

National BIM Standard - United States® Version 3

4 Information Exchange Standards

4.9 Water Systems information exchange (WSie) – Edition 2013

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4.9.1 Scope

4.9.1.1 Business Case Description

4.9.1.1.1 Life-Cycle Phase List

Criteria Definition Phase

Design Phase

Coordination Phase

4.9.1.1.2 Business Case Description

The objectives of this project, which is part of the Life-Cycle Model For Mission Ready Sustainable Facilities (LCM), are to collect and document the requirements for water system design from subject matter experts (SMEs) – architects, engineers and specifiers involved in the design, specification and product selection for interior water usage systems – as well as from published documents on ELie (East, 2012b) and exploratory modeling of water system components and connections (WSie [East, 2012c]) which has not yet been published (Nisbet, McKay and East, n.d.), in order to create formal specifications that can be directly applied to open standard building information models at the coordinated design (also called construction documents) stage. This ontology is documented in the present report. An additional modeling report uses these requirements to update standard building models using commercial off-the-shelf (COTS) software in order to demonstrate the capabilities and limitations of the development of open BIM models.

- East, E.W., 2012b. Equipment Layout information exchange (ELie). Available at: <http://www.buildingsmartalliance.org/index.php/projects/activeprojects/114> 17 August 2012.
- East, E.W., 2012c. Water System information exchange (WSie). Available at: <http://www.buildingsmartalliance.org/index.php/projects/activeprojects/179> 17 August 2012.
- Nisbet, Nicholas, Dave McKay and Bill East, n.d. Water Usage System Information Exchange, Close-out Report. Unpublished draft manuscript, ERDC/CERL TR-08-DRAFT, US Army Corps of Engineers, Version 0.30, dated June 2011.

4.9.1.1.3 Business Case Analysis

This project documents the process flow and data exchange requirements for the design of interior water distribution systems in typical Army facilities. By “water distribution systems” we mean the plumbing supply and waste removal systems for flow delivery terminals such as sinks, toilets, showers and bath tubs. A subsequent part of this project applies the understanding of the process flow and exchange requirements to a “real-world” situation, examining how the information exchanges can be handled in existing Building Information Models (BIM) software, using three example Building Information Models (BIM) based on the BuildingSmart Industry Foundation Class (IFC) BIM schema. The example BIMs include a Duplex Apartment, an Office Building and a Medical Clinic, which represent typical low-rise Army facilities of each of these types. Water supply equipment and systems are updated using commercial off-the-shelf (COTS) BIM software and a native common object library developed in this COTS software. Coordinated IFC models are then generated using the COTS IFC export capability.

4.9.1.2 Participants and Stakeholders

4.9.1.2.1 Participants List

- Amos, Joseph O., FKP Architects Inc. [A]

- Bailey, Omar H., Bailey Edward Architecture [A]
- Bailin, Stewart, Water Harvesting Solutions [S]
- Bogen, Chris. US Army Corps of Engineers [D]
- Cameron, Damon. dbHMS [A]
- Chipman, Tim. Constructivity.com LLC [D]
- East, Edward William. US Army Corps of Engineers [D]
- Fallon, Kristine. Kristine Fallon Associates, Inc. [A]
- Fadojutimi, Omobolawa. Kristine Fallon Associates, Inc. [A]
- Feldman, Robert A. Kristine Fallon Associates, Inc. [D]
- Forester, Jim. Newforma [E, D]
- Kalin, Mark. Kalin Associates. [S]
- Kopischke, Darcie K [A]
- Williams, Gregory. Kristine Fallon Associates, Inc.

4.9.1.2.2 Stakeholders List

- Architect [A]
- Plumbing Engineer [E]
- Plumbing Specifiers [S]
- Software Developers [D]

4.9.1.2.3. Stakeholders Coverage Analysis

Each participant in Clause 4.9.1.2.1 has role(s) indicated according to abbreviations defined in Clause 4.9.1.2.2.

4.9.2 Normative references

4.9.2.1 References and Standards

4.9.2.1.1. 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.

ISO 16739, Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries

4.9.2.1.2. Reference Standards List (Other)

N/A

4.9.2.1.3. Reference Program and Project List

- East, E.W., Danielle Love and Nicholas Nisbet, 2010. A Life-Cycle Model for Contracted Information Exchange. Proceedings of the CIB W78 2010: 27th International Conference –Cairo, Egypt, 16-18 November 2010.
- East, E.W., 2012a. Construction Operations Building Information Exchange (COBie), <http://www.wbdg.org/resources/cobie.php> 6 August 2012]
- East, E.W., 2007. Construction Operations Building Information Exchange (COBIE), Requirements Definition and Pilot Implementation Standard, ERDC/CERL TR-07-30, US Army Corps of Engineers, http://www.wbdg.org/pdfs/erdc_cerl_tr0730.pdf August 2007

4.9.3 Terms, definitions, symbols and abbreviations

For the purpose of this document, the following definitions apply.

4.9.3.1

attribute

unit of information within an entity, defined by a particular type or reference to a particular entity

NOTE There are three kinds of attributes: direct attributes, inverse attributes and derived attributes.

4.9.3.2

inverse attribute

unit of information defining queries for obtaining related data and enforcing referential integrity

NOTE Similar to the term "navigation property" in entity-relational programming frameworks.

4.9.3.3

derived attribute

unit of information computed from other attributes using an expression defined in the schema

4.9.3.4

constraints on attributes

data type restricting the values of attributes

NOTE 1 The most general constraint is about the existence of attribute values. There are basically two types: mandatory and optional attributes. Values of mandatory attributes must be provided whereas values of optional attributes may be omitted.

NOTE 2 For aggregation data types such as Set, List, or Array, the existence constraint is often refined by a minimal and maximal number of elements, which is also known as cardinality.

4.9.3.5

entity

class of information defined by common attributes and constraints as defined in [ISO 10303-11]

NOTE Similar to the term "class" in common programming languages but describing data structure only (not behavior such as methods).

4.9.3.6

identification

capability to find, retrieve, report, change, or delete specific instances without ambiguity

4.9.3.7

instance

occurrence of an entity

NOTE Similar to the term "instance of a class" in object oriented programming.

4.9.3.8**object**

anything perceivable or conceivable that has a distinct existence, albeit not material

4.9.3.9**type**

basic information construct derived from a primitive, an enumeration, or a select of entities

NOTE 1 Similar to the "Type" construct as defined in [ISO 10303-11].

NOTE 2 Similar in concept to "typedef" or "value type" in common programming languages.

4.9.3.10**select**

construct that allows an attribute value to be one of multiple types or entities

NOTE 1 Similar to the "Select" construct as defined in [ISO 10303-11].

NOTE 2 Similar to a "marker interface" in common programming languages.

4.9.3.11**enumeration**

construct that allows an attribute value to be one of multiple predefined values identified by name

NOTE 1 Similar to the "Enumeration" construct as defined in [ISO 10303-11].

NOTE 2 Similar in concept to "enum" in common programming languages.

4.9.3.12**actor**

person, an organization, or person acting on behalf of an organization

NOTE A specialization of the general term object.

4.9.3.13**classification**

categorization, the act of distributing things into classes or categories of the same type

4.9.3.14**constraint**

restriction for a specified reason

NOTE A specialization of the general term control.

4.9.3.15**control**

directive to meet specified requirements such as for scope, time, and/or cost

NOTE A specialization of the general term object.

4.9.3.16**dictionary**

collection of words, terms or concepts, with their definition

4.9.3.17**element**

tangible physical product that can be described by its shape representation, material representations, and other properties

NOTE A specialization of the general term product.

4.9.3.18**element occurrence**

element's position within the project coordinate system and its containment within the spatial structure

4.9.3.19**external reference**

link to information outside the data set, with direct relevance to the specific information the link originates from inside the data set

4.9.3.20**feature**

parametric information and additional property information modifying the shape representation of an element to which it applies

4.9.3.21**group**

collection of information that fulfills a specified purpose

NOTE A specialization of the general term object.

4.9.3.22**library**

catalogue, database or holder of data, that is relevant to information in the data set

NOTE It is information referenced from an external source that is not copied into the data set.

4.9.3.23**object occurrence**

characteristics of an object as an individual

NOTE Similar to "object", "instance", "individual" in other publications.

4.9.3.24**object type**

common characteristics shared by multiple object-occurrences

NOTE Similar to "class", "template", "type" in other publications.

4.9.3.25**process**

object-occurrence located in time, indicating "when"

4.9.3.26**process occurrence**

conceptual object that may occur at a particular time

4.9.3.27**process type**

common characteristics shared by multiple process occurrences

4.9.3.28**product**

physical or conceptual object that occurs in space

NOTE It is specialization of the general term object.

4.9.3.29**product occurrence**

physical or conceptual object that may have a location in space and shape characteristics

4.9.3.30**product type**

common characteristics shared by multiple product occurrences

4.9.3.31**project**

encapsulation of related information for a particular purpose providing context for information contained within

NOTE Context information may include default measurement units or representation context and precision.

4.9.3.32**property**

unit of information that is dynamically defined as a particular entity instance

NOTE Similar to "late-bound" or "run-time" in programming terminology.

4.9.3.33**property occurrence**

unit of information providing a value for a property identified by name

4.9.3.34**property template**

metadata for a property including name, description, and data type

NOTE Similar in concept to "extension property" in common programming languages.

4.9.3.35**property set occurrence**

unit of information containing a set of property occurrences, each having a unique name within the property set

4.9.3.36**property set template**

set of property templates serving a common purpose and having applicability to objects of a particular entity

NOTE Similar in concept to "extension class" in common programming languages.

4.9.3.37**proxy**

object that does not hold a specific object type information

NOTE a specialization of object occurrence.

4.9.3.38**quantity**

measurement of a scope-based metric, specifically length, area, volume, weight, count, or time

4.9.3.39**quantity occurrence**

unit of information providing a value for a quantity

4.9.3.40**quantity set**

unit of information containing a set of quantity occurrences, each having a unique name within the quantity set

4.9.3.41**relationship**

unit of information describing an interaction between items

4.9.3.42**representation**

unit of information describing how an object is displayed, such as physical shape or topology

4.9.3.43**resource**

entity with limited availability such as materials, labor, or equipment

NOTE 1 a specialization of the general term object.

NOTE 2 the "resource definition data schemas" section is unrelated to this concept.

4.9.3.44**resource occurrence**

entity with inherent financial cost, which may be passed onto processes, products, and controls to which it is assigned

4.9.3.45**resource type**

common characteristics shared by multiple resource occurrences

4.9.3.46**space**

area or volume bounded actually or theoretically

NOTE a specialization of the general term product.

4.9.3.47**AEC**

Architecture, Engineering, and Construction

4.9.3.48**AEC/FM**

Architecture, Engineering, Construction, and Facilities Management

4.9.3.49**BIM**

Building Information Modeling

4.9.3.50**GUID**

Globally Unique Identifier

4.9.3.51**IFC**

Industry Foundation Classes

4.9.3.52**IFD**

International Framework for Dictionaries

4.9.3.53**SPF**

STEP Physical File

4.9.3.54

STEP

STandard for the Exchange of Product data

4.9.3.55**URI**

Uniform Resource Identifier

4.9.3.56**UUID**

Universally Unique Identifier

4.9.4 Business Process Documentation**4.9.4.1 Process Models Provided****4.9.4.1.1 Business Process List**Criteria Phase

Develop Facility Occupancy Model

Compare System Options

Schematic Design Phase

Locate Plumbing Fixtures

Propose Plumbing Equipment Requirements

Propose Plumbing Spatial Requirements

Locate and Size Plumbing Equipment Room(s)

Specify Plumbing System Performance

Size Plumbing System

Develop Basis of Design

Document Plumbing Design Schematic

Coordinate With Other Building Systems

Coordinated Design Phase

Update Facility Spatial Configuration

Determine Water Supply Requirements

Calculate Water Balance

Create Piping Schematics

Layout Plumbing System

Update Piping and Equipment Size

Update Plumbing Spatial Requirements

Update Facility Spatial Configuration

Develop Product Specifications and Candidates

Document Plumbing Design Coordinated

Coordinate With Other Building Systems

4.9.4.1.2 Business Process Descriptions**Criteria Phase****Develop Facility Occupancy Model**

Architect receives document(s) from the Owner. Architect uses these documents, in conjunction with Building Code guidelines and standards, to develop the Facility Occupancy Model.

Compare System Options

Plumbing Engineer uses the Facility Occupancy Model, along with standard cost and performance information, to compare plumbing system options and recommend one or more plumbing system type(s) and a preliminary schedule of fixture types and counts.

Schematic Design Phase**Locate Plumbing Fixtures**

Architect uses the recommendations and preliminary schedule from the Plumbing Engineer to indicate locations of the plumbing fixtures in the initial schematic plans.

Propose Plumbing Equipment Requirements

Plumbing Engineer uses the information provided by the Architect on the plumbing system and other water and waste systems to develop one or more proposal(s) for plumbing equipment requirements. Plumbing Engineer creates a Plumbing Equipment List.

Propose Plumbing Spatial Requirements

Plumbing Engineer uses the Plumbing Equipment List and preliminary architectural plans to develop proposed Plumbing Space Requirements.

Locate and Size Plumbing Equipment Room(s)

Architect uses the proposed plumbing spatial requirements developed by the Plumbing Engineer to locate and size any needed plumbing equipment rooms in the schematic plans.

Specify Plumbing System Performance

Plumbing Engineer uses the supplied information to calculate Plumbing System performance values and create a performance specification.

Size Plumbing System

Plumbing Engineer uses this information to size the elements of the Plumbing System.

Develop Basis of Design

Plumbing Engineer uses the supplied information to develop a Basis of Design for the Plumbing System. The Basis of Design is exemplar products with the correct capacities and performance characteristics.

Document Plumbing Design Schematic

Plumbing Engineer creates updated plumbing drawings and schedules that illustrate the Design Schematic plumbing layout.

Coordinate With Other Building Systems

Plumbing Engineer sends the plumbing drawings to the Architect. Typically, piping runs are shown as a single line and may not be annotated as to elevation. Architect takes drawings from all disciplines and either visually compares them (by such means as a light table or computer overlays) or utilizes clash detection software to identify and resolve spatial conflicts between building systems.

Coordinated Design Phase**Update Facility Spatial Configuration**

Architect revises the facility spatial configuration plans based on the results of the coordination that took place at the end of Design Schematic.

Determine Water Supply Requirements

Plumbing Engineer uses the Product Type Template, updated plans and other-discipline information to determine total water supply requirements.

Calculate Water Balance

The Plumbing Engineer performs manual calculations to determine the potential demand and supply of grey water in a facility based on usage by all disciplines. Plumbing Engineer updates the Water Supply Requirements and listing of plumbing equipment types, sizes and locations, if needed.

Create Piping Schematics

The Plumbing Engineer revises riser diagram(s) of the plumbing system based on updated facility spatial configuration provided by the Architect. This is completed by referencing the 2-D plans provided and manually creating a 2-D elevation, generically showing the entire piping system. The Plumbing Engineer creates or updates plumbing topology, plumbing equipment schedule, plumbing controls schedule and plumbing zone diagrams and forwards the drawings and schedules to the Architect.

Layout Plumbing System

The Plumbing Engineer creates updated plumbing layout drawings based on architectural floor plans, the updated requirements of other building systems and previously-created piping schematics.

Update Piping and Equipment Size

Plumbing Engineer updates the schedules of piping and equipment sizes.

Update Plumbing Spatial Requirements

Plumbing Engineer updates the spatial requirements for the needed plumbing equipment based on any architectural design changes. The Plumbing Engineer communicates any increases or reductions in plumbing spatial requirements to the Architect.

Update Facility Spatial Configuration

Architect revises the facility spatial configuration plans based on the updated plumbing layout and spatial requirements provided by the Plumbing Engineer.

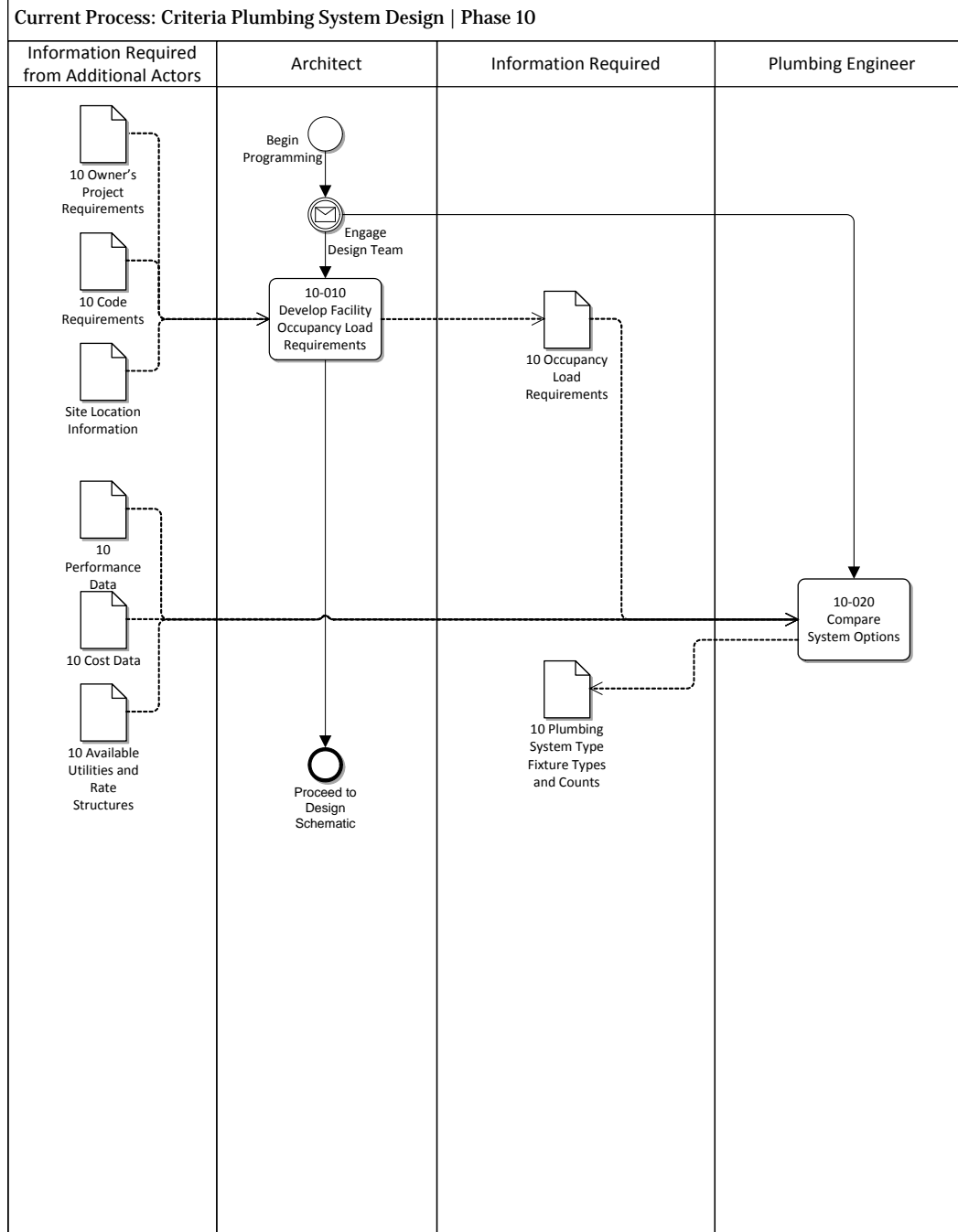
Develop Product Specifications and Candidates

On projects where the product specifications are performance-based rather than proprietary, and the project delivery method is design-bid-build, the Architect downloads multiple manufacturers' product information to compare properties of fixtures. Based on the fixture specification the Architect selects three (3) equal products and e-mails the manufacturers' cut sheet information to the Plumbing Engineer or Specifier. The Plumbing Engineer or Specifier manually creates the 3-part specifications based on information received.

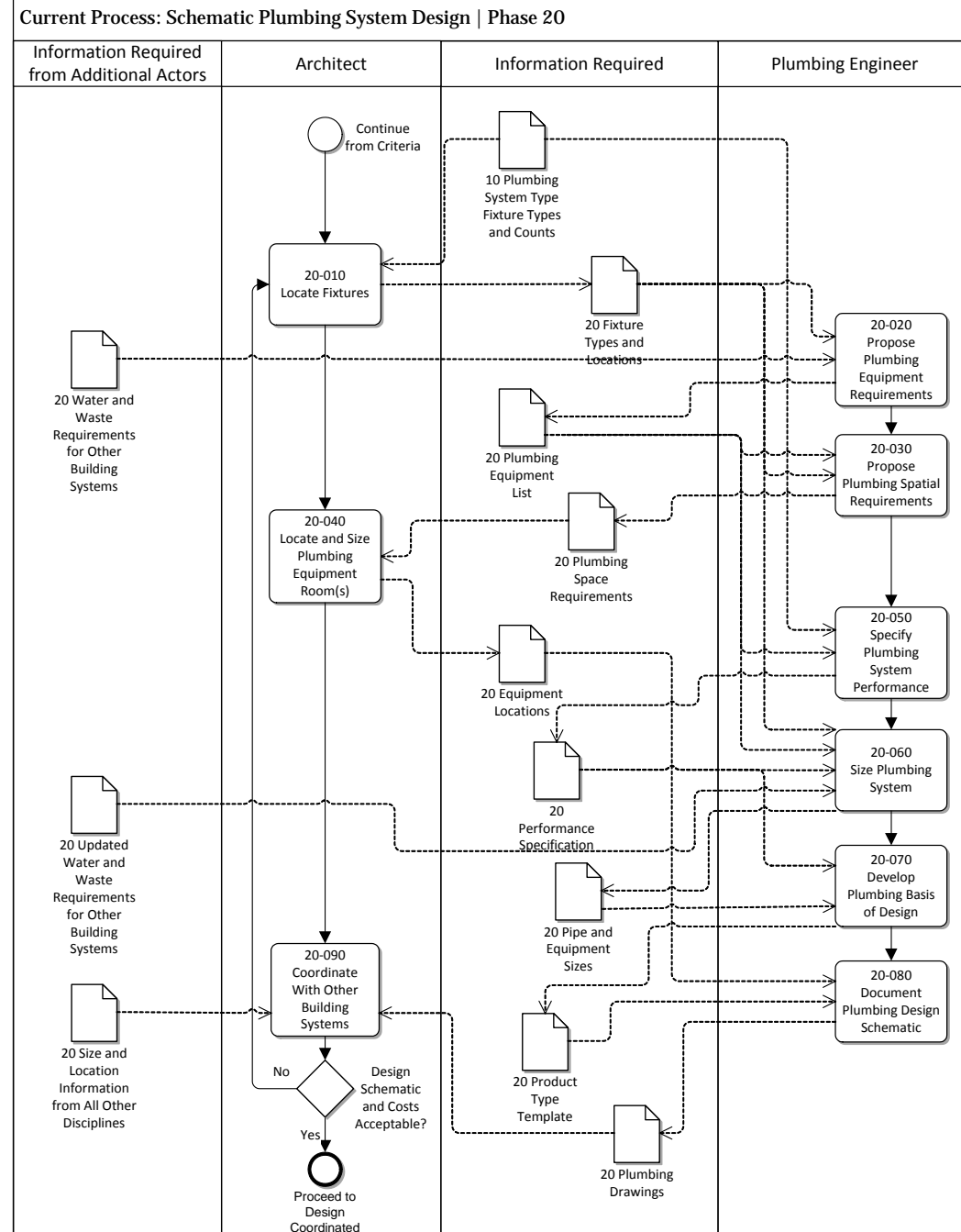
Document Plumbing Design Coordinated

Plumbing Engineer sends the plumbing drawings to the Architect. Typically, piping runs are shown as a single line and are mainly not annotated as to elevation. Architect takes drawings from all disciplines and visually compares them (by such means as a light table, computer overlays or clash detection software in the case of a 3D model) to identify and resolve spatial conflicts between building systems.

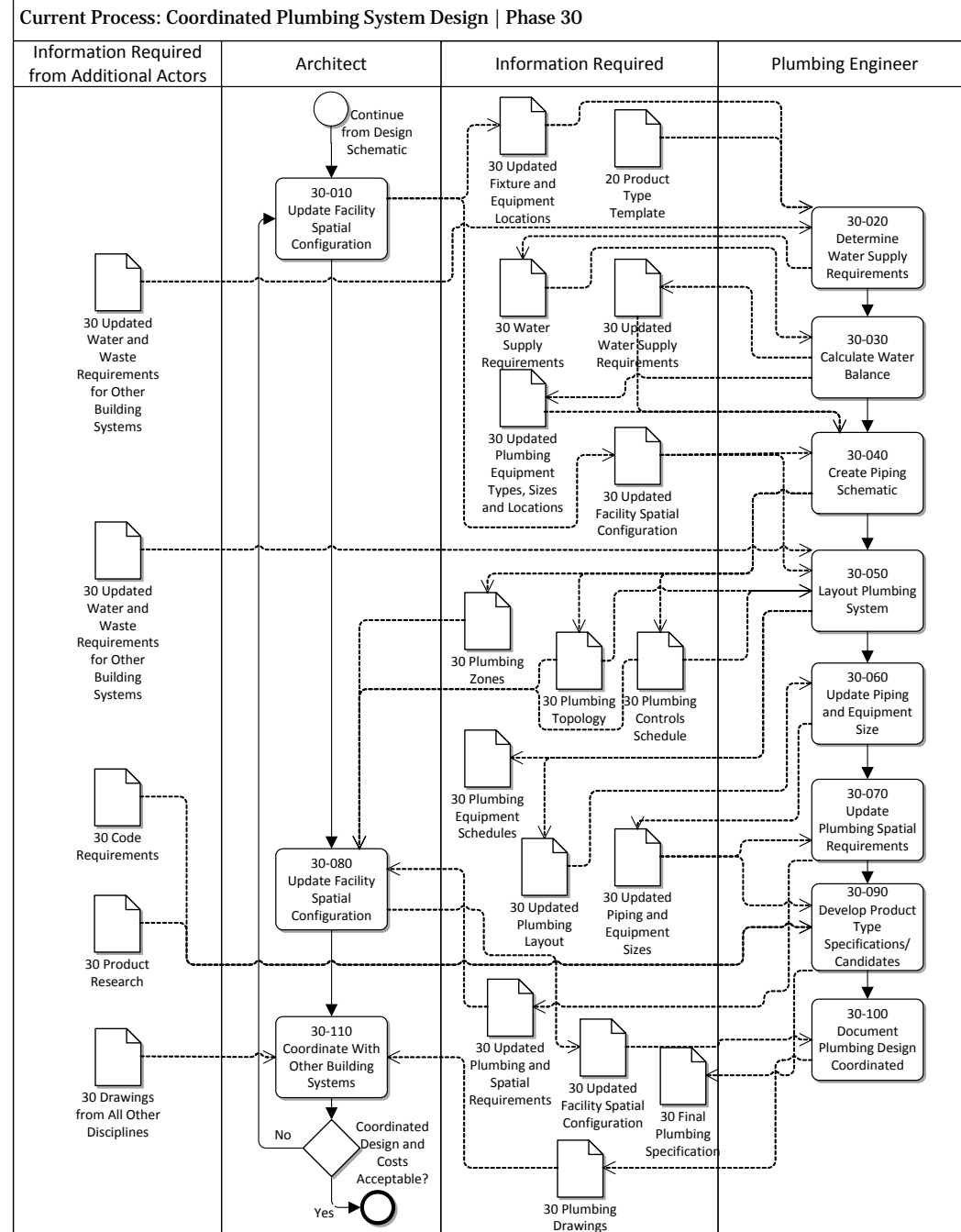
4.9.4.1.3 Business Process Model Diagrams

Criteria Phase


Schematic Design Phase



Coordinated Design Phase



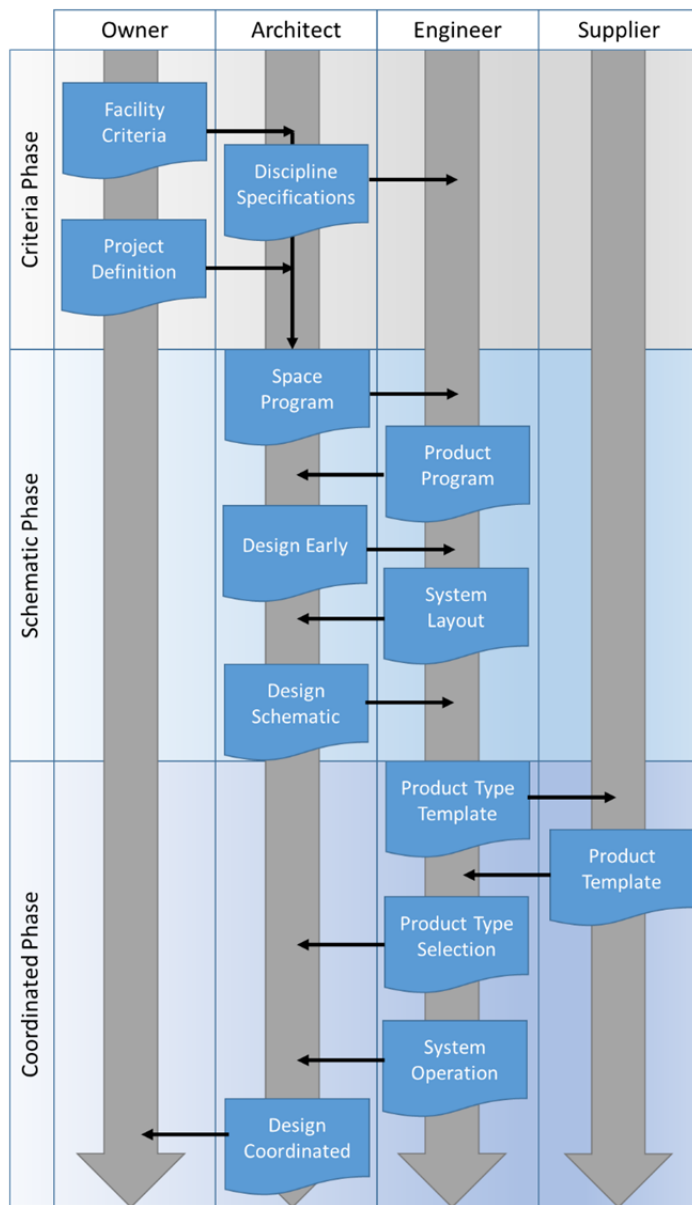
4.9.4.2 Representative Process Models

4.9.4.2.1 Stakeholder Coverage Analysis

In order to validate process diagrams and exchange requirements for building water distribution systems, the team used the following steps:

- Create “straw-man” process diagrams and task descriptions for each of three phases of the design process (Criteria [also called Programming and Concept Design], Schematic Design [Design Development] and Coordinated Design [Construction Documents]). The process diagrams included suggested steps for the typical Army design process and the task descriptions included suggested information requirements needed to accomplish the task step.
- Assemble a group of subject matter experts (SME) to review and comment on the process diagrams and task descriptions. These experts included two architects, two engineers and two specifiers with experience in the design of building plumbing systems.
- Hold meetings with the SME reviewers to explain the process and review criteria.
- Send the process diagrams and task descriptions to the SMEs for their review.
- Analyze the SME comments and contact the SMEs for clarification and additional comments, as needed.
- Revise the process diagrams and task descriptions based on the SME comments.

Processes were rationalized with those in other information exchanges, resulting in the following unified process diagram.



4.9.4.2.2 Process Coverage Analysis

The team felt that providing “straw-man” process diagrams and task description forms for the design of electrical systems would stimulate input from the SME reviewers. The particular selection and sequencing of tasks was intended as a starting point that would be refined using the SME reviewers’ feedback.

4.9.4.2.3 Contract Documentary Deliverable List

The task forms included the following information:

Item	Description
Task ID	Sequential ID number for the task.
Task Name	A short descriptive name for the task
Information Provider (Roles Involved)	The role or roles that provide the input information necessary to do the task.
Information Provider (Phase)	The stage in the process when the required information is created.
Actor (Roles Involved)	The role or roles that complete the task.
Actor (Phase)	The stage in the process at which the task requires the information.
Information Required	The input information necessary to complete the task.
Current Methods	A short description of the task and its inputs and outputs.

4.9.4.2.4 Contract Documentary Deliverable Analysis

For the task forms, the reviewers were asked:

- Do the task forms accurately and completely detail all information needed to perform the task?
- If not, what is missing?
- Who provides the additional inputs?
- Are Current Methods of performing the task accurately described?

For the process diagrams, the reviewers were asked:

- Although every project has unique circumstances, are the tasks shown in the typically correct order?
- Have we missed any tasks?
- Are there any unnecessary tasks?
- Are all tasks assigned to the correct phase(s)?
- Are all tasks assigned to the correct actor?
- Are all actors that provide the Information Required indicated?
- Are any extraneous actors indicated?

4.9.4.3 Process Models Formatting

4.9.4.3.1 BPMN Usage Description

Models in graphical format are provided in Clause 5.1.3.

4.9.5 Exchange requirements

4.9.5.1 Exchange requirements legibility

4.9.5.1.1 Exchange requirements list

Each exchange is listed by name as follows.

- Facility Criteria
- Discipline Specifications
- Project Definition
- Space Program
- Product Program
- Design Early
- System Layout
- Design Schematic
- Product Type Template
- Product Template
- Product Type Selection
- System Operation
- Design Coordinated

4.9.5.1.2 Exchange requirement classification list

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

- 31-30 00 00 Criteria Definition Phase
- 31-40 00 00 Design Phase
- 31-50 00 00 Coordination Phase

4.9.5.1.3 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	31-30 00 00 Criteria Definition Phase	34-10 11 00 Owner	34-20 11 11 Architect
Discipline Specifications	31-30 00 00 Criteria Definition Phase	34-20 11 11 Architect	34-20 11 21 Engineer
Project Definition	31-30 00 00 Criteria Definition Phase	34-10 11 00 Owner	34-20 11 11 Architect
Space Program	31-40 00 00 Design Phase	34-20 11 11 Architect	34-20 11 21 Engineer
Product Program	31-40 00 00 Design Phase	34-20 11 21 Engineer	34-20 11 11 Architect
Design Early	31-40 00 00 Design Phase	34-20 11 11 Architect	34-20 11 21 Engineer
System Layout	31-40 00 00 Design Phase	34-20 11 21 Engineer	34-20 11 11 Architect

Design Schematic	31-40 00 00 Design Phase	34-20 11 21 Engineer	34-20 11 11 Architect
Product Type Template	31-50 00 00 Coordination Phase	34-20 11 21 Engineer	34-35 10 21 Supplier
Product Template	31-50 00 00 Coordination Phase	34-35 10 21 Supplier	34-20 11 21 Engineer
Product Type Selection	31-50 00 00 Coordination Phase	34-20 11 21 Engineer	34-20 11 11 Architect
System Operation	31-50 00 00 Coordination Phase	34-20 11 21 Engineer	34-20 11 11 Architect
Design Coordinated	31-50 00 00 Coordination Phase	34-20 11 11 Architect	34-20 11 21 Engineer

4.9.5.2 Exchange requirements detail

4.9.5.2.1 Exchange requirements definition

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

Facility Criteria

This exchange includes high-level criteria specific to the building to be constructed, but without regard for particular disciplines.

The facility occupancy model describes the site location, owner's project requirements, and building requirements.

The site location indicates the geographic location for determining climate information, and the legal address for determining the jurisdiction and applicable building codes.

Discipline Specifications

Domestic water requirements are based on occupancy load requirements and performance data for equipment.

The following information is captured for each class of fixture:

- Flow rate
- Flow test
- Volume Per Visit
- Visits per Person per Period
- Minutes in Use
- Numbers of Users
- Efficiency Label
- Volume Per Day
- Input / Output Ratio
- Water Input Grade
- Water Output Grade
- Operating Pressure
- Distance to Source – Civil Plans
- Water Supply Fixture Unit (WSFU)
- Pressure Drop

The following information is captured for available systems that may provide the energy source for water heating:

- Gas
- Oil
- Electrical

The following information is captured for water distribution systems:

- Cost of system based on project type
- Cost of system based on anticipated water input

The following information is captured for project cost control:

- System budget
- Available utilities and rate Structures

Project Definition

This exchange includes initial project information to describe a project and its contents.

The owner's project requirements consist of a facility type and a set of space types, each indicating occupancy loads, hours of occupancy, design priorities, and required plumbing fixtures per occupant.

Space Program

This exchange requires spatial information for areas containing plumbing fixtures and equipment to determine allocated space.

Product Program

Plumbing equipment is determined according to water quality and flow properties of allocated sanitary terminals.

Valves are determined according to system transitions (such as from Domestic Cold Water to Irrigation) where backflow preventers or release valves may be required. While not every valve must be elaborated at this stage, those that significantly impact pressure (such as backflow preventers) are required such that pumps may be sized appropriately.

Pumps are determined according to required pressure at fixtures, placement elevations, and pressure drop throughout downstream piping, valves, filters, and pumps.

Water heaters and holding tanks are determined according to required temperature and consumption based on occupancy patterns, and heat loss throughout downstream piping.

Water filtration equipment is determined according to required water quality at fixtures and incoming water quality from the water source (such as utility, community well, or private well).

Equipment rooms may be sized according to clearance volumes of boilers, pumps, filters, and appliances. While the final sizes are not yet known at this stage (piping layout and thermodynamic analysis has not yet been done), space allocation is only accurate according to the general equipment requirements. This includes physical representation as well as clearance volumes, which may take into account handicap accessibility requirements.

Design Early

A preliminary schedule of plumbing fixture types may be indicated:

- Bath
- Toilet
- Shower
- Sink
- Drinking Fountain
- Urinal

For each fixture type, system connections must be indicated including:

- Cold Water
- Hot Water
- Grey Water

- Black Water
- Rainwater Harvesting
- Waste
- Specialty Waste
- Pure water
- Other liquid, gas, or fuel services
- Hot water fuel source

System Layout

This exchange indicates required quantities and sizes of plumbing equipment (pumps, valves, boilers, filters) based on system performance. It does not account for particular piping layout, therefore calculated pressure drop is approximated based on elevation and nominal horizontal routing.

This exchange enables an architect to revise the facility spatial configuration plans based on the results of the coordination at the end of Design Schematic. Required information includes:

- Spatial Elements (Buildings, Levels, Spaces, etc.)
- Building Elements (Walls, Slabs, Doors, Windows, etc.)
- Distribution Elements (Electrical, HVAC, Plumbing, etc.)
- Spatial Zones
- Systems & Circuits
- Connectivity (Space Boundaries, Ports, Connections, Interferences)
- Actors & Assignments

This exchange provides detailed information for connectivity and placement of pipes, including the following:

- Sanitary Terminal: Location, Load, Controls
- Valve: Location, Load
- Pipe Segment: Location, Connections, Load, Length, Material (copper, PEX, PVC, etc.)

Design Schematic

The plumbing design schematic indicates system connectivity among fixtures and indicates pipe sizes, but does not indicate particular paths of pipes.

Product Type Template

Document process model, constraints, formulas, and tables used for making decisions on plumbing design.

- Water calculations showing required and designed flow rate, pressure, and temperature
- Estimated water heater loading
- Estimated water treatment loading
- Estimated water pump loading
- A projection/summation of the pump loads to justify the sizing of the pumps
- Estimated water source loading
- An economic analysis to justify the selection of utility water, community well, or private well (if in rural areas)

Product Template

This exchange includes product type information for specific product models provided by manufacturers.

Product Type Selection

For this exchange, the engineer selects specific plumbing equipment models (or an approved list from several manufacturers).

Based on final allocation of pipe routing, pipes and equipment sizes may be adjusted.

All products may have defined types indicating manufacturer, model, and specifications. Such types may also have assigned tasks and resources for procurement, where resource types indicate supplier, location, and cost.

System Operation

Performance requirements are elaborated for every water terminal, which may be used to size the plumbing system.

Each element requires the following at incoming water connections:

- Pressure range
- Volumetric flow range
- Pipe diameter
- Water quality
- Temperature range
- Environmental temperature range (such as exterior for freeze protection)

Each element requires the following at outgoing drainage connections:

- Volumetric flow range
- Pipe diameter

Calculations are performed to determine the potential demand and supply of grey water in a facility based on usage by all disciplines. Water Supply Requirements are updated to reflect a revised listing of plumbing equipment types, sizes and locations, if needed.

- Flowrate for fixtures (e.g. GPM gallons per minute)
- Volume Per Visit
- Visits per Person per Period
- Minutes in Use
- Numbers of Users
- Efficiency Label
- Volume Per Day
- Input / Output Ratio
- Water Input Grade
- Water Output Grade
- Operating Pressure
- Distance to Source
- Water Supply Fixture Unit (WSFU)

A plumbing engineer uses the product type templates, updated plans, and other discipline information to determine total water supply requirements. For each plumbing fixture, compatible product types are selected for each product occurrence [or if required by contract arrangement, multiple compatible product types are selected that are suitable]. The project delivery method may require the owner's approval for final product selection. The total water supply requirements are calculated on each branch according to concurrent design load.

Design Coordinated

The coordinated design contains full detail for all plumbing devices and their placement and interaction with other services within the building.

For coordination with other building systems, plans are created showing equipment locations as well as pipe routing and connectivity. Plumbing schedules for equipment, fixtures, and pipes are derived.

Slabs, walls, coverings, openings, and system furnishings are included for coordination, as most fixtures and piping is anchored or embedded within such elements, where dimensions must be known for proper sizing and locating of pipes and/or sizing of enclosing furnishings. The anchoring of elements is significant, as it indicates construction precedence: for example, a sink embedded within a counter anchored to a wall implies the counter must be installed prior to the sink installation, whereas direct connection to a wall implies otherwise.

Ports are indicated on all plumbing fixtures and equipment with full location, geometry, and connectivity information. Unlike electrical ports that may simply not have a connection, an open pipe port indicates a leak in the system which must be terminated by a pipe fitting cap or other equipment.

4.9.5.2.2 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	Revision Control	Descriptions	Conversion Units	Classification	Properties for	Actor Assignment	Control Assignment	Product Assignment	Process Assignment	Resource Assignment	Spatial Decomposition	Nesting	Calendar	Footprint Geometry	Site Location	Building Location	Building Storey Elevation	Resource Cost	Resource Quantity
IfcProject	R	O	O	O																
IfcTask	R									R										
IfcWorkCalendar	R						R						O	R						
IfcBuilding	R				R	O		R				O					O			
IfcBuildingStorey	R																	O		
IfcSite	R											R			O	O				
IfcOccupant	R						O													
IfcConstructionProductResource	R										R								O	R

Discipline Specifications

Entity	Identity	Revision Control	Descriptions	Conversion Units	Classification	Properties for Occurrences	Actor Assignment	Group Assignment	Aggregation	Spatial Decomposition	Nesting	Organization Role	Footprint Geometry	Site Location	Building Location	Building Storey Elevation	Resource Cost	Resource Quantity	Resource Cost Rate
IfcActor	R					O	R					R							
IfcProject	R	O	O	O															
IfcBuilding	R				R	O				O					R				
IfcBuildingStorey	R															O			
IfcSite	R									R			O	O					
IfcDistributionSystem	R					R		O	O										
IfcCostSchedule	R										O								
IfcSubContractResource	R																R	R	
IfcSubContractResourceType	R																		R
IfcSanitaryTerminal	R																		

Project Definition

Entity	Identity	Revision Control	Descriptions	Conversion Units	Spatial Decomposition
IfcProject	R	O	O	O	R
IfcBuilding	R				R
IfcBuildingStorey	R				O
IfcSite	R				R
IfcSpace	R				
IfcDistributionSystem	R				

Space Program

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Classification	Object Typing	Properties for	Spatial Decomposition	Ports	Placement	Footprint Geometry	Site Location	Building Location	Building Storey Elevation
IfcProject	R	O	O	O	O				R						
IfcBuilding	R					R		O	R					O	
IfcBuildingStorey	R								R						R
IfcSite	R								R			O	O		
IfcSpace	R					R	O	O							
IfcElectricAppliance	R							O		R					
IfcBoiler	R						O			R					
IfcFilter	R							R		R					
IfcPump	R							R		R					
IfcValve	R							R		R					
IfcSanitaryTerminal	R							R		R	R				

Product Program

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Classification	Object Typing	Properties for Occurrences	Spatial Decomposition	Ports	Footprint Geometry	Site Location	Building Location	Building Storey Elevation
IfcProject	R	O	O	O	O				R					
IfcBuilding	R					R		O	R				R	
IfcBuildingStorey	R								O					R
IfcSite	R								R		O	O		

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Classification	Object Typing	Properties for Occurrences	Spatial Decomposition	Ports	Footprint Geometry	Site Location	Building Location	Building Storey Elevation
IfcSpace	R					R	O	O						
IfcDistributionPort	R							O						
IfcSystemFurnitureElement	R							R						
IfcElectricAppliance	R							R		R				
IfcBoiler	R							R		R				
IfcFilter	R							R		R				
IfcFlowMeter	R							R						
IfcPump	R							R		R				
IfcValve	R							R		R				
IfcSanitaryTerminal	R							R		R				
IfcWasteTerminal	R							R		R				

Design Early

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Project Context	Classification	Object Typing	Properties for Occurrences	Spatial Decomposition	Ports	Placement	Footprint Geometry	Body Geometry	Clearance Geometry	Site Location	Building Location	Building Storey Elevation
IfcProject	R	O	O	O	O	R				R							O	
IfcBuilding	R						R		O	R								
IfcBuildingStorey	R								O	R								R
IfcSite	R									R			O			O		
IfcSpace	R						R	O	O									
IfcDistributionPort	R								O			O						
IfcElectricAppliance	R										R							

IfcSolarDevice	R								R		R						
IfcBoiler	R								R		R						
IfcFilter	R								R		R						
IfcFlowMeter	R								R		R						
IfcPump	R								R		R						
IfcValve	R								R		R						
IfcSanitaryTerminal	R								R		R	O	O	O	O		
IfcWasteTerminal	R								R		R						

System Layout

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Project Context	Classification	Material Profile Set Usage	Object Typing	Properties for Occurrences	Spatial Decomposition	Ports	Spatial Containment	Port Connectivity	Placement	Footprint Geometry	Site Location	Building Location	Building Storey Elevation
IfcProject	R	O	O	O	O	R					R								
IfcBuilding	R						R			O	R							O	
IfcBuildingStorey	R										O								R
IfcSite	R										R					O	O		
IfcSpace	R						R		O	O									
IfcDistributionPort	R							R		O				O	R				
IfcElectricAppliance	R									R		R							
IfcBoiler	R								O	R		R							
IfcFilter	R									R		R	R						
IfcFlowMeter	R																		
IfcPipeSegment	R																		
IfcPump	R									R		R	R						
IfcValve	R									R		R							
IfcSanitaryTerminal	R									R		R			R				

Design Schematic

Building Storey Elevation																													
Building Location																													
Site Location																													
Clearance Geometry																													
Body Geometry																													
Surface Geometry																													
Footprint Geometry																													
Axis Geometry																													
Placement																													
Interference																													
Port Connectivity																													
Path Connectivity																													
Element Connectivity																													
Spatial Containment																													
Ports																													
Voiding																													
Spatial Decomposition																													
Aggregation																													
Properties for Occurrences																													
Object Typing																													
Material Profile Set Usage																													
Material Layer Set Usage																													
Classification																													
Project Context																													
Conversion Units																													
Project Declaration																													
Descriptions																													
Revision Control																													
Identity																													
Entity																													
IfcProject	R	O	O	O	O	R							R																
IfcBuilding	R						R				O		R														O		
IfcBuildingStorey	R												O															R	
IfcOpeningElement	R																	R						R					
IfcSite	R												R									O				O			
IfcSpace	R						R			O	O																		
IfcMember	R																												
IfcSlab	R													R															
IfcSlabElementedCase	R											O				R					R		O						
IfcSlabStandardCase	R							R																R					
IfcWall	R													R					R										
IfcWallElementedCase	R											O				R				R	R		O						
IfcWallStandardCase	R							R													R			R					
IfcDistributionPort	R								R		O								R		O								
IfcElectricAppliance	R										R				R										R				
IfcSolarDevice	R										O				R										R				
IfcBoiler	R									O	R				R										R	O			
IfcFilter	R										R				R	R									R				
IfcFlowMeter	R										O				R	R									R				
IfcPipeFitting	R																												
IfcPipeSegment	R								R						R					O		R							
IfcPump	R										R				R	R									R				
IfcValve	R										R				R										R				
IfcSanitaryTerminal	R										R				R		O				R		R		R	O			

Building Storey Elevation	
Building Location	
Site Location	
Clearance Geometry	O
Body Geometry	R
Surface Geometry	
Footprint Geometry	
Axis Geometry	
Placement	
Interference	
Port Connectivity	
Path Connectivity	
Element Connectivity	
Spatial Containment	
Ports	R
Voiding	
Spatial Decomposition	
Aggregation	
Properties for Occurrences	R
Object Typing	
Material Profile Set Usage	
Material Layer Set Usage	
Classification	
Project Context	
Conversion Units	
Project Declaration	
Descriptions	
Revision Control	
Identity	R
Entity	IfcWasteTerminal

Product Type Template

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Project Context	Classification	Material Profile Set Usage	Properties for Occurrences	Spatial Decomposition
IfcProject	R	O	O	R	O	R				R
IfcDistributionPort	R							R	O	R
IfcSystemFurnitureElementType	R						R			R
IfcElectricApplianceType	R						R			R
IfcSolarDeviceType	R						R			R
IfcBoilerType	R						R			R
IfcFilterType	R						R			R
IfcFlowMeterType	R						R			R
IfcPipeFittingType	R						R			R
IfcPipeSegmentType	R						R			R

IfcPumpType	R						R		R	
IfcValveType	R						R		R	
IfcSanitaryTerminalType	R						R		R	
IfcWasteTerminalType	R						R		R	

Product Template

Entity	Identity	Revision Control	Descriptions	Project Declaration	Conversion Units	Project Context	Classification	Material Profile Set Usage	Properties for Occurrences	Properties for Types	Placement
IfcProject	R	O	O	O	O	O					
IfcDistributionPort	R							R	O		R
IfcElectricApplianceType	R						R			R	
IfcSolarDeviceType	R						R			R	
IfcBoilerType	R						R			R	
IfcFilterType	R						R			R	
IfcFlowMeterType	R						R			R	
IfcPipeFittingType	R						R			R	
IfcPipeSegmentType	R						R			R	
IfcPumpType	R						R			R	
IfcValveType	R						R			R	
IfcSanitaryTerminalType	R						R			R	
IfcWasteTerminalType	R						R			R	

Product Type Selection

Clearance Geometry
Body Geometry
Building Storey Elevation
Building Location
Site Location
Clearance Geometry
Body Geometry
Surface Geometry
Footprint Geometry
Axis Geometry
Placement
Interference
Port Connectivity
Element Connectivity
Spatial Containment
Connectivity
Type-Based Ports
Ports
Spatial Decomposition
Adagregation
System furniture element
Quantity Sets
Properties for Types
Properties for Occurrences
Object Typing
Material Constituents
Material Profile Set Usage
Material Profile Set
Material Layer Set Usage
Classification
Project Context
Conversion Units
Project Declaration
Descriptions
Revision Control
Identity
Entity

Building Storey Elevation	
Building Location	
Site Location	
Clearance Geometry	
Body Geometry	
Surface Geometry	
Footprint Geometry	
Axis Geometry	
Placement	
Interference	
Port Connectivity	
Element Connectivity	
Spatial Containment	
Connectivity	
Ports	
Voiding	
Spatial Decomposition	R
Aggregation	
Quantity Sets	
Properties for Occurrences	
Object Typing	
Material Profile Set Usage	
Material Layer Set Usage	
Classification	
Project Context	R
Conversion Units	O
Project Declaration	O
Descriptions	O
Revision Control	O
Identity	R
Entity	
	IfcProject

	Building Storey Elevation	Building Location	Site Location	Clearance Geometry	Body Geometry	Surface Geometry	Footprint Geometry	Axis Geometry	Placement	Interference	Port Connectivity	Element Connectivity	Spatial Containment	Connectivity	Ports	Voiding	Spatial Decomposition	Aggregation	Quantity Sets	Properties for Occurrences	Object Typing	Material Profile Set Usage	Material Layer Set Usage	Classification	Project Context	Conversion Units	Project Declaration	Descriptions	Revision Control	Identity	Entity
IfcBuilding		O														R				O				R					R		
IfcBuildingStorey	R															O													R		
IfcOpeningElement					R				R																				R		
IfcSite			O				O									R													R		
IfcSpace					R	R	R	R												O	O	O		R					R		
IfcMember																												R			
IfcSlab															R													R			
IfcSlabElementedCase						O			R			R					O												R		
IfcSlabStandardCase						R																R							R		
IfcWall															R													R			
IfcWallElementedCase						O		R	R				R				O												R		
IfcWallStandardCase						R		R														R							R		
IfcDistributionPort									R		R									O		R							R		
IfcSystemFurnitureElement																												R			
IfcSystemFurnitureElementType																												R			
IfcElectricAppliance					R										R					R									R		
IfcElectricApplianceType																												R			
IfcSolarDevice															R					O									R		
IfcSolarDeviceType																												R			
IfcBoiler															R					O	R								R	O	
IfcBoilerType																												R			
IfcFilter															R					R									R		
IfcFilterType																												R			
IfcFlowMeter															R					O									R		
IfcFlowMeterType																												R			
IfcPipeFitting																												R			

Clearance Geometry
Body Geometry
Building Storey Elevation
Building Location
Site Location
Clearance Geometry
Body Geometry
Surface Geometry
Footprint Geometry
Axis Geometry
Placement
Interference
Port Connectivity
Path Connectivity
Element Connectivity
Spatial Containment
Connectivity
Type-Based Ports
Ports
Voiding
Spatial Decomposition
Aggregation
System furniture element
Quantity Sets
Properties for Types
Properties for Occurrences
Object Typing
Material Constituents
Material Profile Set Usage
Material Profile Set
Material Layer Set Usage
Classification
Project Context
Conversion Units
Project Declaration
Descriptions
Revision Control
Identity
Entity

	Clearance Geometry	Body Geometry	Building Storey Elevation	Building Location	Site Location	Clearance Geometry	Body Geometry	Footprint Geometry	Axis Geometry	Placement	Interference	Port Connectivity	Path Connectivity	Element Connectivity	Spatial Containment	Connectivity	Type-Based Ports	Ports	Voiding	Spatial Decomposition	Adaptation	System furniture element	Quantity Sets	Properties for Types	Object Typing	Material Constituents	Material Profile Set Usage	Material Layer Set Usage	Classification	Project Context	Conversion Units	Project Declaration	Descriptions	Revision Control	Identity	Entity		
IfcProject																			R																			
IfcBuilding				R															R						O				R									
IfcBuildingStorey			R																R																			
IfcOpeningElement							R			R																												
IfcSite					R			O											R																			
IfcSpace							R	R		R													O	O	O				R									
IfcMember									R	R															O	R		R										
IfcSlab																			R																			
IfcSlabElementedCase										R				R							O																	
IfcSlabStandardCase																									O		R											
IfcWall													R						R																			
IfcWallElementedCase										R					R					O																		
IfcWallStandardCase																								O			R											
IfcDistributionPort										R			R												O		R											
IfcSystemFurnitureElement										R												O		O		O												
IfcSystemFurnitureElementType																																						
IfcElectricAppliance																		R						R	R													
IfcElectricApplianceType																																						
IfcSolarDevice																		R							O													
IfcSolarDeviceType																																					R O	
IfcBoiler																		R					O		R	R												
IfcBoilerType																																						

	Clearance Geometry	Body Geometry	Building Storey Elevation	Building Location	Site Location	Clearance Geometry	Body Geometry	Surface Geometry	Footprint Geometry	Axis Geometry	Placement	Interference	Port Connectivity	Path Connectivity	Element Connectivity	Spatial Containment	Connectivity	Type-Based Ports	Ports	Voiding	Spatial Decomposition	Aggregation	System furniture element	Quantity Sets	Properties for Types	Properties for Occurrences	Object Typing	Material Constituents	Material Profile Set Usage	Material Layer Set Usage	Classification	Project Context	Conversion Units	Project Declaration	Descriptions	Revision Control	Identity	Entity	
IfcFilter							R										R		R							R													
IfcFilterType																		R																					
IfcFlowMeter							R										R		R								R	O											
IfcFlowMeterType																		R																					
IfcPipeFitting																		R								R	R												
IfcPipeFittingType																			R																				
IfcPipeSegment							R			R		R							R							R	R		R										
IfcPipeSegmentType																										R													
IfcPump							R											R		R						R	R												
IfcPumpType																			R																				
IfcValve																		R		R						R	R												
IfcValveType																			R																				
IfcSanitaryTerminal																		R								R	R												
IfcSanitaryTerminalType																			R																				
IfcWasteTerminal																		R								R	R												
IfcWasteTerminalType																																							

4.9.5.2.3 Business rule definition

Business rule definitions are all defined as re-usable templates as indicated in Clause 7.3.5.

