperties; IfcReinforcingBar; IfcReinforcingBarType; IfcReinforcingElement; IfcReinforcingElementType; IfcReinforcingMesh; IfcReinforcingMeshType; IfcSurfaceFeature; IfcTendon; IfcTendonAnchor; IfcTendonAnchorType; IfcTendonType; IfcVoidingFeature; IfcFootingTypeEnum; IfcPileConstructionEnum; IfcPileTypeEnum; IfcReinforcingBarTypeEnum; IfcReinforcingMeshTypeEnum; IfcSurfaceFeatureTypeEnum; IfcTendonAnchorTypeEnum; IfcTendonTypeEnum; IfcVoidingFeatureTypeEnum; IfcBendingParameterSelect;	0/27 (0%)
IfcActorResource	IfcActorRole; IfcAddress; IfcOrganization; IfcOrganizationRelationship; IfcPerson; IfcPersonAndOrganization; IfcPostalAddress; IfcTelecomAddress; IfcAddressTypeEnum; IfcRoleEnum; <b>IfcActorSelect</b> ;	1/11 (9%)
IfcApprovalResource	IfcApproval; IfcApprovalRelationship; IfcResourceApprovalRelationship;	0/3 (0%)
IfcConstraintResource	<b>IfcConstraint</b> ; <b>IfcMetric</b> ; <b>IfcObjective</b> ; <b>IfcReference</b> ; IfcResourceConstraintRelationship; <b>IfcBenchmarkEnum</b> ; <b>IfcConstraintEnum</b> ; IfcLogicalOperatorEnum; <b>IfcObjectiveEnum</b> ; <b>IfcMetricValueSelect</b> ;	8/10 (80%)
IfcCostResource	IfcAppliedValue; IfcCostValue; IfcCurrencyRelationship; IfcArithmeticOperatorEnum; IfcAppliedValueSelect;	0/5 (0%)
IfcDateTimeResource	IfcEventTime; <b>IfcIrregularTimeSeries</b> ; <b>IfcIrregularTimeSeriesValue</b> ; IfcLagTime; <b>IfcRecurrencePattern</b> ; IfcRegularTimeSeries; IfcResourceTime; <b>IfcSchedulingTime</b> ; IfcTaskTime; IfcTaskTimeRecurring; <b>IfcTimePeriod</b> ; <b>IfcTimeSeries</b> ; IfcTimeSeriesValue; <b>IfcWorkTime</b> ; <b>IfcDate</b> ; <b>IfcDateTime</b> ; IfcDayInMonthNumber; IfcDayInWeekNumber; IfcDuration; IfcMonthInYearNumber; <b>IfcTime</b> ; IfcTimeStamp; <b>IfcDataOriginEnum</b> ; <b>IfcRecurrenceTypeEnum</b> ; IfcTaskDurationEnum; <b>IfcTimeSeriesDataTypeEnum</b> ; IfcTimeOrRatioSelect;	13/27 (48%)
IfcExternalReferenceResource	<b>IfcClassification</b> ; <b>IfcClassificationReference</b> ; IfcDocumentInformation; IfcDocumentInformationRelationship; IfcDocumentReference; <b>IfcExternalInformation</b> ; <b>IfcExternalReference</b> ; IfcExternalReferenceRelationship; IfcLibraryInformation; IfcLibraryReference; IfcResourceLevelRelationship; IfcLanguageId; IfcURIReference; IfcDocumentConfidentialityEnum; IfcDocumentStatusEnum; <b>IfcClassificationReferenceSelect</b> ; <b>IfcClassificationSelect</b> ; IfcDocumentSelect; IfcLibrarySelect; IfcResourceObjectSelect;	6/20 (30%)



Namespace	Definitions	Usage
IfcGeometricConstraintResource	IfcConnectionCurveGeometry; IfcConnectionGeometry; IfcConnectionPointEccentricity; IfcConnectionPointGeometry; IfcConnectionSurfaceGeometry; IfcConnectionVolumeGeometry; IfcGridAxis; IfcGridPlacement; IfcLocalPlacement; IfcObjectPlacement; IfcVirtualGridIntersection; IfcCurveOrEdgeCurve; IfcGridPlacementDirectionSelect; IfcPointOrVertexPoint; IfcSolidOrShell; IfcSurfaceOrFaceSurface;	0/16 (0%)
IfcGeometricModelResource	IfcAdvancedBrep; IfcAdvancedBrepWithVoids; IfcBlock; IfcBooleanClippingResult; IfcBooleanResult; IfcBoundingBox; IfcBoxedHalfSpace; IfcCartesianPointList; IfcCartesianPointList3D; IfcCsgPrimitive3D; IfcCsgSolid; <b>IfcExtrudedAreaSolid</b> ; IfcExtrudedAreaSolidTapered; IfcFaceBasedSurfaceModel; IfcFacetedBrep; IfcFacetedBrepWithVoids; IfcFixedReferenceSweptAreaSolid; <b>IfcGeometricCurveSet</b> ; <b>IfcGeometricSet</b> ; IfcHalfSpaceSolid; IfcManifoldSolidBrep; IfcPolygonalBoundedHalfSpace; IfcRectangularPyramid; <b>IfcRevolvedAreaSolid</b> ; IfcRevolvedAreaSolidTapered; IfcRightCircularCone; IfcRightCircularCylinder; IfcSectionedSpine; IfcShellBasedSurfaceModel; <b>IfcSolidModel</b> ; IfcSphere; IfcSurfaceCurveSweptAreaSolid; <b>IfcSweptAreaSolid</b> ; IfcSweptDiskSolid; IfcSweptDiskSolidPolygonal; IfcTessellatedFaceSet; IfcTessellatedItem; IfcTriangulatedFaceSet; IfcBooleanOperator; IfcBooleanOperand; IfcCsgSelect; <b>IfcGeometricSetSelect</b> ;	7/42 (17%)
IfcGeometryResource	<b>IfcAxis1Placement</b> ; IfcAxis2Placement2D; IfcAxis2Placement3D; IfcBoundaryCurve; <b>IfcBoundedCurve</b> ; IfcBoundedSurface; IfcBSplineCurve; IfcBSplineCurveWithKnots; IfcBSplineSurface; IfcBSplineSurfaceWithKnots; <b>IfcCartesianPoint</b> ; IfcCartesianTransformationOperator; IfcCartesianTransformationOperator2D; IfcCartesianTransformationOperator2DnonUniform; IfcCartesianTransformationOperator3D; IfcCartesianTransformationOperator3DnonUniform; IfcCircle; IfcCompositeCurve; IfcCompositeCurveOnSurface; IfcCompositeCurveSegment; IfcConic; <b>IfcCurve</b> ; IfcCurveBoundedPlane; IfcCurveBoundedSurface; IfcCylindricalSurface; <b>IfcDirection</b> ; IfcElementarySurface; IfcEllipse; <b>IfcGeometricRepresentationItem</b> ; <b>IfcLine</b> ; IfcMappedItem; IfcOffsetCurve2D; IfcOffsetCurve3D; IfcOuterBoundaryCurve; IfcPcurve; <b>IfcPlacement</b> ; IfcPlane; <b>IfcPoint</b> ; IfcPointOnCurve; IfcPointOnSurface; IfcPolyline; IfcRationalBSplineCurveWithKnots; IfcRationalBSplineSurfaceWithKnots; IfcRectangularTrimmedSurface; IfcReparametrisedCompositeCurveSegment; <b>IfcRepresentationItem</b> ; IfcRepresentationMap; IfcSurface; IfcSurfaceOfLinearExtrusion; IfcSurfaceOfRevolution; IfcSweptSurface; IfcTrimmedCurve; <b>IfcVector</b> ; <b>IfcDimensionCount</b> ; IfcBSplineCurveForm; IfcBSplineSurfaceForm; IfcKnotType; IfcTransitionCode; IfcTrimmingPreference; <b>IfcAxis2Placement</b> ; IfcCurveOnSurface; IfcTrimmingSelect; IfcVectorOrDirection;	13/63 (21%)
IfcMaterialResource	<b>IfcMaterial</b> ; IfcMaterialClassificationRelationship; IfcMaterialConstituent; IfcMaterialConstituentSet; <b>IfcMaterialDefinition</b> ; IfcMaterialLayer; IfcMaterialLayerSet; IfcMaterialLayerSetUsage; IfcMaterialLayerWithOffsets; IfcMaterialList; IfcMaterialProfile; IfcMaterialProfileSet; IfcMaterialProfileSetUsage; IfcMaterialProfileSetUsageTapering; IfcMaterialProfileWithOffsets; IfcMaterialProperties; IfcMaterialRelationship; IfcMaterialUsageDefinition; IfcCardinalPointReference; IfcDirectionSenseEnum; IfcLayerSetDirectionEnum; IfcMaterialSelect;	2/22 (9%)
IfcMeasureResource	IfcContextDependentUnit; IfcConversionBasedUnit; IfcConversionBasedUnitWithOffset; IfcDerivedUnit; IfcDerivedUnitElement; IfcDimensionalExponents; IfcMeasureWithUnit; IfcMonetaryUnit; IfcNamedUnit; IfcSIUnit; IfcUnitAssignment; IfcAbsorbedDoseMeasure; IfcAccelerationMeasure; IfcAmountOfSubstanceMeasure; IfcAngularVelocityMeasure; IfcAreaDensityMeasure; <b>IfcAreaMeasure</b> ; <b>IfcBoolean</b> ; IfcComplexNumber; IfcCompoundPlaneAngleMeasure; IfcContextDependentMeasure; <b>IfcCountMeasure</b> ; IfcCurvatureMeasure; IfcDescriptiveMeasure; IfcDoseEquivalentMeasure; IfcDynamicViscosityMeasure; IfcElectricCapacitanceMeasure; IfcElectricChargeMeasure; IfcElectricConductanceMeasure; IfcElectricCurrentMeasure; IfcElectricResistanceMeasure; IfcElectricVoltageMeasure; IfcEnergyMeasure; IfcForceMeasure; IfcFrequencyMeasure; IfcHeatFluxDensityMeasure; IfcHeatingValueMeasure; <b>IfcIdentifier</b> ; <b>IfcIlluminanceMeasure</b> ; IfcInductanceMeasure; <b>IfcInteger</b> ; IfcIntegerCountRateMeasure;	23/121 (19%)