4.9.5.3 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.

4.9.5.3.1 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
31-30 00 00 Criteria Definition Phase		X	X			X	X
31-40 00 00 Design Phase		X			X	X	X
31-50 00 00 Coordination Phase					X	X	X

4.9.5.3.2 Related exchange requirement list

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

Exchange	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
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
System Layout		X		X	X	X	X
Design Schematic		X				X	X
Product Type Template		X			X	X	X
Product Template		X		X	X	X	X

Product Type Selection		X			X	X
System Operation		X		X	X	X
Design Coordinated		X			X	X

4.9.5.3.3 Related exchange requirement reuse analysis

Exchange requirements across other model views are correlated as follows

Exchange	Common Use Definitions	Facilities Management	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
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
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					

4.9.6 Model view definition

4.9.6.1 Data Definition

4.9.6.1.1 Data definitions list

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

- IfcKernel
- IfcActor
- IfcProject
- IfcControlExtension
- IfcPerformanceHistory
- IfcProcessExtension
- IfcTask
- IfcWorkCalendar
- IfcProductExtension
- IfcBuilding
- IfcBuildingStorey
- IfcOpeningElement
- IfcOpeningStandardCase
- IfcSite
- IfcSpace
- IfcSharedBldgElements
- IfcMember
- IfcSlab
- IfcSlabElementedCase
- IfcSlabStandardCase
- IfcWall
- IfcWallElementedCase
- IfcWallStandardCase
- IfcSharedBldgServiceElements
- IfcDistributionPort
- IfcDistributionSystem
- IfcSharedFacilitiesElements
- IfcOccupant
- IfcSystemFurnitureElement
- IfcSystemFurnitureElementType
- IfcSharedMgmtElements
- IfcCostSchedule

- IfcConstructionMgmtDomain
- IfcConstructionProductResource
- IfcSubContractResource
- IfcSubContractResourceType
- IfcElectricalDomain
- IfcElectricAppliance
- IfcElectricApplianceType
- IfcSolarDevice
- IfcSolarDeviceType
- IfcHvacDomain
- IfcBoiler
- IfcBoilerType
- IfcFilter
- IfcFilterType
- IfcFlowMeter
- IfcFlowMeterType
- IfcPipeFitting
- IfcPipeFittingType
- IfcPipeSegment
- IfcPipeSegmentType
- IfcPump
- IfcPumpType
- IfcValve
- IfcValveType
- IfcPlumbingFireProtectionDomain
- IfcSanitaryTerminal
- IfcSanitaryTerminalType
- IfcWasteTerminal
- IfcWasteTerminalType

4.9.6.1.2 Data definitions

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

IfcActor

The *IfcActor* defines all actors or human agents involved in a project during its full life cycle. It facilitates the use of person and organization definitions in the resource part of the IFC object model. This includes name, address, telecommunication addresses, and roles.

HISTORY [New entity in IFC2.0](#)

[EXPRESS Specification:](#)

ENTITY IfcActor

SUPERTYPE OF (IfcOccupant)

SUBTYPE OF (IfcObject);

TheActor : IfcActorSelect;

INVERSE

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

END_ENTITY;

Attribute Definitions:

TheActor : Information about the actor.

IsActingUpon : Reference to the relationship that associates the actor to an object.

Inheritance Graph:

ENTITY IfcActor

ENTITY IfcRoot

GlobalId : IfcGloballyUniqueId;

OwnerHistory : **OPTIONAL** IfcOwnerHistory;

Name : **OPTIONAL** IfcLabel;

Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;

IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;

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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;

Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;

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;

END_ENTITY;

```
<xs:element name="IfcActor" type="ifc:IfcActor" substitutionGroup="ifc:IfcObject" nillable="true"/>
<xs:complexType name="IfcActor">
  <xs:complexContent>
    <xs:extension base="ifc:IfcObject">
      <xs:sequence>
        <xs:element name="TheActor">
          <xs:complexType>
            <xs:group ref="ifc:IfcActorSelect"/>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

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:

HasName : The *Name* attribute has to be provided for IfcProject. It is the short name for the project.
CorrectContext : If a *RepresentationContexts* relation is provided then there shall be no instance of
IfcGeometricRepresentationSubContext directly included in the set of *RepresentationContexts*.
NoDecomposition : The IfcProject represents the root of the any decomposition tree. It shall therefore not be used
 to decompose any other object definition.
HasOwnerHistory : The *OwnerHistory* 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
OwnerHistory. It then overrides the common ownership and change 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 : **OPTIONAL** IfcOwnerHistory;
 Name : **OPTIONAL** IfcLabel;
 Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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 IfcContext

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

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>

```

IfcPerformanceHistory

IfcPerformanceHistory is used to document the actual performance of an occurrence instance over time. It includes machine-measured data from building automation systems and human-specified data such as task and resource usage. The data may represent actual conditions, predictions, or simulations.

The realtime data tracked by performance history takes the form of property sets where all properties are based on time series. Unlike design-based data at occurrences and types, performance-driven data is time-sensitive and may change in realtime by some measurement device. Data may be captured at irregular intervals such as when values change beyond established thresholds, or at regular intervals of specified duration.

Declaration use definition

IfcPerformanceHistory may be declared within a project using *IfcRelDeclares* where *RelatingContext* refers to the *IfcProject* and *RelatedDefinitions* includes the *IfcPerformanceHistory*. Default units (used for property sets) are indicated by the declaring project. Only top-level objects are declared; nested performance history objects (through *IfcRelNests*) do not participate in such relationship.

HISTORY New entity in IFC2x2.

[EXPRESS Specification:](#)

ENTITY IfcPerformanceHistory

SUBTYPE OF (IfcControl);

LifeCyclePhase : IfcLabel;
 PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

[Attribute Definitions:](#)

LifeCyclePhase : Describes the applicable building life-cycle phase. Typical values should be DESIGNDEVELOPMENT, SCHEMATICDEVELOPMENT, CONSTRUCTIONDOCUMENT, CONSTRUCTION, ASBUILT, COMMISSIONING, OPERATION, etc.

Inheritance Graph:

ENTITY IfcPerformanceHistory

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 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 IfcPerformanceHistory

LifeCyclePhase : IfcLabel;
 PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```
<xs:element name="IfcPerformanceHistory" type="ifc:IfcPerformanceHistory" substitutionGroup="ifc:IfcControl"
nillable="true"/>
<xs:complexType name="IfcPerformanceHistory">
  <xs:complexContent>
    <xs:extension base="ifc:IfcControl">
      <xs:attribute name="LifeCyclePhase" type="ifc:IfcLabel" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcTask

An *IfcTask* is an identifiable unit of work to be carried out in a construction project.

A task is typically used to describe an activity for the construction or installation of products, but is not limited to these types. For example it might be used to describe design processes, move operations and other design, construction and operation related activities as well.

Quantities of resources consumed by the task are dealt with by defining the *IfcElementQuantity* for the resource and not at the instance of *IfcTask*.

HISTORY New entity in IFC1.0. Renamed from *IfcWorkTask* in IFC2x.

IFC4 CHANGE Attributes *TaskTime* and *PredefinedType* added. *IfcMove* and *IfcOrderRequest* has been removed in IFC4 and are now represented by *IfcTask*. *IfcRelAssignsTasks* relationship has been removed as well.

Attribute use definition

Each occurrence of *IfcTask* is given a name that is indicative of its content (*IfcRoot.Name*). A textual description of the task may be provided and this may be further elaborated by a narrative long description (*IfcProcess.LongDescription*). A work method may be declared for the method of work used in carrying out a task. A task is identified as being either a milestone task or not. A milestone task is defined by the marker *IsMilestone*. and has no duration. A status and priority for each task may also be set.

Time and duration use definition

Compared to previous IFC releases, basic task time information (scheduled start time, scheduled finish time, duration) is now directly attached to *IfcTask* through the *TaskTime* attribute. Regular tasks are defined through *IfcTaskTime*. Recurring tasks are defined through *IfcTaskTimeRecurring*. In case a regular task is derived from a recurring task both tasks should be linked together through a *IfcRelNests* relationship, where *IfcRelNests.IsNestedBy* points to the recurring task and *IfcRelNests.Nests* points to all regular tasks that have been derived from the recurring task.

Representation of other activities

The use definitions for *IfcTask* have been generalised to represent other activities as well, including activities that had been defined by own entities in previous IFC releases. This includes

- Order actions
- Move operations

IfcTask represents an order that might be carried out by a Helpdesk acting the role of interface for the organization between the facility user and the functional requirement of fulfilling their needs. The actual task represented by the *IfcTask* entity is turning a request into an order and initiating the action that will enable the order to be completed. The *IfcProjectOrder* or one of its subtypes including maintenance work order, is related to the *IfcTask* using *IfcRelAssignsToControl*.

IfcTask can also be used to describe an activity that moves people, groups within an organization or complete organizations together with their associated furniture and equipment from one place to another. It thus replaces the previous IFC entity *IfcMove*. The functionality is represented in *IfcTask* as follows:

- **Move from:** The place from which actors and their associated equipment are moving.
Use *IfcRelAssignsToProcess* where *RelatingProcess* points to the task and *RelatedObjects* holds the location(s) from which to move.
- **Move to:** The place to which actors and their associated equipment are moving.
Use *IfcRelAssignsToProduct* where *RelatedObjects* points to the task(s) and *RelatingProduct* points to the location to which to move.
- **Punch list:** A list of points concerning a move that require attention.
Use *LongDescription* or else identify sub-tasks to track punch list items individually via *IfcRelNests*.

EXPRESS Specification:

ENTITY IfcTask

SUBTYPE OF (IfcProcess);

Status	: OPTIONAL IfcStrippedOptional;
WorkMethod	: OPTIONAL IfcStrippedOptional;
IsMilestone	: IfcStrippedOptional;
Priority	: OPTIONAL IfcStrippedOptional;
TaskTime	: OPTIONAL IfcStrippedOptional;
PredefinedType	: OPTIONAL IfcStrippedOptional;

WHERE

HasName	: EXISTS(SELF\IfcRoot.Name);
CorrectPredefinedType	: NOT(EXISTS(PredefinedType)) OR (PredefinedType <> IfcTaskTypeEnum.USERDEFINED) OR ((PredefinedType = IfcTaskTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcObject.ObjectType));

END_ENTITY;

Attribute Definitions:

Status	: Current status of the task. NOTE Particular values for status are not specified, these should be determined and agreed by local usage. Examples of possible status values include 'Not Yet Started', 'Started', 'Completed'.
WorkMethod	: The method of work used in carrying out a task. NOTE This attribute should not be used if the work method is specified for the <i>IfcTaskType</i>
IsMilestone	: Identifies whether a task is a milestone task (=TRUE) or not (= FALSE). NOTE In small project planning applications, a milestone task may be understood to be a task having no duration. As such, it represents a singular point in time.
Priority	: A value that indicates the relative priority of the task (in comparison to the priorities of other tasks).

Formal Propositions:

HasName	: The Name attribute should be inserted to describe the task name.
CorrectPredefinedType	: The attribute ObjectType must be asserted when the value of PredefinedType is set to USERDEFINED.

Inheritance Graph:

ENTITY IfcTask

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProcess

Identification : **OPTIONAL** IfcStrippedOptional;
LongDescription : **OPTIONAL** IfcStrippedOptional;

INVERSE

OperatesOn : **SET OF** IfcRelAssignsToProcess **FOR** RelatingProcess;

ENTITY IfcTask

Status : **OPTIONAL** IfcStrippedOptional;
WorkMethod : **OPTIONAL** IfcStrippedOptional;
IsMilestone : IfcStrippedOptional;

Priority : **OPTIONAL** IfcStrippedOptional;
 TaskTime : **OPTIONAL** IfcStrippedOptional;
 PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```
<xs:element name="IfcTask" type="Ifc: IfcTask" substitutionGroup="Ifc: IfcProcess" nillable="true"/>
<xs:complexType name="IfcTask">
  <xs:complexContent>
    <xs:extension base="Ifc: IfcProcess"/>
  </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 is valid for the period of 01.09.2010 till 30.08.2011.

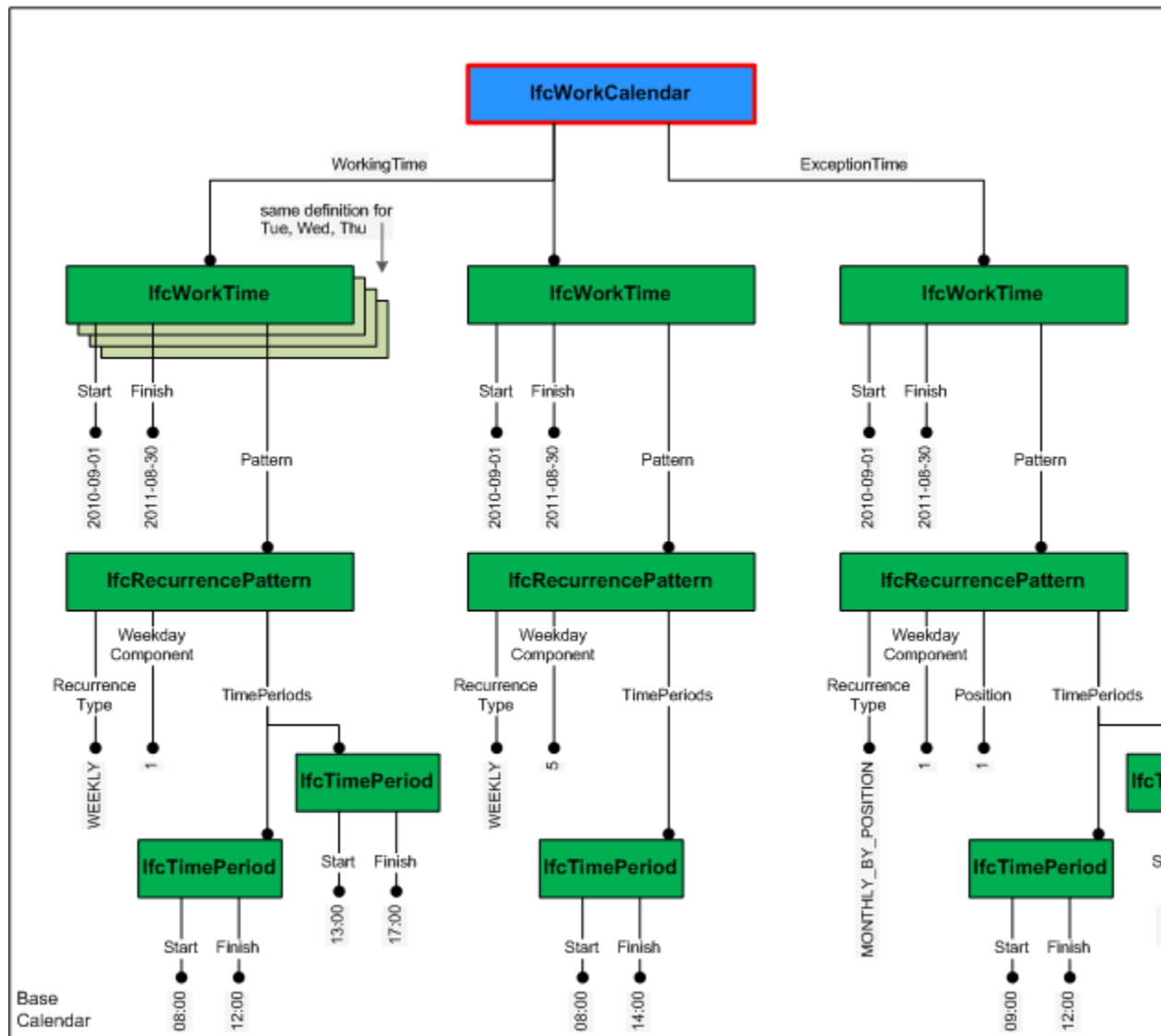


Figure 87 — Work calendar instantiation

[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** IfcOwnerHistory;

Name : **OPTIONAL** IfcLabel;

Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;

IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;

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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 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>
    <xs:extension 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:extension>
  </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.

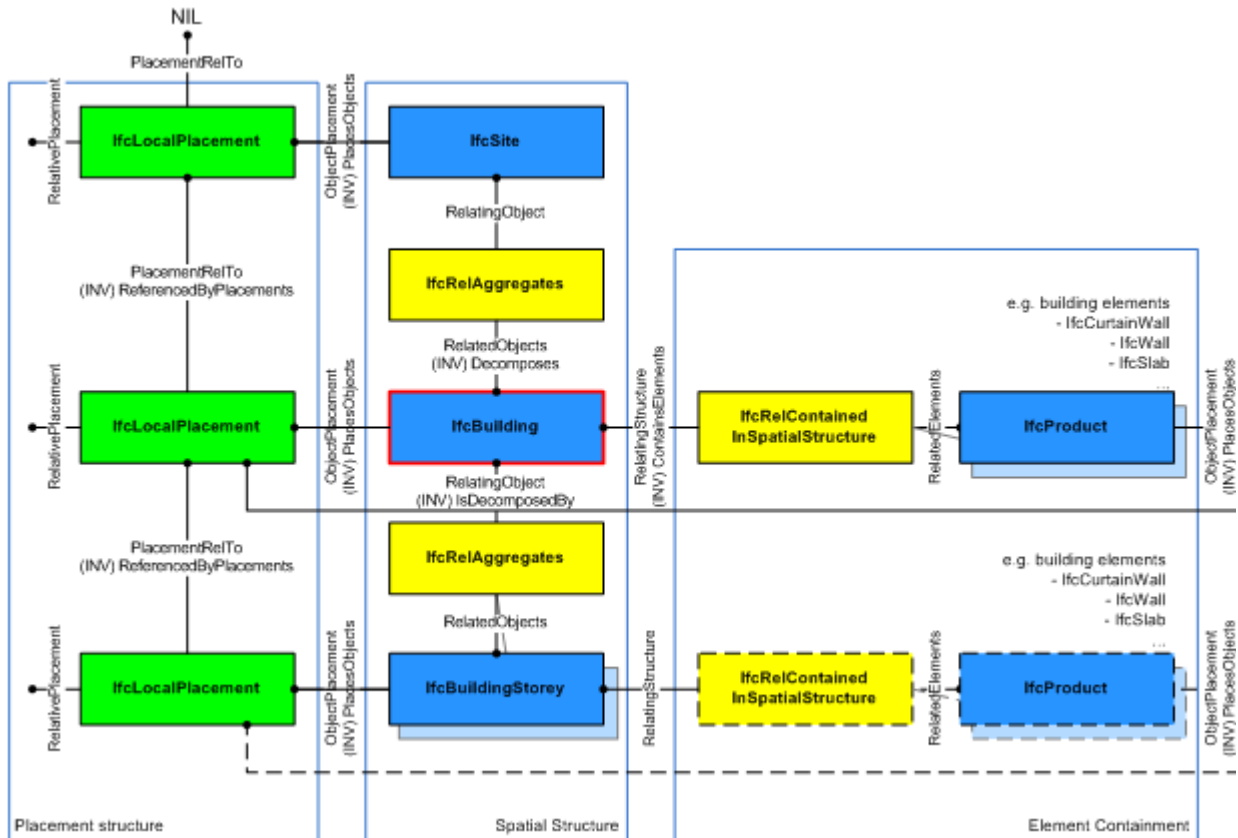


Figure 27 — Building composition

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"

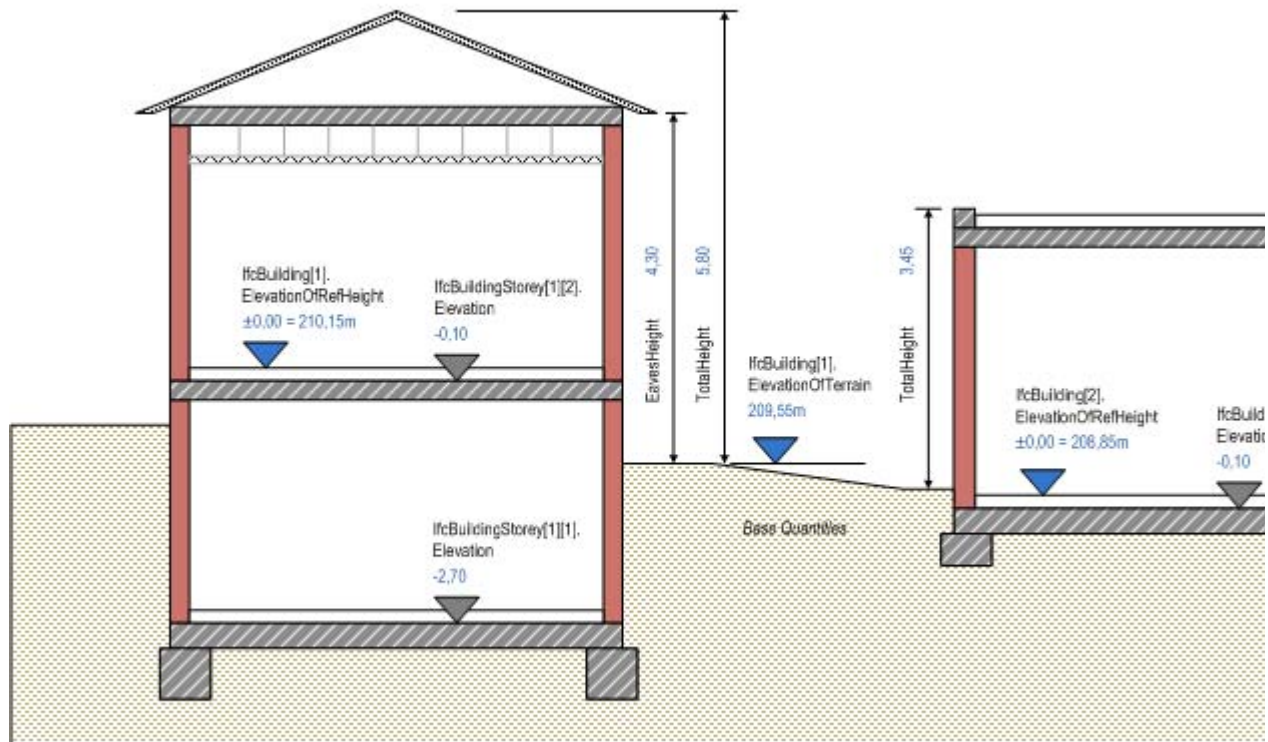


Figure 28 — Building elevations

EXPRESS Specification:

ENTITY IfcBuilding

SUBTYPE OF (IfcSpatialStructureElement);

ElevationOfRefHeight : **OPTIONAL** IfcLengthMeasure;
 ElevationOfTerrain : **OPTIONAL** IfcLengthMeasure;
 BuildingAddress : **OPTIONAL** IfcPostalAddress;

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.
BuildingAddress : Address given to the building for postal purposes.

Inheritance Graph:

ENTITY IfcBuilding**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcSpatialElement

LongName : **OPTIONAL** IfcStrippedOptional;

INVERSE

ContainsElements : **SET OF** IfcRelContainedInSpatialStructure **FOR** RelatingStructure;

ENTITY IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcBuilding

ElevationOfRefHeight : **OPTIONAL** IfcLengthMeasure;

ElevationOfTerrain : **OPTIONAL** IfcLengthMeasure;

BuildingAddress : **OPTIONAL** IfcPostalAddress;

END_ENTITY;

```
<xs:element name="IfcBuilding" type="ifc:IfcBuilding" substitutionGroup="ifc:IfcSpatialStructureElement"
nillable="true"/>
<xs:complexType name="IfcBuilding">
  <xs:complexContent>
    <xs:extension base="ifc:IfcSpatialStructureElement">
      <xs:sequence>
        <xs:element name="BuildingAddress" type="ifc:IfcPostalAddress" nillable="true" minOccurs="0"/>
      </xs:sequence>
      <xs:attribute name="ElevationOfRefHeight" type="ifc:IfcLengthMeasure" use="optional"/>
      <xs:attribute name="ElevationOfTerrain" type="ifc:IfcLengthMeasure" use="optional"/>
    </xs:extension>
  </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.

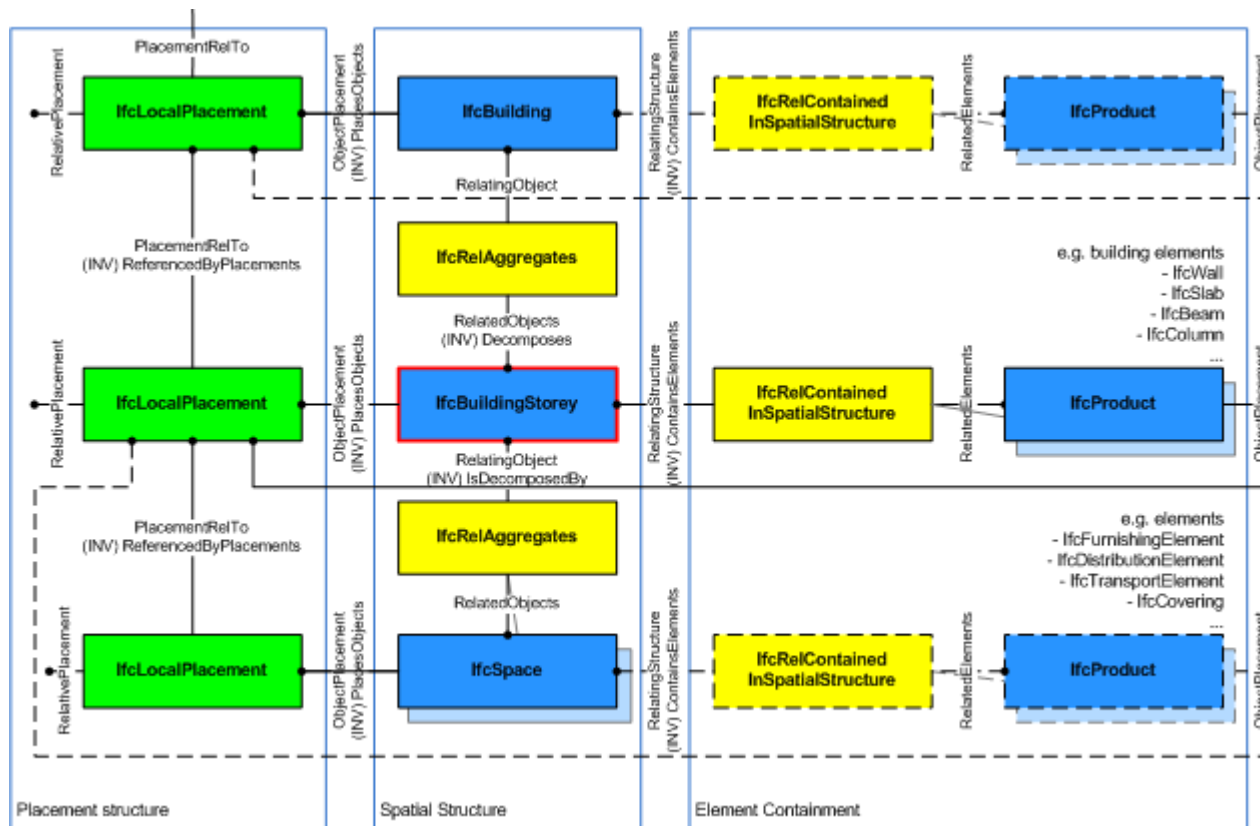


Figure 29 — Building storey composition

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"

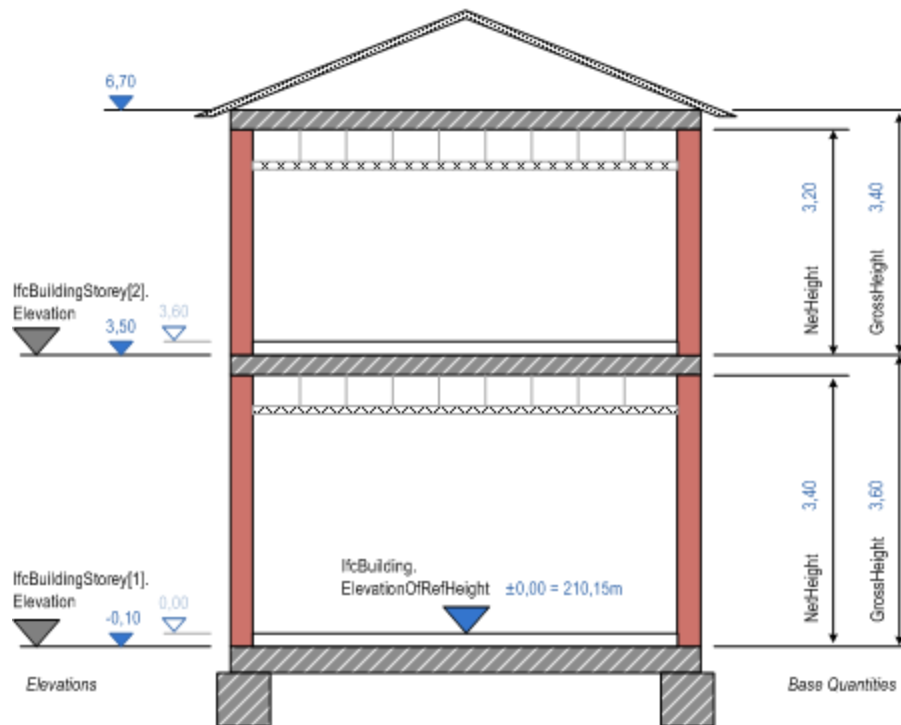


Figure 30 — Building storey elevations

EXPRESS Specification:**ENTITY** IfcBuildingStorey**SUBTYPE OF** (IfcSpatialStructureElement);Elevation : **OPTIONAL** IfcLengthMeasure;**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** IfcOwnerHistory;
Name : **OPTIONAL** IfcLabel;
Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcSpatialElement

LongName : **OPTIONAL** IfcStrippedOptional;

INVERSE

ContainsElements : **SET OF** IfcRelContainedInSpatialStructure **FOR** RelatingStructure;

ENTITY IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcBuildingStorey

Elevation : **OPTIONAL** IfcLengthMeasure;

END_ENTITY;

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

IfcOpeningElement

The opening element stands for opening, recess or chase, all reflecting voids. It represents a void within any element that has physical manifestation. Openings can be inserted into walls, slabs, beams, columns, or other elements.

The IFC specification provides two entities for opening elements:

- *IfcOpeningStandardCase* is used for all openings that have a constant profile along a linear extrusion. They are placed relative to the voided elements and the extrusion direction is perpendicular to the plane of the element (horizontally for walls, vertically for slabs). Only a single extrusion body is allowed. It cuts through the whole thickness of the voided element, i.e. it reflects a true opening.
- *IfcOpeningElement* is used for all other occurrences of openings and in particular also for niches or recesses.
NOTE View definitions or implementer agreements may restrict the types of elements which can be voided by an *IfcOpeningElement* or *IfcOpeningStandardCase*

There are two different types of opening elements:

- an opening, where the thickness of the opening is greater or equal to the thickness of the element;
- a recess or niche, where the thickness of the recess is smaller than the thickness of the element.

The attribute *PredefinedType* should be used to capture the differences,

- the attribute is set to OPENING for an opening or
- the attribute is set to RECESS for a recess or niche.
- If the value for *PredefinedType* is omitted, or the value is set to NOTDEFINED, no specific information of whether it is an opening or recess shall be assumed.

An *IfcOpeningElement* has to be inserted into an *IfcElement* by using the *IfcRelVoidsElement* relationship. The relationship implies a Boolean subtraction operation between the volume of the voided element and the volume of the opening. It may be filled by an *IfcDoor*, *IfcWindow*, or another filling element by using the relationship *IfcRelFillsElements*.

HISTORY New entity in IFC1.0

IFC2x CHANGE The intermediate ABSTRACT supertypes *IfcFeatureElement* and *IfcFeatureSubtraction* have been added.

IFC4 CHANGE The attribute *PredefinedType* has been added at the end of attribute list. It should be used instead of the inherited attribute *ObjectType* from now on.

Containment Use Definition

The *IfcOpeningElement* shall not participate in the containment relationship, i.e. it is not linked directly to the spatial structure of the project. It has a mandatory *VoidsElements* inverse relationship pointing to the *IfcElement* that is contained in the spatial structure.

- The inverse relationship *ContainedInStructure* shall be NIL.

NOTE See *IfcRelVoidsElement* for a diagram on how to apply spatial containment and the voiding relationship.

[EXPRESS Specification:](#)

ENTITY IfcOpeningElement

SUPERTYPE OF (IfcOpeningStandardCase)

SUBTYPE OF (IfcFeatureElementSubtraction);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

INVERSE

END_ENTITY;

[Attribute Definitions:](#)

[Inheritance Graph:](#)

ENTITY IfcOpeningElement

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcFeatureElement

ENTITY IfcFeatureElementSubtraction

INVERSE

VoidsElements : IfcRelVoidsElement **FOR** RelatedOpeningElement;

ENTITY IfcOpeningElement

PredefinedType : **OPTIONAL** IfcStrippedOptional;

INVERSE**END_ENTITY;**

```

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

```

IfcOpeningStandardCase

The standard opening, *IfcOpeningStandardCase*, defines an opening with certain constraints for the dimension parameters, position within the voided element, and with certain constraints for the geometric representation. The *IfcOpeningStandardCase* handles all cases of openings, that:

- are true openings by cutting through the body of the voided element, that is, where the opening depth is greater than or equal to the thickness of the element,
- are extruded perpendicular to the wall plane in case of openings in a wall
- are extruded perpendicular to the slab plane in case of openings in a slab
- have a local placement relative to the local placement of the voided element
- have a 'Body' shape representation with 'SweptSolid' representation type
- have only a single extrusion body within the 'Body' shape representation

[HISTORY New entity in IFC4](#)

[EXPRESS Specification:](#)

ENTITY IfcOpeningStandardCase

SUBTYPE OF (IfcOpeningElement);

END_ENTITY;[Inheritance Graph:](#)

ENTITY IfcOpeningStandardCase

ENTITY IfcRoot

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: OPTIONAL IfcOwnerHistory;
Name	: OPTIONAL IfcLabel;
Description	: OPTIONAL IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0:1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy	: SET [0:1] OF IfcRelDefinesByObject FOR RelatedObjects;
Declares	: SET OF IfcRelDefinesByObject FOR RelatingObject;
IsTypedBy	: SET [0:1] OF IfcRelDefinesByType FOR RelatedObjects;
IsDefinedBy	: SET OF IfcRelDefinesByProperties FOR RelatedObjects;

ENTITY IfcProduct

ObjectPlacement	: OPTIONAL IfcObjectPlacement;
Representation	: OPTIONAL IfcProductRepresentation;

INVERSE

ReferencedBy	: SET OF IfcRelAssignsToProduct FOR RelatingProduct;
--------------	--

ENTITY IfcElement

Tag	: OPTIONAL IfcStrippedOptional;
-----	--

INVERSE

ConnectedTo	: SET OF IfcRelConnectsElements FOR RelatingElement;
IsInterferedByElements	: SET OF IfcRelInterferesElements FOR RelatedElement;
InterferesElements	: SET OF IfcRelInterferesElements FOR RelatingElement;
HasOpenings	: SET OF IfcRelVoidsElement FOR RelatingBuildingElement;
ProvidesBoundaries	: SET OF IfcRelSpaceBoundary FOR RelatedBuildingElement;
ConnectedFrom	: SET OF IfcRelConnectsElements FOR RelatedElement;
ContainedInStructure	: SET [0:1] OF IfcRelContainedInSpatialStructure FOR RelatedElements;

ENTITY IfcFeatureElement

ENTITY IfcFeatureElementSubtraction

INVERSE

VoidsElements : IfcRelVoidsElement **FOR** RelatedOpeningElement;

ENTITY IfcOpeningElement

PredefinedType : **OPTIONAL** IfcStrippedOptional;

INVERSE

ENTITY IfcOpeningStandardCase

END_ENTITY;

```
<xs:element name="IfcOpeningStandardCase" type="ifc:IfcOpeningStandardCase"
substitutionGroup="ifc:IfcOpeningElement" nillable="true"/>
<xs:complexType name="IfcOpeningStandardCase">
  <xs:complexContent>
    <xs:extension base="ifc:IfcOpeningElement"/>
  </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.

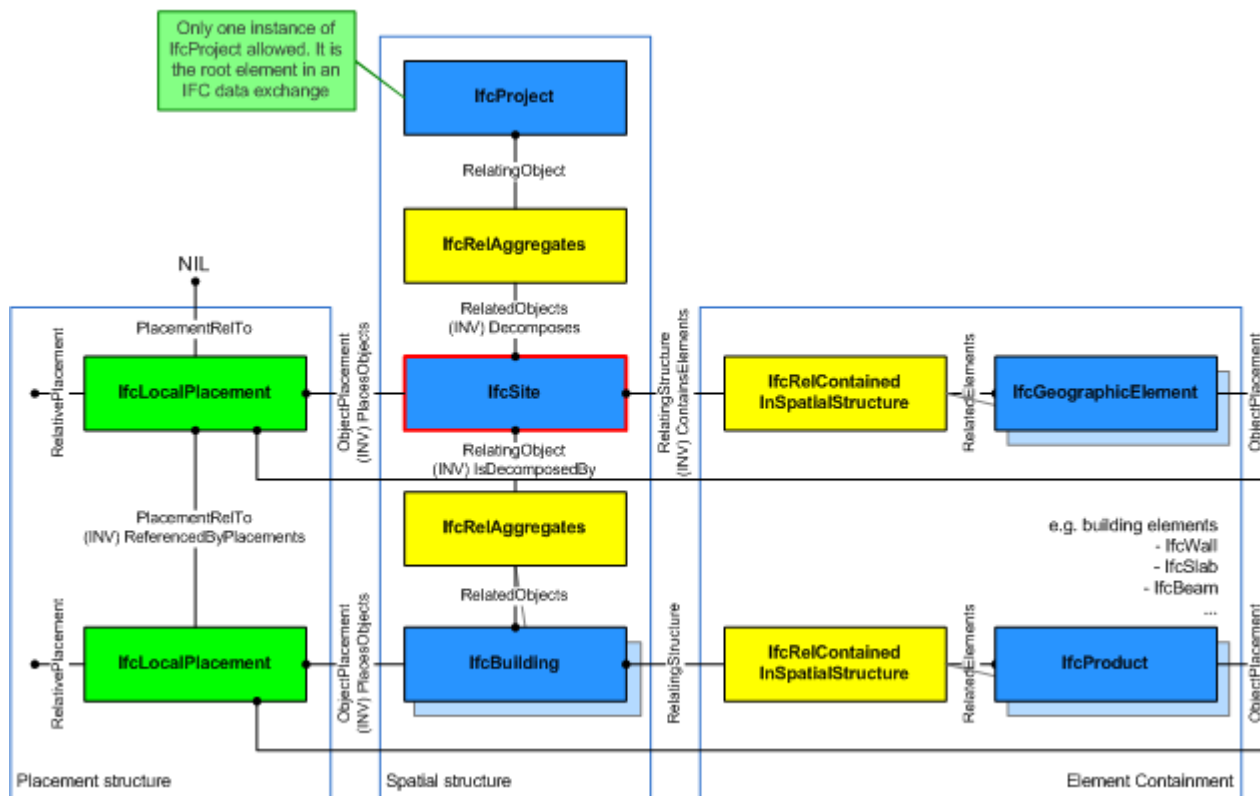


Figure 32 — Site composition

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.

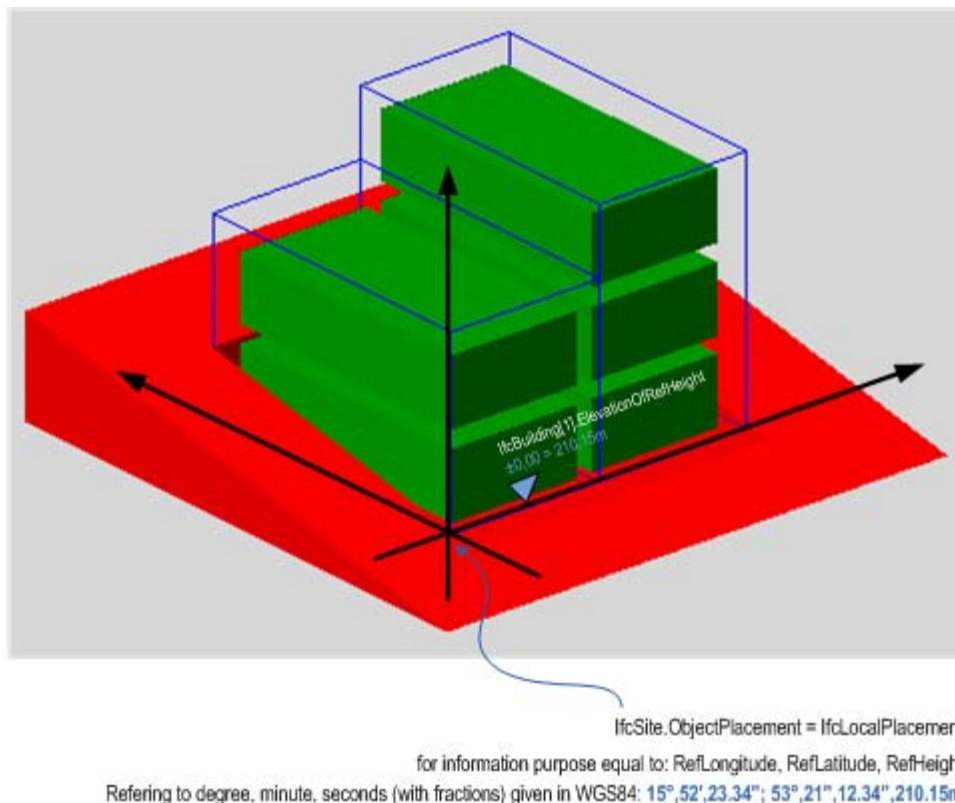


Figure 33 — Site elevations

EXPRESS Specification:

ENTITY IfcSite

SUBTYPE OF (IfcSpatialStructureElement);

RefLatitude	: OPTIONAL IfcCompoundPlaneAngleMeasure;
RefLongitude	: OPTIONAL IfcCompoundPlaneAngleMeasure;
RefElevation	: OPTIONAL IfcLengthMeasure;
LandTitleNumber	: OPTIONAL IfcLabel;
SiteAddress	: OPTIONAL IfcPostalAddress;

END_ENTITY;

Attribute Definitions:

RefLatitude	: World Latitude at reference point (most likely defined in legal description). Defined as integer values for degrees, minutes, seconds, and, optionally, millionths of seconds with respect to the world geodetic system WGS84. NOTE Latitudes are measured relative to the geodetic equator, north of the equator by positive values - from 0 till +90, south of the equator by negative values - from 0 till -90.
RefLongitude	: World Longitude at reference point (most likely defined in legal description). Defined as integer values for degrees, minutes, seconds, and, optionally, millionths of seconds with respect to the world geodetic system WGS84.

NOTE Longitudes are measured relative to the geodetic zero meridian, nominally the same as the Greenwich prime meridian: longitudes west of the zero meridian have negative values - from 0 till -180, longitudes east of the zero meridian have positive values - from 0 till -180.

EXAMPLE Chicago Harbor Light has according to WGS84 a longitude -87.35.40 (or 87.35.40W) and a latitude 41.53.30 (or 41.53.30N).

RefElevation : Datum elevation relative to sea level.
LandTitleNumber : The land title number (designation of the site within a regional system).
SiteAddress : Address given to the site for postal purposes.

Inheritance Graph:

ENTITY IfcSite

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0: 1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0: 1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0: 1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcSpatialElement

LongName : **OPTIONAL** IfcStrippedOptional;

INVERSE

ContainsElements : **SET OF** IfcRelContainedInSpatialStructure **FOR** RelatingStructure;

ENTITY IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcSite

RefLatitude : **OPTIONAL** IfcCompoundPlaneAngleMeasure;

RefLongitude : **OPTIONAL** IfcCompoundPlaneAngleMeasure;

RefElevation : **OPTIONAL** IfcLengthMeasure;

LandTitleNumber : **OPTIONAL** IfcLabel;

SiteAddress : **OPTIONAL** IfcPostalAddress;

END_ENTITY;

```
<xs:element name="IfcSite" type="ifc:IfcSite" substitutionGroup="ifc:IfcSpatialStructureElement" nillable="true"/>
<xs:complexType name="IfcSite">
  <xs:complexContent>
    <xs:extension base="ifc:IfcSpatialStructureElement">
      <xs:sequence>
        <xs:element name="SiteAddress" type="ifc:IfcPostalAddress" nillable="true" minOccurs="0"/>
      </xs:sequence>
      <xs:attribute name="RefLatitude" type="ifc:List-IfcCompoundPlaneAngleMeasure" use="optional"/>
      <xs:attribute name="RefLongitude" type="ifc:List-IfcCompoundPlaneAngleMeasure" use="optional"/>
      <xs:attribute name="RefElevation" type="ifc:IfcLengthMeasure" use="optional"/>
      <xs:attribute name="LandTitleNumber" type="ifc:IfcLabel" use="optional"/>
    </xs:extension>
  </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.

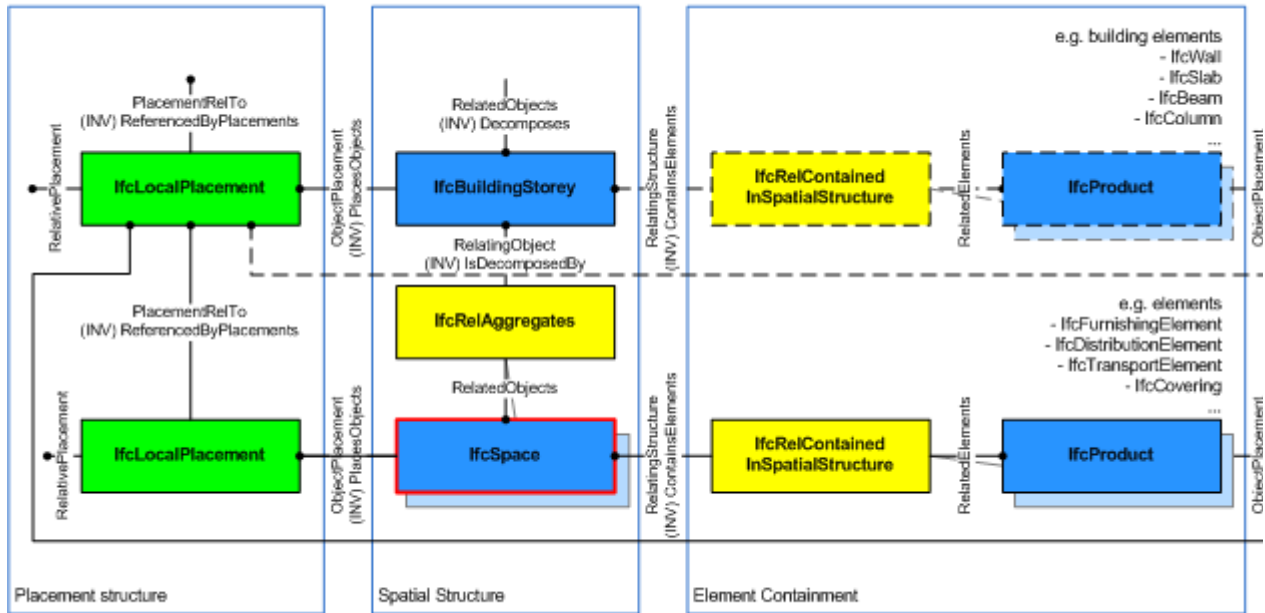


Figure 34 — Space composition

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"

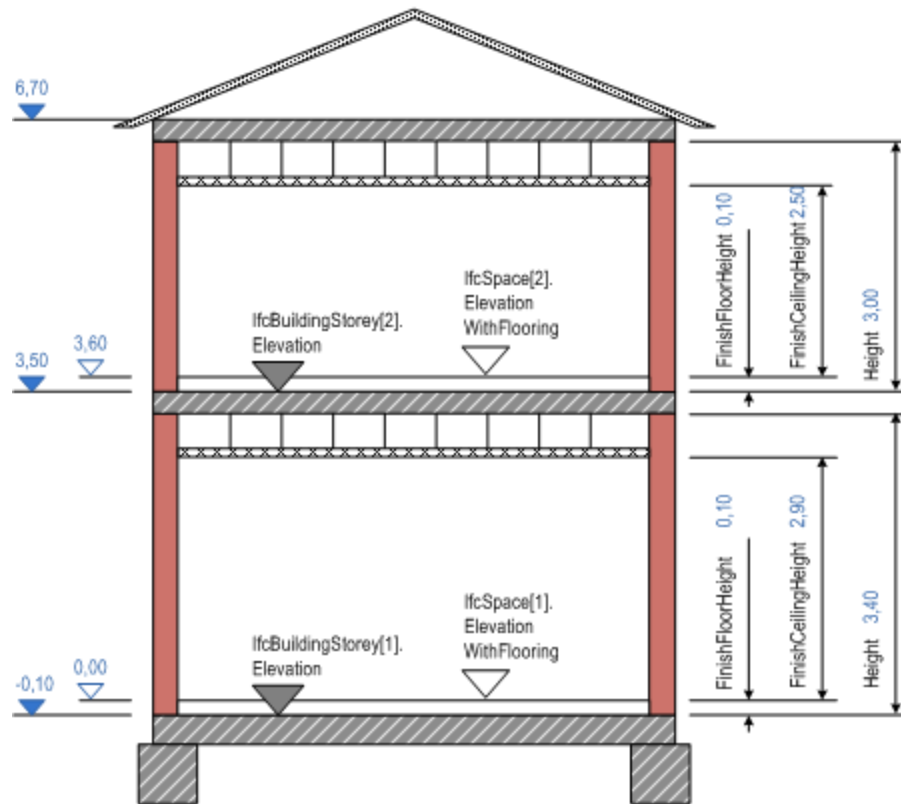


Figure 35 — Space elevations

EXPRESS Specification:

ENTITY IfcSpace

SUBTYPE OF (IfcSpatialStructureElement);

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

INVERSE

BoundedBy : **SET OF** IfcRelSpaceBoundary **FOR** RelatingSpace;

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.

BoundedBy : Reference to a set of IfcRelSpaceBoundary's that defines the physical or virtual delimitation of that space against physical or virtual boundaries.

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 IfcOwnerHistory;
Name	: OPTIONAL IfcLabel;
Description	: OPTIONAL IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0:1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcSpatialElement

LongName : **OPTIONAL** IfcStrippedOptional;

INVERSE

ContainsElements : **SET OF** IfcRelContainedInSpatialStructure **FOR** RelatingStructure;

ENTITY IfcSpatialStructureElement

CompositionType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcSpace

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

INVERSE

BoundedBy : **SET OF** IfcRelSpaceBoundary **FOR** RelatingSpace;

END_ENTITY;

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

IfcMember

An *IfcMember* is a structural member designed to carry loads between or beyond points of support. It is not required to be load bearing. The orientation of the member (being horizontal, vertical or sloped) is not relevant to its definition (in contrary to *IfcBeam* and *IfcColumn*). An *IfcMember* represents a linear structural element from an architectural or structural modeling point of view and shall be used if it cannot be expressed more specifically as either an *IfcBeam* or an *IfcColumn*.

NOTE The representation of a member in a structural analysis model is provided by *IfcStructuralCurveMember* being part of an *IfcStructuralAnalysisModel*.

The IFC specification provides two entities for member occurrences:

- *IfcMemberStandardCase* used for all occurrences of members, that have a profile defined that is swept along a directrix. The profile might be changed uniformly by a taper definition along the directrix. The profile parameter and its cardinal point of insertion can be fully described by the *IfcMaterialProfileSetUsage*. These beams are always represented geometricly by an 'Axis' and a 'SweptSolid' or 'AdvancedSweptSolid' shape representation (or by a 'Clipping' geometry based on the swept solid), if a 3D geometric representation is assigned. In addition they have to have a corresponding *IfcMaterialProfileSetUsage* assigned.

NOTE View definitions and implementer agreements may further constrain the applicable geometry types, such as by excluding tapering from an *IfcMemberStandardCase* implementation.

- *IfcMember* used for all other occurrences of members, particularly for members with changing profile sizes along the extrusion, or members defined by non-linear extrusion, or members having only 'Brep', or 'SurfaceModel' geometry.

HISTORY New entity in IFC2x2 Addendum 1.

EXPRESS Specification:

ENTITY IfcMember

SUBTYPE OF (IfcBuildingElement);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Attribute Definitions:

PredefinedType : Predefined generic type for a member that is specified in an enumeration. There may be a property set given for the predefined types.
NOTE The *PredefinedType* shall only be used, if no *IfcMemberType* is assigned, providing its own *IfcMemberType.PredefinedType*.

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

Formal Propositions:

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

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

Inheritance Graph:**ENTITY** IfcMember**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement

INVERSE

ENTITY IfcMember

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcSlab

A slab is a component of the construction that normally encloses a space vertically. The slab may provide the lower support (floor) or upper construction (roof slab) in any space in a building.

NOTE Definition according to ISO 6707-1

thick, flat or shaped component, usually larger than 300 mm square, used to form a covering or projecting from a building.

Only the core or constructional part of this construction is considered to be a slab. The upper finish (flooring, roofing) and the lower finish (ceiling, suspended ceiling) are considered to be coverings. A special type of slab is the landing, described as a floor section to which one or more stair flights or ramp flights connect.

NOTE There is a representation of slabs for structural analysis provided by a proper subtype of *IfcStructuralMember* being part of the *IfcStructuralAnalysisModel*.

NOTE An arbitrary planar element to which this semantic information is not applicable or irrelevant shall be modeled as *IfcPlate*.

A slab may have openings, such as floor openings, or recesses. They are defined by an *IfcOpeningElement* attached to the slab using the inverse relationship *HasOpenings* pointing to *IfcRelVoidsElement*.

There are three entities for slab occurrences:

- *IfcSlabStandardCase* used for all occurrences of slabs, that are prismatic and where the thickness parameter can be fully described by the *IfcMaterialLayerSetUsage*. These slabs are always represented geometrically by a 'SweptSolid' geometry (or by a 'Clipping' geometry based on 'SweptSolid'), if a 3D geometric representation is assigned. In addition they have to have a corresponding *IfcMaterialLayerSetUsage* assigned.

- *IfcSlabElementedCase* used for occurrences of slabs which are aggregated from subordinate elements, following specific decomposition rules expressed by the mandatory use of *IfcRelAggregates* relationship.
- *IfcSlab* used for all other occurrences of slabs, particularly for slabs with changing thickness, or slabs with non planar surfaces, and slabs having only 'SweptSolid' or 'Brep' geometry.

HISTORY New entity in IFC2.0; it is a merger of the two previous entities *IfcFloor*, *IfcRoofSlab*, introduced in IFC1.0

EXPRESS Specification:

ENTITY *IfcSlab*

SUPERTYPE OF(**ONEOF**(*IfcSlabElementedCase*, *IfcSlabStandardCase*))

SUBTYPE OF (*IfcBuildingElement*);

PredefinedType : **OPTIONAL** *IfcStrippedOptional*;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCSHAREDBLDGELEMENTS.IFCSLABTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Predefined generic type for a slab that is specified in an enumeration. There may be a property set given specifically for the predefined types.
NOTE The *PredefinedType* shall only be used, if no *IfcSlabType* is assigned, providing its own *IfcSlabType.PredefinedType*.

Formal Propositions:

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

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

Inheritance Graph:

ENTITY *IfcSlab*

ENTITY *IfcRoot*

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0: 1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy	: SET [0: 1] OF IfcRelDefinesByObject FOR RelatedObjects;
Declares	: SET OF IfcRelDefinesByObject FOR RelatingObject;
IsTypedBy	: SET [0: 1] OF IfcRelDefinesByType FOR RelatedObjects;
IsDefinedBy	: SET OF IfcRelDefinesByProperties FOR RelatedObjects;

ENTITY IfcProduct

ObjectPlacement	: OPTIONAL IfcObjectPlacement;
Representation	: OPTIONAL IfcProductRepresentation;

INVERSE

ReferencedBy	: SET OF IfcRelAssignsToProduct FOR RelatingProduct;
--------------	--

ENTITY IfcElement

Tag	: OPTIONAL IfcStrippedOptional;
-----	--

INVERSE

ConnectedTo	: SET OF IfcRelConnectsElements FOR RelatingElement;
IsInterferedByElements	: SET OF IfcRelInterferesElements FOR RelatedElement;
InterferesElements	: SET OF IfcRelInterferesElements FOR RelatingElement;
HasOpenings	: SET OF IfcRelVoidsElement FOR RelatingBuildingElement;
ProvidesBoundaries	: SET OF IfcRelSpaceBoundary FOR RelatedBuildingElement;
ConnectedFrom	: SET OF IfcRelConnectsElements FOR RelatedElement;

ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement

INVERSE

ENTITY IfcSlab

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcSlabElementedCase

The *IfcSlabElementedCase* defines a slab with certain constraints for the provision of its components. The *IfcSlabElementedCase* handles all cases of slabs, that are decomposed into parts:

- having components being assigned to the *IfcSlabElementedCase* using the *IfcRelAggregates* relationship accessible by the inverse relationship *IsDecomposedBy*.
- applying the constraint that the parts within the decomposition shall be of type *IfcBeam*, *IfcMember*, *IfcPlate*, *IfcBuildingElementPart* or *IfcBuildingElementProxy*.

HISTORY New entity in IFC4.

Voiding Use Definition:

As shown in Figure 116, openings within the composite slab are directly assigned to *IfcSlabElementedCase* using *IfcRelVoidsElement* pointing to *IfcOpeningElement* and apply to all aggregated parts. If individual parts have cutting and other voiding features, then the decomposed parts have a separate voiding relationship *IfcRelVoidsElement* pointing to *IfcVoidingFeature*.

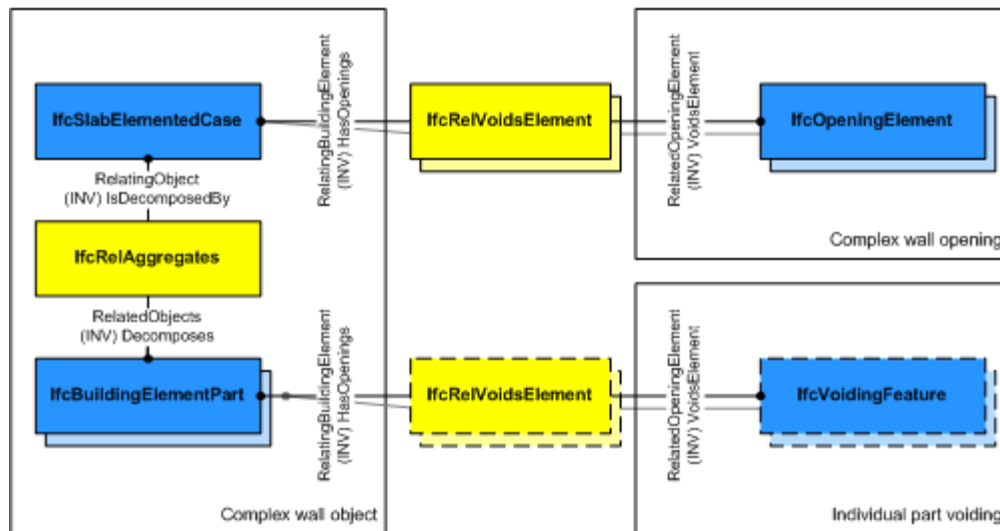


Figure 116 — Slab elemented voiding

EXPRESS Specification:**ENTITY** IfcSlabElementedCase**SUBTYPE OF** (IfcSlab);**WHERE**

HasDecomposition : HIINDEX(SELF\IfcObjectDefinition.IsDecomposedBy) > 0;

END_ENTITY;Formal Propositions:**HasDecomposition** : A valid instance of IfcWallElementedCase has to have parts in a decomposition hierarchy.Inheritance Graph:**ENTITY** IfcSlabElementedCase**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0:1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy	: SET [0:1] OF IfcRelDefinesByObject FOR RelatedObjects;
Declares	: SET OF IfcRelDefinesByObject FOR RelatingObject;
IsTypedBy	: SET [0:1] OF IfcRelDefinesByType FOR RelatedObjects;
IsDefinedBy	: SET OF IfcRelDefinesByProperties FOR RelatedObjects;

ENTITY IfcProduct

ObjectPlacement	: OPTIONAL IfcObjectPlacement;
Representation	: OPTIONAL IfcProductRepresentation;

INVERSE

ReferencedBy	: SET OF IfcRelAssignsToProduct FOR RelatingProduct;
--------------	--

ENTITY IfcElement

Tag	: OPTIONAL IfcStrippedOptional;
-----	--

INVERSE

ConnectedTo	: SET OF IfcRelConnectsElements FOR RelatingElement;
IsInterferedByElements	: SET OF IfcRelInterferesElements FOR RelatedElement;
InterferesElements	: SET OF IfcRelInterferesElements FOR RelatingElement;
HasOpenings	: SET OF IfcRelVoidsElement FOR RelatingBuildingElement;
ProvidesBoundaries	: SET OF IfcRelSpaceBoundary FOR RelatedBuildingElement;
ConnectedFrom	: SET OF IfcRelConnectsElements FOR RelatedElement;
ContainedInStructure	: SET [0:1] OF IfcRelContainedInSpatialStructure FOR RelatedElements;

ENTITY IfcBuildingElement

INVERSE

ENTITY IfcSlab

PredefinedType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcSlabElementedCase

END_ENTITY;

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

IfcSlabStandardCase

The standard slab, *IfcSlabStandardCase*, defines a slab with certain constraints for the provision of material usage, parameters and with certain constraints for the geometric representation. The *IfcSlabStandardCase* handles all cases of slabs, that:

- have a reference to the *IfcMaterialLayerSetUsage* defining the material layers of the slab with thicknesses
- are based on an extrusion of a planar surface as defined by the slab profile
- have a constant thickness along the extrusion direction
- are consistent in using the correct material layer set offset to the base planar surface in regard to the shape representation
- are extruded either perpendicular or slanted to the plane surface

The definitions of slab openings and niches are the same as given at the supertype *IfcSlab*. The same agreements to the special types of slabs, as defined in the *PredefinedType* attribute apply as well.

NOTE If the *IfcSlabStandardCase* is of type Landing and is used within an *IfcStair* or *IfcRamp*, the special agreements to handle stair and ramp geometry will also affect the geometric representation of the *IfcSlabStandardCase*.

HISTORY New entity in IFC4.

EXPRESS Specification:

ENTITY IfcSlabStandardCase

SUBTYPE OF (IfcSlab);

WHERE