Namespace	Definitions	Usage
	<p> <b>IfcIonConcentrationMeasure;</b> <b>IfcIsothermalMoistureCapacityMeasure;</b>  <b>IfcKinematicViscosityMeasure;</b> <b>IfcLabel;</b> <b>IfcLengthMeasure;</b>  <b>IfcLinearForceMeasure;</b> <b>IfcLinearMomentMeasure;</b> <b>IfcLinearStiffnessMeasure;</b>  <b>IfcLinearVelocityMeasure;</b> <b>IfcLogical;</b> <b>IfcLuminousFluxMeasure;</b>  <b>IfcLuminousIntensityDistributionMeasure;</b> <b>IfcLuminousIntensityMeasure;</b>  <b>IfcMagneticFluxDensityMeasure;</b> <b>IfcMagneticFluxMeasure;</b>  <b>IfcMassDensityMeasure;</b> <b>IfcMassFlowRateMeasure;</b> <b>IfcMassMeasure;</b>  <b>IfcMassPerLengthMeasure;</b> <b>IfcModulusOfElasticityMeasure;</b>  <b>IfcModulusOfLinearSubgradeReactionMeasure;</b>  <b>IfcModulusOfRotationalSubgradeReactionMeasure;</b>  <b>IfcModulusOfSubgradeReactionMeasure;</b> <b>IfcMoistureDiffusivityMeasure;</b>  <b>IfcMolecularWeightMeasure;</b> <b>IfcMomentOfInertiaMeasure;</b> <b>IfcMonetaryMeasure;</b>  <b>IfcNonNegativeLengthMeasure;</b> <b>IfcNormalisedRatioMeasure;</b> <b>IfcNumericMeasure;</b>  <b>IfcParameterValue;</b> <b>IfcPHMeasure;</b> <b>IfcPlanarForceMeasure;</b>  <b>IfcPlaneAngleMeasure;</b> <b>IfcPositiveLengthMeasure;</b>  <b>IfcPositivePlaneAngleMeasure;</b> <b>IfcPositiveRatioMeasure;</b> <b>IfcPowerMeasure;</b>  <b>IfcPressureMeasure;</b> <b>IfcRadioActivityMeasure;</b> <b>IfcRatioMeasure;</b> <b>IfcReal;</b>  <b>IfcRotationalFrequencyMeasure;</b> <b>IfcRotationalMassMeasure;</b>  <b>IfcRotationalStiffnessMeasure;</b> <b>IfcSectionalAreaIntegralMeasure;</b>  <b>IfcSectionModulusMeasure;</b> <b>IfcShearModulusMeasure;</b> <b>IfcSolidAngleMeasure;</b>  <b>IfcSoundPowerLevelMeasure;</b> <b>IfcSoundPowerMeasure;</b>  <b>IfcSoundPressureLevelMeasure;</b> <b>IfcSoundPressureMeasure;</b>  <b>IfcSpecificHeatCapacityMeasure;</b> <b>IfcTemperatureGradientMeasure;</b>  <b>IfcTemperatureRateOfChangeMeasure;</b> <b>IfcText;</b> <b>IfcThermalAdmittanceMeasure;</b>  <b>IfcThermalConductivityMeasure;</b> <b>IfcThermalExpansionCoefficientMeasure;</b>  <b>IfcThermalResistanceMeasure;</b> <b>IfcThermalTransmittanceMeasure;</b>  <b>IfcThermodynamicTemperatureMeasure;</b> <b>IfcTimeMeasure;</b>  <b>IfcTorqueMeasure;</b> <b>IfcVaporPermeabilityMeasure;</b> <b>IfcVolumeMeasure;</b>  <b>IfcVolumetricFlowRateMeasure;</b> <b>IfcWarpingConstantMeasure;</b>  <b>IfcWarpingMomentMeasure;</b> <b>IfcDerivedUnitEnum;</b> <b>IfcSIPrefix;</b> <b>IfcSIUnitName;</b>  <b>IfcUnitEnum;</b> <b>IfcDerivedMeasureValue;</b> <b>IfcMeasureValue;</b> <b>IfcSimpleValue;</b> <b>IfcUnit;</b>  <b>IfcValue;</b> </p>	
IfcPresentationAppearanceResource	<p> <b>IfcBlobTexture;</b> <b>IfcColourRgb;</b> <b>IfcColourRgbList;</b> <b>IfcColourSpecification;</b>  <b>IfcCurveStyle;</b> <b>IfcCurveStyleFont;</b> <b>IfcCurveStyleFontAndScaling;</b>  <b>IfcCurveStyleFontPattern;</b> <b>IfcDraughtingPreDefinedColour;</b>  <b>IfcDraughtingPreDefinedCurveFont;</b> <b>IfcExternallyDefinedHatchStyle;</b>  <b>IfcExternallyDefinedSurfaceStyle;</b> <b>IfcExternallyDefinedTextFont;</b> <b>IfcFillAreaStyle;</b>  <b>IfcFillAreaStyleHatching;</b> <b>IfcFillAreaStyleTiles;</b> <b>IfcImageTexture;</b>  <b>IfcIndexedColourMap;</b> <b>IfcIndexedTextureMap;</b> <b>IfcIndexedTriangleTextureMap;</b>  <b>IfcPixelTexture;</b> <b>IfcPreDefinedColour;</b> <b>IfcPreDefinedCurveFont;</b> <b>IfcPreDefinedItem;</b>  <b>IfcPreDefinedTextFont;</b> <b>IfcPresentationStyle;</b> <b>IfcPresentationStyleAssignment;</b>  <b>IfcStyledItem;</b> <b>IfcSurfaceStyle;</b> <b>IfcSurfaceStyleLighting;</b> <b>IfcSurfaceStyleRefraction;</b>  <b>IfcSurfaceStyleRendering;</b> <b>IfcSurfaceStyleShading;</b> <b>IfcSurfaceStyleWithTextures;</b>  <b>IfcSurfaceTexture;</b> <b>IfcTextStyle;</b> <b>IfcTextStyleFontModel;</b>  <b>IfcTextStyleForDefinedFont;</b> <b>IfcTextStyleTextModel;</b> <b>IfcTextureCoordinate;</b>  <b>IfcTextureCoordinateGenerator;</b> <b>IfcTextureMap;</b> <b>IfcTextureVertex;</b>  <b>IfcTextureVertexList;</b> <b>IfcFontStyle;</b> <b>IfcFontVariant;</b> <b>IfcFontWeight;</b>  <b>IfcPresentableText;</b> <b>IfcSpecularExponent;</b> <b>IfcSpecularRoughness;</b>  <b>IfcTextAlignment;</b> <b>IfcTextDecoration;</b> <b>IfcTextFontName;</b> <b>IfcTextTransformation;</b>  <b>IfcNullStyle;</b> <b>IfcReflectanceMethodEnum;</b> <b>IfcSurfaceSide;</b> <b>IfcColour;</b>  <b>IfcColourOrFactor;</b> <b>IfcCurveFontOrScaledCurveFontSelect;</b>  <b>IfcCurveStyleFontSelect;</b> <b>IfcFillStyleSelect;</b> <b>IfcHatchLineDistanceSelect;</b>  <b>IfcPresentationStyleSelect;</b> <b>IfcSizeSelect;</b> <b>IfcSpecularHighlightSelect;</b>  <b>IfcStyleAssignmentSelect;</b> <b>IfcSurfaceStyleElementSelect;</b> <b>IfcTextFontSelect;</b> </p>	0/69 (0%)
IfcPresentationDefinitionResource	<p> <b>IfcAnnotationFillArea;</b> <b>IfcPlanarBox;</b> <b>IfcPlanarExtent;</b> <b>IfcPresentationItem;</b>  <b>IfcTextLiteral;</b> <b>IfcTextLiteralWithExtent;</b> <b>IfcBoxAlignment;</b> <b>IfcTextPath;</b> </p>	0/8 (0%)
IfcPresentationOrganizationResource	<p> <b>IfcLightDistributionData;</b> <b>IfcLightIntensityDistribution;</b> <b>IfcLightSource;</b>  <b>IfcLightSourceAmbient;</b> <b>IfcLightSourceDirectional;</b> <b>IfcLightSourceGoniometric;</b>  <b>IfcLightSourcePositional;</b> <b>IfcLightSourceSpot;</b> <b>IfcPresentationLayerAssignment;</b>  <b>IfcPresentationLayerWithStyle;</b> <b>IfcLightDistributionCurveEnum;</b>  <b>IfcLightEmissionSourceEnum;</b> <b>IfcLayeredItem;</b>  <b>IfcLightDistributionDataSourceSelect;</b> </p>	0/14 (0%)
IfcProfileResource	<p> <b>IfcArbitraryClosedProfileDef;</b> <b>IfcArbitraryOpenProfileDef;</b>  <b>IfcArbitraryProfileDefWithVoids;</b> <b>IfcAsymmetricIShapeProfileDef;</b> </p>	2/31 (6%)