```
HasMaterialLayerSetusage: SIZEOF (QUERY(temp < * USEDIN(SELF,
'IFCKERNEL.IFCREASSOCIATES.RELATEDOBJECTS') |
('IFCPRODUCTEXTENSION.IFCREASSOCIATESMATERIAL' IN TYPEOF(temp)) AND
('IFCMATERIALRESOURCE.IFCMATERIALLAYERSETUSAGE' IN
TYPEOF(temp.RelatingMaterial))) ) = 1;
```

END_ENTITY;

Formal Propositions:

HasMaterialLayerSetusage: A valid instance of IfcSlabStandardCase relies on the provision of an IfcMaterialLayerSetUsage.

Inheritance Graph:

ENTITY IfcSlabStandardCase

ENTITY IfcRoot

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: OPTIONAL IfcOwnerHistory;
Name	: OPTIONAL IfcLabel;
Description	: OPTIONAL IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0: 1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy	: SET [0: 1] OF IfcRelDefinesByObject FOR RelatedObjects;
Declares	: SET OF IfcRelDefinesByObject FOR RelatingObject;
IsTypedBy	: SET [0: 1] OF IfcRelDefinesByType FOR RelatedObjects;
IsDefinedBy	: SET OF IfcRelDefinesByProperties FOR RelatedObjects;

ENTITY IfcProduct

ObjectPlacement	: OPTIONAL IfcObjectPlacement;
Representation	: OPTIONAL IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement**INVERSE****ENTITY** IfcSlab

PredefinedType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcSlabStandardCase**END_ENTITY;**

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

IfcWall

The wall represents a vertical construction that bounds or subdivides spaces. Wall are usually vertical, or nearly vertical, planar elements, often designed to bear structural loads. A wall is however not required to be load bearing.

NOTE Definition according to ISO 6707-1: vertical construction usually in masonry or in concrete which bounds or subdivides a construction works and fulfils a load bearing or retaining function.

NOTE There is a representation of walls for structural analysis provided by a proper subtype of *IfcStructuralMember* being part of the *IfcStructuralAnalysisModel*.

NOTE An arbitrary planar element to which this semantic information is not applicable (is not predominantly vertical), shall be modeled as *IfcPlate*.

A wall may have openings, such as wall openings, openings used for windows or doors, or niches and recesses. They are defined by an *IfcOpeningElement* attached to the wall using the inverse relationship *HasOpenings* pointing to *IfcRelVoidsElement*.

There are three entities for wall occurrences:

- *IfcWallStandardCase* used for all occurrences of walls, that have a non-changing thickness along the wall path and where the thickness parameter can be fully described by a material layer set. These walls are always represented geometrically by an 'Axis' and a 'SweptSolid' shape representation (or by a 'Clipping' geometry based on 'SweptSolid'), if a 3D geometric representation is assigned. In addition they have to have a corresponding *IfcMaterialProfileSetUsage* assigned.
- *IfcWallElementedCase* used for occurrences of walls which are aggregated from subordinate elements, following specific decomposition rules expressed by the mandatory use of *IfcRelAggregates* relationship.
- *IfcWall* used for all other occurrences of wall, particularly for walls with changing thickness along the wall path (e.g. polygonal walls), or walls with a non-rectangular cross sections (e.g. L-shaped retaining walls), and walls having an extrusion axis that is unequal to the global Z axis of the project (i.e. non-vertical walls), or walls having only 'Brep', or 'SurfaceModel' geometry.

HISTORY New entity in IFC1.0

EXPRESS Specification:

ENTITY IfcWall

SUPERTYPE OF (ONEOF (IfcWallElementedCase, IfcWallStandardCase))

SUBTYPE OF (IfcBuildingElement);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCSHAREDBLDGELEMENTS.IFCWALLTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Predefined generic type for a wall that is specified in an enumeration. There may be a property set given specifically for the predefined types.
NOTE The *PredefinedType* shall only be used, if no *IfcWallType* is assigned, providing its own *IfcWallType.PredefinedType*.

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

Formal Propositions:

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

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

Inheritance Graph:

ENTITY IfcWall**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement**INVERSE****ENTITY** IfcWall

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```

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

```

IfcWallElementedCase

The *IfcWallElementedCase* defines a wall with certain constraints for the provision of its components. The *IfcWallElementedCase* handles all cases of walls, that are decomposed into parts:

- having components being assigned to the *IfcWallElementedCase* using the *IfcRelAggregates* relationship accessible by the inverse relationship *IsDecomposedBy*.
- applying the constraint that the parts within the decomposition shall be of type *IfcMember*, *IfcPlate*, *IfcBuildingElementPart* or *IfcBuildingElementProxy*.

HISTORY New entity in IFC4.

Property Set Use Definition:

The property sets relating to the *IfcWallElementedCase* are defined at the supertype *IfcWall*.

NOTE The parts within the decomposition relationship may define their own property sets.

Quantity Use Definition:

The quantities relating to the *IfcWallElementedCase* are defined at the supertype *IfcWall*.

NOTE The parts within the decomposition relationship may define their own individual quantities.

Voiding Use Definition:

As shown in Figure 121, openings within the composite wall are directly assigned to *IfcWallElementedCase* using *IfcRelVoidsElement* pointing to *IfcOpeningElement* and apply to all aggregated parts. If individual parts have cutting and

other voiding features, then the decomposed parts have a separate voiding relationship *IfcRelVoidsElement* pointing to *IfcVoidingFeature*.

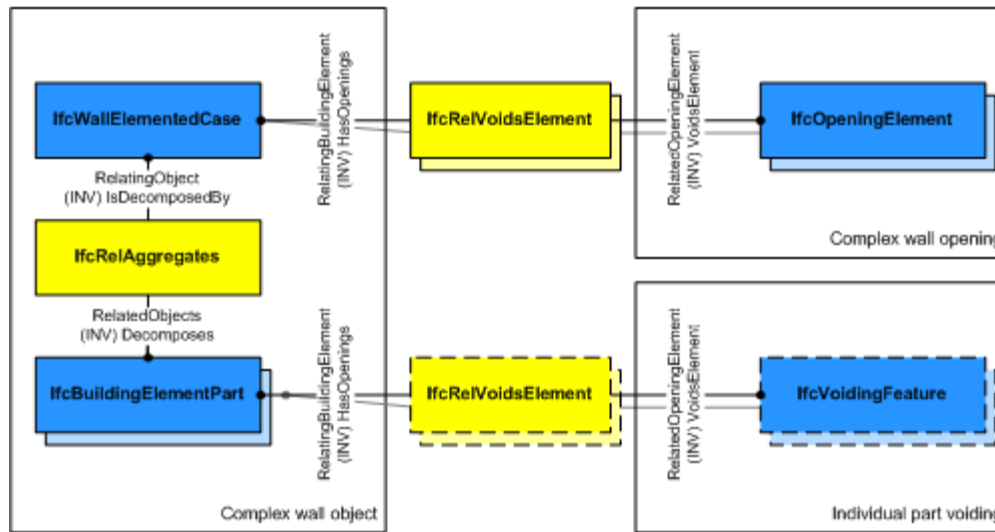


Figure 121 — Wall elemented voiding

Geometric Representation

The standard geometric representation of *IfcWallElementedCase* is defined using the following multiple shape representations for its definition:

- **Axis:** A two-dimensional open curve being a subtype of *IfcBoundedCurve* defining the axis for the elemented wall. It maybe used as a simplified representation directly at the elemented wall.
- **Surface:** A three-dimensional surface being a subtype of *IfcBoundedSurface* defining the reference surface for the elemented wall. It maybe used as a simplified representation directly at the elemented wall.

EXPRESS Specification:

ENTITY *IfcWallElementedCase*

SUBTYPE OF (*IfcWall*);

WHERE

HasDecomposition : HIINDEX(SELf\IfcObjectDefinition.IsDecomposedBy) > 0;

END_ENTITY;

Formal Propositions:

HasDecomposition : A valid instance of *IfcWallElementedCase* has to have parts in a decomposition hierarchy.

Inheritance Graph:

ENTITY *IfcWallElementedCase*

ENTITY *IfcRoot*

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0: 1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0: 1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0: 1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;

IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0: 1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement

INVERSE

ENTITY IfcWall

PredefinedType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcWallElementedCase

END_ENTITY;

```

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

```

IfcWallStandardCase

The *IfcWallStandardCase* defines a wall with certain constraints for the provision of parameters and with certain constraints for the geometric representation. The *IfcWallStandardCase* handles all cases of walls, that are extruded vertically:

- along the positive z axis of the wall object coordinate system, and
 - along the positive z axis of the global (world) coordinate system
- and have a single thickness along the path for each wall layer, i.e.:
- parallel sides for straight walls
 - co-centric sides for curved walls.
- and have either:
- a straight line axis (straight wall), or
 - a circular arc axis (round wall).
- and shall not have
- aggregated components, that is, parts aggregated to a wall by *IfcRelAggregates*
 - shape representation for 'Body' not being an extrusion, or clipped extrusion

The following parameter have to be provided:

- Wall height, taken from the depth of extrusion, provided by the geometric representation.
- Wall thickness, taken from the material layer set usage, attached to the wall
- Wall offset from axis, taken from the material layer set usage, attached to the wall

The *IfcWallStandardCase* requires the provision of the wall axis either a straight line that is parallel to the x-axis of the object coordinate system, or a circular arc where the tangent at start is parallel to the x-axis of the object coordinate system. The direction of the wall axis shall be the positive direction of that x-axis.

The material of the wall is defined by the *IfcMaterialLayerSetUsage* and is attached by the *IfcRelAssociatesMaterial* objectified relationship. It is accessible by the inverse *HasAssociations* relationship. The material layer set usage has to be given (enforced by where rule).

HISTORY New entity in IFC2x.

The standard geometric representation of *IfcWallStandardCase* is defined using the following multiple shape representations for its definition:

- **Axis:** A two-dimensional open curve (*IfcBoundedCurve*) defining the axis for the standard wall. The material layer offset is measured from the wall axis.
- **Body:** A Swept Solid Representation or a CSG representation defining the 3D shape of the standard wall

NOTE It is invalid to exchange a 'SurfaceModel', or 'Brep' or 'MappedRepresentation' representation for the 'Body' shape representation of an *IfcWallStandardCase*.

EXPRESS Specification:

ENTITY IfcWallStandardCase

SUBTYPE OF (IfcWall);

WHERE

```
HasMaterialLayerSetUsage: SIZEOF (QUERY(temp < * USEDIN(SELF,
    'IFCKERNEL.IFCRELASSOCIATES.RELATEDOBJECTS') |
    ('IFCPRODUCTEXTENSION.IFCRELASSOCIATESMATERIAL' IN TYPEOF(temp)) AND
    ('IFCMATERIALRESOURCE.IFCMATERIALLAYERSETUSAGE' IN
    TYPEOF(temp.RelatingMaterial))) ) = 1;
```

END_ENTITY;

Formal Propositions:

HasMaterialLayerSetUsage: A valid instance of *IfcWallStandardCase* relies on the provision of an *IfcMaterialLayerSetUsage*.

Inheritance Graph:

ENTITY IfcWallStandardCase

ENTITY IfcRoot

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: OPTIONAL IfcOwnerHistory;
Name	: OPTIONAL IfcLabel;
Description	: OPTIONAL IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcBuildingElement

INVERSE

ENTITY IfcWall

PredefinedType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcWallStandardCase

END_ENTITY;

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

IfcDistributionPort

A distribution port is an inlet or outlet of a product through which a particular substance may flow.

Distribution ports are used for passage of solid, liquid, or gas substances, as well as electricity for power or communications. Flow segments (pipes, ducts, cables) may be used to connect ports across products. Distribution ports are defined by system type and flow direction such that for two ports to be connected, they must share the same system type and have opposite flow directions (one side being a *SOURCE* and the other being a *SINK*). Ports are similar to openings in that they do not have any visible geometry; such geometry is captured at the shape representation of the enclosing element or element type. Ports may have placement that indicates the position and orientation of the connection.

HISTORY New entity in IFC2x2

IFC4 CHANGE Ports are now related to products and product types using the *IfcRelNests* relationship; use of *IfcRelConnectsPortToElement* is now reserved for dynamically attached ports (such as drilling a hole in a tank).

[EXPRESS Specification:](#)

ENTITY IfcDistributionPort

SUBTYPE OF (IfcPort);

FlowDirection : **OPTIONAL** IfcFlowDirectionEnum;
 PredefinedType : **OPTIONAL** IfcDistributionPortTypeEnum;
 SystemType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

[Attribute Definitions:](#)

FlowDirection : Enumeration that identifies if this port is a Sink (inlet), a Source (outlet) or both a SinkAndSource.
SystemType : Enumeration that identifies the system type. If a system type is defined, the port may only be

connected to other ports having the same system type.

Inheritance Graph:

ENTITY IfcDistributionPort

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcPort**INVERSE**

ContainedIn : **SET** [0:1] OF IfcRelConnectsPortToElement **FOR** RelatingPort;
 ConnectedFrom : **SET** [0:1] OF IfcRelConnectsPorts **FOR** RelatedPort;
 ConnectedTo : **SET** [0:1] OF IfcRelConnectsPorts **FOR** RelatingPort;

ENTITY IfcDistributionPort

FlowDirection : **OPTIONAL** IfcFlowDirectionEnum;
 PredefinedType : **OPTIONAL** IfcDistributionPortTypeEnum;
 SystemType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```
<xs:element name="IfcDistributionPort" type="Ifc: IfcDistributionPort" substitutionGroup="Ifc: IfcPort" nillable="true"/>
<xs:complexType name="IfcDistributionPort">
  <xs:complexContent>
    <xs:extension base="Ifc: IfcPort">
      <xs:attribute name="FlowDirection" type="Ifc: IfcFlowDirectionEnum" use="optional"/>
      <xs:attribute name="PredefinedType" type="Ifc: IfcDistributionPortTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcDistributionSystem

A distribution system is a network designed to receive, store, maintain, distribute, or control the flow of a distribution media. A common example is a heating hot water system that consists of a pump, a tank, and an interconnected piping system for distributing hot water to terminals.

The group *IfcDistributionSystem* defines the occurrence of a specialized system for use within the context of building services.

Important functionalities for the description of a distribution system are derived from existing IFC entities:

- From *IfcSystem* it inherits the ability to couple the distribution system via *IfcRelServicesBuildings* to one or more *IfcSpatialElement* subtypes as necessary.
- From *IfcGroup* it inherits the inverse attribute *IsGroupedBy*, pointing to the relationship entity *IfcRelAssignsToGroup*. This allows to group distribution elements (instances of *IfcDistributionElement* subtypes), and in special cases ports directly (instances of *IfcDistributionPort*).
- From *IfcObject* it inherits the inverse attribute *IsDecomposedBy* pointing to the relationship entity *IfcRelAggregates*. It provides the hierarchy between the separate (partial) distribution systems. For example, an electrical main circuit may be aggregated into branch circuits.

HISTORY New entity in IFC4.

IFC4 CHANGE For electrical power systems, *IfcElectricalCircuit* has been used for low-voltage (12-1000 V) power circuits and has been replaced by *IfcDistributionCircuit* in IFC4; *IfcDistributionSystem* with PredefinedType 'ELECTRICAL' should be used for overall power systems, and *IfcDistributionCircuit* with PredefinedType 'ELECTRICAL' should be used for each switched circuit.

EXPRESS Specification:**ENTITY** IfcDistributionSystem

SUPERTYPE OF (IfcDistributionCircuit)**SUBTYPE OF** (IfcSystem);

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

END_ENTITY;Attribute Definitions:

LongName : Long name for a system, 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 distribution system or branch circuit, and the *LongName* refers to a descriptive name.

PredefinedType : Predefined types of distribution systems.

Inheritance Graph:**ENTITY** IfcDistributionSystem**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcGroup

INVERSE

IsGroupedBy : **SET OF** IfcRelAssignsToGroup **FOR** RelatingGroup;

ENTITY IfcSystem

INVERSE

ENTITY IfcDistributionSystem

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

END_ENTITY;

```

<xs:element name="IfcDistributionSystem" type="Ifc:IfcDistributionSystem" substitutionGroup="Ifc:IfcSystem"
nillable="true"/>
<xs:complexType name="IfcDistributionSystem">
  <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** IfcOwnerHistory;
Name : **OPTIONAL** IfcLabel;
Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
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>
```

IfcSystemFurnitureElement

A system furniture element defines components of modular furniture which are not directly placed in a building structure but aggregated inside furniture.

HISTORY New entity in IFC2x2.

[EXPRESS Specification:](#)**ENTITY** IfcSystemFurnitureElement

SUBTYPE OF (IfcFurnishingElement);

PredefinedType : **OPTIONAL** IfcSystemFurnitureElementTypeEnum;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCSHAREDFACILITIESELEMENTS.IFCSYSTEMFURNITUREELEMENTTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;[Inheritance Graph:](#)**ENTITY** IfcSystemFurnitureElement

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcFurnishingElement**ENTITY** IfcSystemFurnitureElement

PredefinedType : **OPTIONAL** IfcSystemFurnitureElementTypeEnum;

END_ENTITY;

```

<xs:element name="IfcSystemFurnitureElement" type="ifc:IfcSystemFurnitureElement"
substitutionGroup="ifc:IfcFurnishingElement" nillable="true"/>
<xs:complexType name="IfcSystemFurnitureElement">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFurnishingElement">
      <xs:attribute name="PredefinedType" type="ifc:IfcSystemFurnitureElementTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
  
```

IfcSystemFurnitureElementType

The furnishing element type **IfcSystemFurnitureElementType** defines commonly shared information for occurrences of system furniture elements. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements

It is used to define a system furniture element type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcSystemFurnitureElementType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcSystemFurnitureElementType** are represented by instances of *IfcSystemFurnitureElement*. Refer to the documentation at *IfcSystemFurnitureElement* for supported property sets, materials, and composition.

HISTORY New entity in IFC2x2

EXPRESS Specification:**ENTITY** IfcSystemFurnitureElementType**SUBTYPE OF** (IfcFurnishingElementType);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcSystemFurnitureElementTypeEnum.USERDEFINED) OR
 ((PredefinedType = IfcSystemFurnitureElementTypeEnum.USERDEFINED) AND
 EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;[Inheritance Graph:](#)**ENTITY** IfcSystemFurnitureElementType**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcFurnishingElementType

ENTITY IfcSystemFurnitureElementType

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcCostSchedule

An *IfcCostSchedule* brings together instances of *IfcCostItem* either for the purpose of identifying purely cost information as in an estimate for constructions costs or for including cost information within another presentation form such as a work order.

HISTORY New entity in IFC2.0.

IFC4 CHANGE Attribute *ID* renamed to *Identification* and promoted to supertype *IfcControl*, *PredefinedType* made optional, attributes *PreparedBy*, *SubmittedBy*, *TargetUsers* removed.

EXPRESS Specification:

ENTITY IfcCostSchedule

SUBTYPE OF (IfcControl);

PredefinedType : **OPTIONAL** IfcStrippedOptional;
 Status : **OPTIONAL** IfcStrippedOptional;
 SubmittedOn : **OPTIONAL** IfcStrippedOptional;
 UpdateDate : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

Attribute Definitions:

Status : The current status of a cost schedule. Examples of status values that might be used for a cost schedule status include:
 PLANNED

	APPROVED
	AGREED
	ISSUED
	STARTED
SubmittedOn	: The date and time on which the cost schedule was submitted. IFC4 CHANGE Type changed from IfcDateTimeSelect.
UpdateDate	: The date and time that this cost schedule is updated; this allows tracking the schedule history. IFC4 CHANGE Type changed from IfcDateTimeSelect.

Inheritance Graph:

ENTITY IfcCostSchedule

ENTITY IfcRoot

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: OPTIONAL IfcOwnerHistory;
Name	: OPTIONAL IfcLabel;
Description	: OPTIONAL IfcText;

ENTITY IfcObjectDefinition

INVERSE

HasAssignments	: SET OF IfcRelAssigns FOR RelatedObjects;
Nests	: SET [0: 1] OF IfcRelNests FOR RelatedObjects;
IsNestedBy	: SET OF IfcRelNests FOR RelatingObject;
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

IsDeclaredBy	: SET [0: 1] OF IfcRelDefinesByObject FOR RelatedObjects;
Declares	: SET OF IfcRelDefinesByObject FOR RelatingObject;
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 IfcCostSchedule

PredefinedType : **OPTIONAL** IfcStrippedOptional;

Status : **OPTIONAL** IfcStrippedOptional;

SubmittedOn : **OPTIONAL** IfcStrippedOptional;

UpdateDate : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcConstructionProductResource

IfcConstructionProductResource defines the role of a product that is consumed (wholly or partially), or occupied in the performance of construction.

HISTORY New entity in IFC2.0. Renamed from *IfcProductResource* in IFC2x.

Occurrences of *IfcConstructionProductResource* are usage of products to assist the process of construction. More specifically, they are usage of products that result from some construction processes and that are then used as resources to facilitate further construction. For instance, formworks can be instantiated as products resulting from the process 'constructing formwork'. However, they are used as resources in the process 'pouring concrete' in a later stage of the project.

EXPRESS Specification:

ENTITY IfcConstructionProductResource

SUBTYPE OF (IfcConstructionResource);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Attribute Definitions:

Inheritance Graph:

ENTITY IfcConstructionProductResource

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0: 1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0: 1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0: 1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcResource

Identification : **OPTIONAL** IfcStrippedOptional;
LongDescription : **OPTIONAL** IfcStrippedOptional;

INVERSE

ResourceOf : **SET OF** IfcRelAssignsToResource **FOR** RelatingResource;

ENTITY IfcConstructionResource

Usage : **OPTIONAL** IfcStrippedOptional;
 BaseCosts : **OPTIONAL LIST** [1:?] **OF** IfcAppliedValue;
 BaseQuantity : **OPTIONAL** IfcPhysicalQuantity;

ENTITY IfcConstructionProductResource

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcSubContractResource

IfcSubContractResource is a construction resource needed in a construction process that represents a sub-contractor.

HISTORY New entity in IFC2.0.

IFC4 CHANGE The attribute *SubContractor* has been deleted; use *IfcRelAssignsToResource* to assign an *IfcActor* to fulfill the role as the subcontractor. The attribute *JobDescription* has been deleted; use *LongDescription* to describe the job.

An *IfcSubContractResource* can be used in cost estimating and work planning with or without specifying the subcontractor and contract agreement.

The purpose of an *IfcSubContractResource* is to indicate work of a particular type that is that is to be engaged through the use of a sub-contract. Its aim is to identify the description of the sub-contract work required. It can be used to identify the generic type of sub-contract resource that is required for a purpose without having to be specific about the actor (person or organization) providing the resource occurrence. It may be particularly useful when creating an overall plan for a process or processes. For instance, within maintenance or work planning there may be a known task that needs to be done which is planned to require an 'insulation specialist'.

A subcontract resource may be described at various stages and levels of detail through its assignments:

- Subcontract resource designated for particular tasks
- Actors identified to request bids
- Cost schedules (bids) received from actors
- Project order (work order, change order, etc.) executed

EXPRESS Specification:**ENTITY** IfcSubContractResource**SUBTYPE OF** (IfcConstructionResource);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Attribute Definitions:

PredefinedType : Defines types of subcontract resources.
IFC4 New attribute.

Inheritance Graph:

ENTITY IfcSubContractResource

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcResource

Identification : **OPTIONAL** IfcStrippedOptional;
 LongDescription : **OPTIONAL** IfcStrippedOptional;

INVERSE

ResourceOf : **SET OF** IfcRelAssignsToResource **FOR** RelatingResource;

ENTITY IfcConstructionResource

Usage : **OPTIONAL** IfcStrippedOptional;
 BaseCosts : **OPTIONAL LIST** [1:?] **OF** IfcAppliedValue;
 BaseQuantity : **OPTIONAL** IfcPhysicalQuantity;

ENTITY IfcSubContractResource

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcSubContractResourceType

The resource type *IfcSubContractResourceType* defines commonly shared information for occurrences of subcontract resources. The set of shared information may include:

- common productivities
- common cost rates
- common properties within shared property sets

It is used to define a subcontract resource specification (the specific resource information that is common to all occurrences of that resource). Resource types may be exchanged without being already assigned to occurrences.

Occurrences of the *IfcSubContractResourceType* are represented by instances of *IfcSubContractResource*.

HISTORY New entity in IFC4.

EXPRESS Specification:

ENTITY IfcSubContractResourceType

SUBTYPE OF (IfcConstructionResourceType);

PredefinedType : IfcSubContractResourceTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcSubContractResourceTypeEnum.USERDEFINED) OR ((PredefinedType = IfcSubContractResourceTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcTypeResource.ResourceType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Defines types of subcontract resources.

Inheritance Graph:

ENTITY IfcSubContractResourceType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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 IfcTypeResource

Identification : **OPTIONAL** IfcStrippedOptional;
 LongDescription : **OPTIONAL** IfcStrippedOptional;
 ResourceType : **OPTIONAL** IfcStrippedOptional;

INVERSE

ResourceOf : **SET OF** IfcRelAssignsToResource **FOR** RelatingResource;

ENTITY IfcConstructionResourceType

BaseCosts : **OPTIONAL LIST** [1:?] **OF** IfcAppliedValue;

BaseQuantity : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcSubContractResourceType

PredefinedType : IfcSubContractResourceTypeEnum;

END_ENTITY;

```
<xs:element name="IfcSubContractResourceType" type="Ifc:IfcSubContractResourceType"
substitutionGroup="Ifc:IfcConstructionResourceType" nillable="true"/>
<xs:complexType name="IfcSubContractResourceType">
  <xs:complexContent>
    <xs:extension base="Ifc:IfcConstructionResourceType">
      <xs:attribute name="PredefinedType" type="Ifc:IfcSubContractResourceTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcElectricAppliance

An electric appliance is a device intended for consumer usage that is powered by electricity.

Electric appliances may be fixed in place or may be able to be moved from one space to another. Electric appliances require an electrical supply that may be supplied either by an electrical circuit or provided from a local battery source.

HISTORY New entity in IFC4

EXPRESS Specification:**ENTITY** IfcElectricAppliance**SUBTYPE OF** (IfcFlowTerminal);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCELECTRICDOMAIN.IFCELECTRICAPPLIANCETYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Formal Propositions:

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

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

Inheritance Graph:

ENTITY *IfcElectricAppliance*

ENTITY *IfcRoot*

GlobalId	: IfcGloballyUniqueId;
OwnerHistory	: OPTIONAL <i>IfcOwnerHistory</i> ;
Name	: OPTIONAL <i>IfcLabel</i> ;
Description	: OPTIONAL <i>IfcText</i> ;

ENTITY *IfcObjectDefinition*

INVERSE

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

ENTITY *IfcObject*

ObjectType	: OPTIONAL <i>IfcStrippedOptional</i> ;
------------	--

INVERSE

IsDeclaredBy	: SET [0: 1] OF <i>IfcRelDefinesByObject</i> FOR <i>RelatedObjects</i> ;
Declares	: SET OF <i>IfcRelDefinesByObject</i> FOR <i>RelatingObject</i> ;
IsTypedBy	: SET [0: 1] OF <i>IfcRelDefinesByType</i> FOR <i>RelatedObjects</i> ;
IsDefinedBy	: SET OF <i>IfcRelDefinesByProperties</i> FOR <i>RelatedObjects</i> ;

ENTITY *IfcProduct*

ObjectPlacement	: OPTIONAL <i>IfcObjectPlacement</i> ;
Representation	: OPTIONAL <i>IfcProductRepresentation</i> ;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement**INVERSE**

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement**INVERSE****ENTITY** IfcFlowTerminal**ENTITY** IfcElectricAppliance

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcElectricApplianceType

The flow terminal type **IfcElectricApplianceType** defines commonly shared information for occurrences of electric appliances. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a electric appliance type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcElectricApplianceType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcElectricApplianceType** are represented by instances of *IfcElectricAppliance*. Refer to the documentation at *IfcElectricAppliance* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcElectricApplianceType

SUBTYPE OF (IfcFlowTerminalType);

PredefinedType : IfcElectricApplianceTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcElectricApplianceTypeEnum.USERDEFINED) OR ((PredefinedType = IfcElectricApplianceTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Identifies the predefined types of electrical appliance from which the type required may be set.

Inheritance Graph:

ENTITY IfcElectricApplianceType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType**ENTITY** IfcDistributionFlowElementType**ENTITY** IfcFlowTerminalType**ENTITY** IfcElectricApplianceType

PredefinedType : IfcElectricApplianceTypeEnum;

END_ENTITY;

```

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

```

```

<xs:attribute name="PredefinedType" type="Ifc:IfcElectricApplianceTypeEnum" use="optional"/>
</xs:extension>
</xs:complexContent>
</xs:complexType>

```

IfcSolarDevice

A solar device converts solar radiation into other energy such as electric current or thermal energy.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcSolarDevice

SUBTYPE OF (IfcEnergyConversionDevice);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCELECTRICDOMAIN.IFCSOLARDEVICETYPE' IN
TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Inheritance Graph:

ENTITY IfcSolarDevice

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0: 1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;

Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;

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

IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;

Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;

IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;

InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;

HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;

ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;

ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;

ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcEnergyConversionDevice

ENTITY IfcSolarDevice

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```

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

```

IfcSolarDeviceType

The energy conversion device type **IfcSolarDeviceType** defines commonly shared information for occurrences of solar devices. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a solar device type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcSolarDeviceType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcSolarDeviceType** are represented by instances of *IfcSolarDevice*. Refer to the documentation at *IfcSolarDevice* for supported property sets, materials, composition, and ports.

[EXPRESS Specification:](#)

ENTITY IfcSolarDeviceType

SUBTYPE OF (IfcEnergyConversionDeviceType);

PredefinedType : IfcSolarDeviceTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcSolarDeviceTypeEnum.USERDEFINED) OR ((PredefinedType = IfcSolarDeviceTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

[Inheritance Graph:](#)

ENTITY IfcSolarDeviceType**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcEnergyConversionDeviceType

ENTITY IfcSolarDeviceType

PredefinedType : IfcSolarDeviceTypeEnum;

END_ENTITY;

```
<xs:element name="IfcSolarDeviceType" type="ifc:IfcSolarDeviceType"
substitutionGroup="ifc:IfcEnergyConversionDeviceType" nillable="true"/>
<xs:complexType name="IfcSolarDeviceType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcEnergyConversionDeviceType">
      <xs:attribute name="PredefinedType" type="ifc:IfcSolarDeviceTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcBoiler

A boiler is a closed, pressure-rated vessel in which water or other fluid is heated using an energy source such as natural gas, heating oil, or electricity. The fluid in the vessel is then circulated out of the boiler for use in various processes or heating applications.

IfcBoiler is a vessel solely used for heating of water or other fluids. Storage vessels, such as for drinking water storage are considered as tanks and use the *IfcTank* entity.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcBoiler

SUBTYPE OF (IfcEnergyConversionDevice);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCHVACDOMAIN.IFCBOILERTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Formal Propositions:

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

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

Inheritance Graph:**ENTITY** IfcBoiler**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0: 1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcEnergyConversionDevice

ENTITY IfcBoiler

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcBoilerType

The energy conversion device type **IfcBoilerType** defines commonly shared information for occurrences of boilers. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a boiler type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcBoilerType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcBoilerType** are represented by instances of *IfcBoiler*. Refer to the documentation at *IfcBoiler* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcBoilerType

SUBTYPE OF (IfcEnergyConversionDeviceType);

PredefinedType : IfcBoilerTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcBoilerTypeEnum.USERDEFINED) OR ((PredefinedType = IfcBoilerTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Defines types of boilers.

Inheritance Graph:

ENTITY IfcBoilerType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcEnergyConversionDeviceType

ENTITY IfcBoilerType

PredefinedType : IfcBoilerTypeEnum;

END_ENTITY;

```
<xs:element name="IfcBoilerType" type="ifc: IfcBoilerType" substitutionGroup="ifc: IfcEnergyConversionDeviceType"
nillable="true"/>
<xs:complexType name="IfcBoilerType">
  <xs:complexContent>
    <xs:extension base="ifc: IfcEnergyConversionDeviceType">
      <xs:attribute name="PredefinedType" type="ifc: IfcBoilerTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcFilter

A filter is an apparatus used to remove particulate or gaseous matter from fluids and gases.

HISTORY [New entity in IFC4](#)

[EXPRESS Specification:](#)**ENTITY** IfcFilter**SUBTYPE OF** (IfcFlowTreatmentDevice);PredefinedType : **OPTIONAL** IfcStrippedOptional;**WHERE**

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCHVACDOMAIN.IFCFILTERTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;[Formal Propositions:](#)

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

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

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

GlobalId : IfcGloballyUniqueId;

OwnerHistory : **OPTIONAL** IfcOwnerHistory;

Name : **OPTIONAL** IfcLabel;

Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;

IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;

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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcFlowTreatmentDevice

ENTITY IfcFilter

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcFilterType

The flow treatment device type **IfcFilterType** defines commonly shared information for occurrences of filters. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a filter type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcFilterType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcFilterType** are represented by instances of *IfcFilter*. Refer to the documentation at *IfcFilter* for supported property sets, materials, composition, and ports.

[EXPRESS Specification:](#)

ENTITY IfcFilterType

SUBTYPE OF (IfcFlowTreatmentDeviceType);

PredefinedType : IfcFilterTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcFilterTypeEnum.USERDEFINED) OR ((PredefinedType = IfcFilterTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

[Attribute Definitions:](#)

PredefinedType : The type of air filter.

[Inheritance Graph:](#)

ENTITY IfcFilterType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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** IfcRepresentationMap;
Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowTreatmentDeviceType

ENTITY IfcFilterType

PredefinedType : IfcFilterTypeEnum;

END_ENTITY;

```
<xs:element name="IfcFilterType" type="ifc:IfcFilterType" substitutionGroup="ifc:IfcFlowTreatmentDeviceType"
nillable="true"/>
<xs:complexType name="IfcFilterType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowTreatmentDeviceType">
      <xs:attribute name="PredefinedType" type="ifc:IfcFilterTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcFlowMeter

A flow meter is a device that is used to measure the flow rate in a system.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcFlowMeter

SUBTYPE OF (IfcFlowController);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Formal Propositions:

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

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

Inheritance Graph:

ENTITY IfcFlowMeter

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement**INVERSE**

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement**INVERSE****ENTITY** IfcFlowController**ENTITY** IfcFlowMeter

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```

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

```

IfcFlowMeterType

The flow controller type **IfcFlowMeterType** defines commonly shared information for occurrences of flow meters. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a flow meter type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcFlowMeterType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcFlowMeterType** are

represented by instances of *IfcFlowMeter*. Refer to the documentation at *IfcFlowMeter* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcFlowMeterType

SUBTYPE OF (IfcFlowControllerType);

PredefinedType : IfcFlowMeterTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcFlowMeterTypeEnum.USERDEFINED) OR ((PredefinedType = IfcFlowMeterTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Defines the type of flow meter.

Inheritance Graph:

ENTITY IfcFlowMeterType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowControllerType

ENTITY IfcFlowMeterType

PredefinedType : IfcFlowMeterTypeEnum;

END_ENTITY;

```
<xs:element name="IfcFlowMeterType" type="ifc:IfcFlowMeterType" substitutionGroup="ifc:IfcFlowControllerType"
nillable="true"/>
<xs:complexType name="IfcFlowMeterType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowControllerType">
      <xs:attribute name="PredefinedType" type="ifc:IfcFlowMeterTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcPipeFitting

A pipe fitting is a junction or transition in a piping flow distribution system used to connect pipe segments, resulting in changes in flow characteristics to the fluid such as direction or flow rate.

HISTORY [New entity in IFC4](#)

EXPRESS Specification:**ENTITY** IfcPipeFitting**SUBTYPE OF** (IfcFlowFitting);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;Formal Propositions:

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

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

Inheritance Graph:**ENTITY** IfcPipeFitting**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcFlowFitting

ENTITY IfcPipeFitting

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcPipeFittingType

The flow fitting type **IfcPipeFittingType** defines commonly shared information for occurrences of pipe fittings. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a pipe fitting type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcPipeFittingType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcPipeFittingType** are represented by instances of *IfcPipeFitting*. Refer to the documentation at *IfcPipeFitting* for supported property sets, materials, composition, and ports.

[EXPRESS Specification:](#)

ENTITY IfcPipeFittingType

SUBTYPE OF (IfcFlowFittingType);

PredefinedType : IfcPipeFittingTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcPipeFittingTypeEnum.USERDEFINED) OR ((PredefinedType = IfcPipeFittingTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

[Attribute Definitions:](#)

PredefinedType : The type of pipe fitting.

[Inheritance Graph:](#)

ENTITY IfcPipeFittingType**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowFittingType

ENTITY IfcPipeFittingType

PredefinedType : IfcPipeFittingTypeEnum;

END_ENTITY;

```
<xs:element name="IfcPipeFittingType" type="ifc: IfcPipeFittingType" substitutionGroup="ifc: IfcFlowFittingType"
nillable="true"/>
<xs:complexType name="IfcPipeFittingType">
  <xs:complexContent>
    <xs:extension base="ifc: IfcFlowFittingType">
      <xs:attribute name="PredefinedType" type="ifc: IfcPipeFittingTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcPipeSegment

A pipe segment is used to typically join two sections of a piping network.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcPipeSegment

SUBTYPE OF (IfcFlowSegment);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCHVACDOMAIN.IFCPIPESEGMENTTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;

Formal Propositions:

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

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

Inheritance Graph:

ENTITY IfcPipeSegment**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement**INVERSE**

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement**INVERSE****ENTITY** IfcFlowSegment**ENTITY** IfcPipeSegment

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```

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

```

IfcPipeSegmentType

The flow segment type **IfcPipeSegmentType** defines commonly shared information for occurrences of pipe segments. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a pipe segment type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcPipeSegmentType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcPipeSegmentType** are represented by instances of *IfcPipeSegment*. Refer to the documentation at *IfcPipeSegment* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcPipeSegmentType

SUBTYPE OF (IfcFlowSegmentType);

PredefinedType : IfcPipeSegmentTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcPipeSegmentTypeEnum.USERDEFINED) OR ((PredefinedType = IfcPipeSegmentTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : The type of pipe segment.

Inheritance Graph:

ENTITY IfcPipeSegmentType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowSegmentType

ENTITY IfcPipeSegmentType

PredefinedType : IfcPipeSegmentTypeEnum;

END_ENTITY;

```
<xs:element name="IfcPipeSegmentType" type="ifc:IfcPipeSegmentType" substitutionGroup="ifc:IfcFlowSegmentType"
nillable="true"/>
<xs:complexType name="IfcPipeSegmentType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowSegmentType">
      <xs:attribute name="PredefinedType" type="ifc:IfcPipeSegmentTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcPump

A pump is a device which imparts mechanical work on fluids or slurries to move them through a channel or pipeline. A typical use of a pump is to circulate chilled water or heating hot water in a building services distribution system.

HISTORY [New entity in IFC4](#)

EXPRESS Specification:**ENTITY** IfcPump**SUBTYPE OF** (IfcFlowMovingDevice);PredefinedType : **OPTIONAL** IfcStrippedOptional;**WHERE**

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCHVACDOMAIN.IFCPUMPTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;Formal Propositions:

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

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

Inheritance Graph:**ENTITY** IfcPump**ENTITY** IfcRoot

GlobalId : IfcGloballyUniqueId;

OwnerHistory : **OPTIONAL** IfcOwnerHistory;

Name : **OPTIONAL** IfcLabel;

Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;

IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;

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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcFlowMovingDevice

ENTITY IfcPump

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcPumpType

The flow moving device type **IfcPumpType** defines commonly shared information for occurrences of pumps. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a pump type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcPumpType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcPumpType** are represented by instances of *IfcPump*. Refer to the documentation at *IfcPump* for supported property sets, materials, composition, and ports.

[EXPRESS Specification:](#)

ENTITY IfcPumpType

SUBTYPE OF (IfcFlowMovingDeviceType);

PredefinedType : IfcPumpTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcPumpTypeEnum.USERDEFINED) OR ((PredefinedType = IfcPumpTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

[Attribute Definitions:](#)

PredefinedType : Defines the type of pump typically used in building services.

[Inheritance Graph:](#)

ENTITY IfcPumpType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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** IfcRepresentationMap;
Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowMovingDeviceType

ENTITY IfcPumpType

PredefinedType : IfcPumpTypeEnum;

END_ENTITY;

```
<xs:element name="IfcPumpType" type="IfcPumpType" substitutionGroup="IfcFlowMovingDeviceType"
nillable="true"/>
<xs:complexType name="IfcPumpType">
  <xs:complexContent>
    <xs:extension base="IfcFlowMovingDeviceType">
      <xs:attribute name="PredefinedType" type="IfcPumpTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcValve

A valve is used in a building services piping distribution system to control or modulate the flow of the fluid.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcValve

SUBTYPE OF (IfcFlowController);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Formal Propositions:

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

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

Inheritance Graph:

ENTITY IfcValve

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement**INVERSE**

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement**INVERSE****ENTITY** IfcFlowController**ENTITY** IfcValve

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

```

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

```

IfcValveType

The flow controller type **IfcValveType** defines commonly shared information for occurrences of valves. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a valve type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcValveType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and

may be exchanged with or without occurrences of the type. Occurrences of **IfcValveType** are represented by instances of *IfcValve*. Refer to the documentation at *IfcValve* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcValveType

SUBTYPE OF (IfcFlowControllerType);

PredefinedType : IfcValveTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcValveTypeEnum.USERDEFINED) OR ((PredefinedType = IfcValveTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : The type of valve.

Inheritance Graph:

ENTITY IfcValveType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowControllerType

ENTITY IfcValveType

PredefinedType : IfcValveTypeEnum;

END_ENTITY;

```
<xs:element name="IfcValveType" type="ifc:IfcValveType" substitutionGroup="ifc:IfcFlowControllerType"
nillable="true"/>
<xs:complexType name="IfcValveType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowControllerType">
      <xs:attribute name="PredefinedType" type="ifc:IfcValveTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcSanitaryTerminal

A sanitary terminal is a fixed appliance or terminal usually supplied with water and used for drinking, cleaning or foul water disposal or that is an item of equipment directly used with such an appliance or terminal.

HISTORY [New entity in IFC4](#)

[EXPRESS Specification:](#)**ENTITY** IfcSanitaryTerminal**SUBTYPE OF** (IfcFlowTerminal);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

CorrectTypeAssigned : (SIZEOF(IsTypedBy) = 0) OR ('IFCPLUMBINGFIREPROTECTIONDOMAIN.IFCSANITARYTERMINALTYPE' IN TYPEOF(SELF\IfcObject.IsTypedBy[1].RelatingType));

END_ENTITY;[Formal Propositions:](#)

CorrectPredefinedType :

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

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

GlobalId : IfcGloballyUniqueId;

OwnerHistory : **OPTIONAL** IfcOwnerHistory;

Name : **OPTIONAL** IfcLabel;

Description : **OPTIONAL** IfcText;

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;

Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;

IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;

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

IsDeclaredBy : **SET** [0:1] OF IfcRelDefinesByObject **FOR** RelatedObjects;
 Declares : **SET OF** IfcRelDefinesByObject **FOR** RelatingObject;
 IsTypedBy : **SET** [0:1] OF IfcRelDefinesByType **FOR** RelatedObjects;
 IsDefinedBy : **SET OF** IfcRelDefinesByProperties **FOR** RelatedObjects;

ENTITY IfcProduct

ObjectPlacement : **OPTIONAL** IfcObjectPlacement;
 Representation : **OPTIONAL** IfcProductRepresentation;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement

INVERSE

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement

INVERSE

ENTITY IfcFlowTerminal

ENTITY IfcSanitaryTerminal

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcSanitaryTerminalType

The flow terminal type **IfcSanitaryTerminalType** defines commonly shared information for occurrences of sanitary terminals. The set of shared information may include:

- common properties with shared property sets
- common representations
- common materials
- common composition of elements
- common ports

It is used to define a sanitary terminal type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcSanitaryTerminalType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcSanitaryTerminalType** are represented by instances of *IfcSanitaryTerminal*. Refer to the documentation at *IfcSanitaryTerminal* for supported property sets, materials, composition, and ports.

[EXPRESS Specification:](#)

ENTITY IfcSanitaryTerminalType

SUBTYPE OF (IfcFlowTerminalType);

PredefinedType : IfcSanitaryTerminalTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcSanitaryTerminalTypeEnum.USERDEFINED) OR ((PredefinedType = IfcSanitaryTerminalTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

[Attribute Definitions:](#)

PredefinedType : Identifies the predefined types of sanitary terminal from which the type required may be set.

Inheritance Graph:**ENTITY** IfcSanitaryTerminalType**ENTITY** IfcRoot

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

ENTITY IfcObjectDefinition**INVERSE**

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

ENTITY IfcDistributionElementType

ENTITY IfcDistributionFlowElementType

ENTITY IfcFlowTerminalType

ENTITY IfcSanitaryTerminalType

PredefinedType : IfcSanitaryTerminalTypeEnum;

END_ENTITY;

```
<xs:element name="IfcSanitaryTerminalType" type="ifc:IfcSanitaryTerminalType"
substitutionGroup="ifc:IfcFlowTerminalType" nillable="true"/>
<xs:complexType name="IfcSanitaryTerminalType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowTerminalType">
      <xs:attribute name="PredefinedType" type="ifc:IfcSanitaryTerminalTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```

IfcWasteTerminal

A waste terminal has the purpose of collecting or intercepting waste from one or more sanitary terminals or other fluid waste generating equipment and discharging it into a single waste/drainage system.

A waste terminal provides for all forms of trap and waste point that collects discharge from a sanitary terminal and discharges it into a waste/drainage subsystem or that collects waste from several terminals and passes it into a single waste/drainage subsystem. This includes the P and S traps from soil sanitary terminals, sinks, and basins as well as floor wastes and gully traps that provide collection points.

HISTORY New entity in IFC4

EXPRESS Specification:

ENTITY IfcWasteTerminal

SUBTYPE OF (IfcFlowTerminal);

PredefinedType : **OPTIONAL** IfcStrippedOptional;

WHERE

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

END_ENTITY;

Formal Propositions:

CorrectPredefinedType :

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

Inheritance Graph:

ENTITY *IfcWasteTerminal*

ENTITY *IfcRoot*

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

ENTITY *IfcObjectDefinition*

INVERSE

HasAssignments : **SET OF** *IfcRelAssigns* **FOR** *RelatedObjects*;
 Nests : **SET** [0:1] OF *IfcRelNests* **FOR** *RelatedObjects*;
 IsNestedBy : **SET OF** *IfcRelNests* **FOR** *RelatingObject*;
 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

IsDeclaredBy : **SET** [0:1] OF *IfcRelDefinesByObject* **FOR** *RelatedObjects*;
 Declares : **SET OF** *IfcRelDefinesByObject* **FOR** *RelatingObject*;
 IsTypedBy : **SET** [0:1] OF *IfcRelDefinesByType* **FOR** *RelatedObjects*;
 IsDefinedBy : **SET OF** *IfcRelDefinesByProperties* **FOR** *RelatedObjects*;

ENTITY *IfcProduct*

ObjectPlacement : **OPTIONAL** *IfcObjectPlacement*;
 Representation : **OPTIONAL** *IfcProductRepresentation*;

INVERSE

ReferencedBy : **SET OF** *IfcRelAssignsToProduct* **FOR** *RelatingProduct*;

ENTITY IfcElement

Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ConnectedTo : **SET OF** IfcRelConnectsElements **FOR** RelatingElement;
 IsInterferedByElements : **SET OF** IfcRelInterferesElements **FOR** RelatedElement;
 InterferesElements : **SET OF** IfcRelInterferesElements **FOR** RelatingElement;
 HasOpenings : **SET OF** IfcRelVoidsElement **FOR** RelatingBuildingElement;
 ProvidesBoundaries : **SET OF** IfcRelSpaceBoundary **FOR** RelatedBuildingElement;
 ConnectedFrom : **SET OF** IfcRelConnectsElements **FOR** RelatedElement;
 ContainedInStructure : **SET** [0:1] OF IfcRelContainedInSpatialStructure **FOR** RelatedElements;

ENTITY IfcDistributionElement**INVERSE**

HasPorts : **SET OF** IfcRelConnectsPortToElement **FOR** RelatedElement;

ENTITY IfcDistributionFlowElement**INVERSE****ENTITY** IfcFlowTerminal**ENTITY** IfcWasteTerminal

PredefinedType : **OPTIONAL** IfcStrippedOptional;

END_ENTITY;

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

IfcWasteTerminalType

The flow terminal type **IfcWasteTerminalType** defines commonly shared information for occurrences of waste terminals. The set of shared information may include:

- common properties with shared property sets

- common representations
- common materials
- common composition of elements
- common ports

It is used to define a waste terminal type specification indicating the specific product information that is common to all occurrences of that product type. The **IfcWasteTerminalType** may be declared within *IfcProject* or *IfcProjectLibrary* using *IfcRelDeclares* and may be exchanged with or without occurrences of the type. Occurrences of **IfcWasteTerminalType** are represented by instances of *IfcWasteTerminal*. Refer to the documentation at *IfcWasteTerminal* for supported property sets, materials, composition, and ports.

EXPRESS Specification:

ENTITY IfcWasteTerminalType

SUBTYPE OF (IfcFlowTerminalType);

PredefinedType : IfcWasteTerminalTypeEnum;

WHERE

CorrectPredefinedType : (PredefinedType <> IfcWasteTerminalTypeEnum.USERDEFINED) OR ((PredefinedType = IfcWasteTerminalTypeEnum.USERDEFINED) AND EXISTS(SELF\IfcElementType.ElementType));

END_ENTITY;

Attribute Definitions:

PredefinedType : Identifies the predefined types of waste terminal from which the type required may be set.

Inheritance Graph:

ENTITY IfcWasteTerminalType

ENTITY IfcRoot

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

ENTITY IfcObjectDefinition

INVERSE

HasAssignments : **SET OF** IfcRelAssigns **FOR** RelatedObjects;
 Nests : **SET** [0:1] OF IfcRelNests **FOR** RelatedObjects;
 IsNestedBy : **SET OF** IfcRelNests **FOR** RelatingObject;
 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** IfcRepresentationMap;
 Tag : **OPTIONAL** IfcStrippedOptional;

INVERSE

ReferencedBy : **SET OF** IfcRelAssignsToProduct **FOR** RelatingProduct;

ENTITY IfcElementType

ElementType : **OPTIONAL** IfcStrippedOptional;

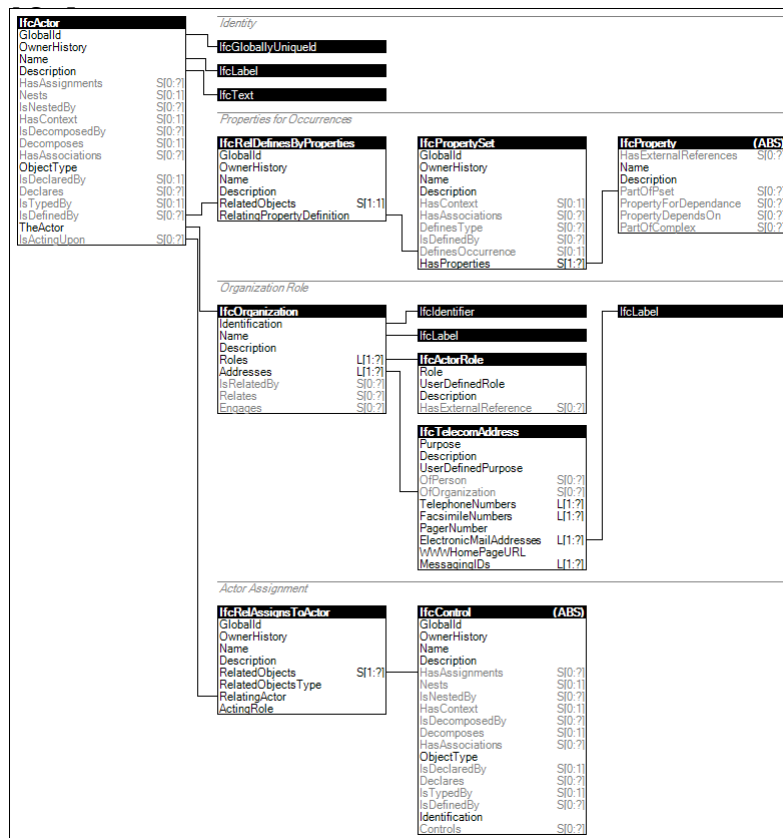
ENTITY IfcDistributionElementType**ENTITY** IfcDistributionFlowElementType**ENTITY** IfcFlowTerminalType**ENTITY** IfcWasteTerminalType

PredefinedType : IfcWasteTerminalTypeEnum;

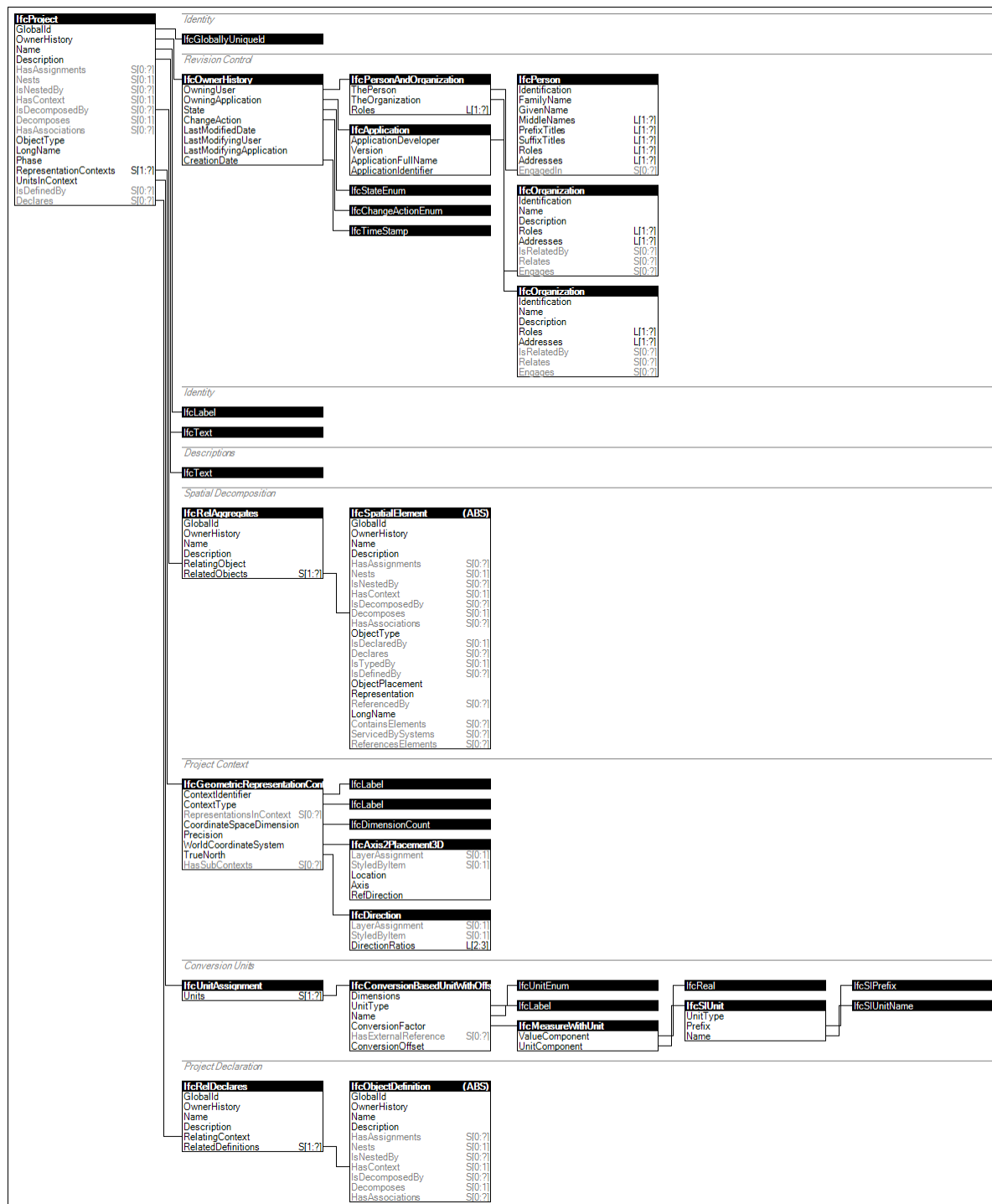
END_ENTITY;

```
<xs:element name="IfcWasteTerminalType" type="ifc:IfcWasteTerminalType"
substitutionGroup="ifc:IfcFlowTerminalType" nillable="true"/>
<xs:complexType name="IfcWasteTerminalType">
  <xs:complexContent>
    <xs:extension base="ifc:IfcFlowTerminalType">
      <xs:attribute name="PredefinedType" type="ifc:IfcWasteTerminalTypeEnum" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```


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



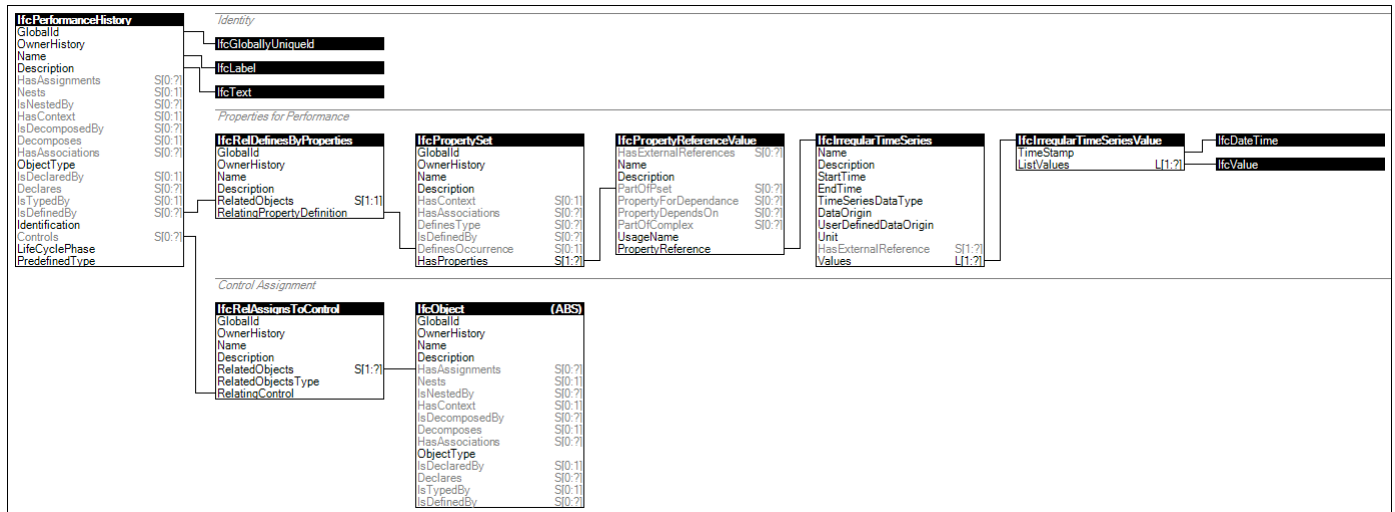
Conversion Units

If units are omitted, SI base units are implicit.

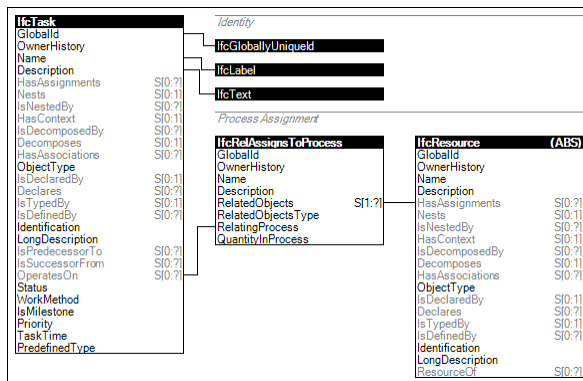
Project Declaration

Objects are declared within a project (or project library) to indicate top-level positioning within the project hierarchy and to indicate the relevant context for units and geometry.

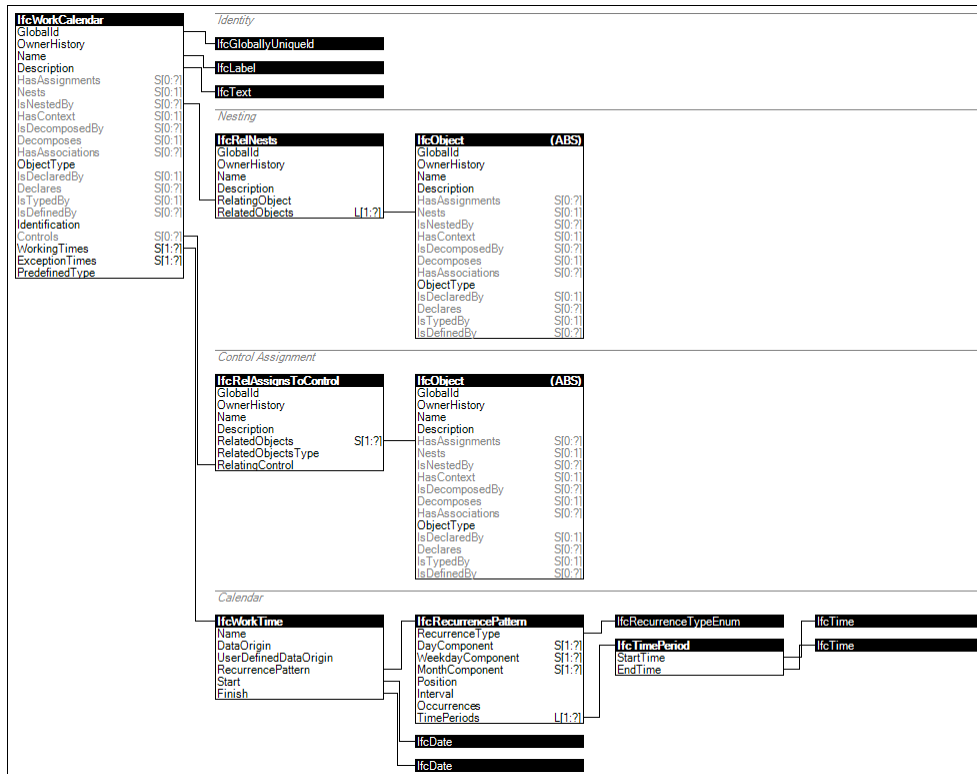
IfcPerformanceHistory



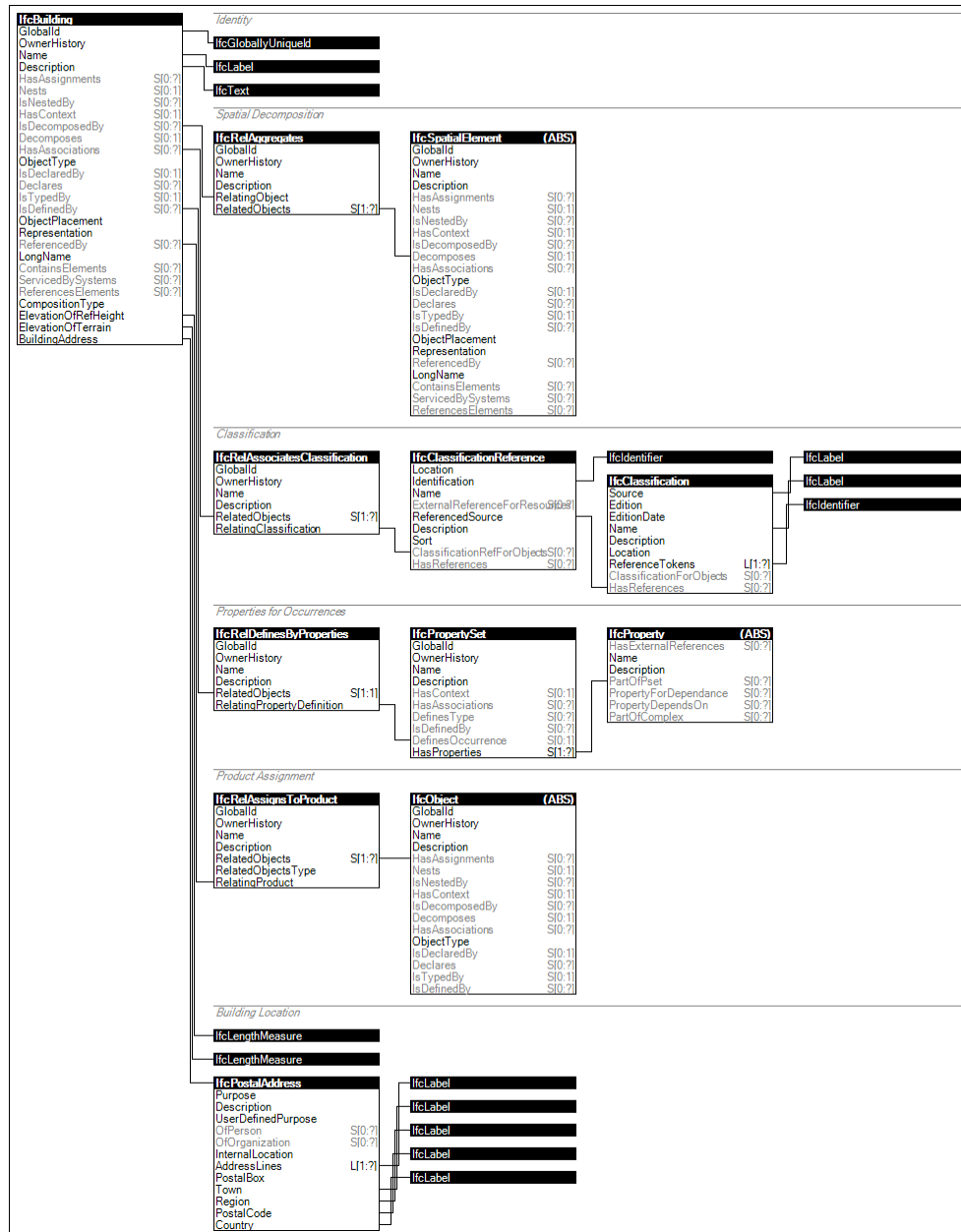
IfcTask



IfcWorkCalendar



IfcBuilding



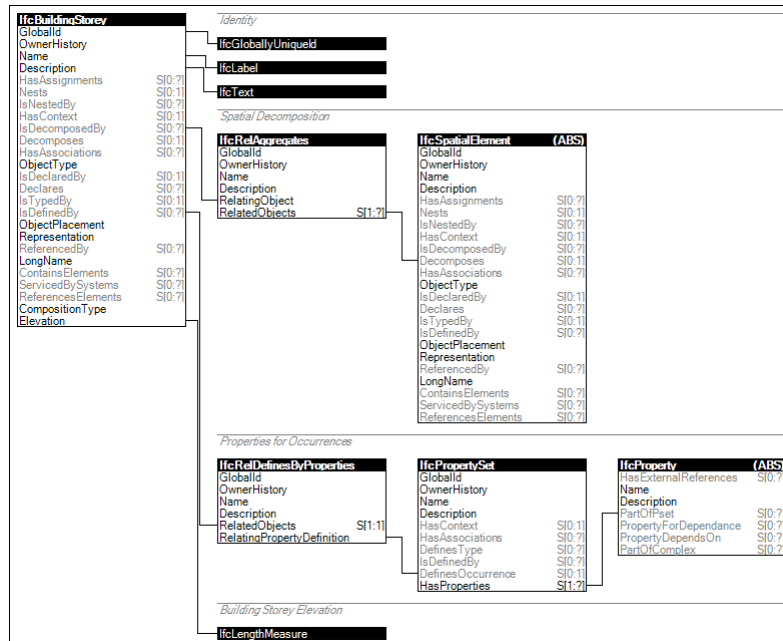
Classification

Classification is required to determine the required plumbing fixtures per occupant.

Building Location

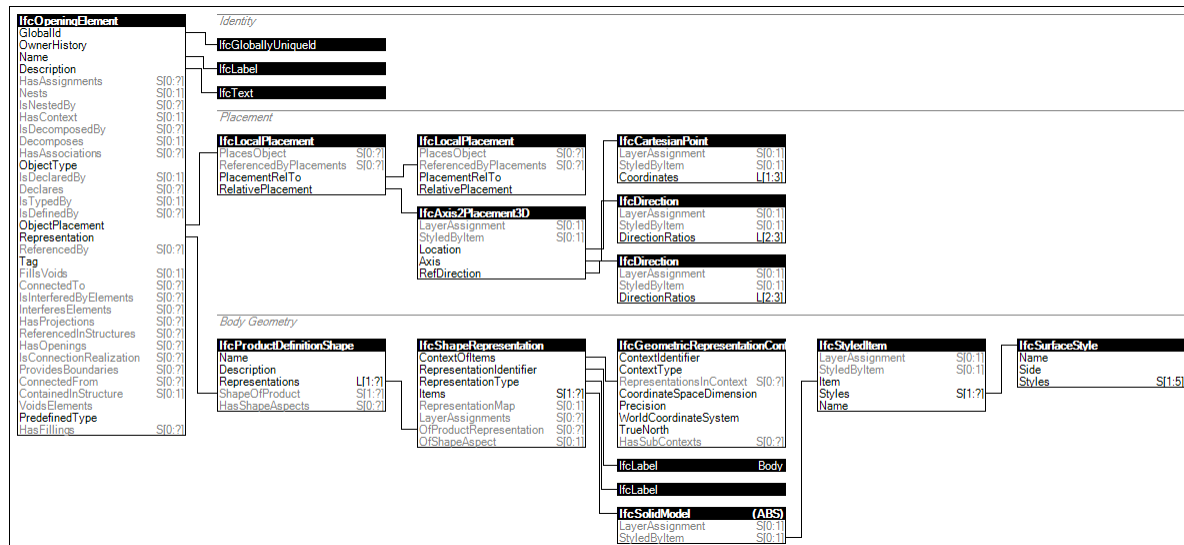
The building elevation must be known to determine pressure requirements for connected utilities.

IfcBuildingStorey



IfcOpeningElement

Openings are required for plumbing design to determine placement of fixtures and piping.



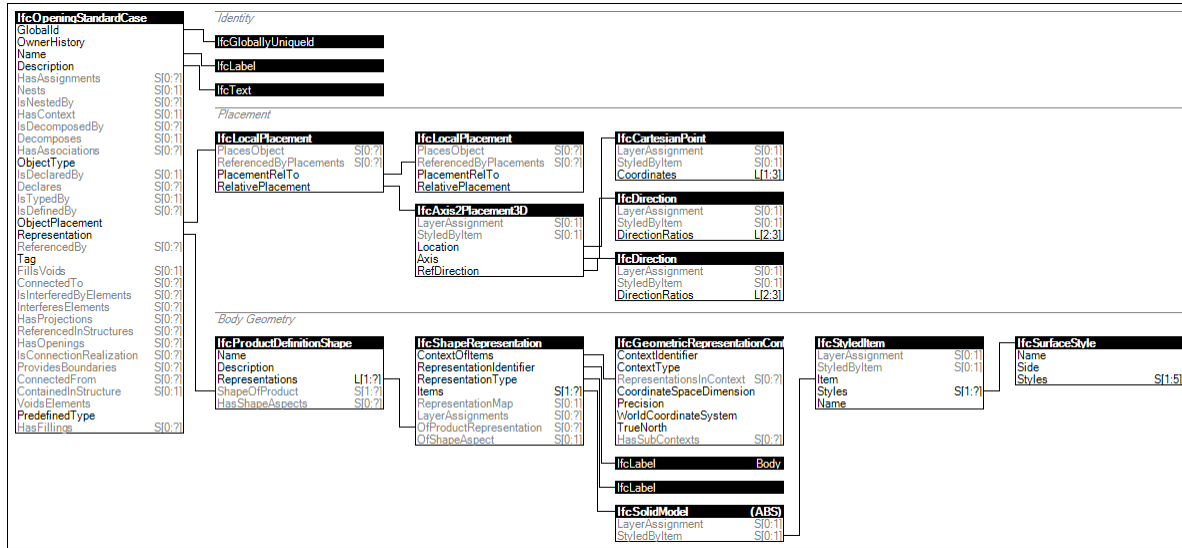
Placement

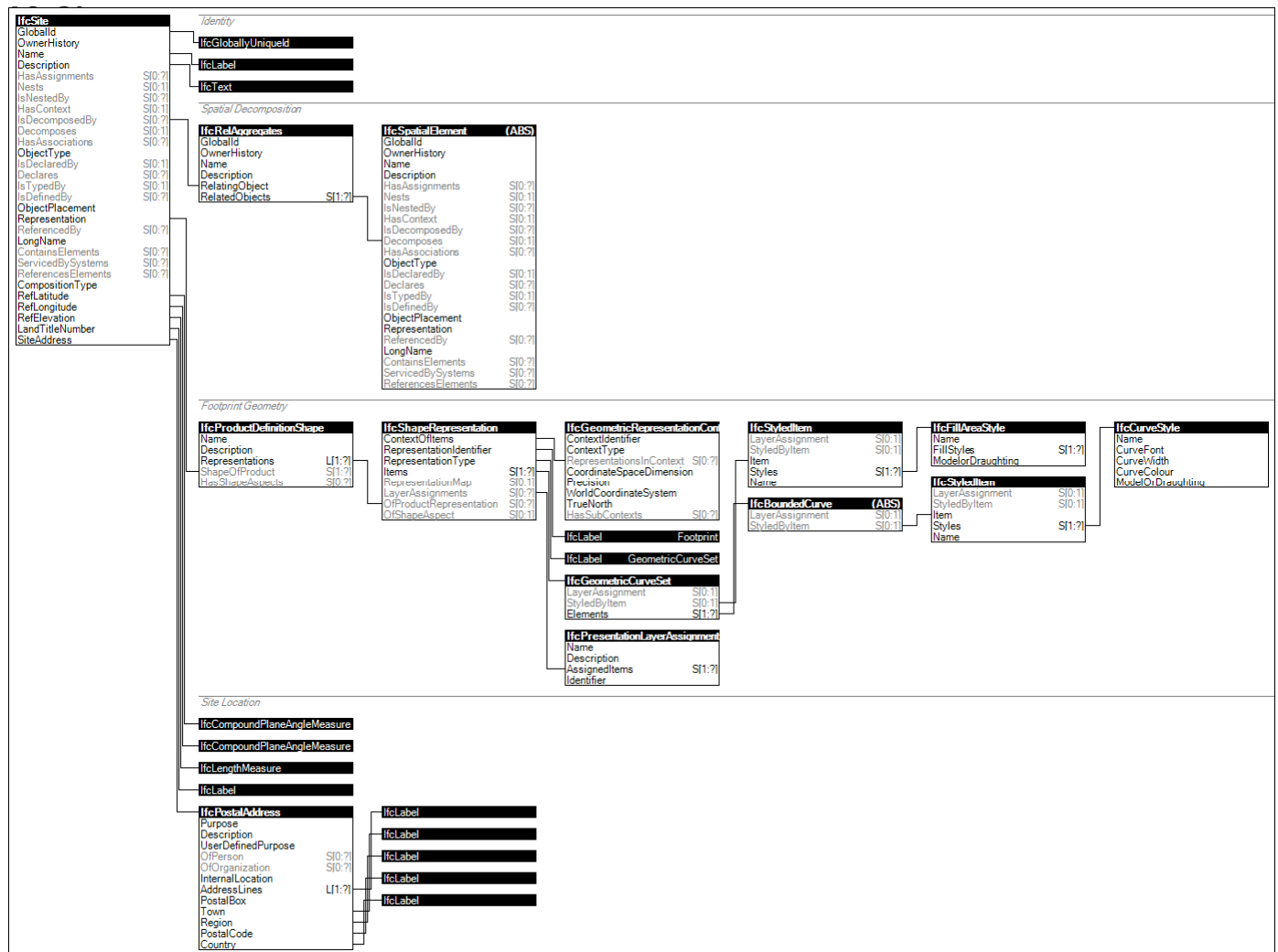
Opening locations must be known for layout of plumbing fixtures and piping.

Body Geometry

Opening geometry must be known for layout of plumbing fixtures and piping.

IfcOpeningStandardCase





Footprint Geometry

The foot print representation of *IfcSite* is given by either a single 2D curve (such as *IfcPolyline* or *IfcCompositeCurve*), or by a list of 2D curves (in case of inner boundaries).

The representation identifier and type of this geometric representation of *IfcSite* is:

- *IfcShapeRepresentation.RepresentationIdentifier* = 'FootPrint'
- *IfcShapeRepresentation.RepresentationType* = 'GeometricCurveSet', or 'Annotation2D'



- *IfcShapeRepresentation.RepresentationIdentifier* = 'FootPrint'.
- *IfcShapeRepresentation.RepresentationType* = 'Curve2D' or 'GeometricCurveSet'.

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- **Profile:** *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 106 shows a two-dimensional bounded curve representing the foot print of *IfcSpace*.

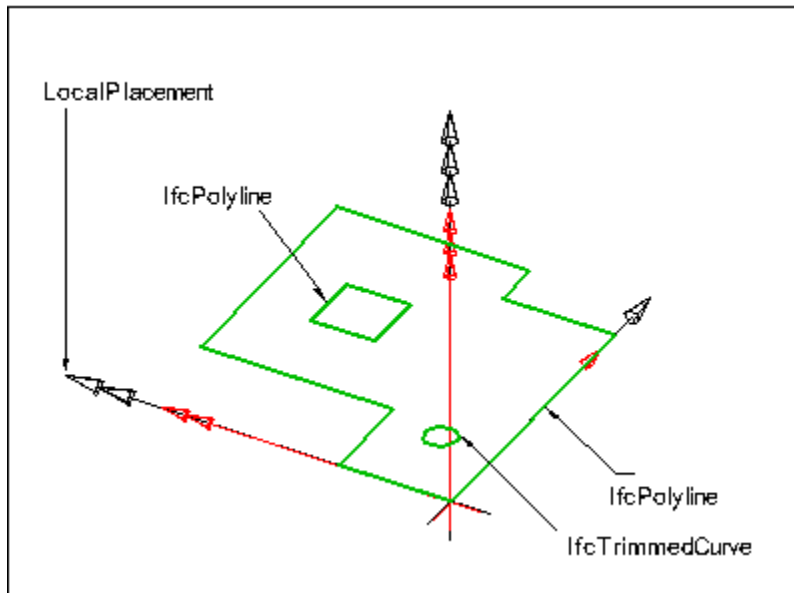


Figure 106 — Space footprint

Body Geometry

The standard geometric representation of *IfcSpace* is defined using the swept area solid geometry. The following attribute values should be inserted

- *IfcShapeRepresentation.RepresentationIdentifier* = 'Body'.
- *IfcShapeRepresentation.RepresentationType* = 'SweptSolid'.

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

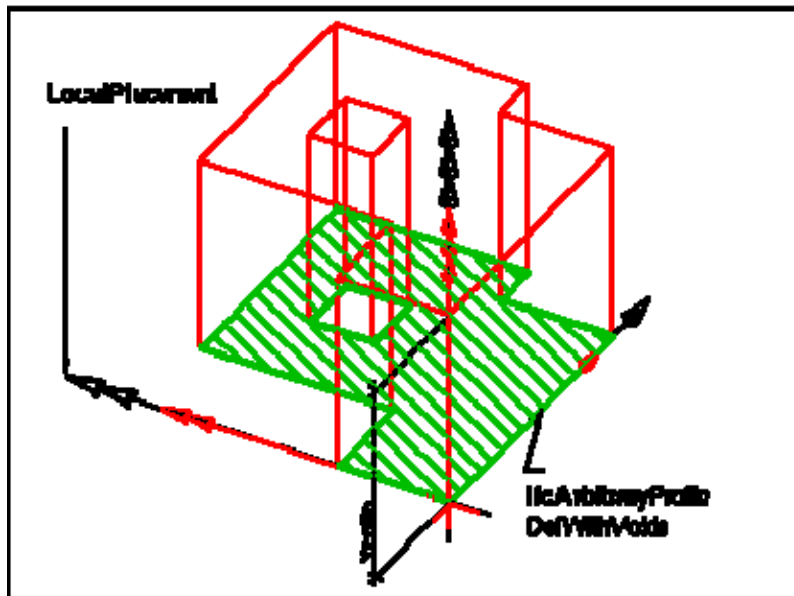


Figure 107 — Space body swept solid

The advanced geometric representation of *IfcSpace* is defined using the swept area solid geometry that can be subjected to a Boolean expression. The following attribute values should be inserted.

- *IfcShapeRepresentation.RepresentationIdentifier* = 'Body'.
- *IfcShapeRepresentation.RepresentationType* = 'Clipping'.

The following additional constraints apply to the advanced representation:

- Solid: see standard geometric representation,
- Profile: see standard geometric representation,
- Extrusion: see standard geometric representation,
- Boolean result: The difference operation with the second operand being of type *IfcHalfSpaceSolid* (or one of its subtypes) shall be supported.

Figure 108 shows an extrusion of an arbitrary profile definition into the swept area solid. The solid and an half space solid are operands of the Boolean result of *IfcSpace*.

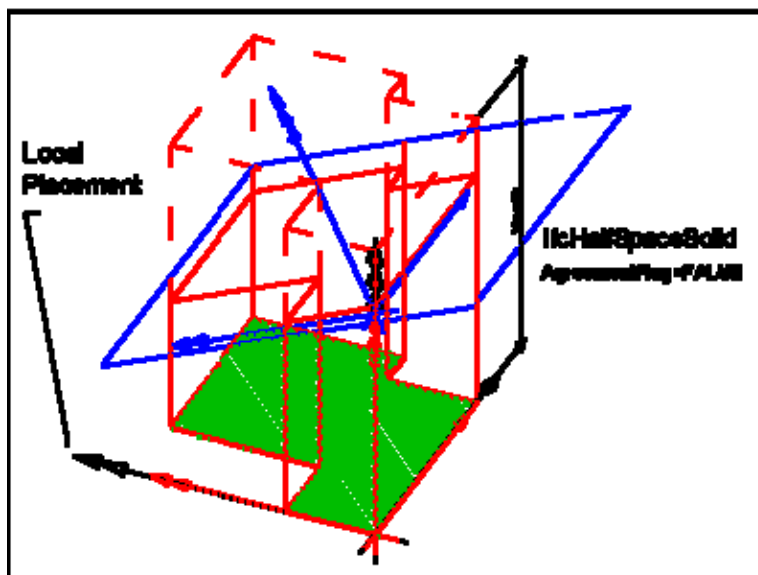


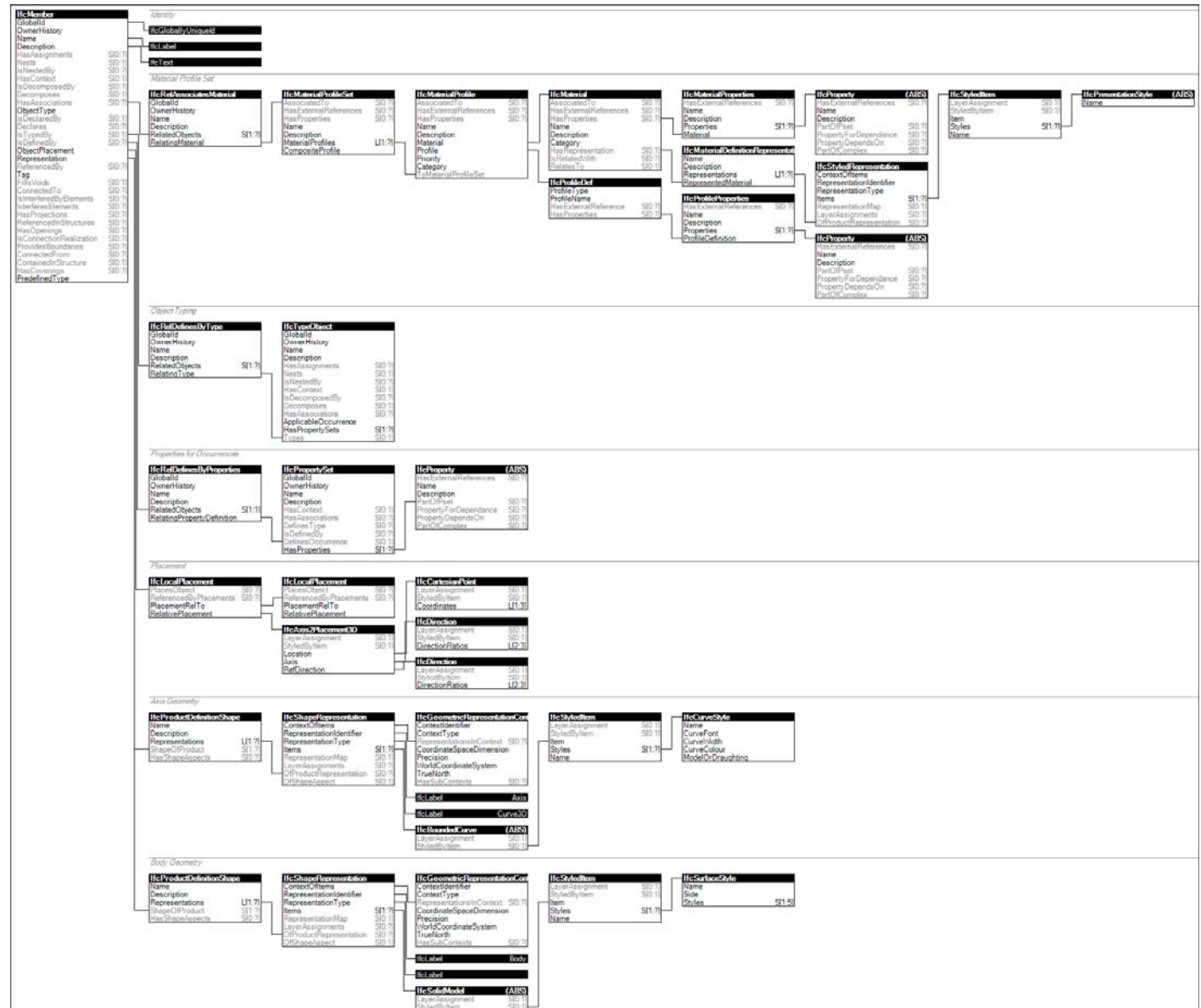
Figure 108 — Space body clipping

The fallback advanced geometric representation of *IfcSpace* is defined using the Brep solid geometry. It may be represented as a single or multiple instances of *IfcFacetedBrep* or *IfcFacetedBrepWithVoids*. The Brep representation allows for the representation of complex element shape. The following attribute values for the *IfcShapeRepresentation* holding this geometric representation shall be used:

- *IfcShapeRepresentation.RepresentationIdentifier* : 'Body'
- *IfcShapeRepresentation.RepresentationType* : 'Brep'

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.

IfcMember



Material Profile Set

The material of the *IfcMember* is defined by the *IfcMaterialProfileSet* or as fallback by *IfcMaterial*, and it is attached either directly or at the *IfcMemberType*.

NOTE It is illegal to assign an *IfcMaterialProfileSetUsage* to an *IfcMember*. Only the subtype *IfcMemberStandardCase* supports this concept.

Placement

The local placement for *IfcMember* is defined in its supertype *IfcProduct*. It is defined by the *IfcLocalPlacement*, which defines the local coordinate system that is referenced by all geometric representations.

- The *PlacementRelTo* relationship of *IfcLocalPlacement* shall point (if given) to the local placement of the same *IfcSpatialStructureElement*, which is used in the *ContainedInStructure* inverse attribute, or to a spatial structure element at a higher level, referenced by that.
- If the relative placement is not used, the absolute placement is defined within the world coordinate system.

Axis Geometry

The axis representation can be used to represent the system length of a member that may extent the body length of the member.

Body Geometry

The body representation of *IfcBeam* can be represented using the representation types 'SweptSolid', 'Clipping', 'AdvancedSweptSolid', 'MappedRepresentation', 'SurfaceModel', and 'Brep'. The representation types 'SurfaceModel' and 'Brep' are explained at *IfcBuildingElement*.

SweptSolid Representation Type

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

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'SweptSolid'

The following additional constraints apply to the 'SweptSolid' representation:

- Solid: *IfcExtrudedAreaSolid*, *IfcRevolvedAreaSolid* shall be supported
- Profile: all subtypes of *IfcProfileDef* (with exception of *IfcArbitraryOpenProfileDef*)
- Extrusion: All extrusion directions shall be supported.

Figure 111 illustrates a 'SweptSolid' geometric representation. There are no restrictions or conventions on how to use the local placement (black), solid of extrusion placement (red) and profile placement (green).

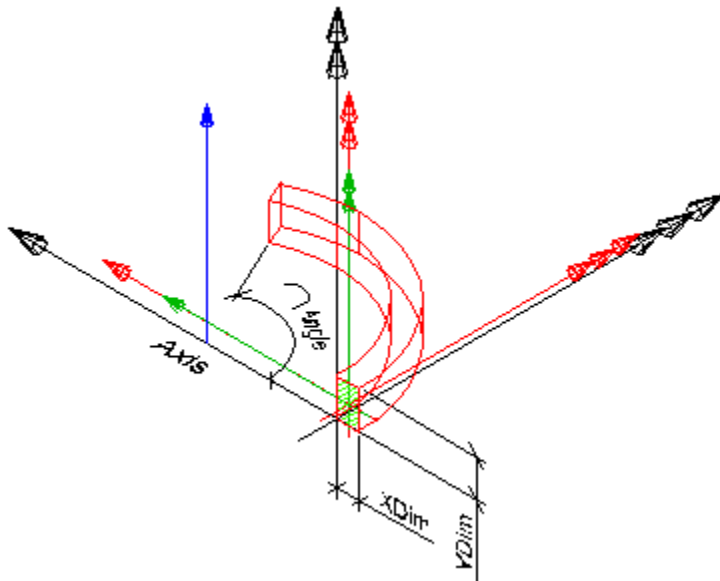


Figure 111 — Member swept solid

Clipping Representation Type

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

- *RepresentationIdentifier* : 'Body'

- *RepresentationType* : 'Clipping'

The following constraints apply to the advanced representation:

- Solid: see 'SweptSolid' geometric representation
- Profile: see 'SweptSolid' geometric representation
- Extrusion: see 'SweptSolid' geometric representation
- Boolean result: The *IfcBooleanClippingResult* shall be supported, allowing for Boolean differences between the swept solid (here *IfcExtrudedAreaSolid*) and one or several *IfcHalfSpaceSolid* (or its subtypes).

Figure 112 illustrates a 'Clipping' geometric representation with use of *IfcBooleanClippingResult* between an *IfcExtrudedAreaSolid* and an *IfcHalfSpaceSolid* to create a clipped body.

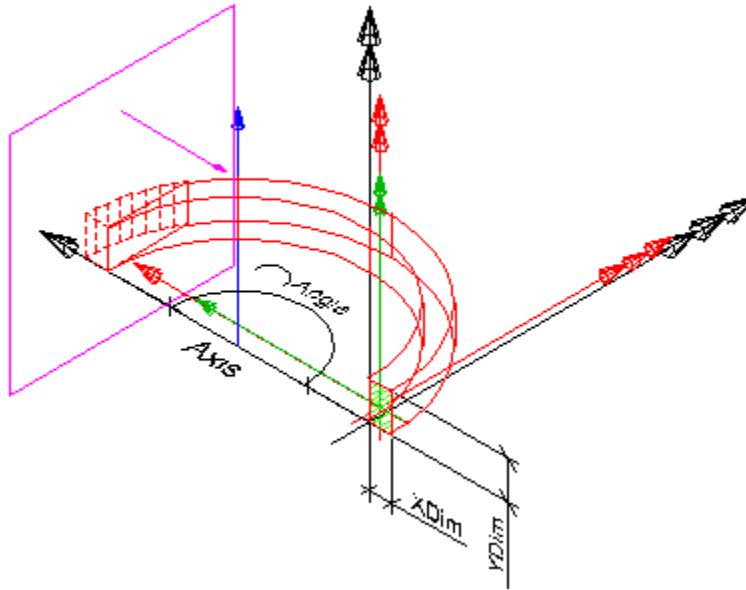


Figure 112 — Member clipping

AdvancedSweptSolid Representation Type

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

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'AdvancedSweptSolid'

The following additional constraints apply to the 'AdvancedSweptSolid' representation type:

- Solid: *IfcSurfaceCurveSweptAreaSolid*, *IfcFixedReferenceSweptAreaSolid*, *IfcExtrudedAreaSolidTapered*, *IfcRevolvedAreaSolidTapered* shall be supported.

NOTE View definitions and implementer agreements can further constrain the allowed swept solid types.

- Profile: see 'SweptSolid' geometric representation
- Extrusion: not applicable

MappedRepresentation Representation Type

The 'MappedRepresentation' representation type is supported as it allows for reusing the geometry definition of the beam type at all occurrences of the same type. The following attribute values for the *IfcShapeRepresentation* holding this geometric representation shall be used:

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'MappedRepresentation'

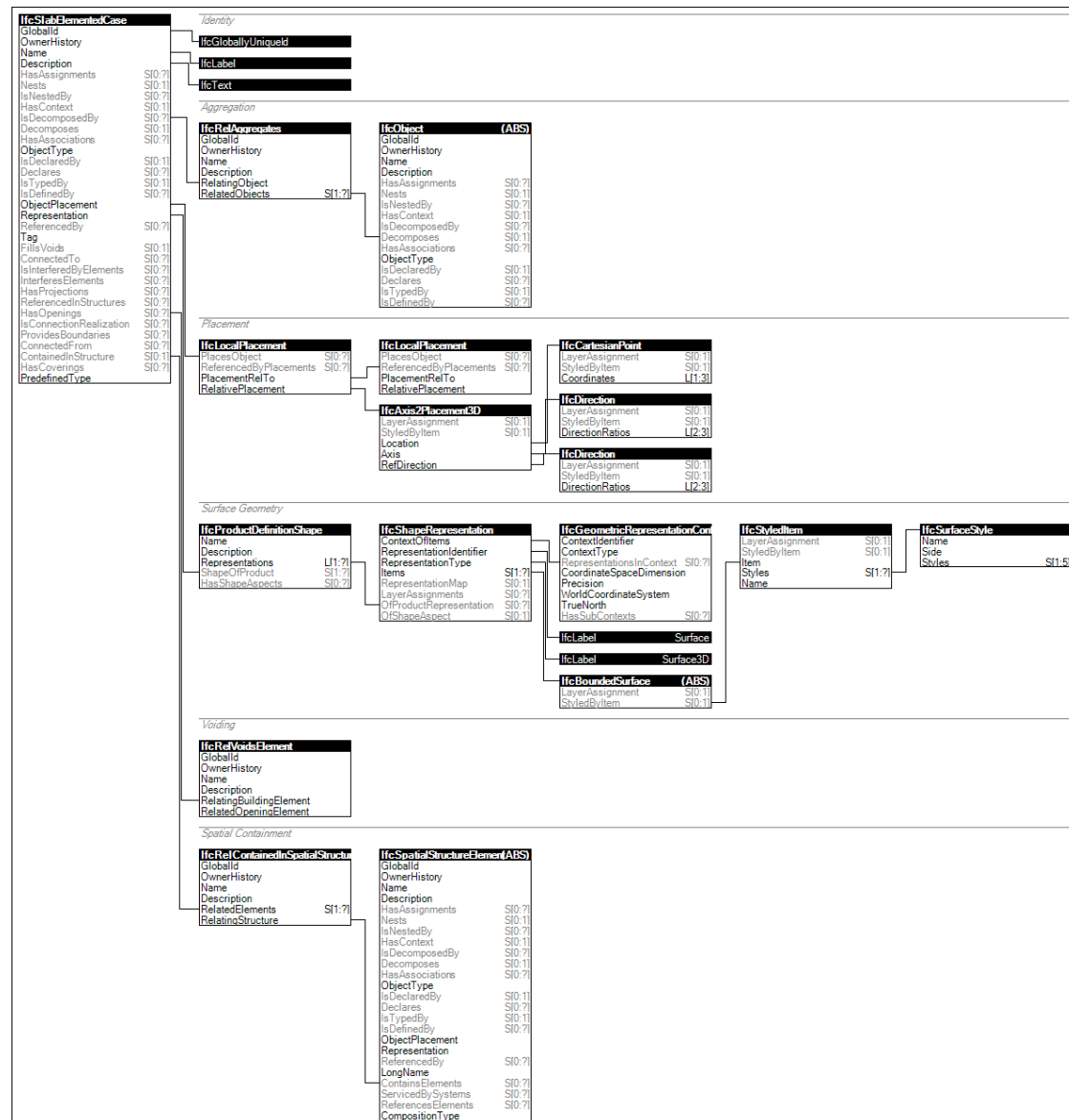
The same constraints, as given for the 'SweptSolid', 'Clipping', 'AdvancedSweptSolid', 'SurfaceModel' and 'Bre' geometric representation, shall apply to the *MappedRepresentation* of the *IfcRepresentationMap*.

IfcSlab

IfcSlab		Identity	
GlobalId		IfcGloballyUniqueId	
OwnerHistory			
Name		IfcLabel	
Description		IfcText	
HasAssignments	SI(0..?)		
Nests	SI(0..1)		
IsNestedBy	SI(0..?)		
HasContext	SI(0..1)		
IsDecomposedBy	SI(0..?)		
Decomposes	SI(0..1)		
HasAssociations	SI(0..?)		
ObjectType			
IsDeclaredBy	SI(0..1)		
Declares	SI(0..?)		
IsTypedBy	SI(0..1)		
IsDefinedBy	SI(0..?)		
ObjectPlacement			
Representation			
ReferencedBy	SI(0..?)		
Tag			
fillsVoids	SI(0..1)		
ConnectedTo	SI(0..?)		
IsInterferedByElements	SI(0..?)		
InterferesElements	SI(0..?)		
HasProjections	SI(0..?)		
ReferencedInStructures	SI(0..?)		
HasOpenings	SI(0..?)		
IsConnectionRealization	SI(0..?)		
ProvidesBoundaries	SI(0..?)		
ConnectedFrom	SI(0..?)		
ContainedInStructure	SI(0..1)		
HasCoverings	SI(0..?)		
RedefinedType			

IfcRelVoidsElement	
GlobalId	
OwnerHistory	
Name	
Description	
RelatingBuildingElement	
RelatedOpeningElement	

IfcSlabElementedCase



Surface Geometry

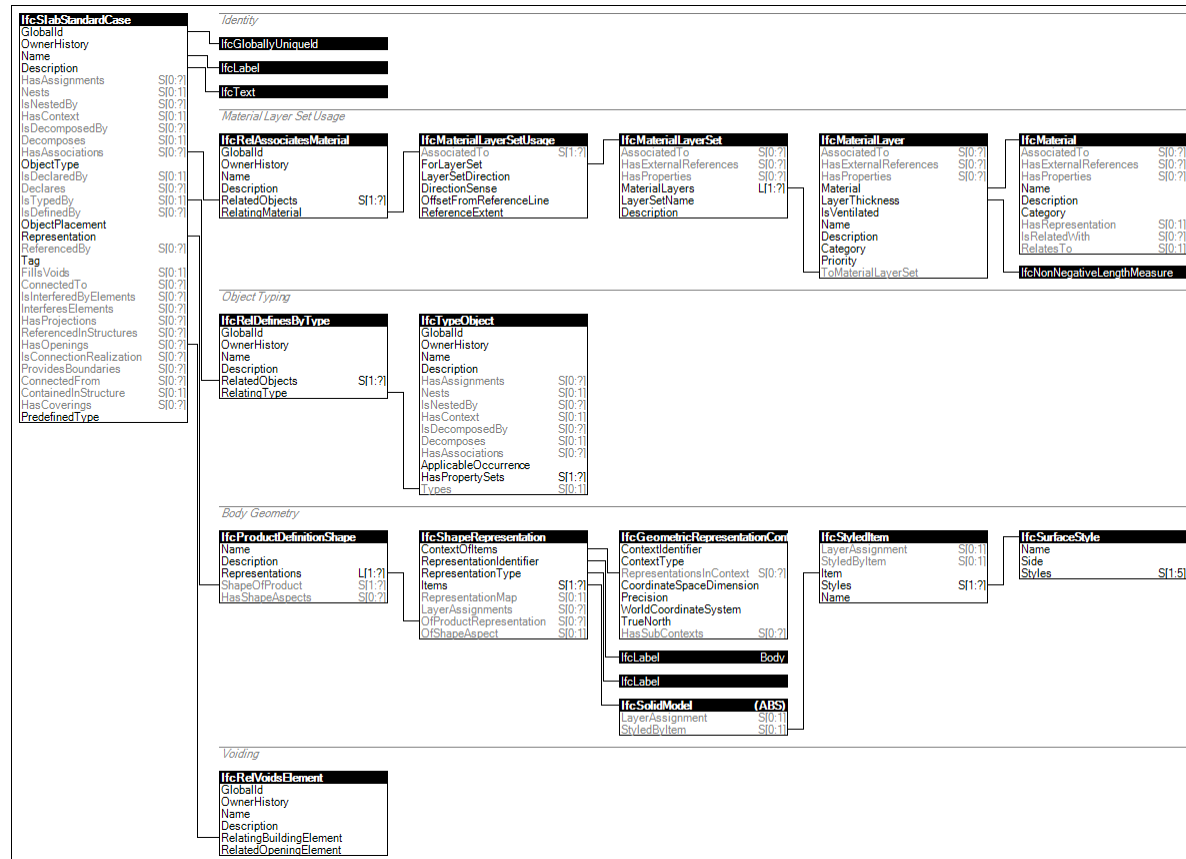
The standard geometric representation of *IfcSlabElementedCase* is defined using the following multiple shape representations for its definition:

- **Surface:** A three-dimensional surface being a subtype of *IfcBoundedSurface* defining the reference surface for the elemented slab. It maybe used as a simplified representation directly at the elemented slab.
NOTE It is invalid to exchange a 'Body' shape representation of an *IfcSlabElementedCase*. The body geometry is defined by the parts within the decomposition.