Namespace	Definitions	Usage
	IfcCenterLineProfileDef; IfcCircleHollowProfileDef; IfcCircleProfileDef; IfcCompositeProfileDef; IfcCShapeProfileDef; IfcDerivedProfileDef; IfcEllipseProfileDef; IfcIShapeProfileDef; IfcLShapeProfileDef; IfcMirroredProfileDef; IfcParameterizedProfileDef; <b>IfcProfileDef</b> ; IfcProfileProperties; IfcRectangleHollowProfileDef; IfcRectangleProfileDef; IfcReinforcementBarProperties; IfcRoundedRectangleProfileDef; IfcSectionProperties; IfcSectionReinforcementProperties; IfcTrapeziumProfileDef; IfcTShapeProfileDef; IfcUShapeProfileDef; IfcZShapeProfileDef; <b>IfcProfileTypeEnum</b> ; IfcReinforcingBarSurfaceEnum; IfcSectionTypeEnum;	
IfcPropertyResource	IfcComplexProperty; IfcExtendedProperties; IfcPreDefinedProperties; <b>IfcProperty</b> ; <b>IfcPropertyAbstraction</b> ; <b>IfcPropertyBoundedValue</b> ; IfcPropertyDependencyRelationship; IfcPropertyEnumeratedValue; IfcPropertyEnumeration; <b>IfcPropertyListValue</b> ; <b>IfcPropertyReferenceValue</b> ; <b>IfcPropertySingleValue</b> ; IfcPropertyTableValue; <b>IfcSimpleProperty</b> ; IfcCurveInterpolationEnum; IfcObjectReferenceSelect;	7/16 (44%)
IfcQuantityResource	IfcPhysicalComplexQuantity; <b>IfcPhysicalQuantity</b> ; <b>IfcPhysicalSimpleQuantity</b> ; IfcQuantityArea; IfcQuantityCount; IfcQuantityLength; IfcQuantityTime; IfcQuantityVolume; IfcQuantityWeight;	2/9 (22%)
IfcRepresentationResource	IfcCoordinateOperation; IfcCoordinateReferenceSystem; <b>IfcGeometricRepresentationContext</b> ; IfcGeometricRepresentationSubContext; IfcMapConversion; IfcMaterialDefinitionRepresentation; <b>IfcProductDefinitionShape</b> ; <b>IfcProductRepresentation</b> ; IfcProjectedCRS; <b>IfcRepresentation</b> ; <b>IfcRepresentationContext</b> ; IfcShapeAspect; <b>IfcShapeModel</b> ; <b>IfcShapeRepresentation</b> ; IfcStyledRepresentation; IfcStyleModel; IfcTopologyRepresentation; IfcGeometricProjectionEnum; IfcGlobalOrLocalEnum; IfcCoordinateReferenceSystemSelect; IfcProductRepresentationSelect;	7/21 (33%)
IfcStructuralLoadResource	IfcBoundaryCondition; IfcBoundaryEdgeCondition; IfcBoundaryFaceCondition; IfcBoundaryNodeCondition; IfcBoundaryNodeConditionWarping; IfcFailureConnectionCondition; IfcSlippageConnectionCondition; IfcStructuralConnectionCondition; IfcStructuralLoad; IfcStructuralLoadConfiguration; IfcStructuralLoadLinearForce; IfcStructuralLoadOrResult; IfcStructuralLoadPlanarForce; IfcStructuralLoadSingleDisplacement; IfcStructuralLoadSingleDisplacementDistortion; IfcStructuralLoadSingleForce; IfcStructuralLoadSingleForceWarping; IfcStructuralLoadStatic; IfcStructuralLoadTemperature; IfcSurfaceReinforcementArea; IfcModulusOfRotationalSubgradeReactionSelect; IfcModulusOfSubgradeReactionSelect; IfcModulusOfTranslationalSubgradeReactionSelect; IfcRotationalStiffnessSelect; IfcTranslationalStiffnessSelect; IfcWarpingStiffnessSelect;	0/26 (0%)
IfcTopologyResource	IfcAdvancedFace; IfcClosedShell; IfcConnectedFaceSet; IfcEdge; IfcEdgeCurve; IfcEdgeLoop; IfcFace; IfcFaceBound; IfcFaceOuterBound; IfcFaceSurface; IfcLoop; IfcOpenShell; IfcOrientedEdge; IfcPath; IfcPolyLoop; IfcSubedge; IfcTopologicalRepresentationItem; IfcVertex; IfcVertexLoop; IfcVertexPoint; IfcShell;	0/21 (0%)
IfcUtilityResource	IfcApplication; IfcOwnerHistory; <b>IfcTable</b> ; <b>IfcTableColumn</b> ; IfcTableRow; <b>IfcGloballyUniqueId</b> ; IfcChangeActionEnum; IfcStateEnum;	3/8 (38%)