The surfacic geometric representation of *IfcSlabElementedCase* is defined using the 'Surface' representation.

- **RepresentationIdentifier:** 'Surface'
 - **RepresentationType:** 'Surface3D'
- NOTE The 'Surface' can be used to define a surfacic model of the building (e.g. for analytical purposes, or for reduced Level of Detail representation). It should suppress the geometric details of the parts in the decomposition.

IfcSlabStandardCase



Object Typing

The *IfcSlabStandardCase* defines in addition that the *IfcSlabType* should have a unique *IfcMaterialLayerSet*, that is referenced by the *IfcMaterialLayerSetUsage* assigned to all occurrences of this *IfcSlabType*.

Figure 117 illustrates assignment of *IfcMaterialLayerSetUsage* and *IfcMaterialLayerSet* to the *IfcSlabStandardCase* as the slab occurrence and to the *IfcSlabType*. The same *IfcMaterialLayerSet* shall be shared by many occurrences of *IfcMaterialLayerSetUsage*. This relationship shall be consistent to the relationship between the *IfcSlabType* and the *IfcSlabStandardCase*.

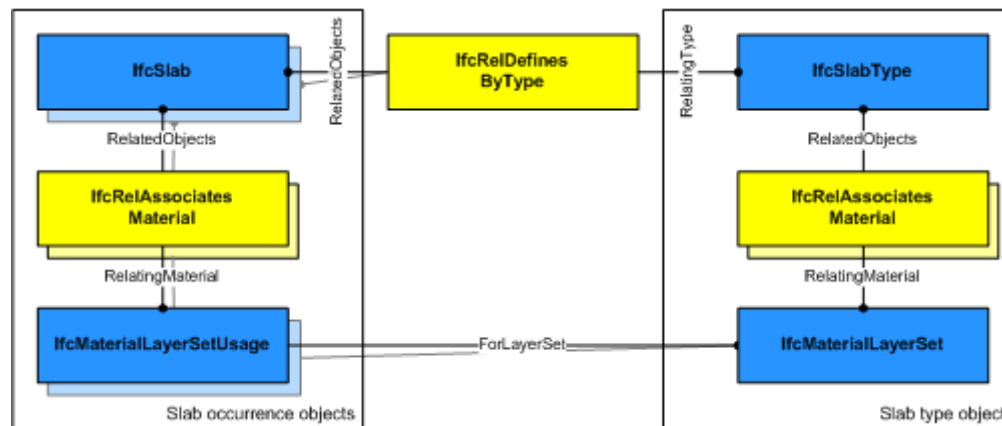


Figure 117 — Slab type definition

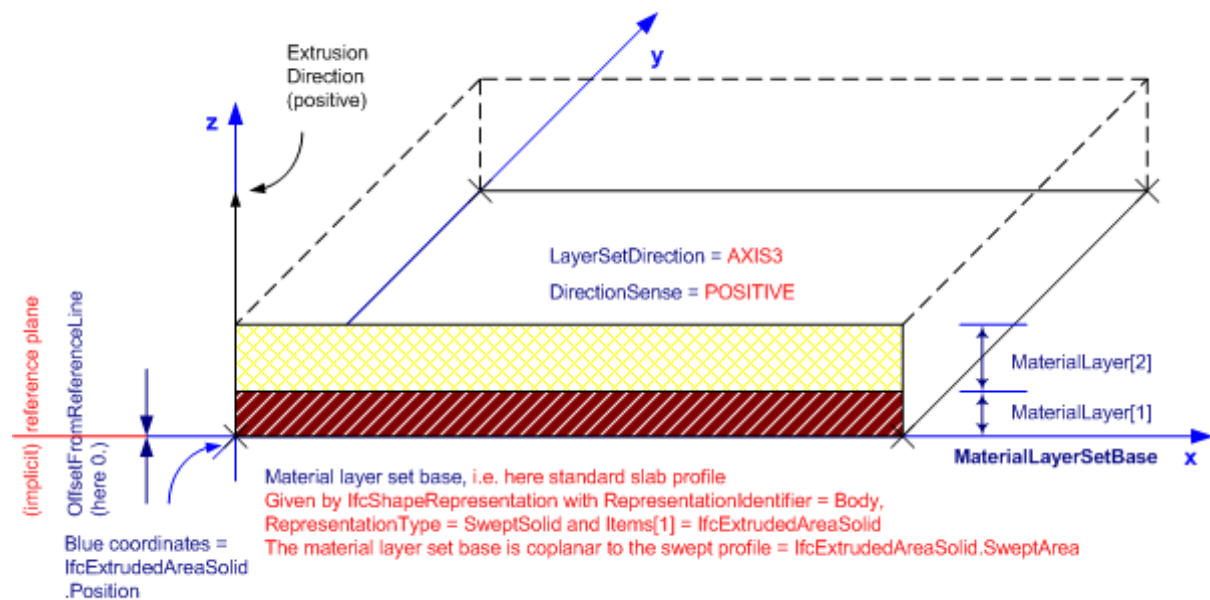
Material Layer Set Usage

The material of the *IfcSlabStandardCase* is defined by *IfcMaterialLayerSetUsage* and attached by the *IfcRelAssociatesMaterial.RelatingMaterial*. It is accessible by the inverse *HasAssociations* relationship. Multi-layer slabs can be represented by referring to several *IfcMaterialLayer*'s within the *IfcMaterialLayerSet* that is referenced from the *IfcMaterialLayerSetUsage*.

Material information can also be given at the *IfcSlabType*, defining the common attribute data for all occurrences of the same type. It is then accessible by the inverse *IsDefinedBy* relationship pointing to *IfcSlabType.HasAssociations* and via *IfcRelAssociatesMaterial.RelatingMaterial*. See **Type Use Definition** for additional agreements for standard slabs.

Figure 118 illustrates slab material usage, where the following conventions shall be met:

- The reference coordinate system is the coordinate system established by the *IfcExtrudedAreaSolid.Position*.
- The reference plane is the plane defined by the extruded profile of *IfcExtrudedAreaSolid.SweptSolid*. The *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* is given as a distance from this plane.
- The *IfcMaterialLayerSetUsage.DirectionSense* defines how the *IfcMaterialLayer*'s are assigned to the reference plane. POSITIVE means in direction to the positive z-axis of the reference coordinate system.
- The *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* is the distance parallel to the reference plane and always perpendicular to the base (XY) plane of the reference coordinate system. This is independent of a potential non-perpendicular extrusion given by *IfcExtrudedAreaSolid.ExtrudedDirection* $\neq 0,0,1$. A positive value of *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* would then point into the positive z-axis of the reference coordinate system.
- The *Thickness* of each *IfcMaterialLayer* shall be the parallel distance (measured perpendicular to the base plane). The *TotalThickness* of the *IfcMaterialLayerSet* is the sum of all layer thicknesses and in case of a perpendicular extrusion identical with *IfcExtrudedAreaSolid.Depth*.
- The *IfcMaterialLayerSetUsage.LayerSetDirection* is always AXIS3.



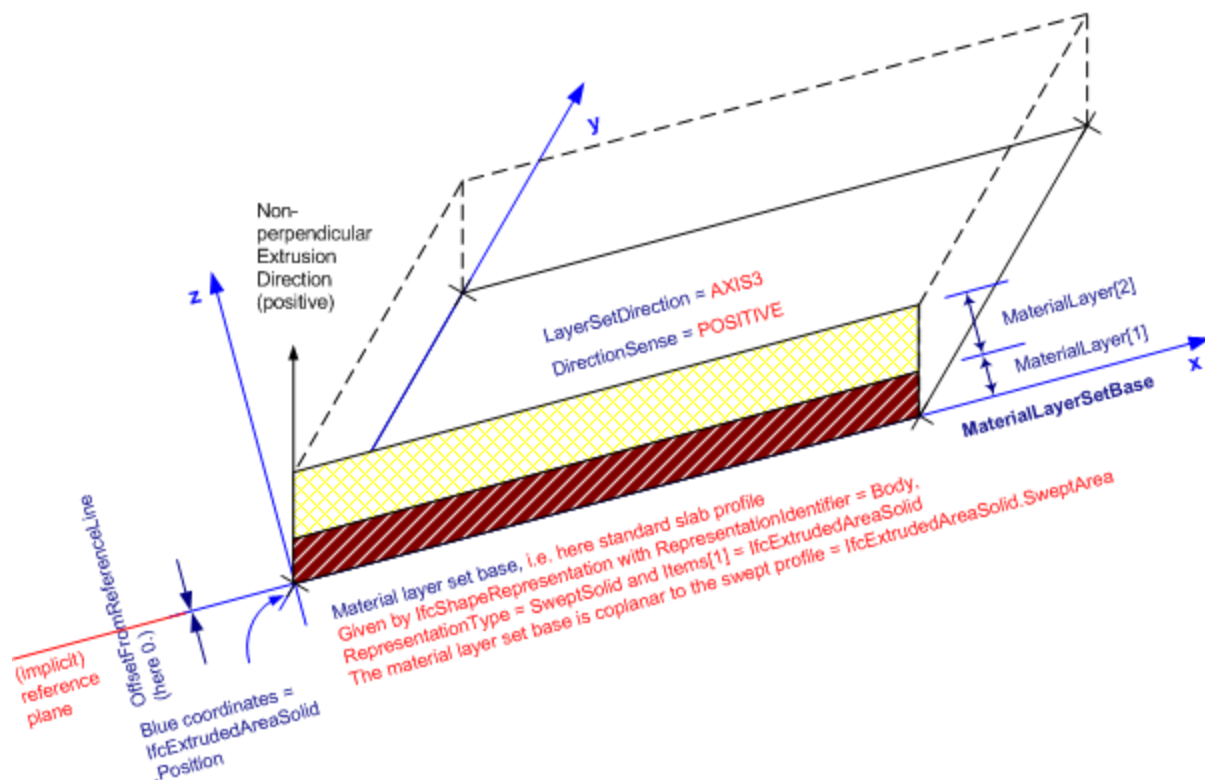


Figure 118 — Slab material layers

Body Geometry

Currently, the use of 'SweptSolid' and 'Clipping' representations is supported. In addition the general representation type 'BoundingBox' is allowed. The geometry use definitions for 'BoundingBox', is explained at *IfcBuildingElement*.

NOTE If the *IfcSlabStandardCase* is of type Landing and is used within an *IfcStair* or *IfcRamp*, the special agreements to handle stair and ramp geometry will also affect the geometric representation of the *IfcSlabStandardCase*.

SweptSolid Representation

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

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'SweptSolid'

The following additional constraints apply to the swept solid representation:

- **Solid**: *IfcExtrudedAreaSolid* is required,
- **Profile**: *IfcArbitraryClosedProfileDef*, *IfcRectangleProfileDef*, *IfcCircleProfileDef*, *IfcEllipseProfileDef* shall be supported.
- **Extrusion**: The profile can be extruded perpendicularly or non-perpendicularly to the plane of the swept profile.
- **Material**: The definition of the *IfcMaterialLayerSetUsage*, particularly of the *OffsetFromReferenceLine* and the *ForLayerSet.TotalThickness*, has to be consistent to the 'SweptSolid' representation.

Figure 119 illustrates a 'SweptSolid' geometric representation.

NOTE The following interpretation of dimension parameter applies for polygonal slabs (in ground floor view):

- *IfcArbitraryClosedProfileDef.OuterCurve*: closed bounded curve interpreted as area (or foot print) of the slab.

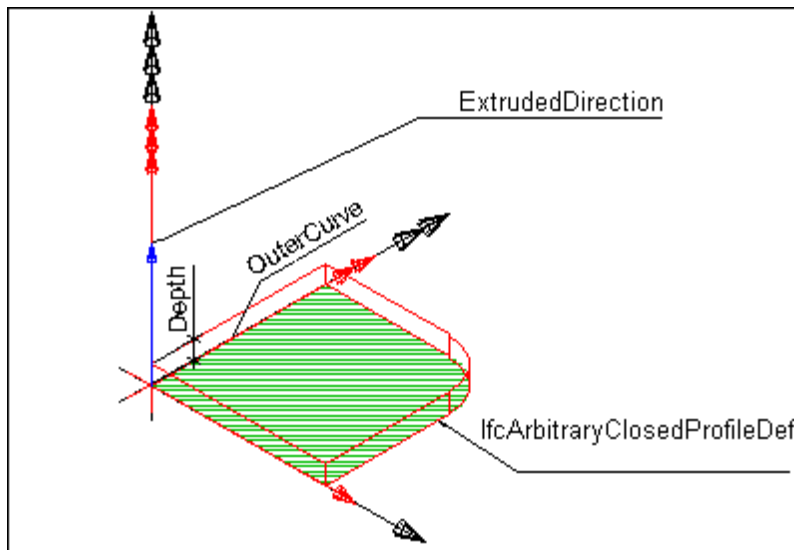


Figure 119 — Slab body extrusion

Clipping representation

The 'Clipping' geometric representation of *IfcSlabStandardCase* is defined using the swept area geometry with additional clippings applied. The following attribute values for the *IfcShapeRepresentation* holding this geometric representation shall be used:

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'Clipping'

The following constraints apply to the 'Clipping' representation:

- Solid: see 'SweptSolid' shape representation,
- Profile: see 'SweptSolid' shape representation,
- Extrusion: see 'SweptSolid' shape representation,
- Material: see 'SweptSolid' shape representation,
- Boolean result: The *IfcBooleanClippingResult* shall be supported, allowing for Boolean differences between the swept solid (here *IfcExtrudedAreaSolid*) and one or several *IfcHalfSpaceSolid*.

Figure 120 illustrates a 'Clipping' geometric representation with definition of a roof slab using advanced geometric representation. The profile is extruded non-perpendicular and the slab body is clipped at the eave.

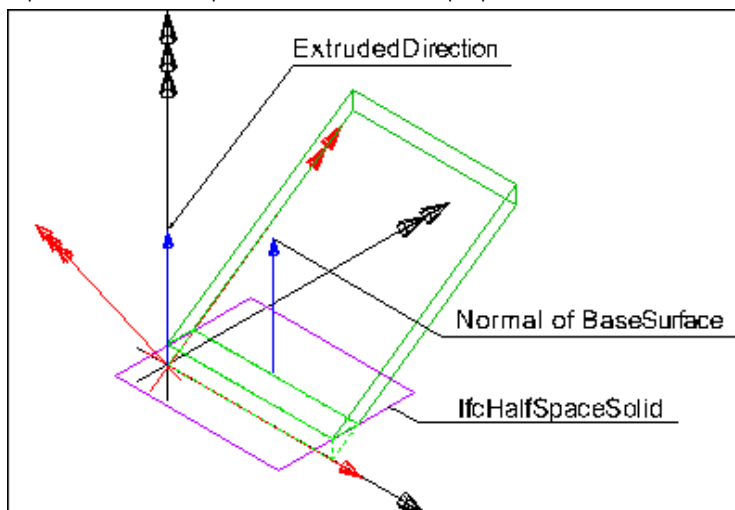
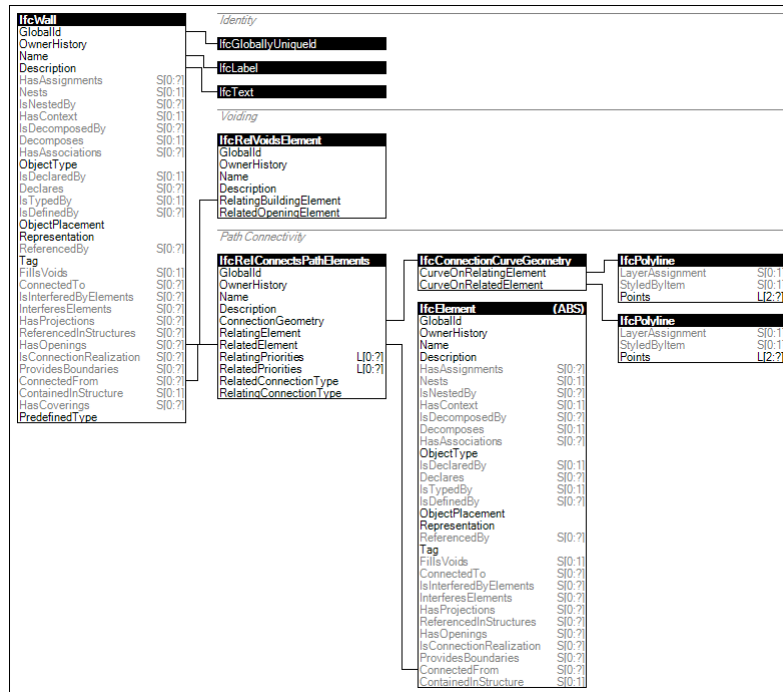


Figure 120 — Slab body clipping

IfcWall





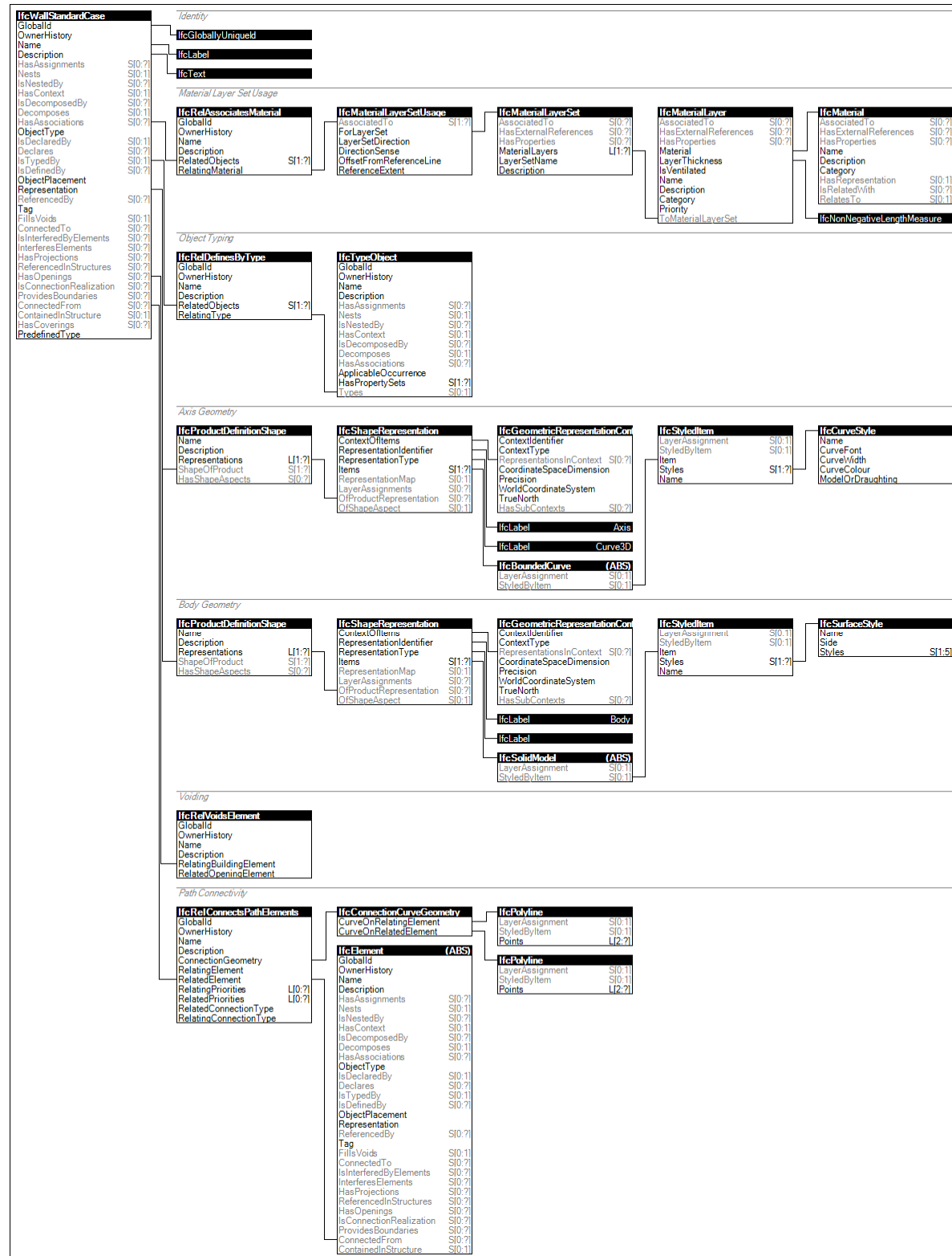
- *RepresentationIdentifier* : 'Surface'

- *RepresentationType* : 'Surface3D'

NOTE The 'Surface' can be used to define a surfacic model of the building (e.g. for analytical purposes, or for reduced Level of Detail representation). It could suppress the geometric details of the parts in the decomposition.

NOTE It is invalid to exchange a 'Body' shape representation of an *IfcWallElementedCase*. The body geometry is defined by the parts within the decomposition.

IfcWallStandardCase



Object Typing

The *IfcWallType* should have a unique *IfcMaterialLayerSet*, that is referenced by the *IfcMaterialLayerSetUsage* assigned to all occurrences of this *IfcWallType*.

Figure 122 illustrates assignment of *IfcMaterialLayerSetUsage* and *IfcMaterialLayerSet* to the wall type and the wall occurrence.

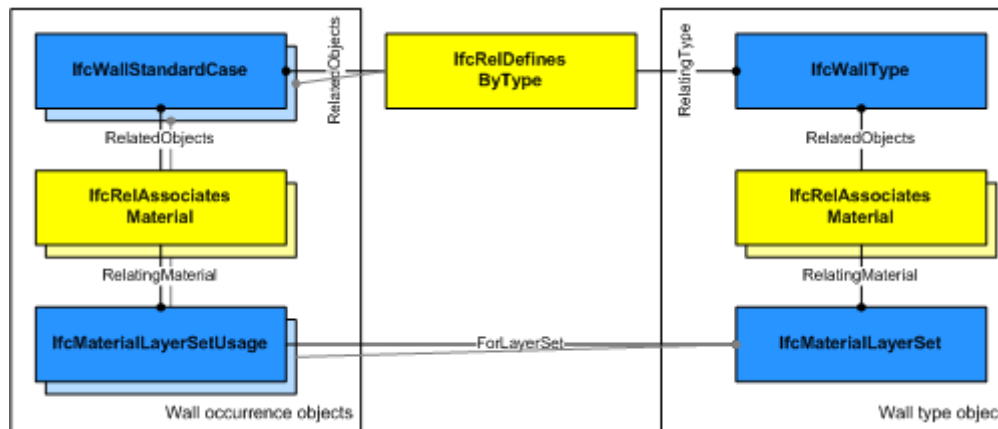


Figure 122 — Wall Standard Object Typing

Material Layer Set Usage

The material of the *IfcWallStandardCase* is defined by *IfcMaterialLayerSetUsage* and attached by the *IfcRelAssociatesMaterial.RelatingMaterial*. It is accessible by the inverse *HasAssociations* relationship. Multi-layer walls can be represented by referring to several *IfcMaterialLayer*'s within the *IfcMaterialLayerSet* that is referenced from the *IfcMaterialLayerSetUsage*.

Material information can also be given at the *IfcWallType*, defining the common attribute data for all occurrences of the same type. It is then accessible by the inverse *IsDefinedBy* relationship pointing to *IfcSlabType.HasAssociations* and via *IfcRelAssociatesMaterial.RelatingMaterial*. See **Type Use Definition** for additional agreements for standard slabs.

Figure 123 illustrates material layer usage, where the following conventions shall be met:

- The reference coordinate system is the local coordinate system established by the *ObjectPlacement* of the *IfcWallStandardCase*.
- The reference axis is the axis defined by the *IfcShapeRepresentation* with *RepresentationType*='Axis' as one of the *Representation.Representations* of the *IfcWallStandardCase*.
- The *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* is given as a distance from this axis.
- The *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* is the distance parallel to the reference axis and always within the base (XY) plane of the reference coordinate system. A positive value of *IfcMaterialLayerSetUsage.OffsetFromReferenceLine* would then point into the positive y-axis of the reference coordinate system.
- The *IfcMaterialLayerSetUsage.DirectionSense* defines how the *IfcMaterialLayer*'s are assigned to the reference axis. POSITIVE means in direction to the positive y-axis of the reference coordinate system.
- The *Thickness* of each *IfcMaterialLayer* is provided starting from the *OffsetFromReferenceLine* and in the direction given by *DirectionSense*. It is applied without any gap or overlap between two consecutive layers. The *TotalThickness* of the *IfcMaterialLayerSet* is the sum of all layer thicknesses.
- The *IfcMaterialLayerSetUsage.LayerSetDirection* is always AXIS2.

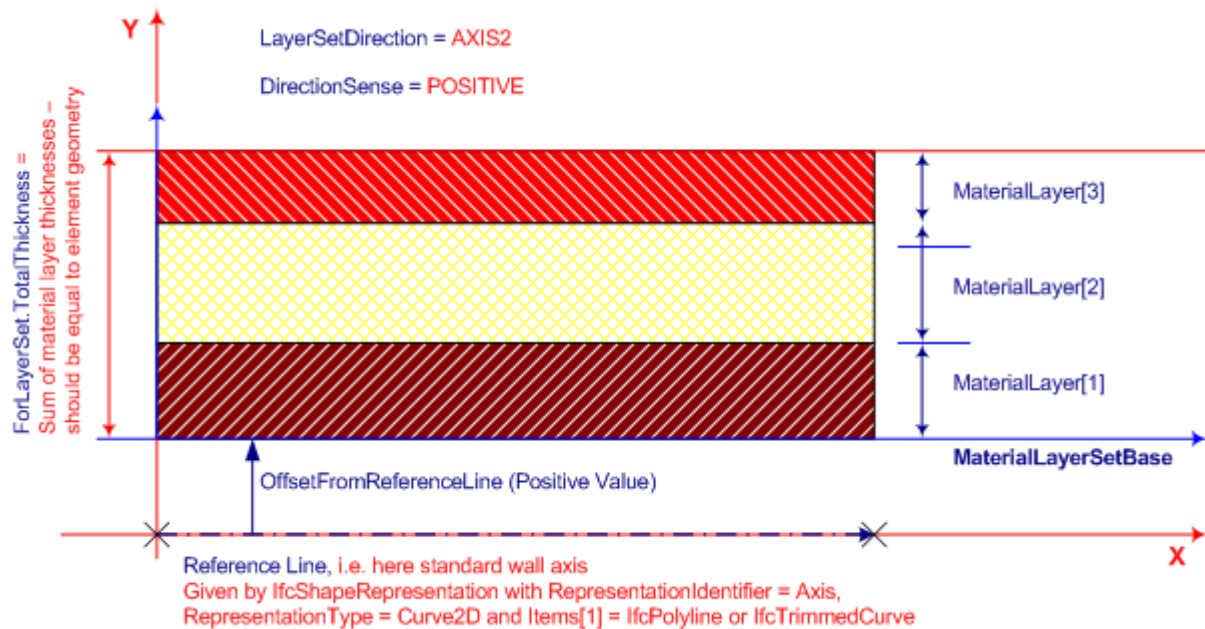


Figure 123 — Wall material layers

Axis Geometry

The wall axis is represented by a two-dimensional open curve within a particular shape representation. The wall axis is used to apply the material layer set usage parameter to the wall geometry.

Figure 124 illustrates an axis representation for a straight wall. In case of a straight wall, the set of items shall include a single geometric representation item of type *IfcPolyline* or *IfcTrimmedCurve* with the *BasisCurve* being an *IfcLine*. The *IfcPolyline* or *IfcTrimmedCurve* shall be parallel (here in a special case co-linear) to the x-axis of the object coordinate system. The direction shall be identical to the direction of the x-axis.

Figure 125 illustrates an axis representation for a curved wall. In case of a curved wall, the set of items shall include a single geometric representation item of type *IfcTrimmedCurve*. The curve shall have a *BasisCurve* of type *IfcCircle*. The tangent of the *IfcTrimmedCurve* shall be parallel at start to the x-axis of the object coordinate system. The direction shall be identical to the direction of the x-axis.

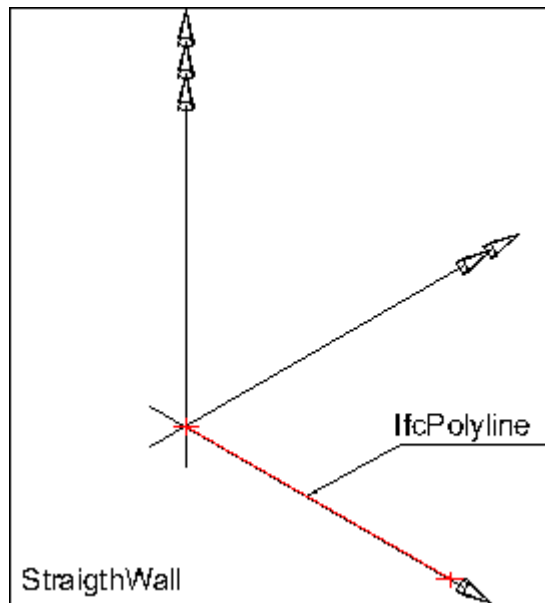


Figure 124 — Wall axis straight

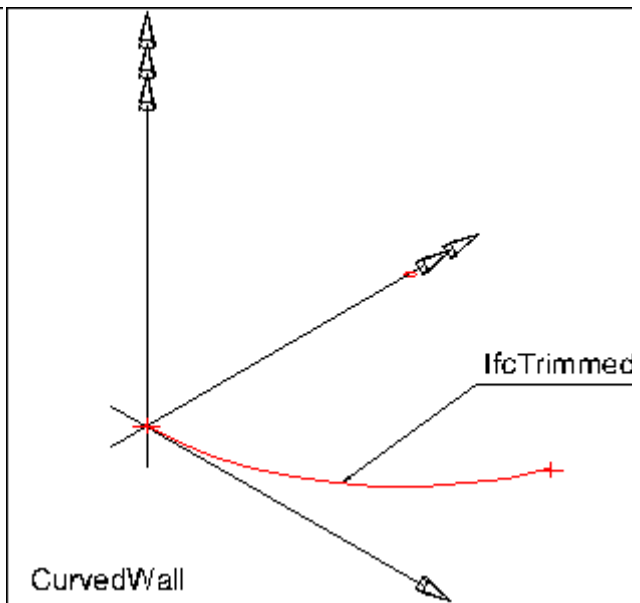


Figure 125 — Wall axis curved

Body Geometry

The body representation of *IfcWallStandardCase* is defined by using 'SweptSolid' representation for walls without clippings or 'Clipping' representation for walls with clippings (e.g. under sloped roof slabs).

SweptSolid Representation Type

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

- RepresentationIdentifier : 'Body'
- RepresentationType : 'SweptSolid'

The following additional constraints apply to the 'SweptSolid' representation:

- Solid: *IfcExtrudedAreaSolid* is required,
- Profile: *IfcArbitraryClosedProfileDef* and *IfcRectangleProfileDef* shall be supported.
- Extrusion: The profile shall be extruded vertically, i.e., in the direction of the z-axis of the co-ordinate system of the referred spatial structure element. It might be further constraint to be in the direction of the global z-axis in implementers agreements. The extrusion axis shall be perpendicular to the swept profile, i.e. pointing into the direction of the z-axis of the Position of the *IfcExtrudedAreaSolid*.

The profile of a wall is described in the ground view and extruded vertically. The profile (also identical with the foot print of the wall) is defined by the *IfcArbitraryClosedProfileDef* (excluding its subtypes). The profile is given with all wall connections already resolved.

Figure 126 illustrates a body representation for a straight wall. In case of a straight wall, the two sides of the profile shall be parallel to the wall axis, that is, the wall has a single unchanged thickness.

Figure 127 illustrates a body representation for a curved wall. In case of a curved wall, the two sides of the profile shall be parallel (with defined offset) to the wall axis, that is, the wall has a single unchanged thickness.

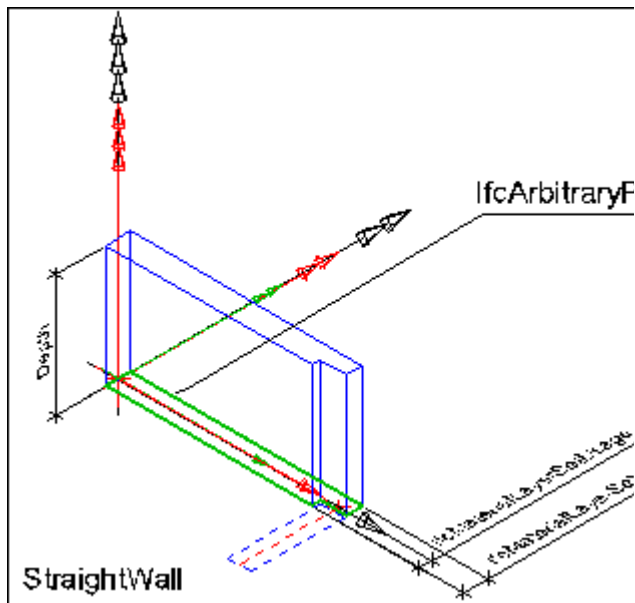


Figure 126 — Wall body extrusion straight

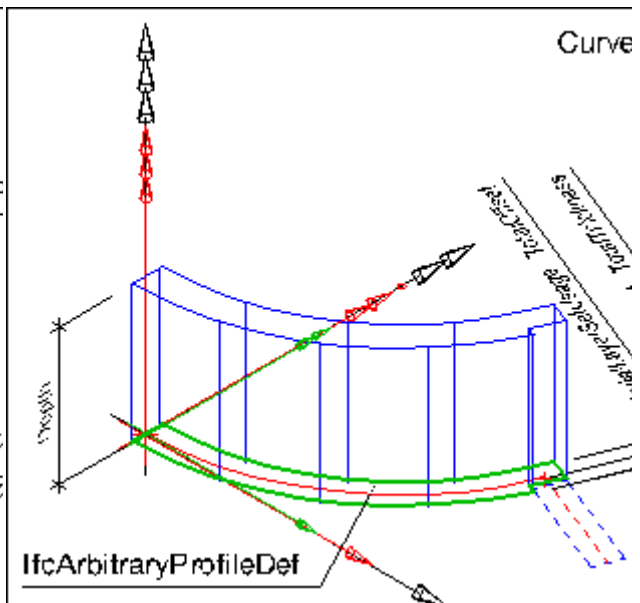


Figure 127 — Wall body extrusion curved

Clipping Representation Type

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

- *RepresentationIdentifier* : 'Body'
- *RepresentationType* : 'Clipping'

The following constraints apply to the 'Clipping' representation:

- Solid: see standard geometric representation
- Profile: see standard geometric representation
- Extrusion: see standard geometric representation
- Boolean result: The *IfcBooleanClippingResult* shall be supported, allowing for Boolean differences between the swept solid (here *IfcExtrudedAreaSolid*) and one or several *IfcHalfSpaceSolid* (or subtypes).

Figure 128 illustrates a clipping for a straight wall using an *IfcPolygonalBoundedHalfSpace* as *SecondOperand* in the *IfcBooleanClippingResult*.

Figure 129 illustrates a clipping for a curved wall using an *IfcHalfSpaceSolid* as *SecondOperand* in the *IfcBooleanClippingResult*.

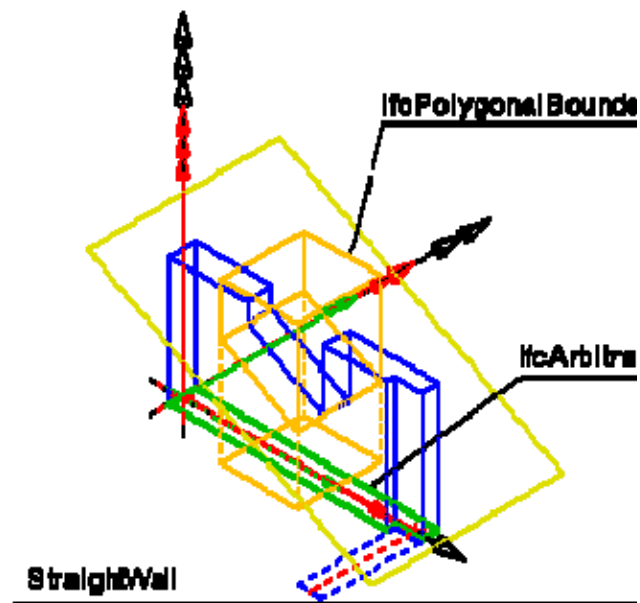


Figure 128 — Wall body clipping straight

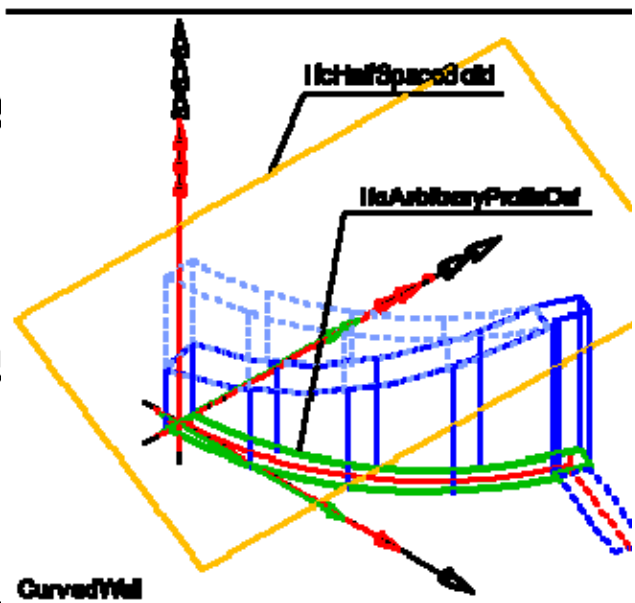
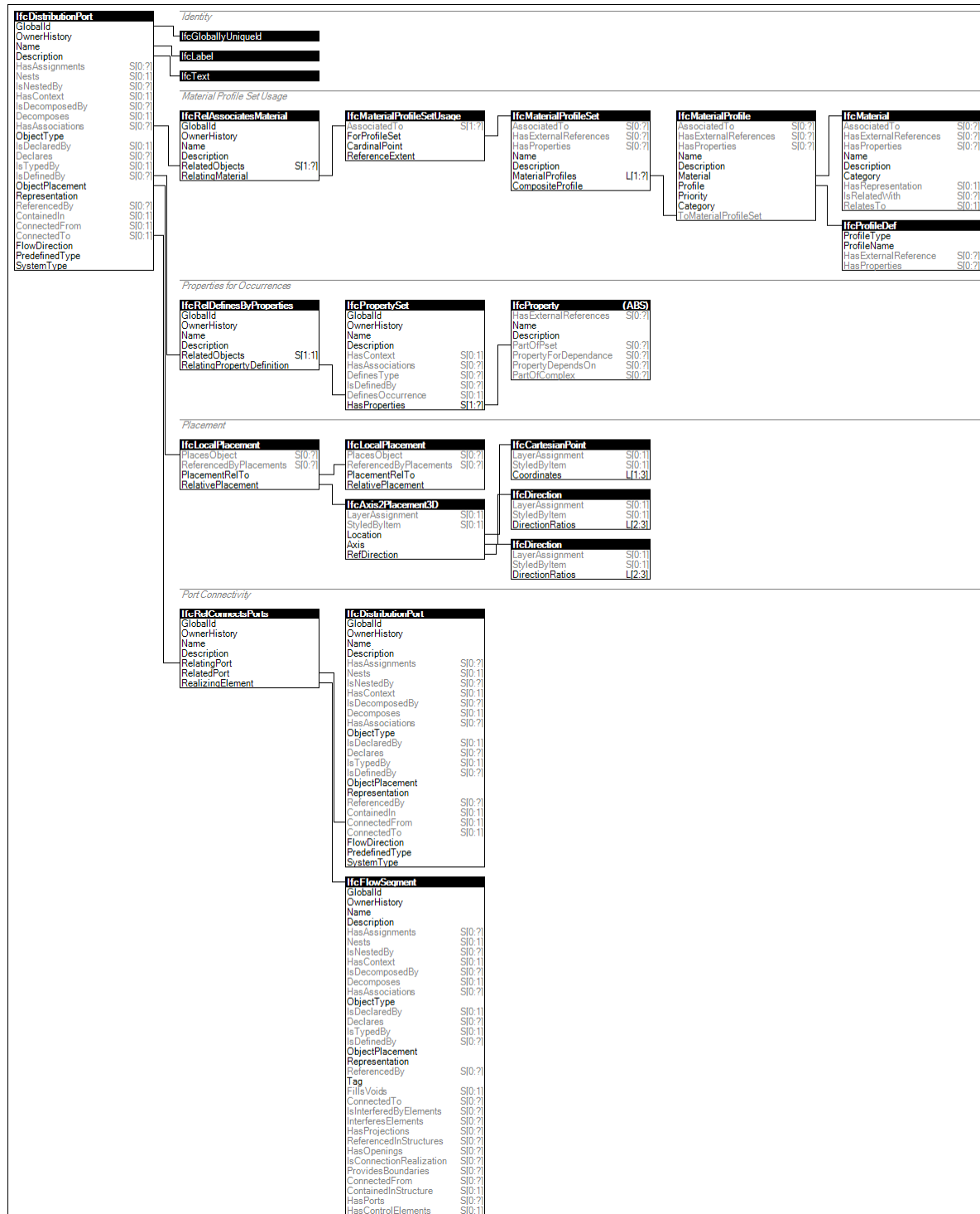


Figure 129 — Wall body clipping curved

IfcDistributionPort



Port Connectivity

IfcDistributionPort may be connected to other objects as follows using the indicated relationship:

- **IfcDistributionPort (IfcRelConnectsPorts)** : Indicates a connection to another port having the same type and opposite flow direction. For port connections between elements, the *RelatingPort* is set to a port having *FlowDirection*=SOURCE and

the *RelatedPort* is set to a port having *FlowDirection*=*SINK*. For aggregation scenarios, ports on a device may be mapped to aggregated devices within, in which case ports on the outer device indicate a single *FlowDirection* but have an additional connection internally to a port on an aggregated inner device. Refer to *IfcUnitaryEquipment* for an example.

- *IfcDistributionElement* (*IfcRelConnectsPortToElement*): For dynamic ports, indicates the containing element.

Figure 131 illustrates distribution port connectivity.

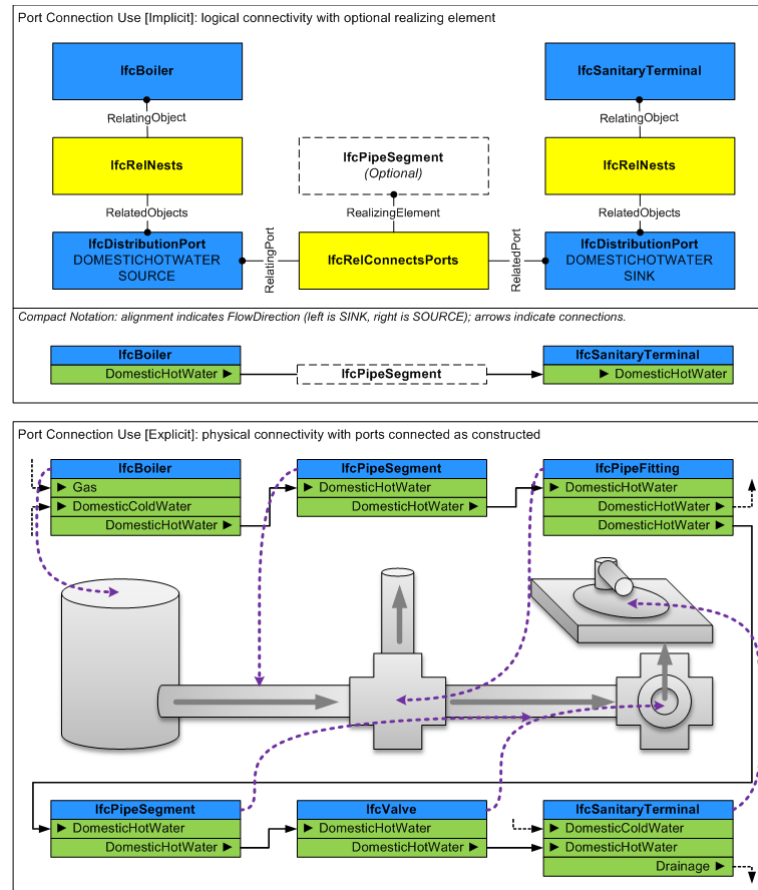


Figure 131 — Distribution port connectivity

Placement

The placement of a port indicates the position and orientation of how it may connect to a compatible port on another product. The placement shall be relative to the nesting *IfcDistributionElement*, *IfcDistributionElementType*, or enclosing *IfcDistributionPort*.

The *Location* is the midpoint of the physical connection, unless otherwise indicated by cardinal point on a material profile.

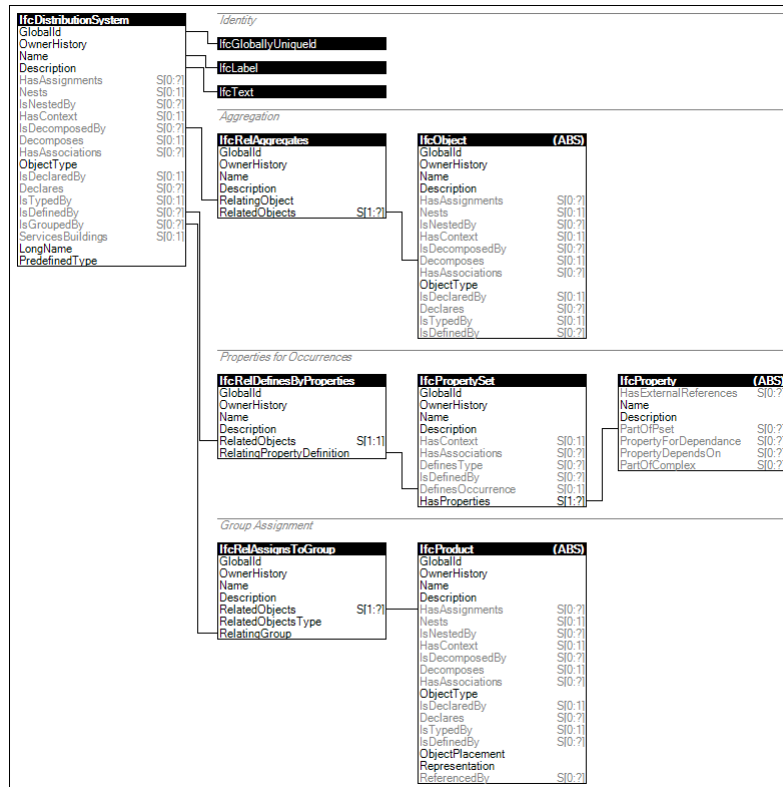
The *Axis* points in the direction of the physical connection away from the product if *FlowDirection* equals *SOURCE* (or *SOURCEANDSINK* or *NOTDEFINED*), or points opposite direction (to the product) if the *FlowDirection* equals *SINK*.

NOTE The rationale for positioning the *Axis* in the direction of flow is to allow for the same geometry to be used, such as for connectors with polarized cross-section.

The *RefDirection* points in the direction of the local X axis of the material profile, where the local Y axis points up if looking towards the *Axis* where the local X axis points right.

Upon connecting elements through ports with rigid connections, each object shall be aligned such that the effective *Location*, *Axis*, and *RefDirection* of each port is aligned to be equal (with exception for circular profiles where the *RefDirection* need not be equal).

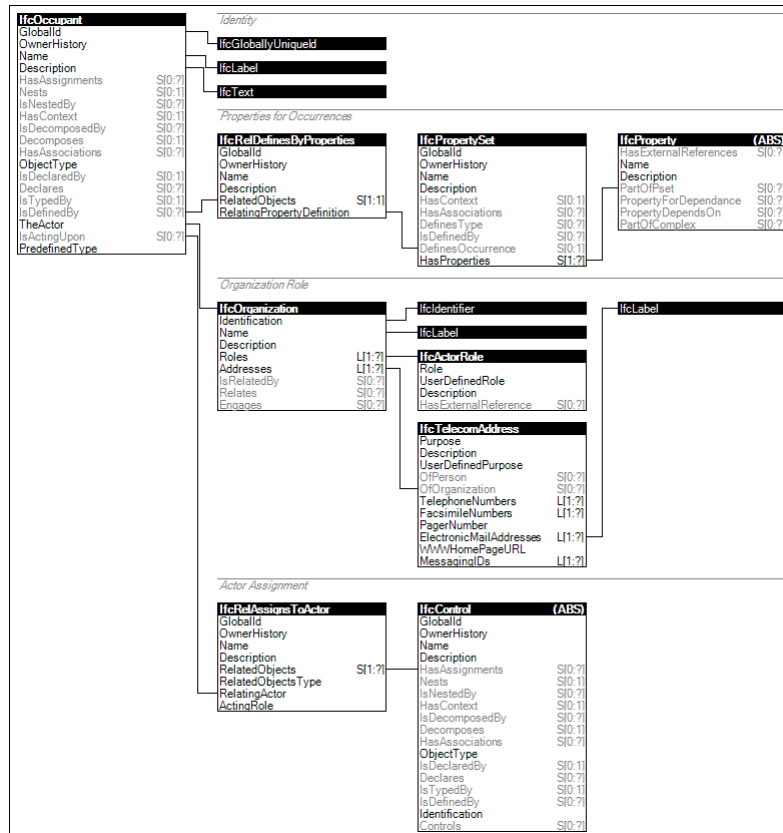
IfcDistributionSystem



Aggregation

Domestic water distribution systems may be subdivided into circuits indicating subsets with the same pressure requirements, such as within a range of building storeys.

IfcOccupant

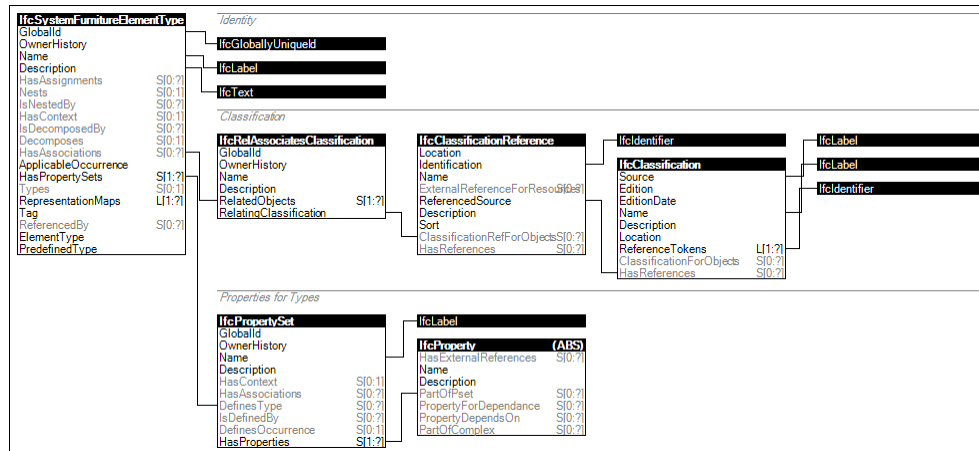


Actor Assignment

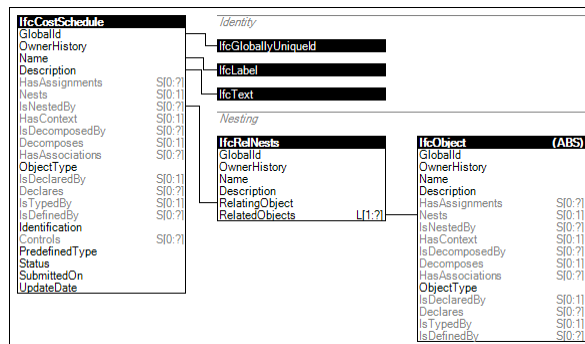


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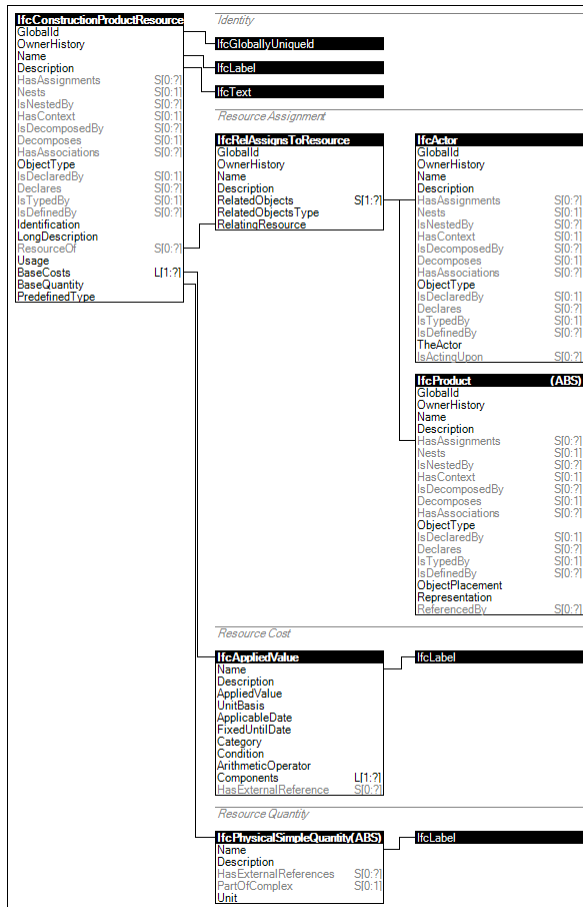
IfcSystemFurnitureElementType



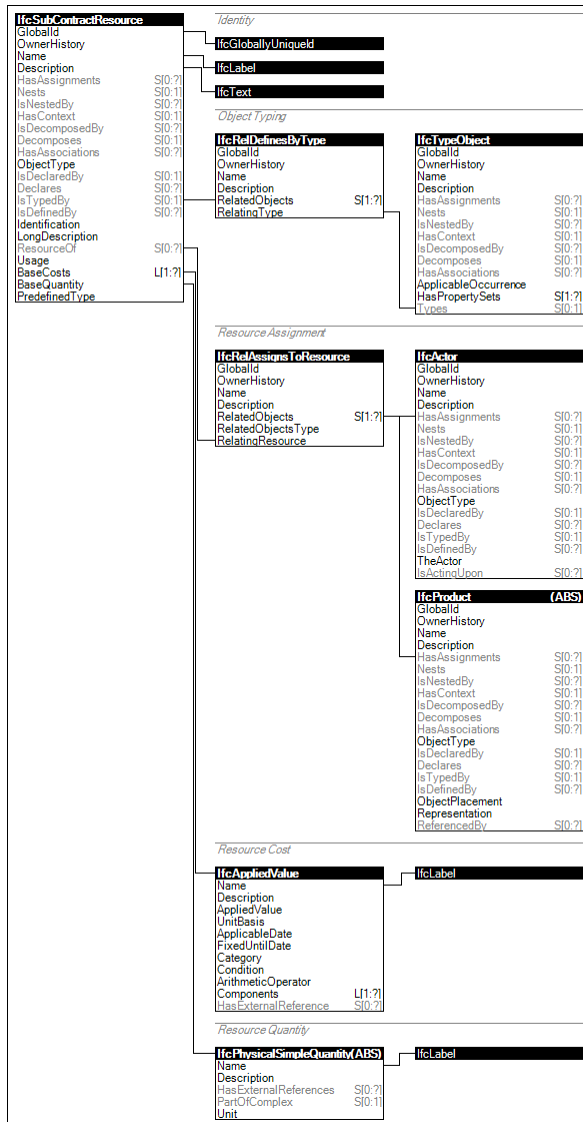
IfcCostSchedule



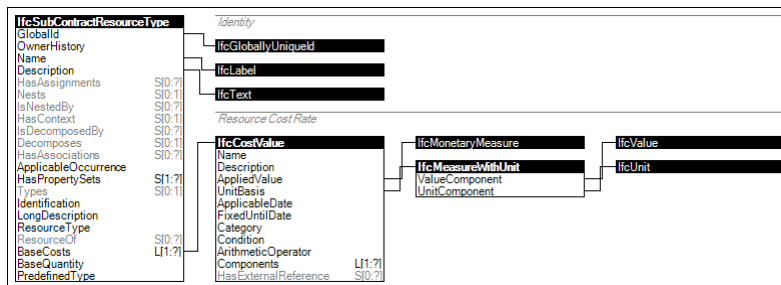
IfcConstructionProductResource

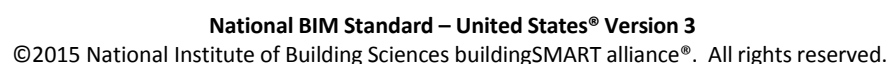


IfcSubContractResource

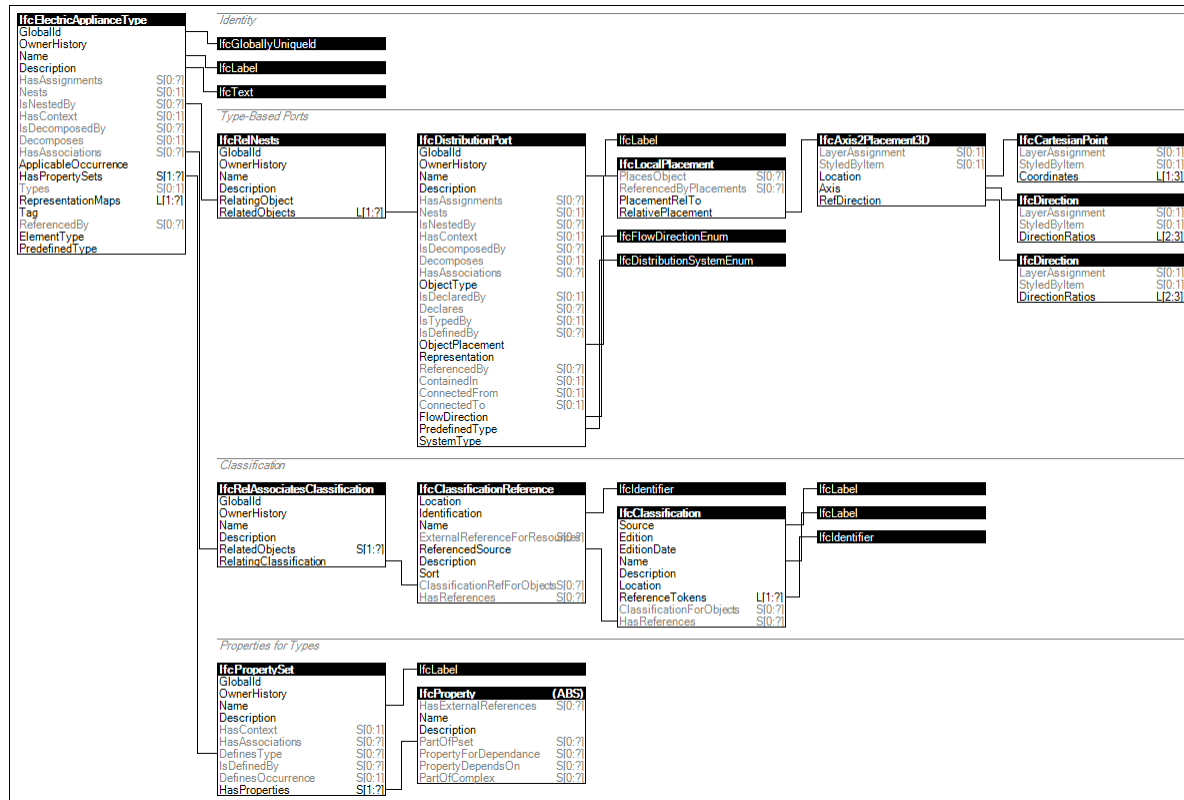


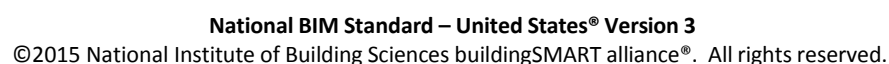
IfcSubContractResourceType



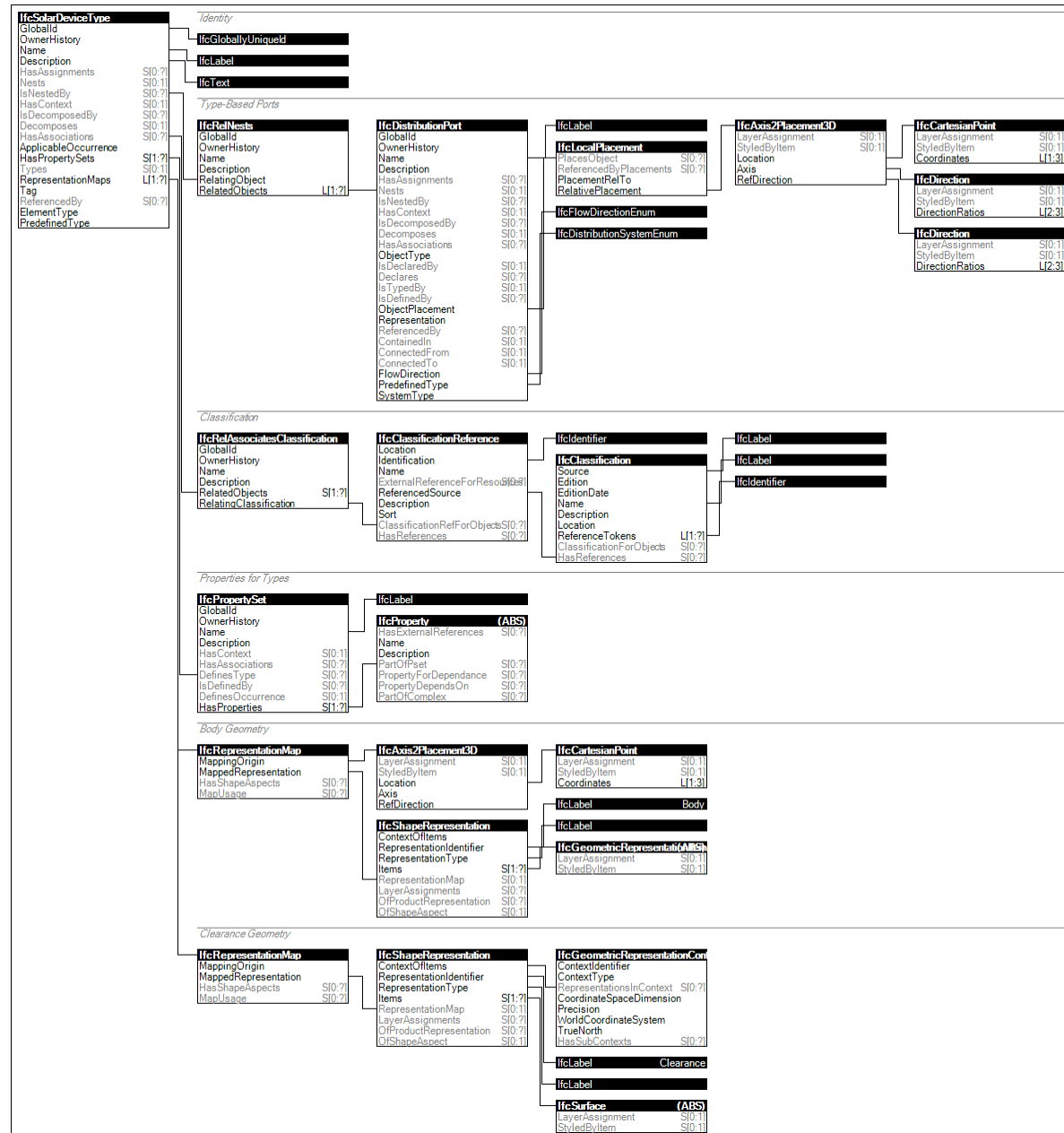


IfcElectricApplianceType

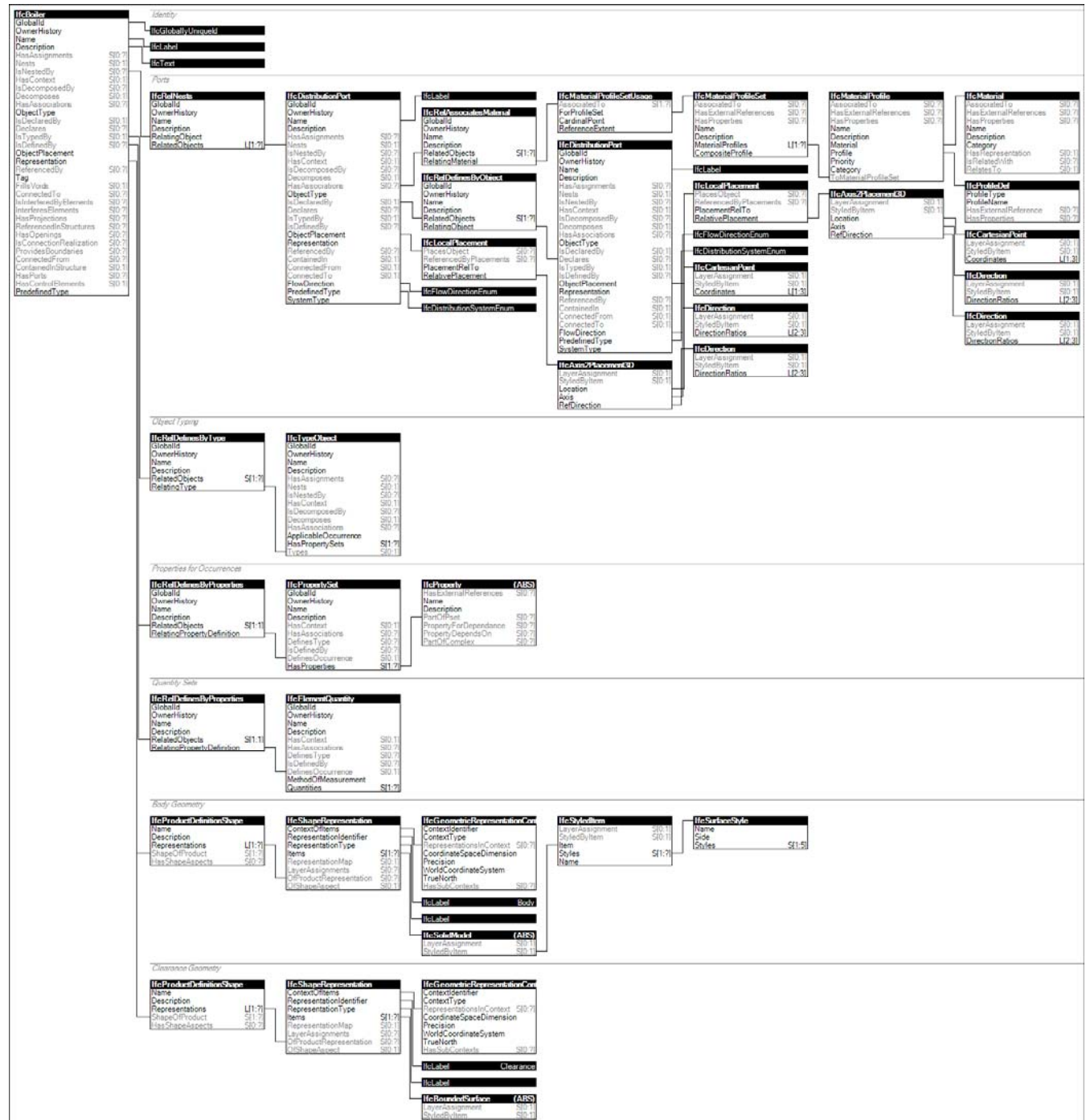




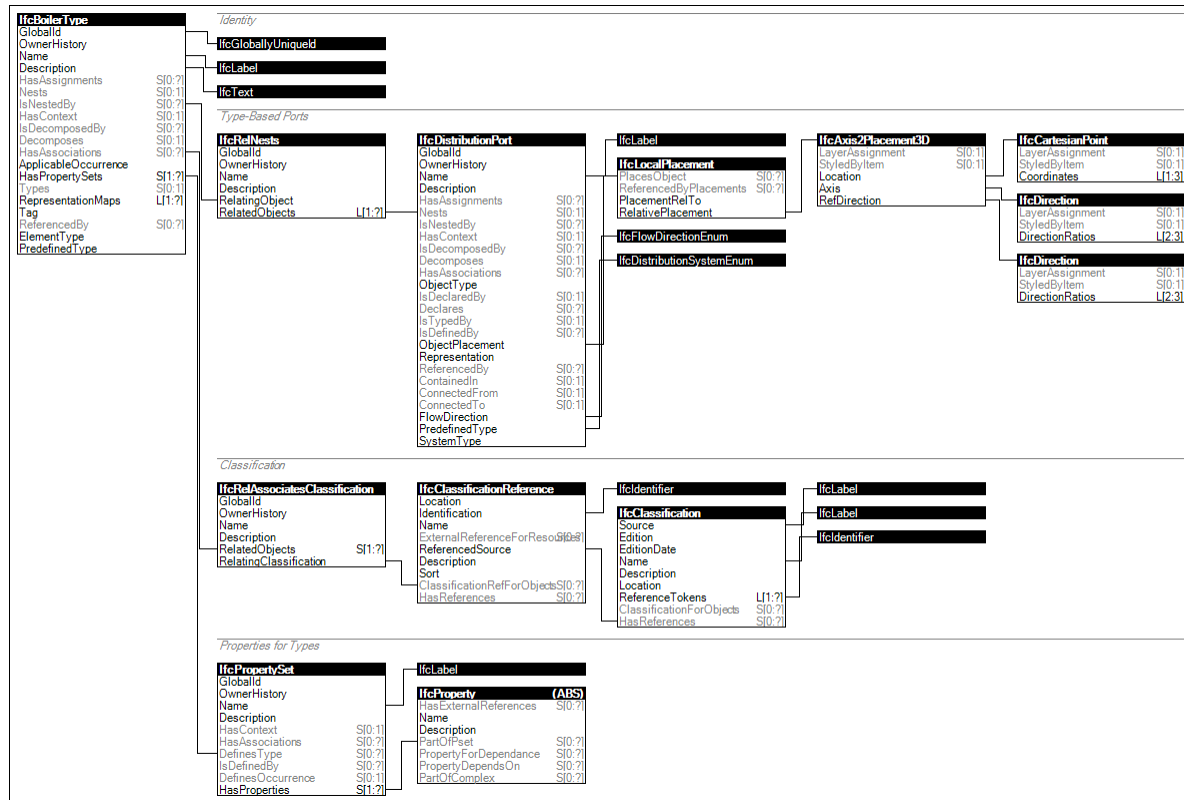
IfcSolarDeviceType



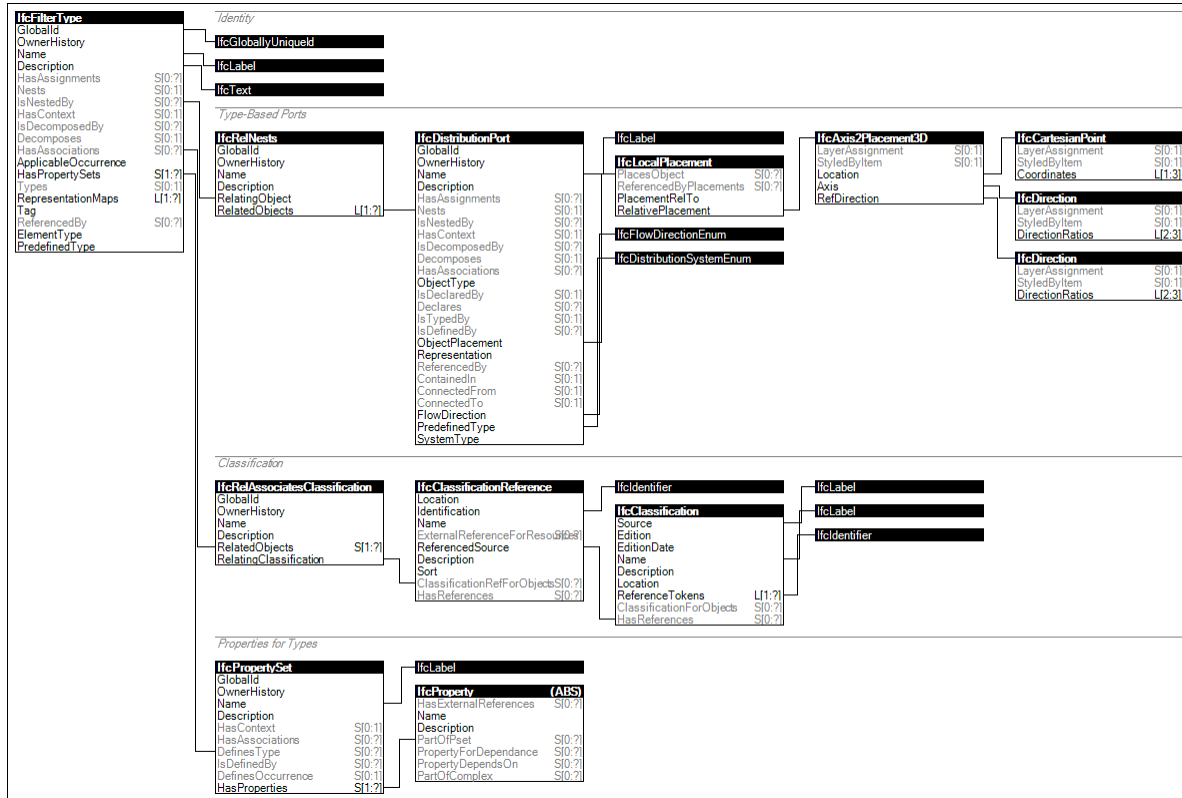
IfcBoiler

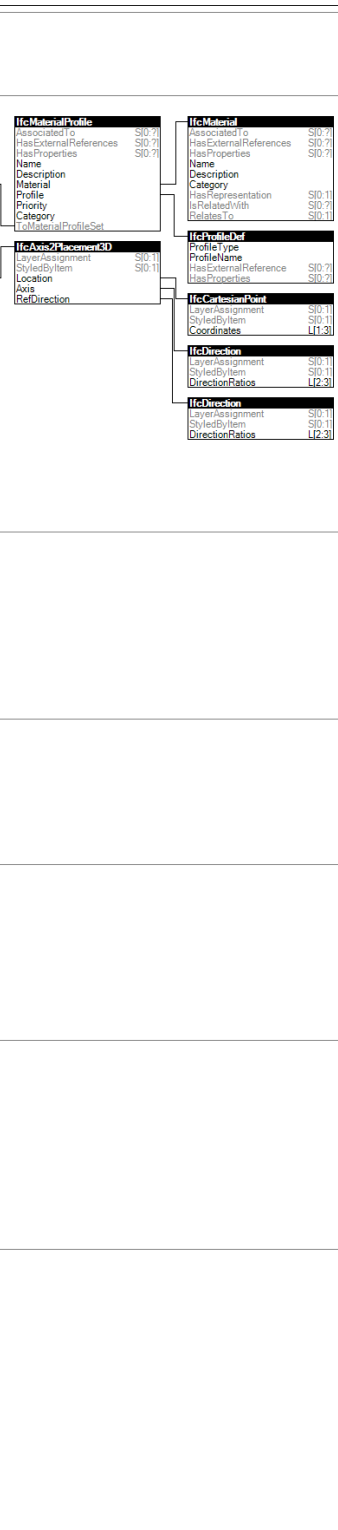


IfcBoilerType

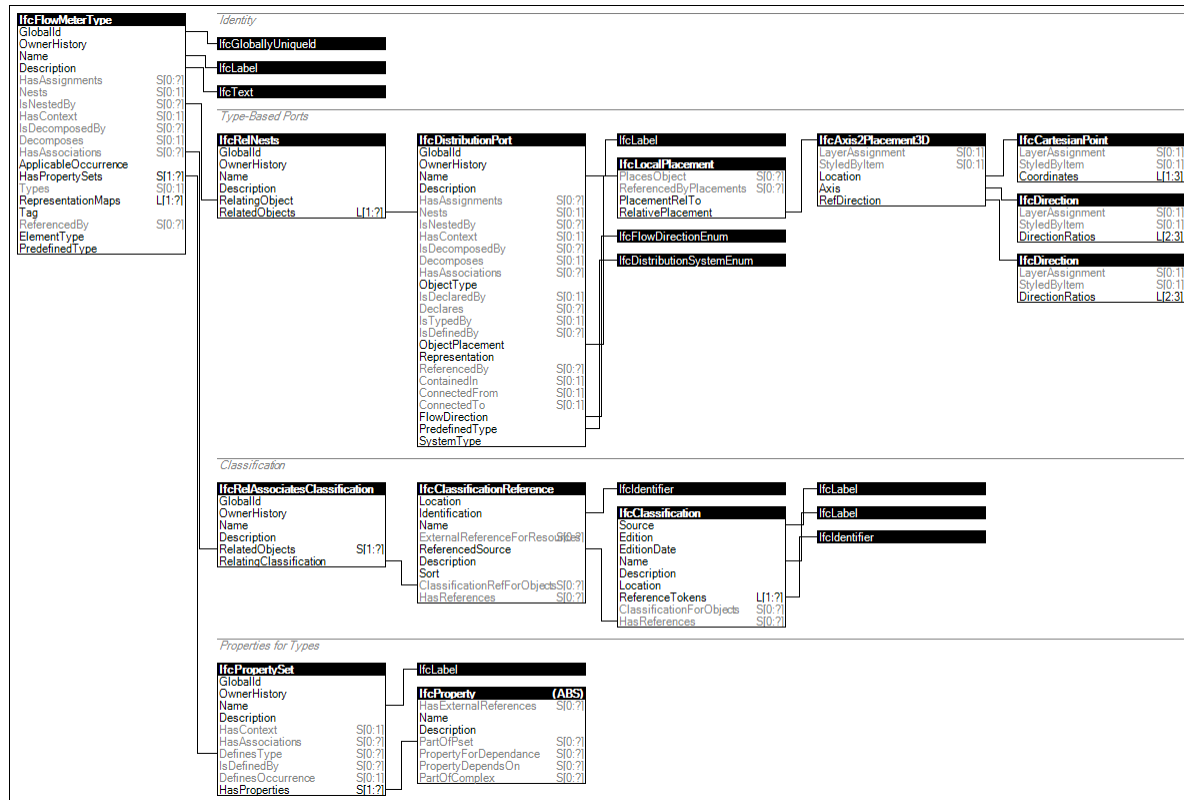


IfcFilterType

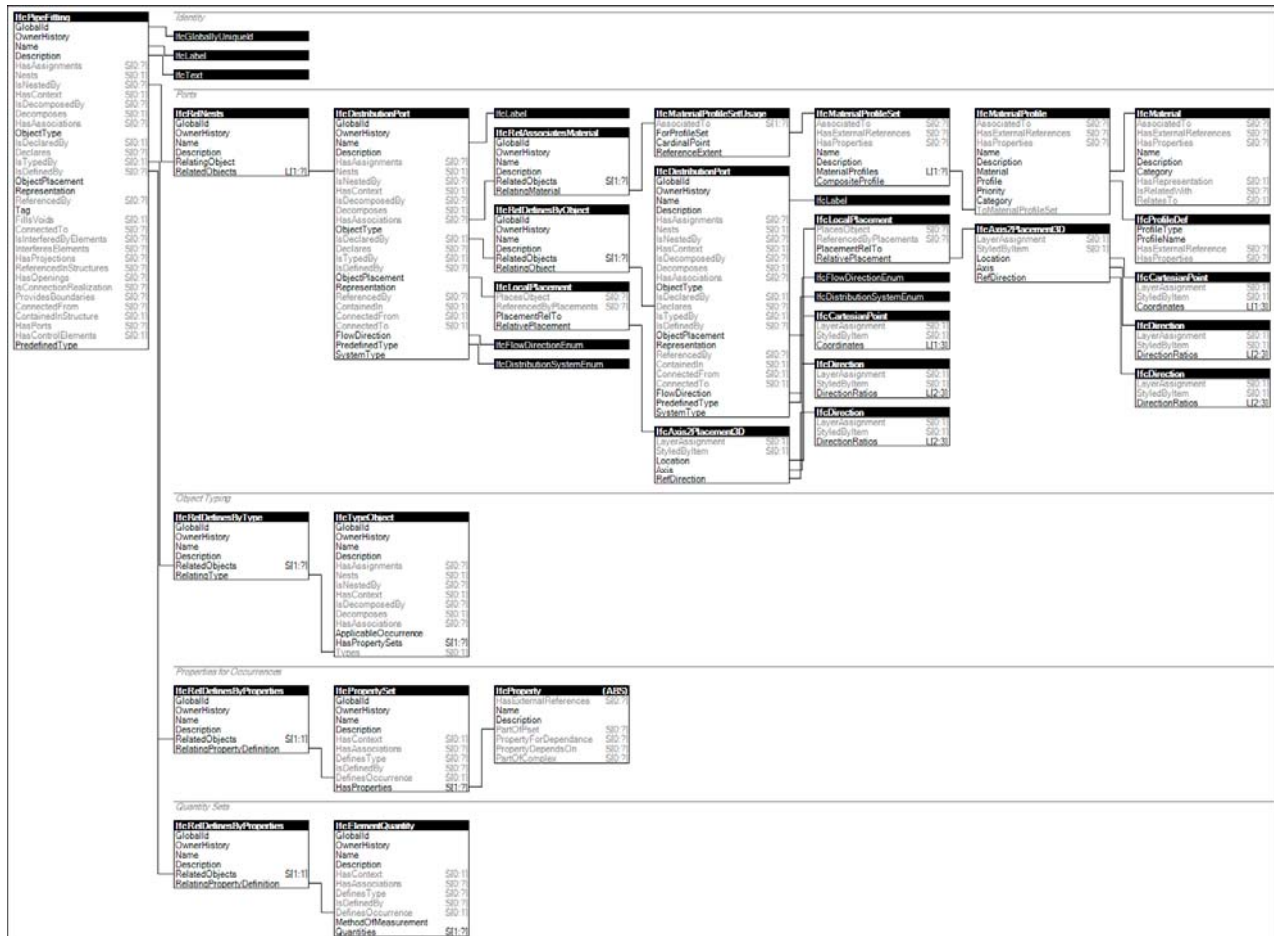




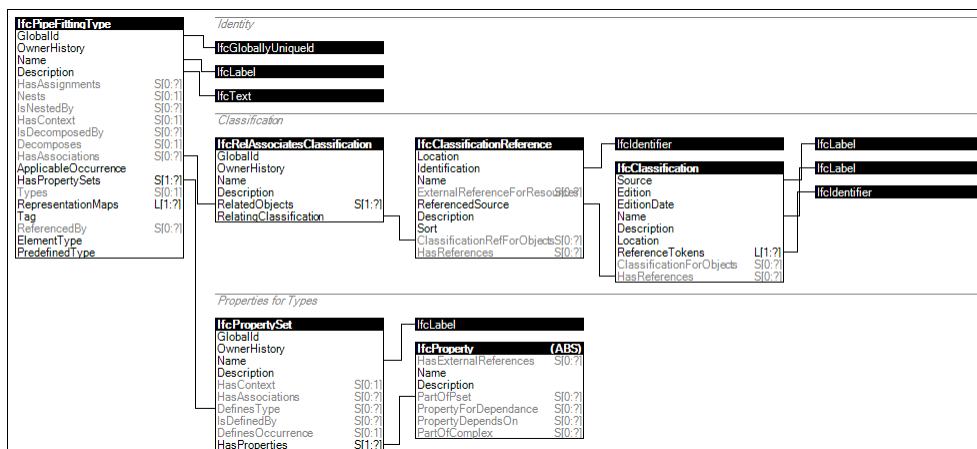
IfcFlowMeterType

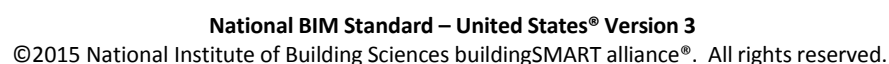


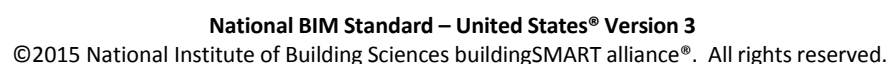
lfcPipeFitting



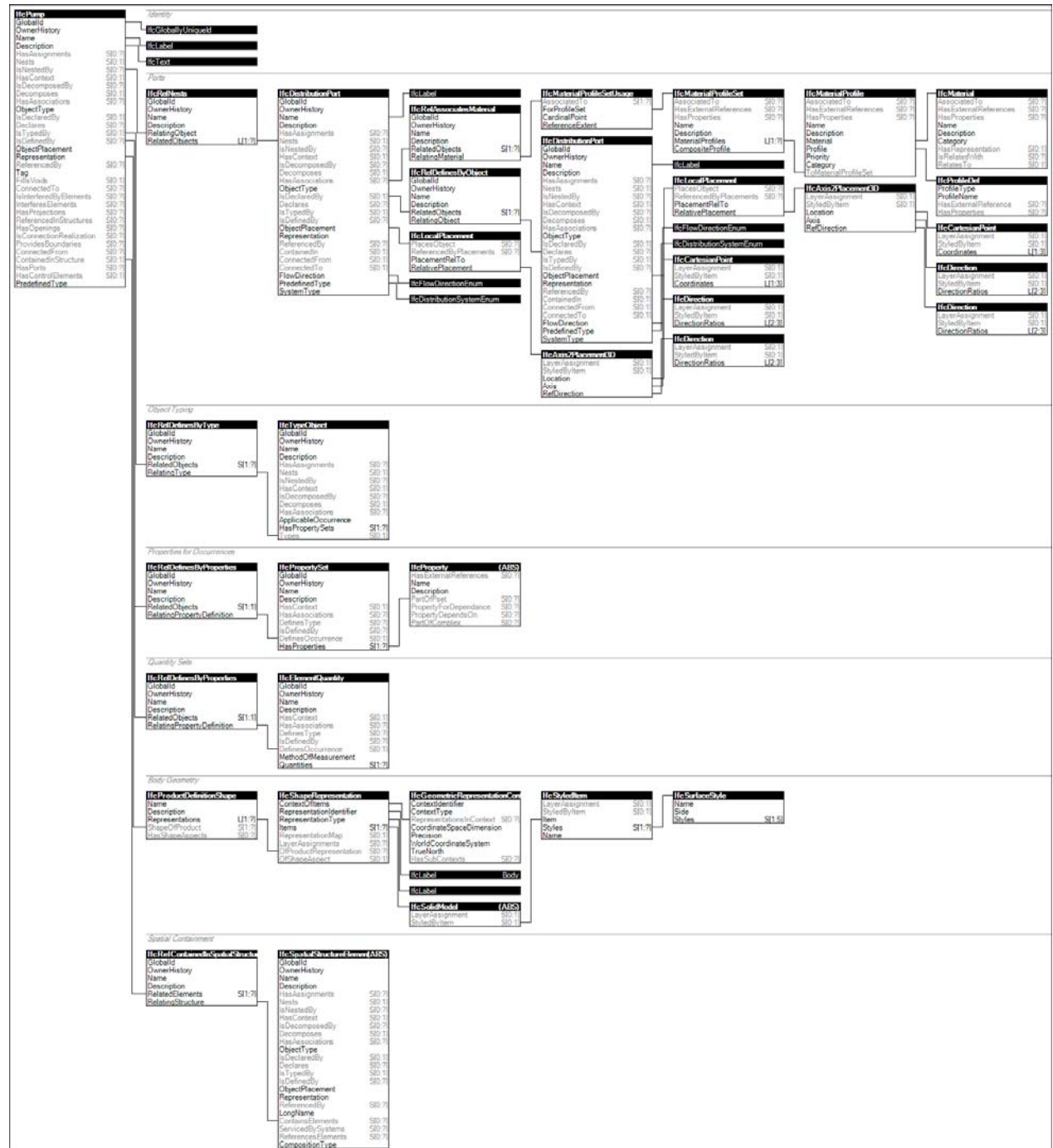
IfcPipeFittingType



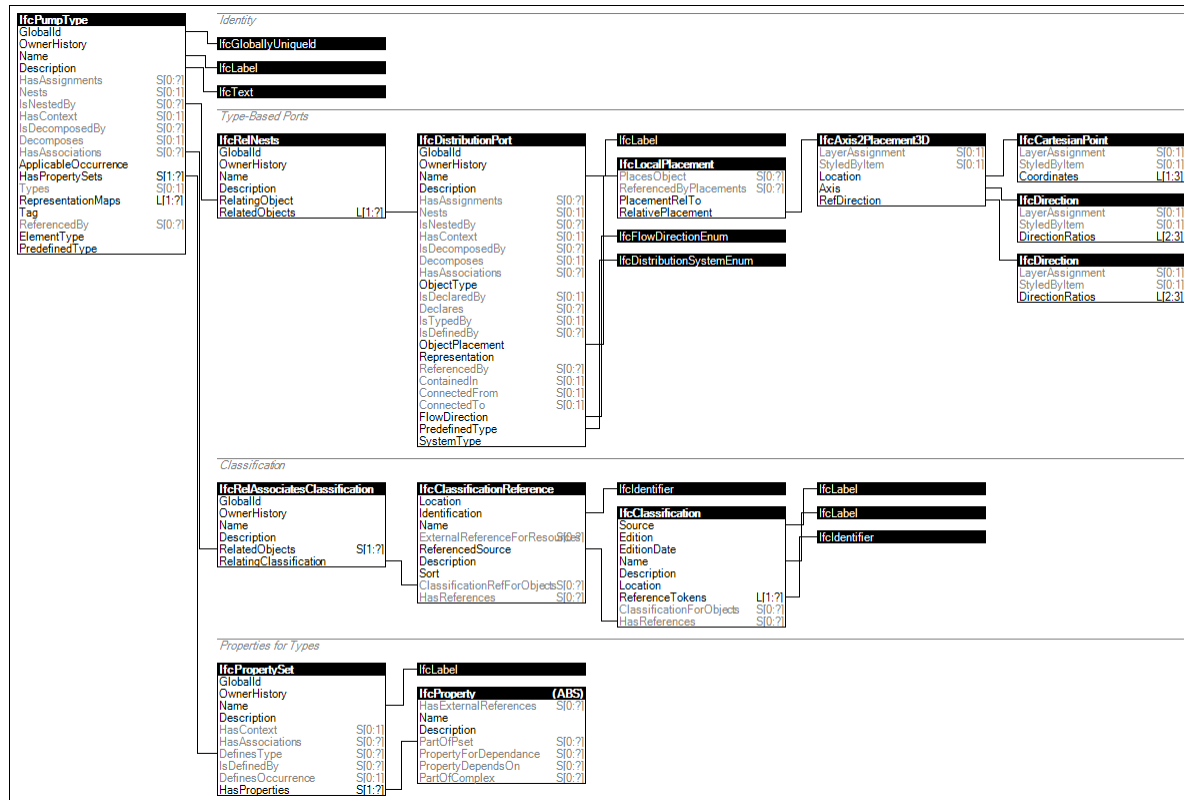


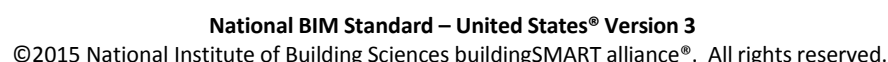


IfcPump

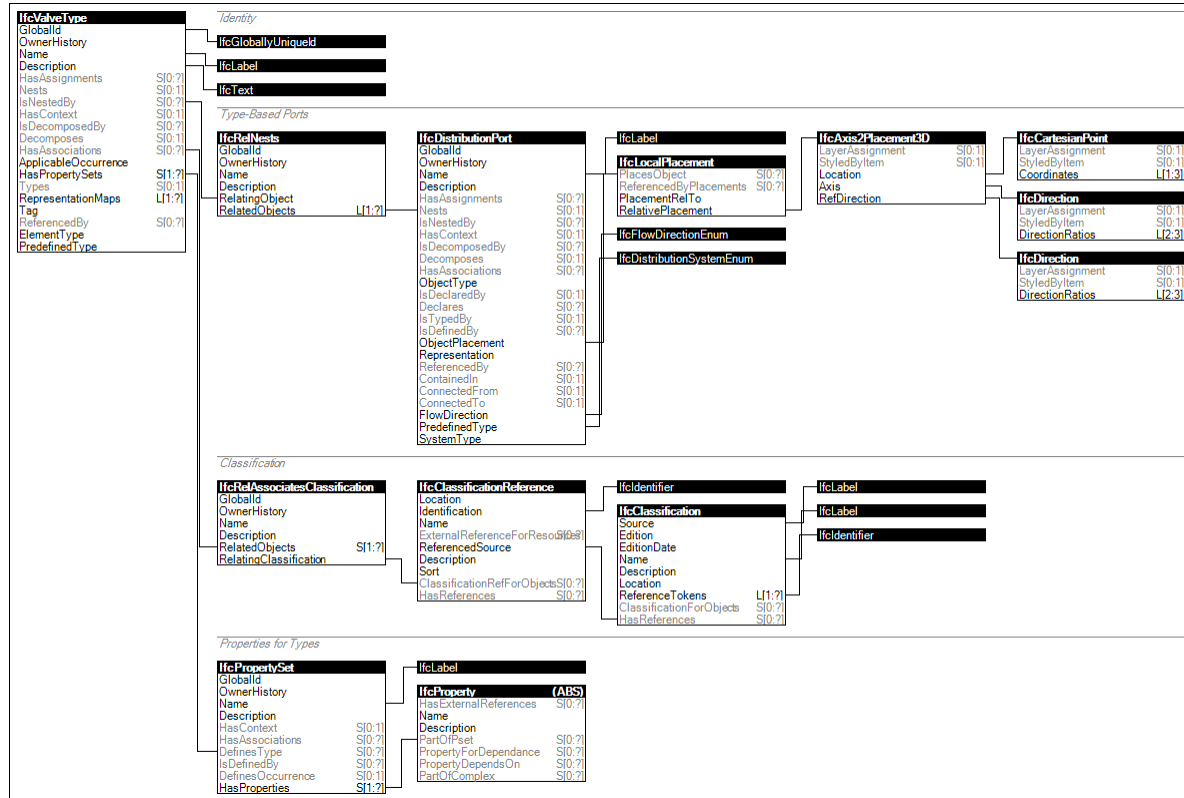


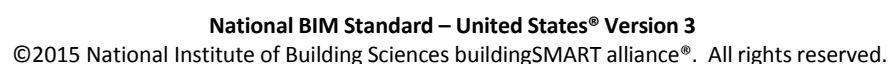
IfcPumpType



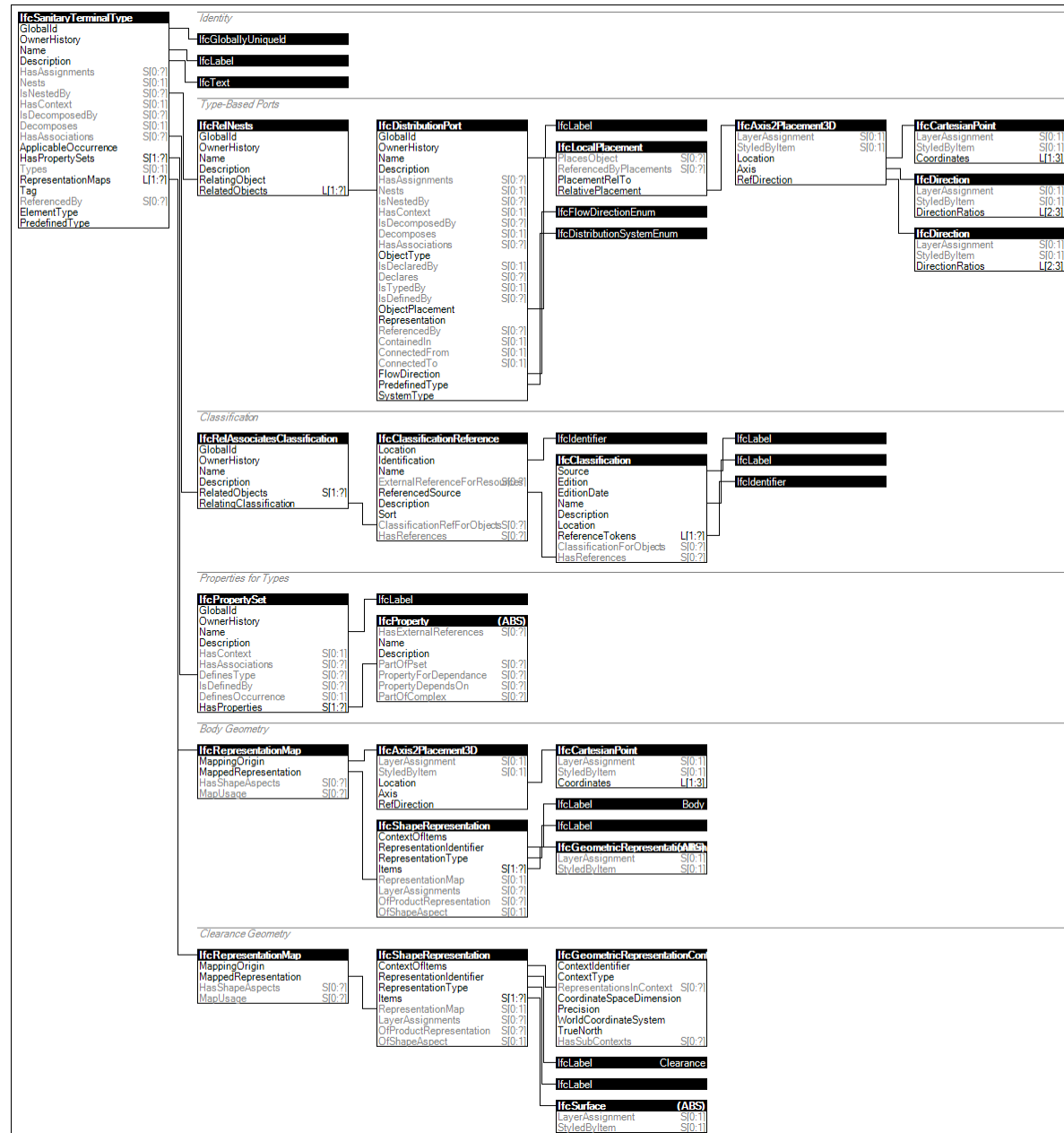


IfcValveType

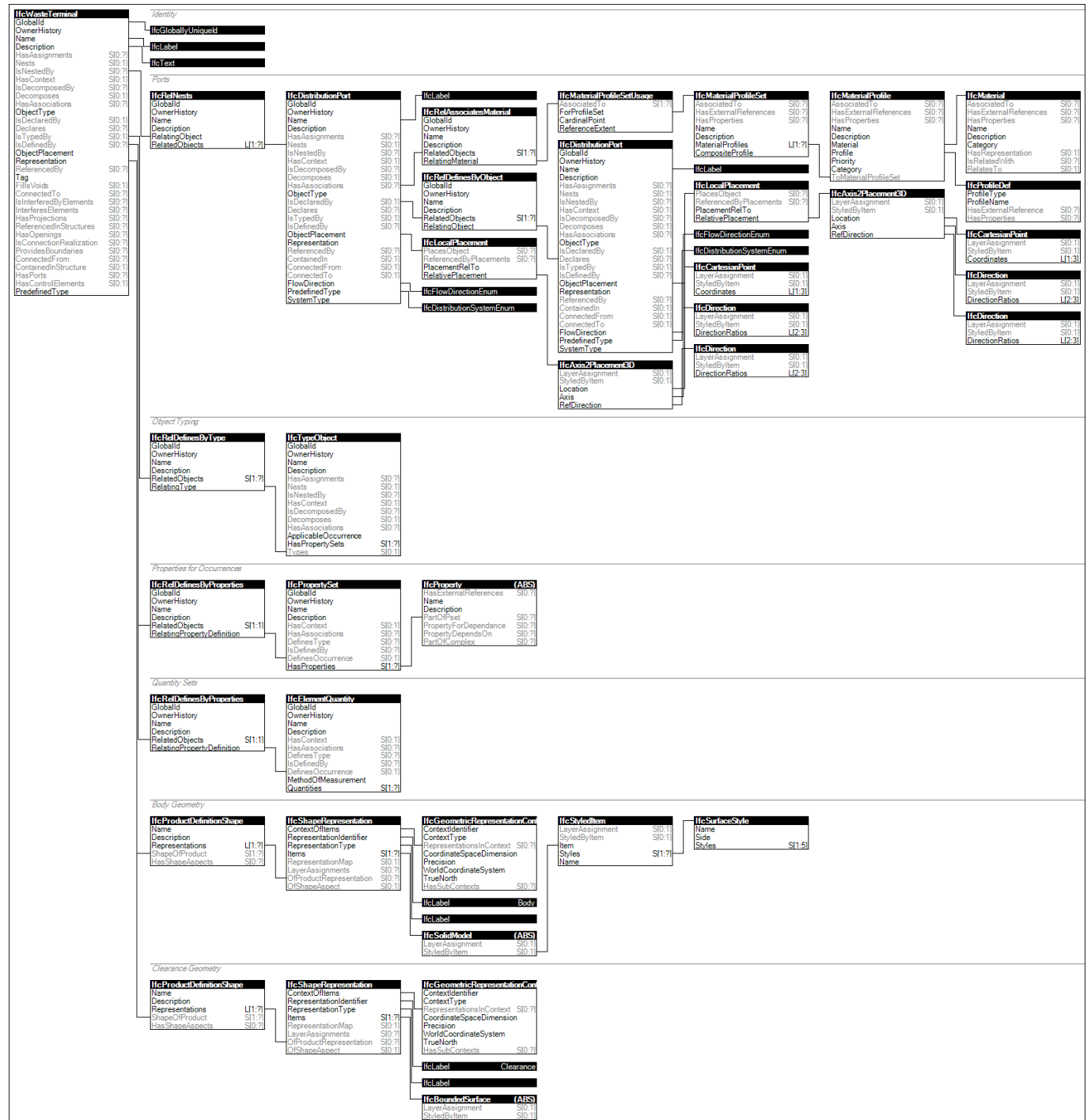




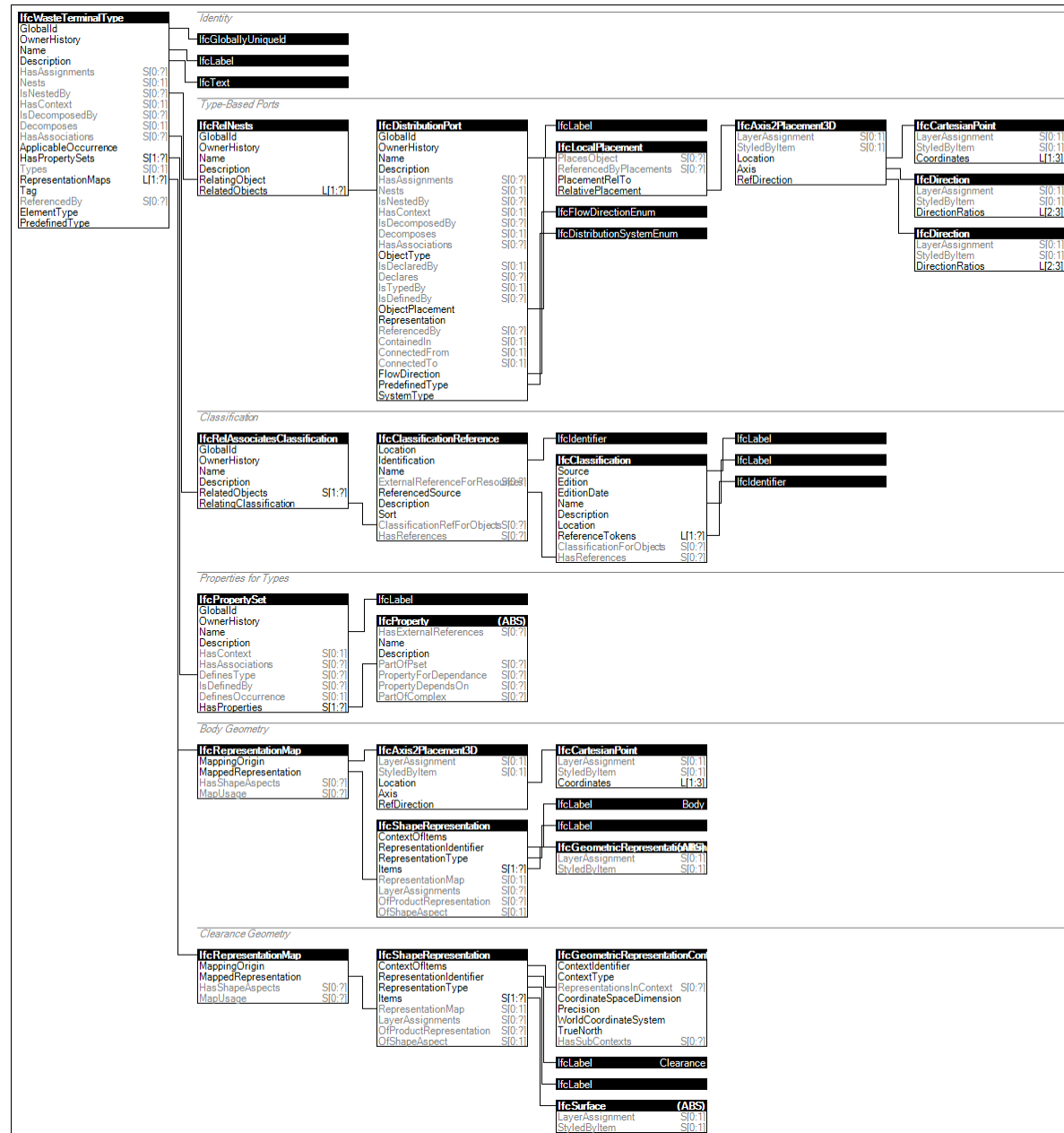
IfcSanitaryTerminalType



IfcWasteTerminal



IfcWasteTerminalType



4.9.6.2.3 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.