## 4.6.7 Conformance Testing Procedures

### 4.6.7.1 Format and content requirements

This submission contains (in Annex') the following formats:

- Process map and exchange requirements in human readable format. This documentation simply states the needed data to enable business processes.

- Exchange requirements Models. This formats binds the process needs described in human readable format to a specific data schema (ifc). For implementers this might be sufficient to fulfill a specific implementation and/or validation project. This could be tuned to fit a certain exchange including business rules applied
- MVD format which would enable certification of software. Telling implementers which data it should be possible to exchange within a related programming, design exchange.

#### **4.6.7.1.1 Test rule list**

#### **4.6.7.1.2 Test rule definition**

#### **4.6.7.1.3 Test rules formatting**

#### **4.6.7.1.4 Test rule coverage analysis**

#### **4.6.7.2 Examples and mapping requirements**

BPie was adopted by COBie in 2012, and part of the COBie challenge 2013. Examples, mappings, test files etc. can be found and downloaded from [http://www.nibs.org/?page=bsa\\_bpie](http://www.nibs.org/?page=bsa_bpie)

##### **4.6.7.2.1 Example file list**

- Responsibility Matrix Update
- Example Duplex Model
- Example Clinic Model (IFC)
- Example Clinic Model (SpreadsheetXML)
- Clinic Room List Room Data Sheet list (xlsx)

##### **4.6.7.2.2 Example file description**

##### **4.6.8.2.3 Common BIM file reuse**

Sample files can be found at: [http://www.nibs.org/?page=bsa\\_commonbimfiles](http://www.nibs.org/?page=bsa_commonbimfiles)

##### **4.6.7.2.4 Implementers' agreements**

##### **4.6.7.2.5 Transformations/mapping allowed**

##### **4.6.7.2.6 Transformation/mapping documentation**

#### **4.6.7.3 Testing tools and procedures**

BPie was one of the information exchanges included in the COBie challenge 2013. Through this challenge sample files and implementation guidance were produced and published. The specifications were also implemented in the COBie responsibility matrix and in the COBie challenge tools, and are available as an "IDM filter" in this tool.