Properties for Occurrences

Entity	PredefinedType	Name
IfcActor		Pset_ActorCommon
IfcBuilding		Pset_BuildingCommon
IfcBuildingStorey		Pset_BuildingStoreyCommon
IfcSpace		Pset_SpaceOccupancyRequirements
		Pset_SpaceCommon
IfcMember		Pset_MemberCommon
IfcDistributionPort	PIPE	Pset_DistributionPortTypePipe
IfcDistributionSystem		Pset_DistributionSystemCommon
	DOMESTICCOLDWATER	Pset_DistributionSystemTypePlumbing
IfcOccupant		
IfcSystemFurnitureElement		Pset_SystemFurnitureElementTypeCommon
	PANEL	Pset_SystemFurnitureElementTypePanel
	WORKSURFACE	Pset_SystemFurnitureElementTypeWorkSurface
IfcElectricAppliance		Pset_ElectricAppliancePHistory
		Pset_ElectricApplianceTypeCommon
	DISHWASHER	Pset_ElectricApplianceTypeDishwasher
IfcSolarDevice		Pset_SolarDeviceTypeCommon
IfcBoiler		Pset_BoilerPHistory
		Pset_BoilerTypeCommon
	STEAM	Pset_BoilerTypeSteam
	WATER	Pset_BoilerTypeWater
IfcFilter		Pset_FilterPHistory
		Pset_FilterTypeCommon
	WATERFILTER	Pset_FilterTypeWaterFilter
IfcFlowMeter		Pset_FlowMeterOccurrence
		Pset_FlowMeterTypeCommon
	ENERGYMETER	Pset_FlowMeterTypeEnergyMeter
IfcPipeFitting		Pset_PipeFittingOccurrence
		Pset_PipeFittingPHistory
	BEND	Pset_PipeFittingTypeBend
		Pset_PipeFittingTypeCommon
	JUNCTION	Pset_PipeFittingTypeJunction
IfcPipeSegment		Pset_PipeConnectionFlanged
		Pset_PipeSegmentOccurrence
		Pset_PipeSegmentPHistory
		Pset_PipeSegmentTypeCommon
	CULVERT	Pset_PipeSegmentTypeCulvert
	GUTTER	Pset_PipeSegmentTypeGutter

Entity	PredefinedType	Name
IfcPump		
IfcValve		Pset_ValvePHistory
	AIRRELEASE	Pset_ValveTypeAirRelease
		Pset_ValveTypeCommon
	DRAWOFFCOCK	Pset_ValveTypeDrawOffCock
	FAUCET	Pset_ValveTypeFaucet
	FLUSHING	Pset_ValveTypeFlushing
	GASTAP	Pset_ValveTypeGasTap
	ISOLATING	Pset_ValveTypeIsolating
	MIXING	Pset_ValveTypeMixing
	PRESSUREREDUCING	Pset_ValveTypePressureReducing
	PRESSURERELIEF	Pset_ValveTypePressureRelief
IfcSanitaryTerminal	BATH	Pset_SanitaryTerminalTypeBath
	BIDET	Pset_SanitaryTerminalTypeBidet
	CISTERN	Pset_SanitaryTerminalTypeCistern
		Pset_SanitaryTerminalTypeCommon
	SANITARYFOUNTAIN	Pset_SanitaryTerminalTypeSanitaryFountain
	SHOWER	Pset_SanitaryTerminalTypeShower
	SINK	Pset_SanitaryTerminalTypeSink
	TOILETPAN	Pset_SanitaryTerminalTypeToiletPan
	URINAL	Pset_SanitaryTerminalTypeUrinal
	WASHHANDBASIN	Pset_SanitaryTerminalTypeWashHandBasin
IfcWasteTerminal		Pset_WasteTerminalTypeCommon
	FLOORTRAP	Pset_WasteTerminalTypeFloorTrap
	FLOORWASTE	Pset_WasteTerminalTypeFloorWaste
	GULLYSUMP	Pset_WasteTerminalTypeGullySump
	GULLYTRAP	Pset_WasteTerminalTypeGullyTrap
	ROOFDRAIN	Pset_WasteTerminalTypeRoofDrain
	WASTEDISPOSALUNIT	Pset_WasteTerminalTypeWasteDisposalUnit
	WASTETRAP	Pset_WasteTerminalTypeWasteTrap

Organization Role

Entity	Role	UserDefinedRole
IfcActor	USERDEFINED	ElectricalUtility
IfcOccupant		

Actor Assignment

Entity	Type
IfcActor	IfcWorkPlan
IfcOccupant	IfcSpatialStructureElement
	IfcWorkCalendar

Spatial Decomposition

Entity	Spatial Parts
IfcProject	IfcSite
IfcBuilding	IfcBuildingStorey
IfcBuildingStorey	IfcSpace
IfcSite	IfcBuilding

Conversion Units

Entity	UnitType	Name	ConversionType	ConversionFactor	BaseUnitPrefix	BaseUnitName	ConversionOffset
IfcProject							

Project Context

Entity	ContextIdentifier	ContextType
IfcProject	Plan	2D
	Model	3D

Project Declaration

Entity	Type
IfcProject	IfcSpaceType
	IfcOccupant
	IfcActor
	IfcSpace
	IfcWorkPlan
	IfcDistributionElementType
	IfcDistributionSystem

Control Assignment

Entity	Type
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IfcPerformanceHistory	IfcGroup
	IfcProduct
IfcWorkCalendar	IfcSpatialStructureElement

Process Assignment

Entity	Type
IfcTask	IfcSubContractResource
	IfcConstructionProductResource

Nesting

Entity	Type
IfcWorkCalendar	IfcCostSchedule
IfcCostSchedule	IfcCostItem

Classification

Entity	Source	Name	Tokens
IfcBuilding	CSI	OmniClass	11-00 00 00
IfcSpace	CSI	OmniClass	13-00 00 00
IfcSystemFurnitureElementType			
IfcElectricApplianceType			
IfcSolarDeviceType			
IfcBoilerType			
IfcFilterType			
IfcFlowMeterType			
IfcPipeFittingType			
IfcPipeSegmentType			
IfcPumpType			
IfcValveType			
IfcSanitaryTerminalType			
IfcWasteTerminalType			

Product Assignment

Entity	Type
IfcBuilding	IfcTask

Placement

Entity	Type
IfcOpeningElement	

IfcSpace	IfcLocalPlacement
IfcMember	
IfcSlabElementedCase	
IfcWallElementedCase	
IfcDistributionPort	
IfcSystemFurnitureElement	
IfcFlowMeter	IfcLocalPlacement
IfcSanitaryTerminal	IfcLocalPlacement

Body Geometry

Entity	RepresentationType	Geometry
IfcOpeningElement	SweptSolid	IfcExtrudedAreaSolid
	Brep	IfcFacetedBrep
IfcSpace	SweptSolid	IfcExtrudedAreaSolid
	Clipping	IfcBooleanClippingResult
	Brep	IfcFacetedBrep
IfcMember	SweptSolid	IfcExtrudedAreaSolid
	Clipping	IfcBooleanClippingResult
	AdvancedSweptSolid	IfcSweptAreaSolid
	SurfaceModel	IfcFaceBasedSurfaceModel
	Brep	IfcFacetedBrep
	MappedRepresentation	IfcMappedItem
IfcSlabStandardCase	SweptSolid	IfcExtrudedAreaSolid
	Clipping	IfcBooleanClippingResult
IfcWallStandardCase	SweptSolid	IfcExtrudedAreaSolid
	Clipping	IfcBooleanClippingResult
IfcSystemFurnitureElement		
IfcElectricAppliance	MappedRepresentation	IfcMappedItem
IfcSolarDevice	MappedRepresentation	IfcMappedItem
IfcBoiler	MappedRepresentation	IfcMappedItem
IfcFilter	MappedRepresentation	IfcMappedItem
IfcFlowMeter	MappedRepresentation	IfcMappedItem
IfcPipeSegment	MappedRepresentation	IfcMappedItem
	SweptSolid	IfcExtrudedAreaSolid
IfcPump	MappedRepresentation	IfcMappedItem
IfcValve	MappedRepresentation	IfcMappedItem
IfcSanitaryTerminal	MappedRepresentation	IfcMappedItem
IfcWasteTerminal	MappedRepresentation	IfcMappedItem

Footprint Geometry

Entity	RepresentationType	Geometry
IfcSite	GeometricCurveSet	IfcGeometricCurveSet
	Annotation2D	IfcAnnotationFillArea
IfcSpace	GeometricCurveSet	IfcGeometricCurveSet
IfcSanitaryTerminal	GeometricCurveSet	IfcGeometricCurveSet

Object Typing

Entity	Type
IfcSpace	IfcSpaceType
IfcMember	IfcMemberType
IfcSlabStandardCase	IfcSlabType
IfcWallStandardCase	IfcWallType
IfcSystemFurnitureElement	IfcSystemFurnitureElementType
IfcSubContractResource	
IfcElectricAppliance	IfcElectricApplianceType
IfcSolarDevice	IfcSolarDeviceType
IfcBoiler	IfcBoilerType
IfcFilter	IfcFilterType
IfcFlowMeter	IfcFlowMeterType
IfcPipeFitting	IfcPipeFittingType
IfcPipeSegment	IfcPipeSegmentType
IfcPump	IfcPumpType
IfcValve	IfcValveType
IfcSanitaryTerminal	
IfcWasteTerminal	IfcWasteTerminalType

Space Boundaries

Entity	RelatedBuildingElement
IfcSpace	

Axis Geometry

Entity	RepresentationType	Geometry
IfcMember	Curve3D	IfcBoundedCurve
IfcWallElementedCase	Curve2D	IfcBoundedCurve
IfcWallStandardCase	Curve2D	IfcBoundedCurve
IfcPipeSegment	Curve3D	IfcPolyline

Voiding

Entity	RelatedOpening
IfcSlab	
IfcWall	IfcOpeningElement

Aggregation

Entity	PredefinedType	RelatedObjects
IfcSlabElementedCase		IfcBeam
		IfcPlate
		IfcBuildingElementPart
IfcWallElementedCase		IfcMember
		IfcPlate
		IfcBuildingElementPart
		IfcBeam
IfcDistributionSystem		IfcDistributionCircuit

Surface Geometry

Entity	RepresentationType	Geometry
IfcSlabElementedCase	Surface3D	IfcBoundedSurface
IfcWallElementedCase	Surface3D	IfcBoundedSurface

Spatial Containment

Entity	Structure
IfcSlabElementedCase	IfcBuildingStorey
IfcWallElementedCase	IfcSite
	IfcBuildingStorey
IfcFilter	
IfcFlowMeter	IfcSite
IfcPump	

Material Layer Set Usage

Entity	Name
IfcSlabStandardCase	
IfcWallStandardCase	

Path Connectivity

Entity	RelatedElement
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IfcWall	IfcWall
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Material Profile Set Usage

Entity	Name
IfcDistributionPort	Pipe
IfcPipeSegment	Casing
	Coating
	Insulation
	Lining

Properties for Types

Entity	Name
IfcDistributionPort	
IfcSystemFurnitureElementType	
IfcElectricApplianceType	
IfcSolarDeviceType	
IfcBoilerType	
IfcFilterType	
IfcFlowMeterType	
IfcPipeFittingType	
IfcPipeSegmentType	
IfcPumpType	
IfcValveType	
IfcSanitaryTerminalType	Pset_SanitaryTerminalCommon
IfcWasteTerminalType	

Group Assignment

Entity	Type
IfcDistributionSystem	IfcSanitaryTerminal
	IfcPump
	IfcValve
	IfcBoiler
	IfcWasteTerminal
	IfcFilter

Material Constituents

Entity	Name
IfcSystemFurnitureElement	Finish
	Frame

	Hardware
	Padding
	Panel
IfcValve	Casing
	Operation

Resource Cost

Entity	CostType	CostName	ValueType
IfcConstructionProductResource	IfcCostValue	Product	IfcMonetaryMeasure
	IfcCostValue	Shipping	IfcMonetaryMeasure
IfcSubContractResource			

Resource Quantity

Entity	QuantityType	QuantityName
IfcConstructionProductResource	IfcQuantityCount	Count
IfcSubContractResource		

Resource Assignment

Entity	Type
IfcConstructionProductResource	IfcSanitaryTerminal
IfcSubContractResource	IfcActor

Ports

Entity	PredefinedType	Name	Flow	Type
IfcElectricAppliance	DISHWASHER	HotWater	SINK	DOMESTICHOTWATER
	DISHWASHER	Drainage	SOURCE	DRAINAGE
	FRIDGE_FREEZER	ColdWater	SINK	DOMESTICCOLDWATER
	WASHINGMACHINE	ColdWater	SINK	DOMESTICCOLDWATER
	WASHINGMACHINE	HotWater	SINK	DOMESTICHOTWATER
	WASHINGMACHINE	Drainage	SOURCE	DRAINAGE
IfcSolarDevice	SOLARCOLLECTOR	Inlet	SOURCE	HEATING
	SOLARCOLLECTOR	Outlet	SINK	HEATING
IfcBoiler	WATER	Gas	SINK	GAS
	WATER	Exhaust	SOURCE	EXHAUST
	WATER	ColdWater	SINK	DOMESTICCOLDWATER
	WATER	HotWater	SOURCE	DOMESTICHOTWATER
IfcFilter	ODORFILTER	Inlet	SINK	EXHAUST
	ODORFILTER	Outlet	SOURCE	EXHAUST
	STRAINER	Inlet	SINK	DRAINAGE
	STRAINER	Outlet	SOURCE	DRAINAGE
	WATERFILTER	Inlet	SINK	DOMESTICCOLDWATER

Entity	PredefinedType	Name	Flow	Type
	WATERFILTER	Outlet	SOURCE	DOMESTICCOLDWATER
IfcFlowMeter	GASMETER	Inlet	SINK	GAS
	GASMETER	Outlet	SOURCE	GAS
	WATERMETER	Inlet	SINK	DOMESTICCOLDWATER
	WATERMETER	Outlet	SOURCE	DOMESTICCOLDWATER
IfcPipeFitting	BEND	Inlet	SINK	NOTDEFINED
	BEND	Outlet	SOURCE	NOTDEFINED
	CONNECTOR	Inlet	SINK	NOTDEFINED
	CONNECTOR	Outlet	SOURCE	NOTDEFINED
	ENTRY	Outlet	SOURCE	NOTDEFINED
	EXIT	Inlet	SINK	NOTDEFINED
	JUNCTION	Inlet	SINK	NOTDEFINED
	JUNCTION	Outlet#1	SOURCE	NOTDEFINED
	JUNCTION	Outlet#2	SOURCE	NOTDEFINED
	OBSTRUCTION	Inlet	SINK	NOTDEFINED
	OBSTRUCTION	Outlet	SOURCE	NOTDEFINED
IfcPipeSegment		Inlet	SINK	NOTDEFINED
		Outlet	SOURCE	NOTDEFINED
IfcPump		Power	SINK	ELECTRICAL
		Inlet	SINK	NOTDEFINED
		Outlet	SOURCE	NOTDEFINED
IfcValve	AIRHANDLER	Inlet	SINK	NOTDEFINED
	ANTIVACUUM	Outlet	SOURCE	NOTDEFINED
	CHANGEOVER	Inlet	SINK	NOTDEFINED
	CHANGEOVER	Outlet#1	SINK	NOTDEFINED
	CHANGEOVER	Outlet#2	SINK	NOTDEFINED
	CHECK	Inlet	SINK	NOTDEFINED
	CHECK	Outlet	SINK	NOTDEFINED
	COMMISSIONING	Inlet	SINK	NOTDEFINED
	COMMISSIONING	Outlet	SOURCE	NOTDEFINED
	DIVERTING	Inlet	SINK	NOTDEFINED
	DIVERTING	Outlet#1	SINK	NOTDEFINED
	DIVERTING	Outlet#2	SINK	NOTDEFINED
	DOUBLECHECK	Inlet	SINK	NOTDEFINED
	DOUBLECHECK	Outlet	SINK	NOTDEFINED
	DOUBLEREGULATING	Inlet	SINK	NOTDEFINED
	DOUBLEREGULATING	Outlet	SINK	NOTDEFINED
	DRAWOFFCOCK	Inlet	SINK	NOTDEFINED
	FAUCET	Inlet	SINK	NOTDEFINED

Entity	PredefinedType	Name	Flow	Type
	FLUSHING	Inlet	SINK	NOTDEFINED
	FLUSHING	Outlet	SINK	NOTDEFINED
	GASCOCK	Inlet	SINK	GAS
	GASTAP	Inlet	SINK	GAS
	ISOLATING	Inlet	SINK	GAS
	ISOLATING	Outlet	SOURCE	GAS
	MIXING	Inlet#1	SINK	NOTDEFINED
	MIXING	Inlet#2	SINK	NOTDEFINED
	MIXING	Outlet	SOURCE	NOTDEFINED
	PRESSUREREDUCING	Inlet	SINK	NOTDEFINED
	PRESSUREREDUCING	Outlet	SOURCE	NOTDEFINED
	PRESSURERELIEF	Inlet	SINK	NOTDEFINED
	REGULATING	Inlet	SINK	NOTDEFINED
	REGULATING	Inlet	SOURCE	NOTDEFINED
	SAFETYCUTOFF	Inlet	SINK	NOTDEFINED
	SAFETYCUTOFF	Outlet	SOURCE	NOTDEFINED
	STEAMTRAP	Inlet	SINK	NOTDEFINED
	STEAMTRAP	Outlet	SOURCE	NOTDEFINED
	STOPCOCK	Inlet	SINK	NOTDEFINED
IfcSanitaryTerminal	BATH	ColdWater	SINK	DOMESTICCOLDWATER
	BATH	HotWater	SINK	DOMESTICHOTWATER
	BATH	Drainage	SOURCE	DRAINAGE
	BIDET	ColdWater	SINK	DOMESTICCOLDWATER
	BIDET	HotWater	SINK	DOMESTICHOTWATER
	BIDET	Drainage	SOURCE	DRAINAGE
	CISTERN	ColdWater	SINK	DOMESTICCOLDWATER
	CISTERN	HotWater	SINK	DOMESTICHOTWATER
	CISTERN	Drainage	SOURCE	DRAINAGE
	SANITARYFOUNTAIN	ColdWater	SINK	DOMESTICCOLDWATER
	SANITARYFOUNTAIN	HotWater	SINK	DOMESTICHOTWATER
	SANITARYFOUNTAIN	Drainage	SOURCE	DRAINAGE
	SHOWER	ColdWater	SINK	DOMESTICCOLDWATER
	SHOWER	HotWater	SINK	DOMESTICHOTWATER
	SHOWER	Drainage	SOURCE	DRAINAGE
	SINK	ColdWater	SINK	DOMESTICCOLDWATER
	SINK	HotWater	SINK	DOMESTICHOTWATER
	SINK	Drainage	SOURCE	DRAINAGE
	TOILETPAN	ColdWater	SINK	DOMESTICCOLDWATER
	TOILETPAN	Drainage	SOURCE	DRAINAGE

Entity	PredefinedType	Name	Flow	Type
	URINAL	ColdWater	SINK	DOMESTICCOLDWATER
	URINAL	Drainage	SOURCE	DRAINAGE
	WASHHANDBASIN	ColdWater	SINK	DOMESTICCOLDWATER
	WASHHANDBASIN	HotWater	SINK	DOMESTICHOTWATER
	WASHHANDBASIN	Drainage	SOURCE	DRAINAGE
IfcWasteTerminal	FLOORTRAP	Inlet	SINK	DRAINAGE
	FLOORTRAP	Outlet	SOURCE	DRAINAGE
	FLOORWASTE	Inlet	SINK	WASTE
	FLOORWASTE	Outlet	SOURCE	WASTE
	GULLYSUMP	Inlet	SINK	WASTE
	GULLYSUMP	Inlet	SOURCE	WASTE
	GULLYTRAP	Inlet	SINK	WASTE
	GULLYTRAP	Inlet	SOURCE	WASTE
	ROOFDRAIN	Outlet	SOURCE	RAINWATER
	WASTEDISPOSALUNIT	Inlet	SINK	WASTE
	WASTEDISPOSALUNIT	Outlet	SOURCE	WASTE
	WASTETRAP	Inlet	SINK	WASTE
	WASTETRAP	Outlet	SOURCE	WASTE

Body Geometry

Entity	RepresentationType	Geometry
IfcSolarDeviceType	Brep	IfcFacetedBrep
IfcSanitaryTerminalType	Brep	IfcFacetedBrep
IfcWasteTerminalType		

Clearance Geometry

Entity	Type	Geometry
IfcSolarDeviceType	SurfaceModel	IfcFaceBasedSurfaceModel
IfcSanitaryTerminalType	SurfaceModel	IfcFaceBasedSurfaceModel
IfcWasteTerminalType	SurfaceModel	IfcFaceBasedSurfaceModel

Clearance Geometry

Entity	RepresentationType	Geometry
IfcBoiler		
IfcSanitaryTerminal		
IfcWasteTerminal		

Element Connectivity

Entity	Type
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IfcSanitaryTerminal	IfcSlab
	IfcCovering
	IfcSystemFurnitureElement

4.9.6.2.4 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
- Revision Control
- Descriptions
- Project
- Project Declaration
- Project Units
- Conversion Units
- Project Context
- Association
- Classification
- Material
- Material Layer Set Usage
- Material Profile Set
- Material Profile Set Usage
- Material Constituents
- Definition
- Object Typing
- Property Sets
- Properties for Occurrences
- Properties for Types
- Properties for Performance
- Quantity Sets
- Quantity Sets for Occurrences
- Quantities on Occurrences
- Predefined Type
- System furniture element types
- Assignment
- Actor Assignment
- Control Assignment
- Group Assignment
- Product Assignment
- Process Assignment
- Resource Assignment
- Composition
- Aggregation
- Spatial Decomposition
- Voiding
- Nesting
- Ports
- Type-Based Ports
- Connectivity
- Spatial Structure
- Spatial Containment
- Space Boundaries
- Element Connectivity
- Path Connectivity
- Port Requirements
- At least two ports expected
- At least one port
- Ports to be twinned
- Port Connectivity
- Interference
- Actor
- Organization Role
- Control
- Calendar
- Product
- Placement
- Geometry
- Axis Geometry
- Axis 2D Geometry
- Axis 3D Geometry
- Footprint Geometry
- FootPrint GeomSet Geometry
- FootPrint Annotation Geometry
- Surface Geometry
- Surface 3D Geometry
- Body Geometry
- Body SurfaceOrSolidModel Geometry
- Body SurfaceModel Geometry
- Body Tessellation Geometry

- Body SweptSolid Geometry
- Body AdvancedSweptSolid Geometry
- Body Brep Geometry
- Body AdvancedBrep Geometry
- Body CSG Geometry
- Body Clipping Geometry
- Clearance Geometry
- Site Location
- Building Location
- Building Storey Elevation
- Product Type
- Product Type Representation
- Body Geometry
- Clearance Geometry
- Resource
- Resource Cost
- Resource Quantity
- Resource Type
- Resource Cost Rate

4.9.6.2.5 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.

IfcActor

Concept	Facility Criteria	Discipline Specifications	Project Definition	Space Program	Product Program	Design Early	System Layout	Design Schematic	Product Type Template	Product Template	Product Type Selection	System Operation	Design Coordinated
Identity		R											
Properties for Occurrences		O											
Organization Role		R											
Actor Assignment		R											

IfcProject

Concept	Facility Criteria	Discipline Specifications	Project Definition	Space Program	Product Program	Design Early	System Layout	Design Schematic	Product Type Template	Product Template	Product Type Selection	System Operation	Design Coordinated
Identity	R	R	R	R	R	R	R	R	R	R	R	R	R
Revision Control	O	O	O	O	O	O	O	O	O	O	O	O	O
Descriptions	O	O	O	O	O	O	O	O	O	O	O	O	O

Spatial Decomposition			R	R	R	R	R	R	R	O	R	R	R
Conversion Units	O	O	O	O	O	O	O	O	O	O	O	O	O
Project Context						R	R	R	R	O	R	R	R
Project Declaration				O	O	O	O	O	R	O	O	O	O

IfcPerformanceHistory

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity													
Properties for Performance													
Control Assignment													

IfcTask

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R												
Process Assignment	R												

Concept	Design Coordinated	R	R	R
	System Operation	R	R	R
	Product Type Selection	R	R	R
	Product Template			
	Product Type Template			
	Design Schematic	R	R	R
	System Layout			
	Design Early			
	Product Program			
Space Program				
Project Definition				
Discipline				
Facility Criteria				
Concept				

Design Coordinated	R
System Operation	R
Product Type Selection	R
Product Template	
Product Type Template	
Design Schematic	R
System Layout	R
Design Early	R
Product Program	R
Space Program	R
Project Definition	R
Discipline Specifications	R
Facility Criteria	R
Concept	
Identity	
Site Location	
Spatial Decomposition	
Footprint Geometry	

IfcSpace

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R	R	R	R	R	R			
Object Typing	O	O	O			O	O	O	O	O	R			
Classification	R	R	R			R	R	R	R	R				
Properties for Occurrences	O	O	O			O	O	O	O	O				
Quantity Sets	O	O	O			O	O	O	O	O				
Space Boundaries	O	O	O			O	O	O	O	O				
Placement	R	R	R			O	O	O	O	O				
Footprint Geometry	R	R	R			O	O	O	O	O				
Body Geometry	R	R	R			O	O	O	O	O				

IfcMember

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R								
Object Typing	R	R	R			R								
Properties for Occurrences	O	R	O			R								

Material Profile Set									R			R	R	R
Placement									R			R	R	R
Axis Geometry									R			R	R	R
Body Geometry									R			R	R	R

IfcSlab

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline	Facility Criteria	Concept
Identity	R	R	R		R								
Voiding	R	R			R								

IfcSlabElementedCase

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R			R								
Aggregation	O	O			O								
Placement	R	R			R								
Surface Geometry	O	O			O								
Spatial Containment	R	R			R								

IfcSlabStandardCase

Design Coordinated				
System Operation	R	R	R	R
Product Type Selection	R	O	R	O
Product Template			R	R
Product Type Template				
Design Schematic	R	R	R	R
System Layout				
Design Early				
Product Program				
Space Program				
Project Definition				
Discipline Specifications				
Facility Criteria				
Concept				
Identity				
Object Typing				
Material Layer Set Usage				
Body Geometry				

IfcWall

Design Coordinated			
System Operation	R	R	R
Product Type Selection	R		R
Product Template			
Product Type Template			
Design Schematic	R	R	R
System Layout			
Design Early			
Product Program			
Space Program			
Project Definition			
Discipline Specifications			
Facility Criteria			
Concept			
Identity			
Path Connectivity			
Voiding			

IfcWallElementedCase

Design Coordinated	
System Operation	R
Product Type Selection	R
Product Template	
Product Type Template	
Design Schematic	R
System Layout	
Design Early	
Product Program	
Space Program	
Project Definition	
Discipline Specifications	
Facility Criteria	
Concept	
Identity	

Aggregation									O			O	O	O
Placement									R			R	R	R
Axis Geometry									R			R	R	R
Surface Geometry									O			O	O	O
Spatial Containment									R			R	R	R

IfcWallStandardCase

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R		R								
Object Typing	O	R	O		R								
Material Layer Set Usage	R	R	R		R								
Axis Geometry	R	R	R		R								
Body Geometry	R	R	R		R								

IfcDistributionPort

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept

Identity					R	R	R	R	R	R	R	R	R
Properties for Occurrences					O	O	O	O	O	O	O	O	O
Material Profile Set Usage					O	O	R	R	R	R	R	R	R
Port Connectivity					O	O	R	O		R	O	O	O
Placement					O	O	R	O		R	R	R	R
Properties for Types					O	O	R	O	R	R	R	R	R

IfcDistributionSystem

	Concept	Facility Criteria	Discipline Specifications	Project Definition	Space Program	Product Program	Design Early	System Layout	Design Schematic	Product Type Template	Product Template	Product Type Selection	System Operation	Design Coordinated
Identity		R	R											
Properties for Occurrences		R	R											
Aggregation		O	R											
Group Assignment		O	R											

IfcOccupant

	Concept	Facility Criteria	Discipline Specifications	Project Definition	Space Program	Product Program	Design Early	System Layout	Design Schematic	Product Type Template	Product Template	Product Type Selection	System Operation	Design Coordinated
Identity		R												
Actor Assignment		O												
Properties for Occurrences		O												
Organization Role		O												

IfcSystemFurnitureElement

Design Coordinated	R	R	R
System Operation	R	R	R
Product Type Selection	R	R	R
Product Template			
Product Type Template	R	R	R
Design Schematic			
System Layout			
Design Early			
Product Program			
Space Program			
Project Definition			
Discipline Specifications			
Facility Criteria			
Concept			
	Identity	Properties for Types	Classification

Design Coordinated	
System Operation	
Product Type Selection	
Product Template	
Product Type Template	
Design Schematic	
System Layout	
Design Early	
Product Program	
Space Program	
Project Definition	
Discipline Specifications	R
Facility Criteria	
Concept	
	Identity

Concept	Design Coordinated			
	System Operation			
	Product Type Selection			
	Product Template			
	Product Type Template			
	Design Schematic			
	System Layout			
	Design Early			
	Product Program			
	Space Program			
Project Definition				
Discipline Specifications				
Facility Criteria	R	O	R	R

Design Coordinated				
System Operation				
Product Type Selection				
Product Template				
Product Type Template				
Design Schematic				
System Layout				
Design Early				
Product Program				
Space Program				
Project Definition				
Discipline Specifications	R			
Facility Criteria		R		
Concept			R	
	Identity			R
	Object Typing			
	Resource Cost			
	Resource Quantity			
	Resource Assignment			

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Design Coordinated		
System Operation		
Product Type Selection		
Product Template		
Product Type Template		
Design Schematic		
System Layout		
Design Early		
Product Program		
Space Program		
Project Definition		
Discipline Specifications	R	
Facility Criteria		R
Concept		
Identity		
Resource Cost Rate		

IfcElectricAppliance

Design Coordinated									
System Operation	R	R	R						
Product Type Selection	R	R	R						
Product Template									
Product Type Template									
Design Schematic	R	R	R						
System Layout	R	R	R						
Design Early	R	R	R						
Product Program	R	R	R						
Space Program	R	R	R						
Project Definition									
Discipline Specifications									
Facility Criteria									
Concept									
Identity									
Object Typing									
Properties for Occurrences									
Ports									
Body Geometry									

IfcElectricApplianceType

Design Coordinated								
System Operation	R	R	R					
Product Type Selection	R	R	R					
Product Template	R	R	R					
Product Type Template	R	R	R					
Design Schematic								
System Layout								
Design Early								
Product Program								
Space Program								
Project Definition								
Discipline Specifications								
Facility Criteria								
Concept								
Identity								
Properties for Types								
Type-Based Ports								

Classification									R	R	R	R	R
----------------	--	--	--	--	--	--	--	--	---	---	---	---	---

IfcSolarDevice

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R		R		R						
Object Typing	R	R	R		R		R						
Properties for Occurrences	O	O	O		O		R						
Ports	R	R	R		R		R						
Body Geometry	R	R	R		R		R						

IfcSolarDeviceType

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R	R	R								
Properties for Types	R	R	R	R	R								
Type-Based Ports	R	R	R	R	R								
Body Geometry	R	R	R	R	R								
Clearance Geometry	O	R	O	R	R								
Classification	O	R	O	R	R								

IfcBoiler

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R	R	R	R	R				
Object Typing	R	O	R			O	O	R		O				
Properties for Occurrences	R	R	R			R	R	R	R	O				
Quantity Sets	O	R	R			R	R	R	R	O				
Ports	R	R	R			R	R	R	R	R				
Body Geometry	R	R	R			R	R	R	R	R				
Clearance Geometry	O	O	O			O			R	R				

IfcBoilerType

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R	R	R									
Properties for Types	R	R	R	R	R									
Type-Based Ports	R	R	R	R	R									
Classification	R	R	R	R	R									

IfcFilter

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R	R	R	R	R				
Object Typing	R	R	R			R	R	R	R	R				
Properties for Occurrences	R	R	R			R	R	R	R	R				
Ports	R	R	R			R	R	R	R	R				
Spatial Containment	R	R	R			R	R	R	R	R				
Body Geometry	R	R	R			R	R	R	R	R				

IfcFilterType

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R	R	R									
Properties for Types	R	R	R	R	R									
Type-Based Ports	R	R	R	R	R									
Classification	R	R	R	R	R									

IfcFlowMeter

Design Coordinated										
System Operation	R	R	R							
Product Type Selection	R	R	R	O	O	O				
Product Template										
Product Type Template										
Design Schematic	R	R	R	O						
System Layout	R	R	R	R	R	R				
Design Early	R	R	R	R	R	R				
Product Program	R	R	R	R	R	R				
Space Program										
Project Definition										
Discipline Specifications										
Facility Criteria										
Concept										
Identity										
Object Typing										
Properties for Occurrences										
Ports										
Placement										
Body Geometry										
Spatial Containment										

IfcFlowMeterType

Design Coordinated										
System Operation	R	R	R	R	R	R				
Product Type Selection	R	R	R	R	R	R				
Product Template	R	R	R	R	R	R				
Product Type Template	R	R	R	R	R	R				
Design Schematic										
System Layout										
Design Early										
Product Program										
Space Program										
Project Definition										
Discipline Specifications										
Facility Criteria										
Concept										
Identity										
Properties for Types										
Type-Based Ports										
Classification										

IfcPipeFitting

Design Coordinated										
System Operation										
Product Type Selection										
Product Template										
Product Type Template										
Design Schematic										
System Layout										
Design Early										
Product Program										
Space Program										
Project Definition										
Discipline Specifications										
Facility Criteria										
Concept										

Design Coordinated					
System Operation	R	R	R	R	R
Product Type Selection	R	R	R	R	R
Product Template					
Product Type Template					
Design Schematic	R	R	R	R	R
System Layout					
Design Early					
Product Program					
Space Program					
Project Definition					
Discipline Specifications					
Facility Criteria					
Concept					
Identity					
Object Typing					
Properties for Occurrences					
Quantity Sets					
Ports					

IfcPipeFittingType

Design Coordinated					
System Operation	R	R	R	R	R
Product Type Selection	R	R	R	R	R
Product Template	R	R	R	R	R
Product Type Template	R	R	R	R	R
Design Schematic					
System Layout					
Design Early					
Product Program					
Space Program					
Project Definition					
Discipline Specifications					
Facility Criteria					
Concept					
Identity					
Properties for Types					
Classification					

IfcPipeSegment

Design Coordinated					
System Operation	R	R	R	R	R
Product Type Selection	R	R	R	R	R
Product Template					
Product Type Template					
Design Schematic	R	R	R	R	R
System Layout	R	R	R	R	R
Design Early					
Product Program					
Space Program					
Project Definition					
Discipline Specifications					
Facility Criteria					
Concept					
Identity					
Object Typing					
Properties for Occurrences					

Design Coordinated		R		
System Operation		R	R	R
Product Type Selection		R	R	R
Product Template		R	R	R
Product Type Template	R	R	R	R
Design Schematic				
System Layout				
Design Early				
Product Program				
Space Program				
Project Definition				
Discipline Specifications				
Facility Criteria				
Concept				
	Identity			
	Properties for Types			
	Material Profile Set			
	Classification			

Design Coordinated
System Operation
Product Type Selection
Product Template
Product Type Template
Design Schematic
System Layout
Design Early
Product Program
Space Program
Project Definition
Discipline Specifications
Facility Criteria
Concept

Design Coordinated	R
System Operation	R
Product Type Selection	R
Product Template	R
Product Type Template	R
Design Schematic	
System Layout	
Design Early	
Product Program	
Space Program	
Project Definition	
Discipline Specifications	
Facility Criteria	
Concept	
Identity	
Properties for Types	
Type-Based Ports	
Classification	

Design Coordinated
System Operation
Product Type Selection
Product Template
Product Type Template
Design Schematic
System Layout
Design Early
Product Program
Space Program
Project Definition
Discipline Specifications
Facility Criteria
Concept

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R	R	R	R	R				
Object Typing	R	R	R			R	R	R	R	R				
Properties for Occurrences	R	R	R			R	R	R	R	R				
Quantity Sets	O	R	R			R	R	R	R	R				
Material Constituents	O	R	R			R	R	R	R	R				
Connectivity	R	R	R			R	R	R	R	R				
Ports	R	R	R			R	R	R	R	R				
Body Geometry	R	R	R			R	R	R	R	R				

IfcValveType

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R			R	R	R								
Properties for Types	R			R	R	R								
Type-Based Ports	R			R	R	R								
Classification	R			R	R	R								

IfcSanitaryTerminal

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R			R	R	R	R	R		R		
Object Typing	R	R	R			R	R	R	R	R		R		
Properties for Occurrences	R	R	R			R	R	R	R	R		R		
Quantity Sets	O	R	R			R	R	R	R	R		R		
Ports	R	R	R			R	R	R	R	R		R		
Placement	R	R	R			R	O	R		R		R		
Footprint Geometry	R	R	R			R	O	R		R		R		
Body Geometry	R	R	R			R	O	R		R		R		
Clearance Geometry	O	O	O			O	R	O		R		R		
Element Connectivity	O	O	O			O	R	O		R		R		

I fcSanitaryTerminalType

	Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R	R	R									
Properties for Types	R	R	R	R	R									
Type-Based Ports	R	R	R	R	R									
Body Geometry	R	R	R	R	R									
Clearance Geometry	R	R	R	R	R									
Classification	R	R	R	R	R									

I fcWasteTerminal

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R				R	R					
Object Typing	R	R	R				R	R					
Properties for Occurrences	R	R	R				R	R					
Quantity Sets	R	R	R				R	R					
Ports	R	R	R				R	R					
Body Geometry	R	R	R				R	R					
Clearance Geometry	O	O	O				R	R					

IfcWasteTerminalType

Design Coordinated	System Operation	Product Type Selection	Product Template	Product Type Template	Design Schematic	System Layout	Design Early	Product Program	Space Program	Project Definition	Discipline Specifications	Facility Criteria	Concept
Identity	R	R	R	R	R								
Type-Based Ports	R	R	R	R	R								
Body Geometry	R	R	R	R	R								
Clearance Geometry	R	R	R	R	R								
Properties for Types	R	R	R	R	R								
Classification	R	R	R	R	R								

4.9.6.3 Concept definitions

4.9.6.3.1 Concept list

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

- Identity
- Properties for Occurrences
- Organization Role
- Actor Assignment
- Revision Control
- Descriptions
- Spatial Decomposition
- Conversion Units

- Project Context
- Project Declaration
- Properties for Performance
- Control Assignment
- Process Assignment
- Nesting
- Calendar
- Classification
- Product Assignment
- Building Location
- Building Storey Elevation
- Placement
- Body Geometry
- Site Location
- Footprint Geometry
- Object Typing
- Quantity Sets
- Space Boundaries
- Material Profile Set
- Axis Geometry
- Voiding
- Aggregation
- Surface Geometry
- Spatial Containment
- Material Layer Set Usage
- Path Connectivity
- Material Profile Set Usage
- Port Connectivity
- Properties for Types
- Group Assignment
- Material Constituents
- System furniture element types
- Resource Cost
- Resource Quantity
- Resource Assignment
- Resource Cost Rate
- Ports
- Type-Based Ports
- Body Geometry
- Clearance Geometry
- Clearance Geometry
- Interference
- Connectivity
- Element Connectivity

4.9.6.3.2 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
Properties for Occurrences	X	X	X	X		X	X
Organization Role						X	X
Actor Assignment	X		X			X	X

Concept	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
Revision Control	X	X		X	X	X	X
Descriptions			X		X	X	X
Spatial Decomposition	X		X	X	X	X	X
Conversion Units	X	X		X	X	X	X
Project Context	X				X	X	X
Project Declaration	X	X	X	X	X	X	X
Properties for Performance	X			X		X	X
Control Assignment	X	X	X	X		X	X
Process Assignment	X					X	X
Nesting	X			X		X	X
Calendar			X			X	X
Classification	X	X	X	X	X	X	X
Product Assignment	X			X			X
Building Location						X	X
Building Storey Elevation							X
Placement	X					X	X
Body Geometry	X					X	X
Site Location						X	X
Footprint Geometry	X					X	X
Object Typing	X	X	X	X	X	X	X
Quantity Sets	X		X				X
Space Boundaries	X						X
Material Profile Set	X					X	X
Axis Geometry	X					X	X
Voiding	X						X
Aggregation	X			X	X	X	X

Concept	Common Use Definitions	Facilities Management Handover	Building Programming	Building Automation	Mechanical System Design	Electrical System Design	Plumbing System Design
Surface Geometry	X					X	X
Spatial Containment	X	X		X		X	X
Material Layer Set Usage	X						X
Path Connectivity	X						X
Material Profile Set Usage	X					X	X
Port Connectivity	X			X		X	X
Properties for Types		X	X	X		X	X
Group Assignment	X	X		X		X	X
Material Constituents	X						X
System furniture element types							X
Resource Cost	X					X	X
Resource Quantity	X					X	X
Resource Assignment	X					X	X
Resource Cost Rate						X	X
Ports	X			X		X	X
Type-Based Ports						X	X
Body Geometry	X						X
Clearance Geometry	X						X
Clearance Geometry	X					X	X
Interference						X	X
Connectivity	X						X
Element Connectivity	X						X

4.9.6.3.4 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		
\IfcRoot.Name		
\IfcRoot.Name\IfcLabel		
\IfcRoot.Description		
\IfcRoot.Description\IfcText		

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		

Organization Role

Reference	Cardinality	Parameter
\IfcActor.TheActor		
\IfcActor.TheActor\IfcOrganization		
\IfcActor.TheActor\IfcOrganization.Identification		
\IfcActor.TheActor\IfcOrganization.Identification\IfcIdentifier		
\IfcActor.TheActor\IfcOrganization.Name		
\IfcActor.TheActor\IfcOrganization.Name\IfcLabel		
\IfcActor.TheActor\IfcOrganization.Roles		
\IfcActor.TheActor\IfcOrganization.Roles\IfcActorRole		
\IfcActor.TheActor\IfcOrganization.Roles\IfcActorRole.Role		Role
\IfcActor.TheActor\IfcOrganization.Roles\IfcActorRole.UserDefinedRole		UserDefinedRole

\IfcActor.TheActor\IfcOrganization.Addresses		
\IfcActor.TheActor\IfcOrganization.Addresses\IfcTelecomAddress		
\IfcActor.TheActor\IfcOrganization.Addresses\IfcTelecomAddress.ElectronicMailAddresses		
\IfcActor.TheActor\IfcOrganization.Addresses\IfcTelecomAddress.ElectronicMailAddresses\IfcLabel		

Actor Assignment

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

Revision Control

Reference	Cardinality	Parameter
\IfcRoot.OwnerHistory		
\IfcRoot.OwnerHistory\IfcOwnerHistory		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser\IfcPersonAndOrganization		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser\IfcPersonAndOrganization.ThePerson		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser\IfcPersonAndOrganization.ThePerson\IfcPerson		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser\IfcPersonAndOrganization.TheOrganization		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningUser\IfcPersonAndOrganization.TheOrganization\IfcOrganization		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningApplication		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningApplication\IfcApplication		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningApplication\IfcApplication.ApplicationDeveloper		
\IfcRoot.OwnerHistory\IfcOwnerHistory.OwningApplication\IfcApplication.ApplicationDeveloper\IfcOrganization		
\IfcRoot.OwnerHistory\IfcOwnerHistory.State		
\IfcRoot.OwnerHistory\IfcOwnerHistory.State\IfcStateEnum		
\IfcRoot.OwnerHistory\IfcOwnerHistory.ChangeAction		
\IfcRoot.OwnerHistory\IfcOwnerHistory.ChangeAction\IfcChangeActionEnum		
\IfcRoot.OwnerHistory\IfcOwnerHistory.CreationDate		
\IfcRoot.OwnerHistory\IfcOwnerHistory.CreationDate\IfcTimeStamp		

Descriptions

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

Spatial Decomposition

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

Conversion Units

Reference	Cardinality	Parameter
\IfcContext.UnitsInContext		
\IfcContext.UnitsInContext\IfcUnitAssignment		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.UnitType		UnitType
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.UnitType\IfcUnitEnum		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.Name		Name
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.Name\IfcLabel		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.ValueComponent		ConversionType
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.ValueComponent\IfcReal		ConversionFactor
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent\IfcSIUnit		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent\IfcSIUnit.Prefix		BaseUnitPrefix
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent\IfcSIUnit.Prefix\IfcSIPrefix		
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent\IfcSIUnit.Name		BaseUnitName
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionFactor\IfcMeasureWithUnit.UnitComponent\IfcSIUnit.Name\IfcSIUnitName		

Reference	Cardinality	Parameter
\IfcContext.UnitsInContext\IfcUnitAssignment.Units\IfcConversionBasedUnitWithOffset.ConversionOffset		ConversionOffset

Project Context

Reference	Cardinality	Parameter
\IfcContext.RepresentationContexts		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.ContextIdentifier		ContextIdentifier
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.ContextIdentifier\IfcLabel		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.ContextType		ContextType
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.ContextType\IfcLabel		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.CoordinateSpaceDimension		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.CoordinateSpaceDimension\IfcDimensionCount		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.WorldCoordinateSystem		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.WorldCoordinateSystem\IfcAxis2Placement3D		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.TrueNorth		
\IfcContext.RepresentationContexts\IfcGeometricRepresentationContext.TrueNorth\IfcDirection		

Project Declaration

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

Properties for Performance

Reference	Cardinality	Parameter
\IfcPerformanceHistory.IsDefinedBy		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue		

\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values\IfcIrregularTimeSeriesValue		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values\IfcIrregularTimeSeriesValue.TimeStamp		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values\IfcIrregularTimeSeriesValue.TimeStamp\IfcDateTime		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values\IfcIrregularTimeSeriesValue.ListValues		
\IfcPerformanceHistory.IsDefinedBy\IfcRelDefinesByProperties.RelatingPropertyDefinition\IfcPropertySet.HasProperties\IfcPropertyReferenceValue.PropertyReference\IfcIrregularTimeSeries.Values\IfcIrregularTimeSeriesValue.ListValues\IfcValue		

Control Assignment

Reference	Cardinality	Parameter
\IfcControl.Controls		
\IfcControl.Controls\IfcRelAssignsToControl		
\IfcControl.Controls\IfcRelAssignsToControl.RelatedObjects		Type
\IfcControl.Controls\IfcRelAssignsToControl.RelatedObjects\IfcObject		

Process Assignment

Reference	Cardinality	Parameter
\IfcProcess.OperatesOn		
\IfcProcess.OperatesOn\IfcRelAssignsToProcess		
\IfcProcess.OperatesOn\IfcRelAssignsToProcess.RelatedObjects		Type
\IfcProcess.OperatesOn\IfcRelAssignsToProcess.RelatedObjects\IfcResource		

Nesting

Reference	Cardinality	Parameter
\IfcObjectDefinition.IsNestedBy		
\IfcObjectDefinition.IsNestedBy\IfcRelNests		
\IfcObjectDefinition.IsNestedBy\IfcRelNests.RelatedObjects		Type
\IfcObjectDefinition.IsNestedBy\IfcRelNests.RelatedObjects\IfcObject		

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		

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

Reference	Cardinality	Parameter
\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		

Product Assignment

Reference	Cardinality	Parameter
\IfcProduct.ReferencedBy		
\IfcProduct.ReferencedBy\IfcRelAssignsToProduct		
\IfcProduct.ReferencedBy\IfcRelAssignsToProduct.RelatedObjects		Type
\IfcProduct.ReferencedBy\IfcRelAssignsToProduct.RelatedObjects\IfcObject		

Building Location

Reference	Cardinality	Parameter
\IfcBuilding.ElevationOfRefHeight		
\IfcBuilding.ElevationOfRefHeight\IfcLengthMeasure		
\IfcBuilding.ElevationOfTerrain		
\IfcBuilding.ElevationOfTerrain\IfcLengthMeasure		
\IfcBuilding.BuildingAddress		
\IfcBuilding.BuildingAddress\IfcPostalAddress		
\IfcBuilding.BuildingAddress\IfcPostalAddress.AddressLines		
\IfcBuilding.BuildingAddress\IfcPostalAddress.AddressLines\IfcLabel		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Town		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Town\IfcLabel		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Region		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Region\IfcLabel		
\IfcBuilding.BuildingAddress\IfcPostalAddress.PostalCode		
\IfcBuilding.BuildingAddress\IfcPostalAddress.PostalCode\IfcLabel		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Country		
\IfcBuilding.BuildingAddress\IfcPostalAddress.Country\IfcLabel		

Building Storey Elevation

Reference	Cardinality	Parameter
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\IfcBuildingStorey.Elevation		
\IfcBuildingStorey.Elevation\IfcLengthMeasure		

Placement

Reference	Cardinality	Parameter
\IfcProduct.ObjectPlacement	[0:1]	Type
\IfcProduct.ObjectPlacement\IfcLocalPlacement		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint.Dim		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint.Dim\IfcDimensionCount		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint.Dim\IfcDimensionCount.Value=3		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection.Dim		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection.Dim\IfcDimensionCount		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection.Dim\IfcDimensionCount.Value=3		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection.Dim		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection.Dim\IfcDimensionCount		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection.Dim\IfcDimensionCount.Value=3		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.PlacementRelTo		
\IfcProduct.ObjectPlacement\IfcLocalPlacement.PlacementRelTo\IfcLocalPlacement		

Body 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		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Body		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		RepresentationType
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Geometry
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcSolidModel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcSolidModel.StyledByItem	[0:1]	
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcSolidModel.StyledByItem\IfcStyledItem		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcSolidModel.StyledByItem\IfcStyledItem.Styles		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcSolidModel.StyledByItem\IfcStyledItem.Styles\IfcSurfaceStyle		

Site Location

Reference	Cardinality	Parameter
\IfcSite.RefLatitude		
\IfcSite.RefLatitude\IfcCompoundPlaneAngleMeasure		
\IfcSite.RefLongitude		
\IfcSite.RefLongitude\IfcCompoundPlaneAngleMeasure		
\IfcSite.RefElevation		
\IfcSite.RefElevation\IfcLengthMeasure		
\IfcSite.LandTitleNumber		
\IfcSite.LandTitleNumber\IfcLabel		
\IfcSite.SiteAddress		
\IfcSite.SiteAddress\IfcPostalAddress		
\IfcSite.SiteAddress\IfcPostalAddress.AddressLines		
\IfcSite.SiteAddress\IfcPostalAddress.AddressLines\IfcLabel		

Reference	Cardinality	Parameter
\IfcSite.SiteAddress\IfcPostalAddress.Town		
\IfcSite.SiteAddress\IfcPostalAddress.Town\IfcLabel		
\IfcSite.SiteAddress\IfcPostalAddress.Region		
\IfcSite.SiteAddress\IfcPostalAddress.Region\IfcLabel		
\IfcSite.SiteAddress\IfcPostalAddress.Country		
\IfcSite.SiteAddress\IfcPostalAddress.Country\IfcLabel		
\IfcSite.SiteAddress\IfcPostalAddress.PostalCode		
\IfcSite.SiteAddress\IfcPostalAddress.PostalCode\IfcLabel		

Footprint Geometry

Reference	Cardinality	Parameter
\IfcProduct.Representation		
\IfcProduct.Representation\IfcProductDefinitionShape		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Footprint		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		RepresentationType
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel.Value=GeometricCurveSet		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Geometry
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements\IfcBoundedCurve		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements\IfcBoundedCurve.StyledByItem	[0:1]	
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements\IfcBoundedCurve.StyledByItem\IfcStyledItem		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements\IfcBoundedCurve.StyledByItem\IfcStyledItem.Styles		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.Elements\IfcBoundedCurve.StyledByItem\IfcStyledItem.Styles\If		

Reference	Cardinality	Parameter
cCurveStyle		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.StyledByItem	[0:1]	
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.StyledByItem\IfcStyledItem		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.StyledByItem\IfcStyledItem.Styles		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcGeometricCurveSet.StyledByItem\IfcStyledItem.Styles\IfcFillAreaStyle		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems\IfcGeometricRepresentationContext		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.LayerAssignments		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.LayerAssignments\IfcPresentationLayerAssignment		

Object Typing

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

Quantity Sets

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

Space Boundaries

Reference	Cardinality	Parameter
\IfcSpace.BoundedBy		
\IfcSpace.BoundedBy\IfcRelSpaceBoundary		
\IfcSpace.BoundedBy\IfcRelSpaceBoundary.RelatedBuildingElement		RelatedBuildingElement
\IfcSpace.BoundedBy\IfcRelSpaceBoundary.RelatedBuildingElement\IfcElement		

Material Profile Set

Reference	Cardinality	Parameter
\IfcElementType.HasAssociations		

Reference	Cardinality	Parameter
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material	[0: 1]	
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem.Styles		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem.Styles\IfcPresentationStyle		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasProperties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasProperties\IfcMaterialProperties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasProperties\IfcMaterialProperties.Properties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial.HasProperties\IfcMaterialProperties.Properties\IfcProperty		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile	[1: 1]	
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef		

Reference	Cardinality	Parameter
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef.HasProperties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef.HasProperties\IfcProfileProperties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef.HasProperties\IfcProfileProperties.Properties		
\IfcElementType.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef.HasProperties\IfcProfileProperties.Properties\IfcProperty		

Axis 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		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Axis		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		RepresentationType
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel.Value=Curve3D		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Geometry
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedCurve		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedCurve.StyledByItem	[0: 1]	
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedCurve.StyledByItem\IfcStyledItem		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedCurve.StyledByItem\IfcStyledItem.Styles		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedCurve.StyledByItem\IfcStyledItem.Styles\IfcCurveStyle		

Voiding

Reference	Cardinality	Parameter
\IfcElement.HasOpenings		
\IfcElement.HasOpenings\IfcRelVoidsElement		
\IfcElement.HasOpenings\IfcRelVoidsElement.RelatedOpening		RelatedOpening
\IfcElement.HasOpenings\IfcRelVoidsElement.RelatedOpening\IfcVoidingFeature		

Aggregation

Reference	Cardinality	Parameter
\IfcObjectDefinition.PredefinedType		PredefinedType
\IfcObjectDefinition.IsDecomposedBy		
\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates		
\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates.RelatedObjects		RelatedObjects
\IfcObjectDefinition.IsDecomposedBy\IfcRelAggregates.RelatedObjects\IfcObject		

Surface 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		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Surface		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		RepresentationType
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel.Value=Surface3D		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Geometry
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedSurface		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedSurface.StyledByItem	[0:1]	
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		

Reference	Cardinality	Parameter
ion.Items\IfcBoundedSurface.StyledByItem\IfcStyledItem		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedSurface.StyledByItem\IfcStyledItem.Styles		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedSurface.StyledByItem\IfcStyledItem.Styles\IfcSurfaceStyle		

Spatial Containment

Reference	Cardinality	Parameter
\IfcElement.ContainedInStructure		
\IfcElement.ContainedInStructure\IfcRelContainedInSpatialStructure		
\IfcElement.ContainedInStructure\IfcRelContainedInSpatialStructure.RelatingStructure		Structure
\IfcElement.ContainedInStructure\IfcRelContainedInSpatialStructure.RelatingStructure\IfcSpatialStructureElement		

Material Layer Set Usage

Reference	Cardinality	Parameter
\IfcProduct.HasAssociations		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer.Name		Name
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer.Material		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer.Material\IfcMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer.LayerThickness		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialLayerSetUsage.ForLayerSet\IfcMaterialLayerSet.MaterialLayers\IfcMaterialLayer.LayerThickness\IfcNonNegativeLengthMeasure		

Path Connectivity

Reference	Cardinality	Parameter
\IfcElement.ConnectedFrom		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements		

Reference	Cardinality	Parameter
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.RelatedElement		RelatedElement
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.RelatedElement\IfcElement		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry\IfcConnectionCurveGeometry		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry\IfcConnectionCurveGeometry.CurveOnRelatingElement		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry\IfcConnectionCurveGeometry.CurveOnRelatingElement\IfcPolyline		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry\IfcConnectionCurveGeometry.CurveOnRelatedElement		
\IfcElement.ConnectedFrom\IfcRelConnectsPathElements.ConnectionGeometry\IfcConnectionCurveGeometry.CurveOnRelatedElement\IfcPolyline		

Material Profile Set Usage

Reference	Cardinality	Parameter
\IfcProduct.HasAssociations		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Name		Name
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef		

Port Connectivity

	Cardinality	Parameter
\IfcDistributionPort.ConnectedTo		
\IfcDistributionPort.ConnectedTo\IfcRelConnectsPorts		
\IfcDistributionPort.ConnectedTo\IfcRelConnectsPorts.RelatedPort		
\IfcDistributionPort.ConnectedTo\IfcRelConnectsPorts.RelatedPort\IfcDistributionPort		
\IfcDistributionPort.ConnectedTo\IfcRelConnectsPorts.RealizingElement		
\IfcDistributionPort.ConnectedTo\IfcRelConnectsPorts.RealizingElement\IfcFlowSegment		

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		

Group Assignment

Reference	Cardinality	Parameter
\IfcGroup.IsGroupedBy		
\IfcGroup.IsGroupedBy\IfcRelAssignsToGroup		
\IfcGroup.IsGroupedBy\IfcRelAssignsToGroup.RelatedObjects		Type
\IfcGroup.IsGroupedBy\IfcRelAssignsToGroup.RelatedObjects\IfcProduct		

Material Constituents

Reference	Cardinality	Parameter
\IfcProduct.HasAssociations		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Name		Name
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Name\IfcLabel		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material		

Reference	Cardinality	Parameter
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasProperties		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasProperties\IfcMaterialProperties		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasProperties\IfcMaterialProperties.Properties		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasProperties\IfcMaterialProperties.Properties\IfcProperty		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem.Styles		
\IfcProduct.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialConstituentSet.MaterialConstituents\IfcMaterialConstituent.Material\IfcMaterial.HasRepresentation\IfcMaterialDefinitionRepresentation.Representations\IfcStyledRepresentation.Items\IfcStyledItem.Styles\IfcPresentationStyle		
\IfcProduct.Representation		
\IfcProduct.Representation\IfcProductDefinitionShape		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.Name		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.Name\IfcLabel		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.ShapeRepresentations		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.ShapeRepresentations\IfcShapeRepresentation		

Reference	Cardinality	Parameter
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.ShapeRepresentations\IfcShapeRepresentation.Items		
\IfcProduct.Representation\IfcProductDefinitionShape.HasShapeAspects\IfcShapeAspect.ShapeRepresentations\IfcShapeRepresentation.Items\IfcRepresentationItem		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		
\IfcProduct.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcRepresentationItem		

System furniture element types

Reference	Cardinality	Parameter
\IfcSystemFurnitureElement.PredefinedType		
\IfcSystemFurnitureElement.PredefinedType\IfcSystemFurnitureElementTypeEnum		

Resource Cost

Reference	Cardinality	Parameter
\IfcConstructionResource.BaseCosts		CostType
\IfcConstructionResource.BaseCosts\IfcAppliedValue		
\IfcConstructionResource.BaseCosts\IfcAppliedValue.Name		CostName
\IfcConstructionResource.BaseCosts\IfcAppliedValue.Name\IfcLabel		
\IfcConstructionResource.BaseCosts\IfcAppliedValue.AppliedValue		ValueType

Resource Quantity

Reference	Cardinality	Parameter
\IfcConstructionResource.BaseQuantity		QuantityType
\IfcConstructionResource.BaseQuantity\IfcPhysicalSimpleQuantity		
\IfcConstructionResource.BaseQuantity\IfcPhysicalSimpleQuantity.Name		QuantityName
\IfcConstructionResource.BaseQuantity\IfcPhysicalSimpleQuantity.Name\IfcLabel		

Resource Assignment

Reference	Cardinality	Parameter
\IfcResource.ResourceOf		
\IfcResource.ResourceOf\IfcRelAssignsToResource		
\IfcResource.ResourceOf\IfcRelAssignsToResource.RelatedObjects		Type
\IfcResource.ResourceOf\IfcRelAssignsToResource.RelatedObjects\IfcActor		
\IfcResource.ResourceOf\IfcRelAssignsToResource.RelatedObjects\IfcProduct		

Resource Cost Rate

Reference	Cardinality	Parameter
\IfcConstructionResourceType.BaseCosts		
\IfcConstructionResourceType.BaseCosts\IfcCostValue		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.AppliedValue		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.AppliedValue\IfcMonetaryMeasure		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis\IfcMeasureWithUnit		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis\IfcMeasureWithUnit.ValueComponent		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis\IfcMeasureWithUnit.ValueComponent\IfcValue		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis\IfcMeasureWithUnit.UnitComponent		
\IfcConstructionResourceType.BaseCosts\IfcCostValue.UnitBasis\IfcMeasureWithUnit.UnitComponent\IfcUnit		

Ports

Reference	Cardinality	Parameter
\IfcDistributionElement.PredefinedType		PredefinedType
\IfcDistributionElement.IsNestedBy		
\IfcDistributionElement.IsNestedBy\IfcRelNests		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.Name		Name
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.Name\IfcLabel		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.FlowDirection		Flow
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.FlowDirection\IfcFlowDirectionEnum		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.PredefinedType		Type
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.PredefinedType\IfcDistributionSystemEnum		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location		

Reference	Cardinality	Parameter
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile		
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\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Material\IfcMaterial		
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\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.HasAssociations\IfcRelAssociatesMaterial.RelatingMaterial\IfcMaterialProfileSetUsage.ForProfileSet\IfcMaterialProfileSet.MaterialProfiles\IfcMaterialProfile.Profile\IfcProfileDef		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement		

Reference	Cardinality	Parameter
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.Name		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.Name\IfcLabel		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.FlowDirection		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.FlowDirection\IfcFlowDirectionEnum		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.PredefinedType		
\IfcDistributionElement.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.IsDeclaredBy\IfcRelDefinesByObject.RelatingObject\IfcDistributionPort.PredefinedType\IfcDistributionSystemEnum		

Type-Based Ports

Reference	Cardinality	Parameter
\IfcDistributionElementType.IsNestedBy		
\IfcDistributionElementType.IsNestedBy\IfcRelNests		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.Name		

Reference	Cardinality	Parameter
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.Name\IfcLabel		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.FlowDirection		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.FlowDirection\IfcFlowDirectionEnum		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.PredefinedType		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.PredefinedType\IfcDistributionSystemEnum		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Location\IfcCartesianPoint		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.Axis\IfcDirection		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection		
\IfcDistributionElementType.IsNestedBy\IfcRelNests.RelatedObjects\IfcDistributionPort.ObjectPlacement\IfcLocalPlacement.RelativePlacement\IfcAxis2Placement3D.RefDirection\IfcDirection		

Body Geometry

Reference	Cardinality	Parameter
\IfcTypeProduct.RepresentationMaps		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Body		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationType		RepresentationType

\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.Items		Geometry
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.Items\IfcGeometricRepresentationItem		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappingOrigin		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappingOrigin\IfcAxis2Placement3D		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappingOrigin\IfcAxis2Placement3D.Location		
\IfcTypeProduct.RepresentationMaps\IfcRepresentationMap.MappingOrigin\IfcAxis2Placement3D.Location\IfcCartesianPoint		

Clearance Geometry

Reference	Cardinality	Parameter
\IfcDistributionElementType.RepresentationMaps		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.ContextOfItems		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.ContextOfItems\IfcGeometricRepresentationContext		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Clearance		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationType		Type
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.Items		Geometry
\IfcDistributionElementType.RepresentationMaps\IfcRepresentationMap.MappedRepresentation\IfcShapeRepresentation.Items\IfcSurface		

Clearance Geometry

Reference	Cardinality	Parameter
\IfcElement.Representation		
\IfcElement.Representation\IfcProductDefinitionShape		
\IfcElement.Representation\IfcProductDefinitionShape.Representations		

Reference	Cardinality	Parameter
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.ContextOfItems\IfcGeometricRepresentationContext		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationIdentifier\IfcLabel.Value=Clearance		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType		RepresentationType
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.RepresentationType\IfcLabel		
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items		Geometry
\IfcElement.Representation\IfcProductDefinitionShape.Representations\IfcShapeRepresentation.Items\IfcBoundedSurface		

Interference

Reference	Cardinality	Parameter
\IfcElement.InterferesElements		
\IfcElement.InterferesElements\IfcRelInterferesElements		
\IfcElement.InterferesElements\IfcRelInterferesElements.RelatingElement		
\IfcElement.InterferesElements\IfcRelInterferesElements.RelatingElement\IfcElement		

Connectivity

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

Element Connectivity

Reference	Cardinality	Parameter
\IfcElement.ConnectedFrom		
\IfcElement.ConnectedFrom\IfcRelConnectsElements		
\IfcElement.ConnectedFrom\IfcRelConnectsElements.RelatedElement		Type
\IfcElement.ConnectedFrom\IfcRelConnectsElements.RelatedElement\IfcElement		

4.9.6.3.5 Concept business rule description

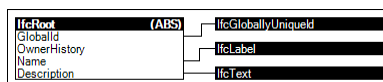
Each concept template is described in a subsection as follows, with diagrams indicating usage of attributes and entities reflecting defined business rules.