Further information of COBie and Building Programming information exchange (BPie) can be found here: [http://www.nibs.org/?page=bsa\\_bpie](http://www.nibs.org/?page=bsa_bpie)

#### **4.6.7.3.1 Testing tool list**

#### **4.6.7.3.2 Testing tool algorithm**

#### **4.6.7.3.3 Testing tools sample files**

#### **4.6.7.3.4 Testing tool software availability**

### **4.6.8 Implementation Resources**

#### **4.6.8.1 Implementation resources list**

The following can be contacted:

- The BPie project, specifications and documentation provided  
Rolf Jerving [rolf@drofus.com](mailto:rolf@drofus.com) and Ole Kristian Kvarsvik [okk@drofus.com](mailto:okk@drofus.com)
- BPie, COBie challenge  
Bill East, [Bill.W.East@erdc.dren.mil](mailto:Bill.W.East@erdc.dren.mil)
- MVD specifications, implementation etc.,  
Tim Chipman (MVD coordinator BuildingSMART International), [tim@timchipman.com](mailto:tim@timchipman.com)
- Documentation available at BuildingSMART international IUG website  
Jan Karlshøj, [Jan.Karlshøj@gravicon.dk](mailto:Jan.Karlshøj@gravicon.dk)

Links to digital implementation resources provided above

#### **4.6.8.1.1 Implementation guides**

#### **4.6.8.2 Implementation resources completeness**

The implementation resources provided should be rather complete in this submission. Some updates must be provided according the latest adjustments, but the overall message is that documentation should be sufficient for implementation in software and commercial business processes.

#### **4.6.8.2.1 Workflow coverage methodology**

#### **4.6.8.2.2 Workflow coverage analysis**

### **4.6.9 Revision plans**

#### **4.6.9.1 Revision plans list**

There are two revisions planned for BPie at this point. One minor upgrade and one major upgrade which will cover the full scope defined in the process map.

- Minor - The space Occupancy schedule which in BPie is mapped to properties in the 2x3 schema and to IfcWorkCalendar for ifc4, will be mapped to wsCalendar. WsCalendar is under revision, and when this is finalized and published in a format 1:1 compliant with IfcWorkCalendar, this will be mapped and published in the BPie specification.

The major revision planned the next year is release of the two missing ER's, BPie\_v2 – July 2014

- There are two Exchange requirements captured in the process map not yet defined. The ER for FF&E requirements and ER for System requirements. These ER's have been addressed in the BuildingSMART "Roadmap 2016", and will be started the fall 2013. Expected completions date July 2014.

It is also expected annual revisions for the already defined exchanges, as organizations and software implement the specified BPie standard.

#### **4.6.9.1.1 Revision management process**

None

#### **4.6.9.1.2 Revision management notification**

None

#### **4.6.9.2 Proposed revision deployment methods:**

None

##### **4.6.9.2.1 Revision management process**

##### **4.6.9.2.2 Revision management notification**

## [Annexes](#)

### **Annex I**

Review report of previously projects related to BPIe “Annex\_I\_2011-03-14-BPIe\_previous\_BS\_programming”

### **Annex II**

Process map for Building Programming/BPIe,  
“Annex\_II\_IDM\_process\_map\_building\_programming\_161111”

### **Annex III**

Exchange Requirement for Space Program “Annex\_III\_er\_exchange\_requirement\_space\_program”

### **Annex IV**

Exchange Requirement for Spatial Requirements  
“Annex\_IV\_er\_exchange\_requirement\_spatial\_requirements”

### **Annex V**

Exchange Requirements Model for ER's in Annex III & IV,  
“Annex\_V\_IDM\_exchange\_req\_building\_programming\_161111”

### **Annex VI**

Model View Definition for BPIe “Annex\_VI\_MVD\_BPIE2013”

### **Annex VI-2**

Updated Model View Definition for BPIe “Annex\_VI\_2\_MVD\_BPIE2013.mvdxml”

### **Bibliography**

None