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.

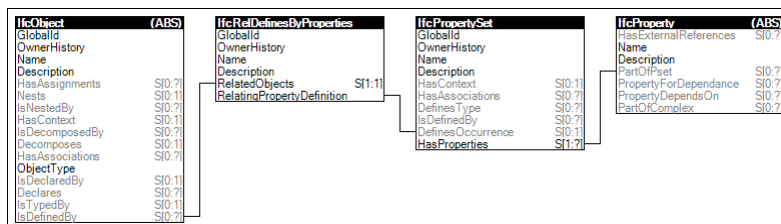
Various objects may have additional identifications that may be human-readable and/or may be structured through classification association.

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.



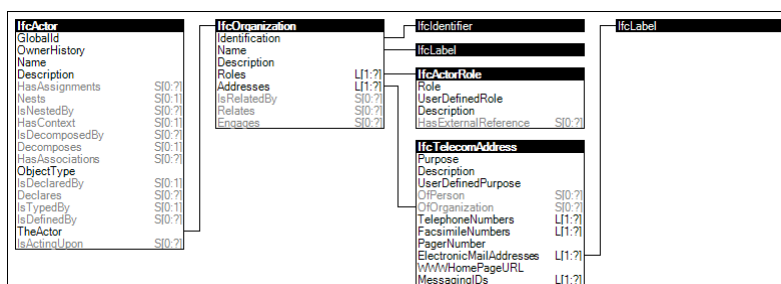
Properties for Occurrences

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.



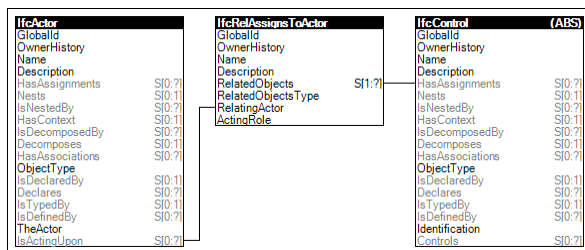
Organization Role

Contact information indicates roles and addresses of people and organizations.



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.



Revision Control

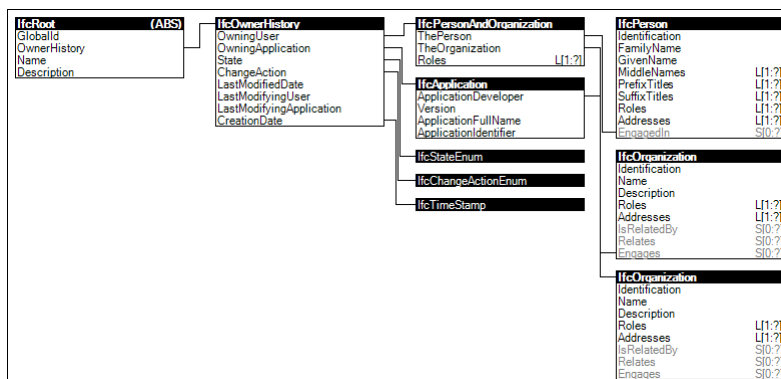
While objects may reflect a final state, they may also be continually revised over the course of a project lifecycle and reflect transient state. For scenarios of multiple users making updates to the same information, there is a concept of local copies of information based upon a shared repository supporting multiple users. Such shared repository is often referred to as a *model server*. A model server is similar in concept to a document revision server, but is able to identify changes declared on a per-object basis rather than inferring changes from differences in text. A model server has a concept of revisions on a per-project basis, where each revision consists of a set of changes to contained objects by a particular user at a particular time.

To support a model server scenario, each object may be marked with a *change action* indicating the object was added, modified, deleted, or has no change since the project was retrieved from the server at a particular revision sequence. Given an object's identity (IFC-GUID) and change action, the state of the object may be merged when submitted to a model server. An object is considered modified when any of its *direct attributes* change, attributes on a referenced resource definition (any entity not deriving from *IfcRoot*) change, items are added or removed from sets, or items are added, removed, or reordered within lists.

For cases when multiple users make conflicting changes to the same objects, users may choose to keep their own changes, accept changes from others, merge both changes, or a combination thereof upon submitting to a server. Alternatively, to avoid such merge scenario and coordinate work, objects may be locked such that a particular user has exclusive access to read and/or write a particular object at the current time.

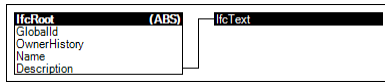
Project libraries may also be retrieved from model servers having particular revision, and potentially different server URI than the referencing Project. As a project may include multiple revisions of the same project library (a common scenario when multiple users are involved using libraries revised by others), the `lfcRoot.ObjectIdentifier` IFC-GUID is only valid within the scope of the referencing project, and a separate *library reference* identifies a project library based object within its originating model server.

Finally, objects may also carry informational attributes indicating when an object was created, who, when, and what application was used to last modify an object, and who currently owns the object, potentially having exclusive use according to its lock state.



Descriptions

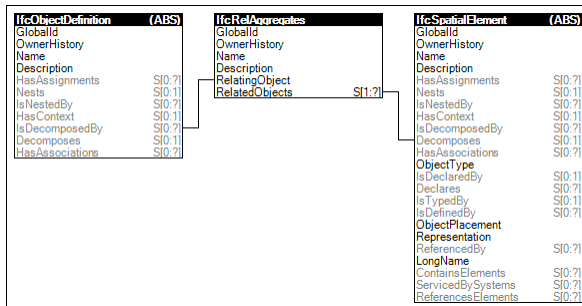
Objects may have descriptions included to aid in human identification of the object.



Spatial Decomposition

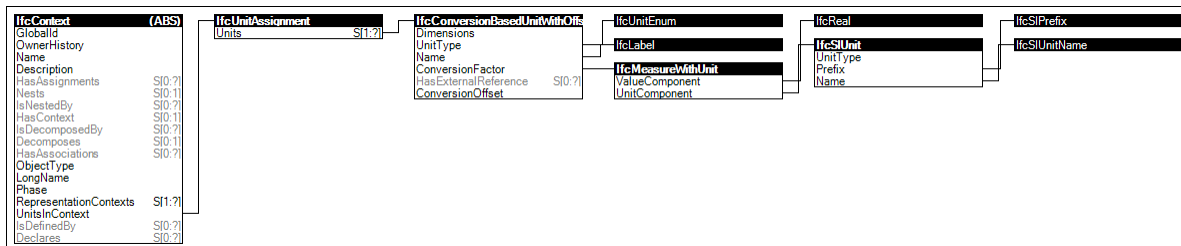
Provision of a spatial structure of the project by aggregating spatial structure elements. The spatial structure is a hierarchical tree of spatial structure elements (site, building, storey, space) ultimately assigned to the project. Decomposition refers to the relationship to lower level elements (e.g.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



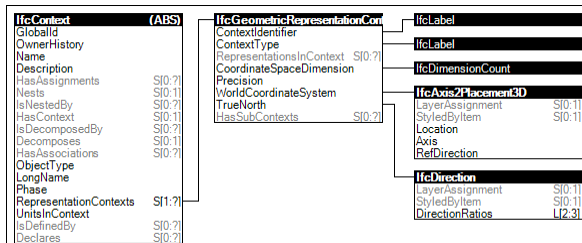
Conversion Units

Conversion units are defined according to a conversion factor (and conversion offset for temperature) relative to a specified base SI unit.



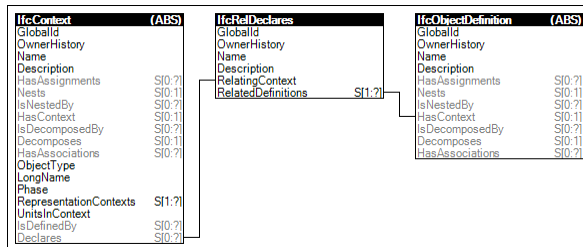
Project Context

A project representation context indicates the coordinate system orientation, direction of true north, precision, and other values that apply to all geometry within a project or project library.



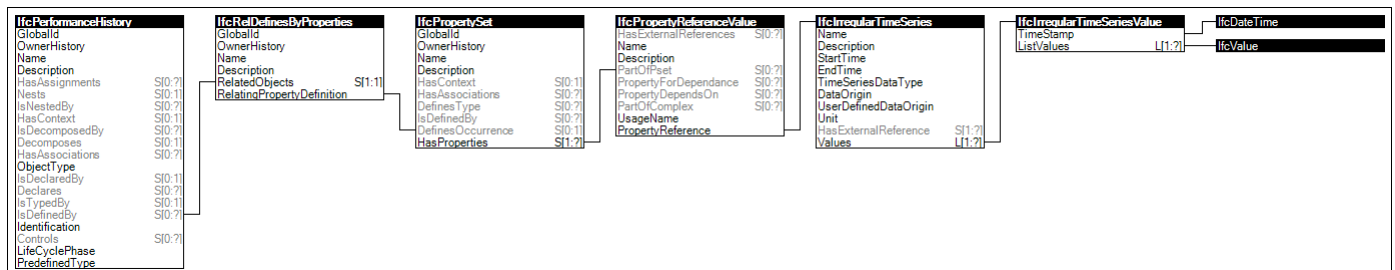
Project Declaration

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



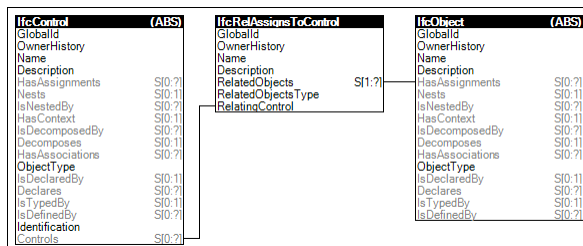
Properties for Performance

For performance history, properties are in the form of time series, for tracking data at points in time.



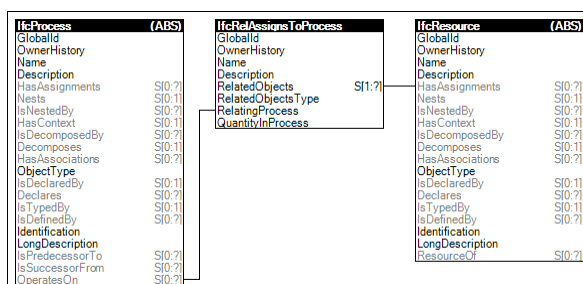
Control Assignment

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.



Process Assignment

Processes may have assignments indicating resources consumed or occupied by the process. An example of such assignment is a carpenter labor resource building a wall.



Nesting

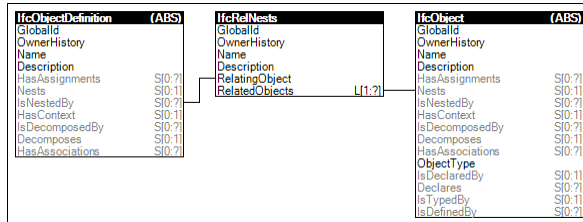
Nesting indicates an ordered arrangement relationship.

Nesting is used on building elements to indicate features placed in sequence such as ports.

Nesting is used on control objects to indicate specification hierarchies.

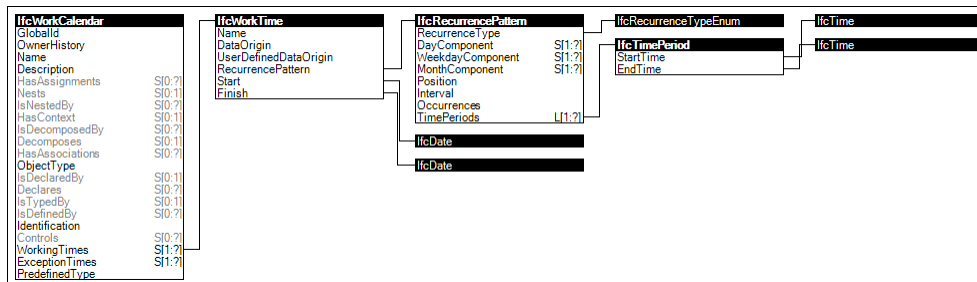
Nesting is used on process objects to indicate subordinate task details.

Nesting is used on resource objects to indicate subordinate resource allocations.



Calendar

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

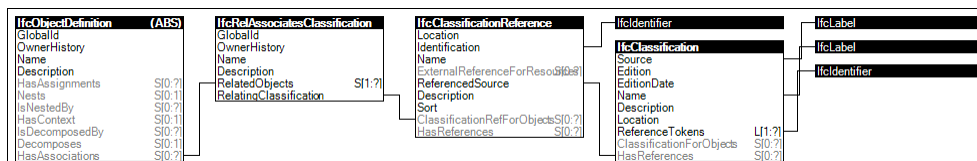


Classification

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:

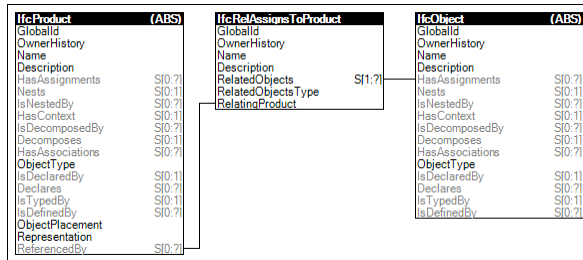
- a classification system;
- a dictionary server;
- any external catalogue that classifies the object further;
- a service that combine the above features.

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.



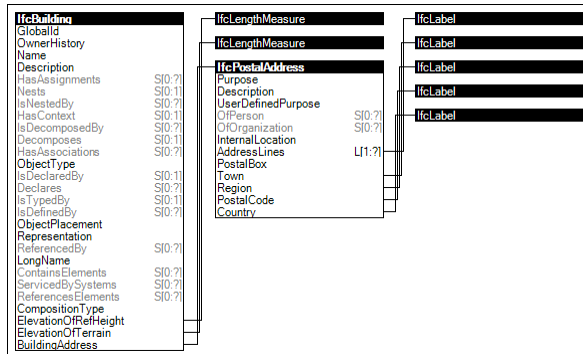
Product Assignment

Products may have assignments indicating processes that operate upon the product. An example of such assignment is a task to construct a wall.

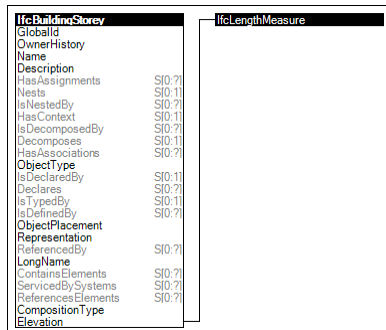


Building Location

The building location may indicate the address as found on a map.



Building Storey Elevation



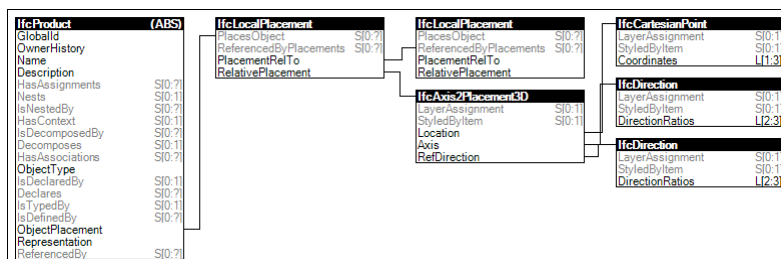
Placement

Product occurrences can be placed in 3D space relative to where they are contained. Placement is defined by a relative position (X, Y, Z coordinates), a horizontal reference direction, and a vertical axis direction. At the outermost level, relative directions are defined according to representation context; for example, +X may point east, +Y may point north, and +Z may point up.

Placement follows aggregation and containment relationships as follows:

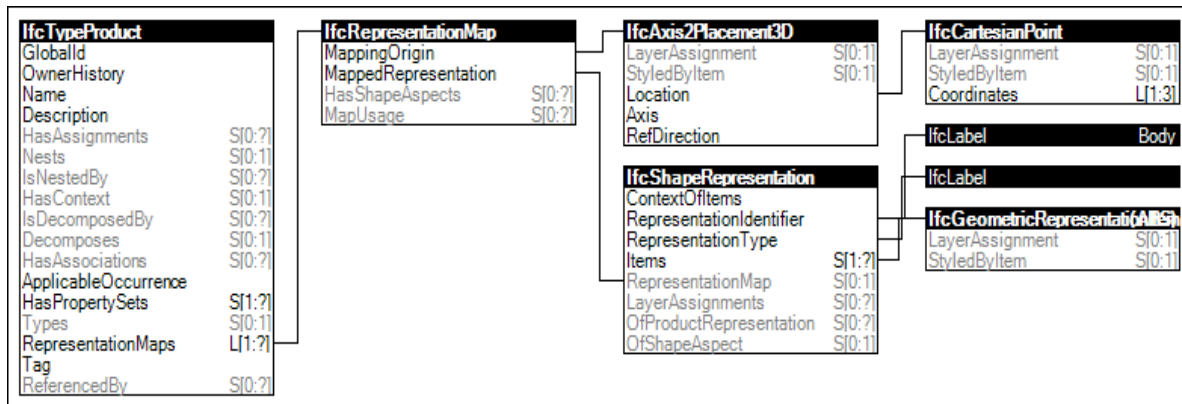
- at the outermost level, a site is globally positioned according to latitude, longitude, and elevation;
- for spatial structures, positioning is relative to aggregation. For example, a site may aggregate multiple buildings, each building may aggregate multiple building storeys, and each building storey may aggregate multiple spaces;
- for building elements, positioning is relative to the containing spatial structure. For example, a building storey may contain slabs, walls, columns, and beams;
- for aggregated parts, positioning is relative to aggregation. For example, a staircase may aggregate one or more stair flights;
- for feature elements, positioning is relative to the affected building element. For example, an opening element is positioned relative to the wall it voids, which in turn is positioned relative to a building storey;
- for fillings, positioning is relative to the filled opening. For example, a door is positioned relative to an opening which in turn is positioned relative to a wall;
- for distribution ports, positioning is relative to the containing distribution element. For example, an air terminal may have a port connection for a duct segment or fitting;
- for distribution elements, positioning is relative to the containing spatial structure, however may be constrained by port connections. For example, a electrical junction box may fill an opening within a wall, and the junction box may contain ports for contained outlets or switches; the placement of such connected elements is contained relative to connected port of the junction box. As another example, an air terminal may fill a ceiling covering which is placed relative to a space; the placement of a connecting duct fitting may be constrained relative to the air terminal.

If a containing spatial structure contains a grid, then placement may also be based relative to grid coordinates.



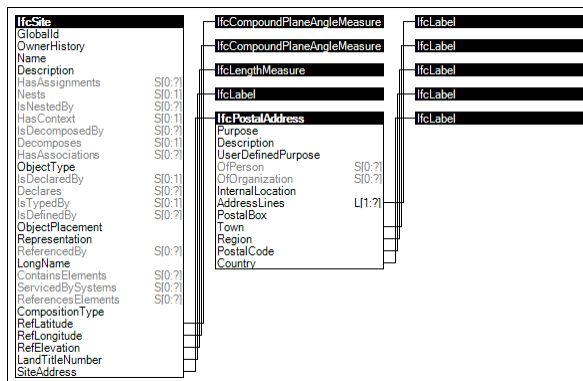
Body Geometry

Elements may have a 'Body' representation describing the volumetric shape of the object. Such representation may be used for 3D rendering or quantity take-off. Geometry may be based on boundary representations describing outer faces, primitives such as spheres or cones, swept solids such as profile extrusions or revolutions, Constructive Solid Geometry (CSG) such as clippings or subtractions of other shapes, or Non-Uniform Rational B-Spline (NURBS) geometry. Surface styles may indicate particular colors, textures, and reflectance for 3D rendering.



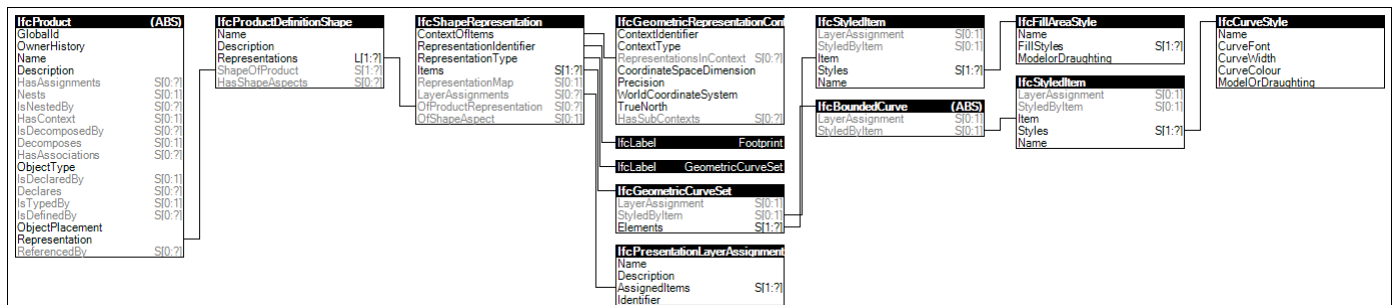
Site Location

The site location may be used to determine climate conditions and applicable building codes.



Footprint Geometry

Elements filling a boundary provide a 'Footprint' representation indicating a rectangle or any arbitrary set of outer and inner boundary curves. Examples of such elements include slabs and spaces. For elements that have a material layer set association indicating material thicknesses, a 'Body' representation may be generated based on the footprint and material layers. Fill area styles may indicate particular colors, tiles, or hatching for 2D rendering.



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.

IfcObject (ABS)	IfcRelDefinesByType	IfcTypeObject
GlobalId	GlobalId	GlobalId
OwnerHistory	OwnerHistory	OwnerHistory
Name	Name	Name
Description	Description	Description
HasAssignments	HasAssignments	HasAssignments
Nests	Nests	Nests
IsNestedBy	IsNestedBy	IsNestedBy
HasContext	HasContext	HasContext
IsDecomposedBy	IsDecomposedBy	IsDecomposedBy
Decomposes	Decomposes	Decomposes
HasAssociations	HasAssociations	HasAssociations
ObjectType	ObjectType	ObjectType
IsDeclaredBy	IsDeclaredBy	IsDeclaredBy
Declares	Declares	Declares
IsTypedBy	IsTypedBy	IsTypedBy
IsDefinedBy	IsDefinedBy	IsDefinedBy
	RelatedObjects S[1..?]	RelatedObjects S[1..?]
	RelatingType	RelatingType
		HasPropertySets S[1..?]
		Types

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.

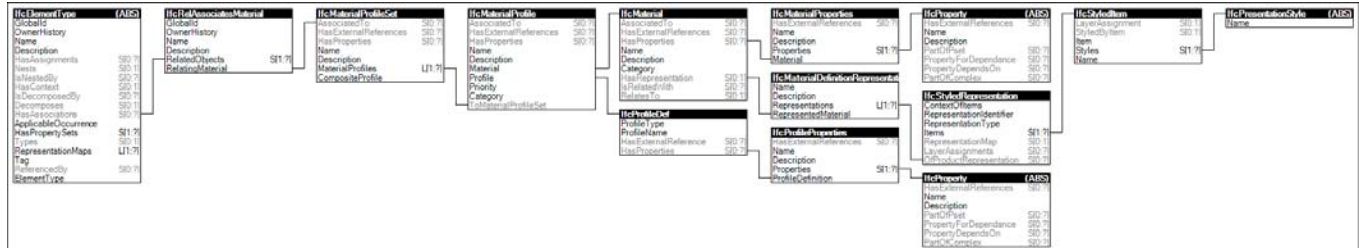
IfcObject (ABS)	IfcRelDefinesByProperties	IfcElementQuantity
GlobalId	GlobalId	GlobalId
OwnerHistory	OwnerHistory	OwnerHistory
Name	Name	Name
Description	Description	Description
HasAssignments	HasAssignments	HasAssignments
Nests	Nests	Nests
IsNestedBy	IsNestedBy	IsNestedBy
HasContext	HasContext	HasContext
IsDecomposedBy	IsDecomposedBy	IsDecomposedBy
Decomposes	Decomposes	Decomposes
HasAssociations	HasAssociations	HasAssociations
ObjectType	ObjectType	ObjectType
IsDeclaredBy	IsDeclaredBy	IsDeclaredBy
Declares	Declares	Declares
IsTypedBy	IsTypedBy	IsTypedBy
IsDefinedBy	IsDefinedBy	IsDefinedBy
	RelatedObjects S[1..1]	RelatedObjects S[1..1]
	RelatingPropertyDefinition	RelatingPropertyDefinition
		DefinesOccurrence S[1..1]
		MethodOfMeasurement
		Quantities S[1..?]

Space Boundaries

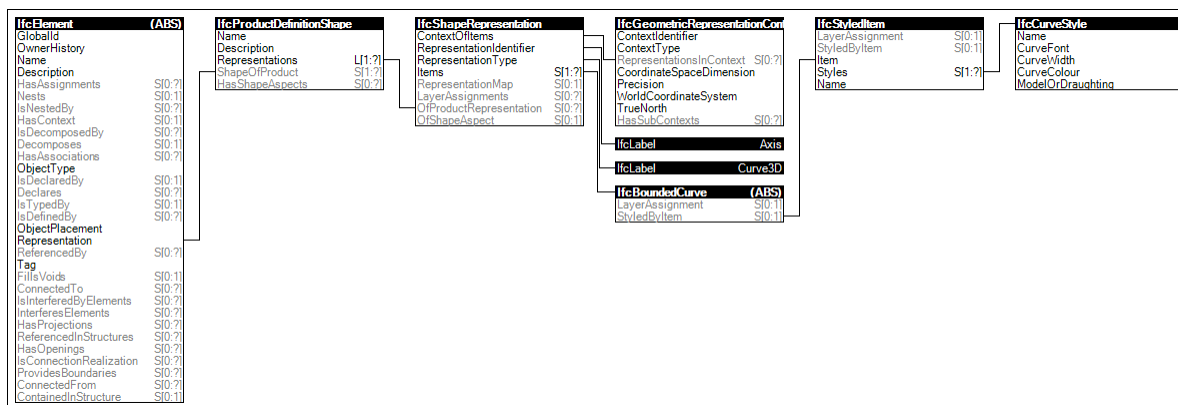
Spaces may have boundaries defined by building elements such as walls, slabs, doors, and windows. Such information may be used to determine heat transmission through surrounding materials.

IfcSpace	IfcRelSpaceBoundary	IfcElement (ABS)
GlobalId	GlobalId	GlobalId
OwnerHistory	OwnerHistory	OwnerHistory
Name	Name	Name
Description	Description	Description
HasAssignments	HasAssignments	HasAssignments
Nests	Nests	Nests
IsNestedBy	IsNestedBy	IsNestedBy
HasContext	HasContext	HasContext
IsDecomposedBy	IsDecomposedBy	IsDecomposedBy
Decomposes	Decomposes	Decomposes
HasAssociations	HasAssociations	HasAssociations
ObjectType	ObjectType	ObjectType
IsDeclaredBy	IsDeclaredBy	IsDeclaredBy
Declares	Declares	Declares
IsTypedBy	IsTypedBy	IsTypedBy
IsDefinedBy	IsDefinedBy	IsDefinedBy
ObjectPlacement	ObjectPlacement	ObjectPlacement
Representation	Representation	Representation
ReferencedBy	ReferencedBy	ReferencedBy
LongName	LongName	LongName
ContainsElements	ContainsElements	ContainsElements
ServedBySystems	ServedBySystems	ServedBySystems
ReferencesElements	ReferencesElements	ReferencesElements
CompositionType	CompositionType	CompositionType
PredefinedType	PredefinedType	PredefinedType
ElevationWithFlooring	ElevationWithFlooring	ElevationWithFlooring
HasCoverings	HasCoverings	HasCoverings
BoundedBy	BoundedBy	BoundedBy
	RelatingSpace	RelatingSpace
	RelatedBuildingElement	RelatedBuildingElement
	ConnectionGeometry	ConnectionGeometry
	PhysicalOrVirtualBoundary	PhysicalOrVirtualBoundary
	InternalOrExternalBoundary	InternalOrExternalBoundary
		IsNestedBy S[1..?]
		HasContext S[1..1]
		IsDecomposedBy S[1..?]
		Decomposes S[1..?]
		HasAssociations S[1..?]
		ObjectType S[1..1]
		IsDeclaredBy S[1..1]
		Declares S[1..1]
		IsTypedBy S[1..1]
		IsDefinedBy S[1..1]
		ObjectPlacement S[1..1]
		Representation S[1..1]
		ReferencedBy S[1..?]
		Tag S[1..1]
		FillsVoids S[1..1]
		ConnectedTo S[1..1]
		IsInterferedByElements S[1..1]
		InterferesElements S[1..1]
		HasProjections S[1..1]
		ReferencedInStructures S[1..1]
		HasOpenings S[1..1]
		IsConnectionRealization S[1..1]
		ProvidesBoundaries S[1..1]
		ConnectedFrom S[1..1]
		ContainedInStructure S[1..1]

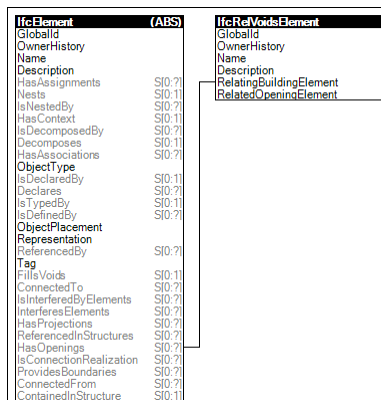
Material Profile Set



Elements following a path provide an 'Axis' representation indicating a line segment or any arbitrary open bounded curve. Examples of such elements include walls, beams, columns, pipes, ducts, and cables. For elements that have a material profile set association indicating cross-section, a 'Body' representation may be generated based on the axis curve and material profiles. Curve styles may indicate particular colors, line thicknesses, and dash patterns for 2D rendering.



Elements may have voids defined, which may be partial recess or extending full depth. Voids for openings may optionally be filled by another element such as a door or window.

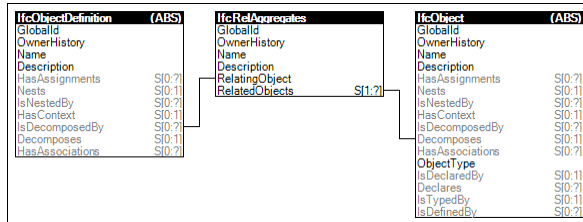


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Aggregation indicates an unordered part composition relationship.

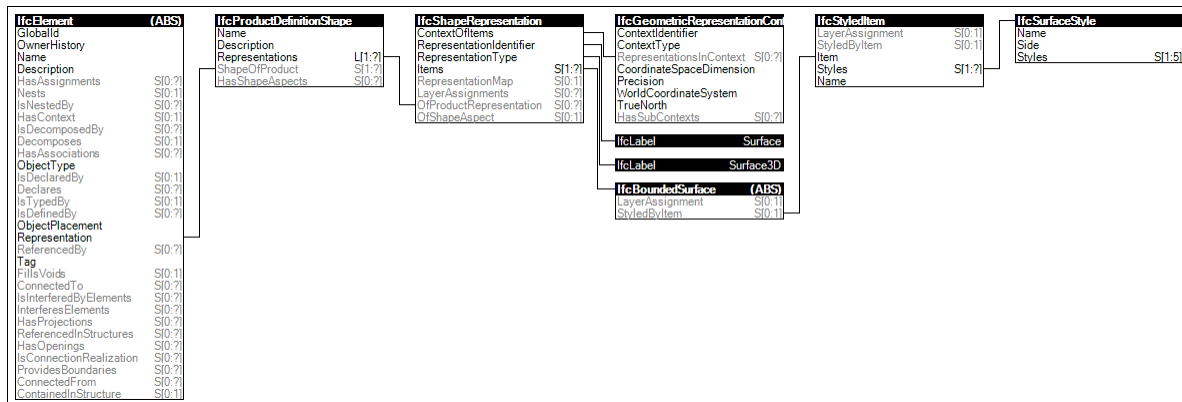
Aggregation is used on building elements to indicate parts such as studs within a wall.

Aggregation is used on systems to indicate subsystems such as branch circuits.



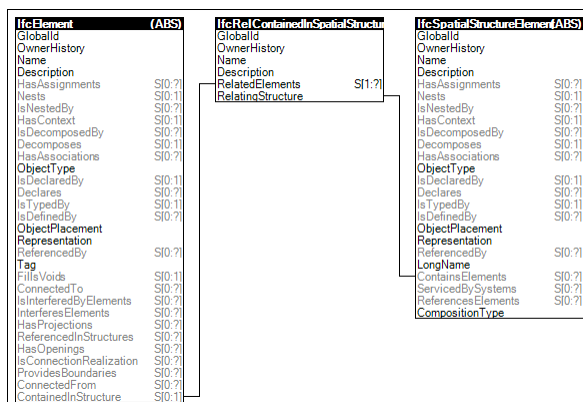
Surface Geometry

Elements may have a 'Surface' representation describing the outer surface of the object. Such representation may be used for hit-testing objects having part composition such as framed walls.



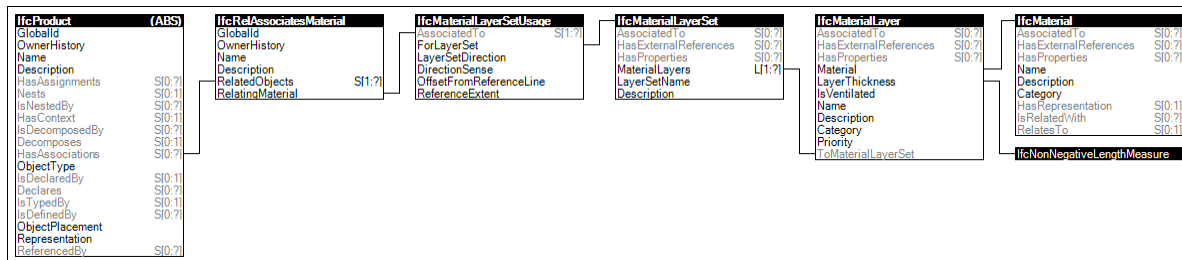
Spatial Containment

Spatial structures may contain physical elements, including building elements, distribution elements, and furnishing elements.



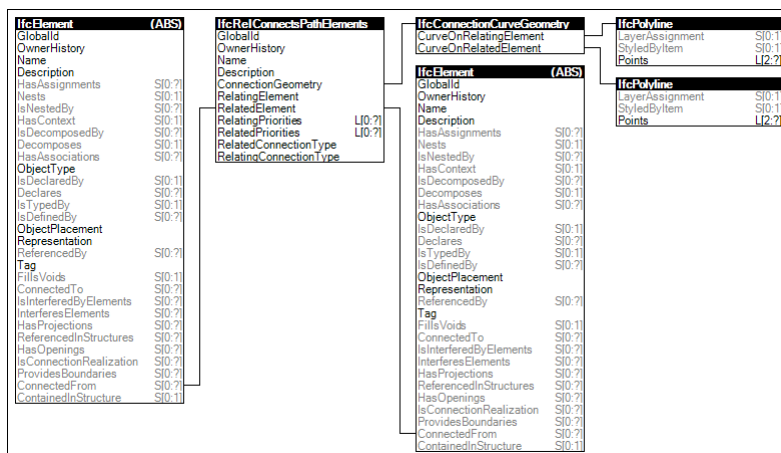
Material Layer Set Usage

Material layer set usage defines layout at occurrences to indicate a direction and offset from the 'Axis' reference curve, and a reference extent such as for a default wall height.



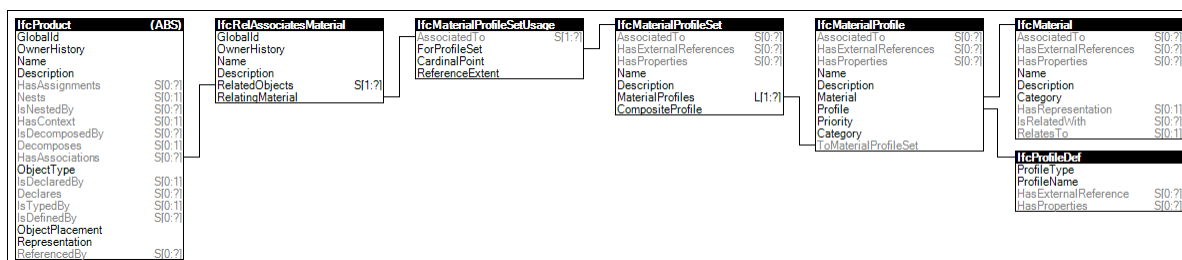
Path Connectivity

Elements based on an 'Axis' representation such as walls, beams, and columns use a path connectivity relationship to indicate parameters for the connection, indicating which side takes precedence for material layers or profiles.



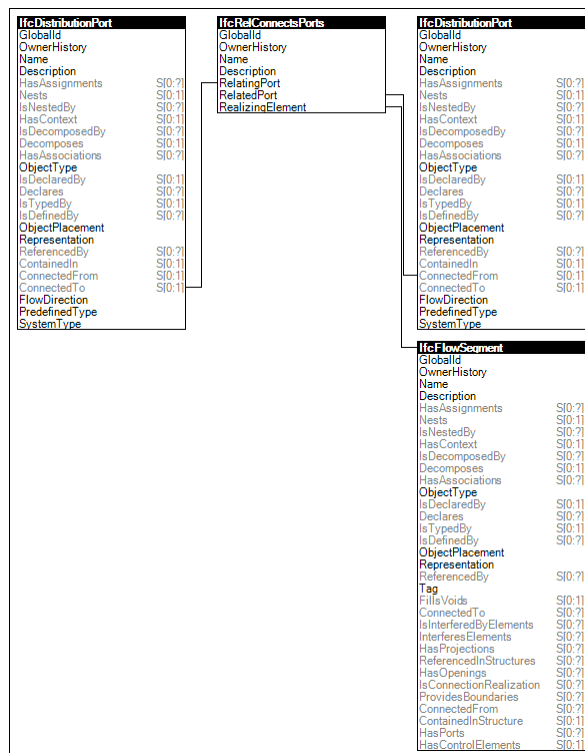
Material Profile Set Usage

Material profile set usage defines layout at occurrences to indicate the offset from the 'Axis' reference curve according to cardinal point, and a reference extent such as for a default column height.



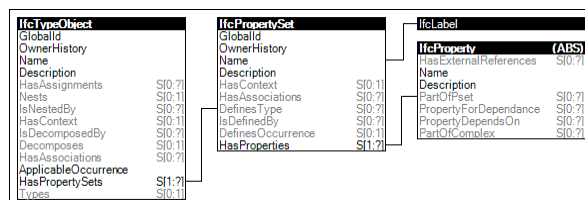
Port Connectivity

Ports on objects may be connected using elements such as cables, ducts, or pipes. Once Components within a System has some ports, then the connectivity should be complete and continuous. The presence of ports for air, water and electrical connections on complex equipment does not imply that all such connectivity is expected: only that if for example the HVAC segments and fittings have ports, then they will need to connect properly to the equipment's air ports.



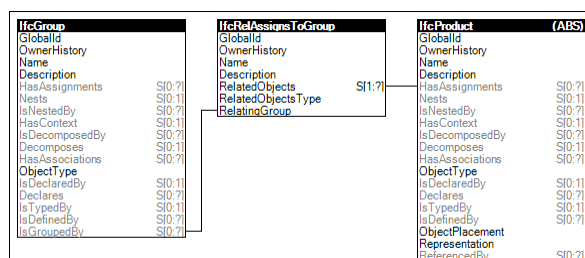
Properties for Types

For object types, property sets are defined directly.



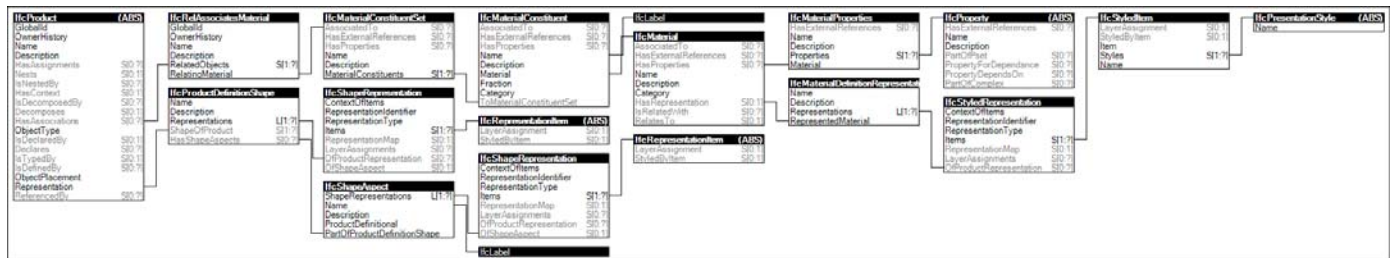
Group Assignment

Groups may have assignments indicating products that are members of the group. An example of such assignment is an air handler belonging to an air conditioning system.

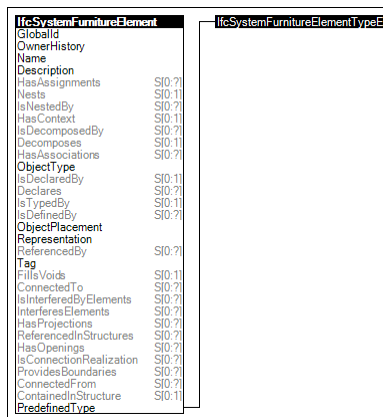


Material Constituents

Material constituents are associated with products where materials are placed arbitrarily (unlike 1D material profiles or 2D material layers). The mapping of materials to geometry may be accomplished using *IfcShapeAspect*.



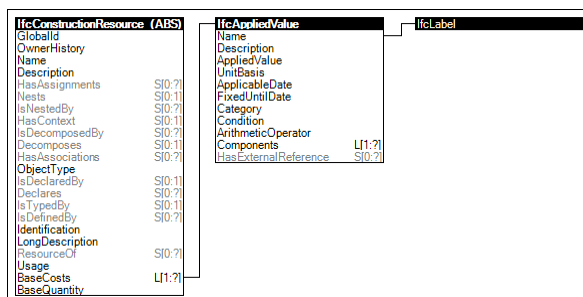
System furniture element types



Resource Cost

Resources can have associated costs indicating financial costs and environmental impacts incurred according to a specified base quantity.

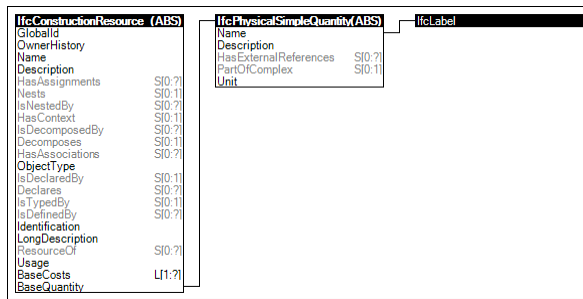
Each cost value may be defined using a constant amount or calculated according to specified formula.



Resource Quantity

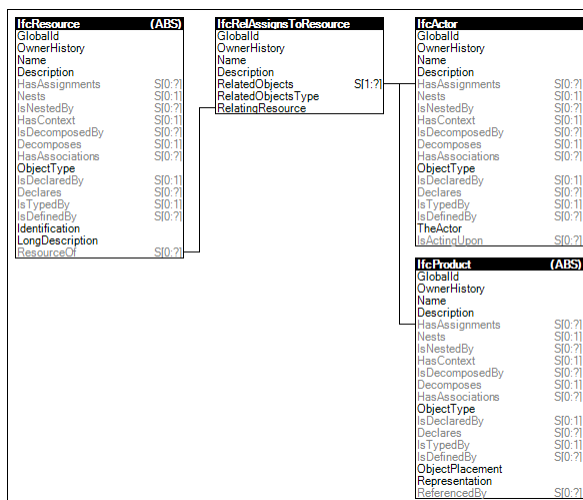
Resources may be defined according to a base quantity, where assigned tasks consume such amount of resource relative to an output quantity.

For work-based resources such as labor and equipment, quantities are based on time. For product-based resources, quantities are based on count. For material-based resources, quantities are based on volume.

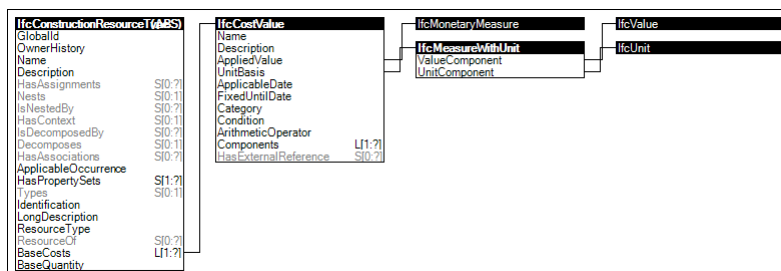


Resource Assignment

Resources may have assignments indicating sources available to be used. An example of such assignment is a person fulfilling a carpenter labor resource.



Resource Cost Rate

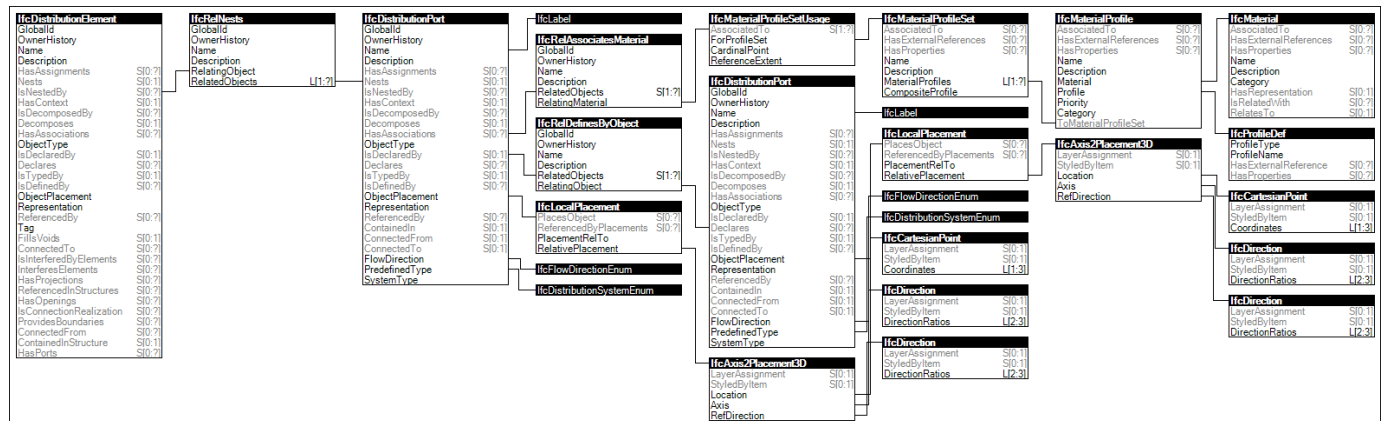


Ports

Ports indicate possible connections to other objects according to specified system types, flow direction, and connection properties. Ports are typically connected between devices via cables, pipes, or ducts.

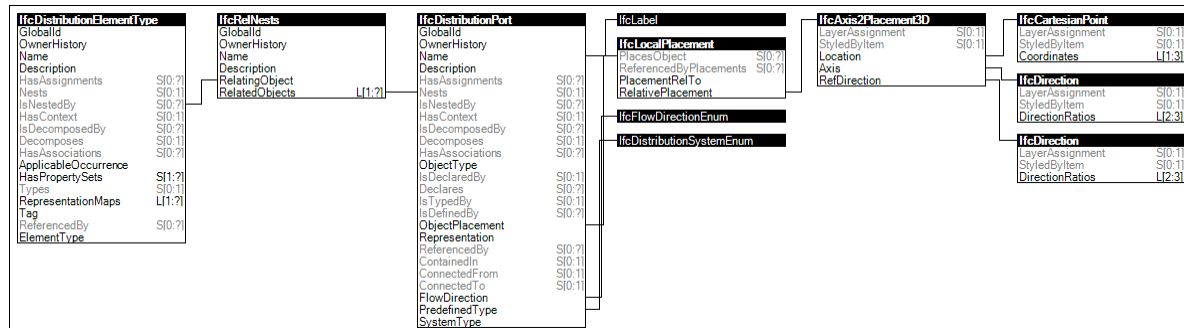
Ports may have placement defined indicating the position and outward orientation of the port relative to the product or product type.

Ports may have material profile sets defined indicating the flow area and connection enclosure.



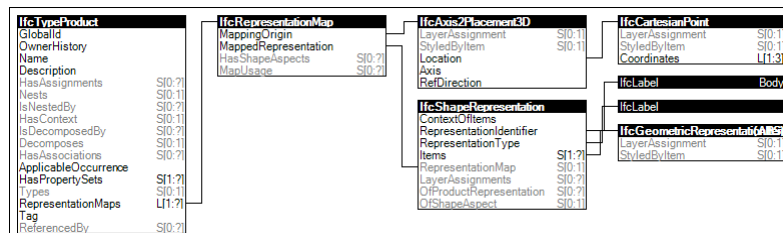
Type-Based Ports

Ports may be specified on types, following the same rules as defined for corresponding occurrences.



Body Geometry

The Body representation defines the physical shape of the product type.



Clearance Geometry

For elements that require clearance such as for safety, maintenance, or other purpose, this represents the 3D clearance volume of the item having RepresentationType of 'Surface3D'. Such clearance region indicates space that should not intersect with the 'Body' representation of other elements, though may intersect with the 'Clearance' representation of other elements.

IfcElement (ABS)		IfcProductDefinitionShape		IfcShapeRepresentation		IfcGeometricRepresentationContext	
GlobalId		Name		ContextOfItems		ContextIdentifier	
OwnerHistory		Description		RepresentationIdentifier		ContextType	
Name		Representations	LI: 1..?	RepresentationType		RepresentationsInContext	SIO: 1..?
Description	SIO: 1..?	ShapeOfProduct	SIO: 1..?	RepresentationMap	SIO: 1..?	CoordinateSpaceDimension	
Nests	SIO: 1..?	HasShapeAspects	SIO: 1..?	LayerAssignments	SIO: 1..?	Precision	
IsNestedBy	SIO: 1..?			OfProductRepresentation	SIO: 1..?	WorldCoordinateSystem	
HasContext	SIO: 1..?			OfShapeAspect	SIO: 1..?	HasSubContexts	SIO: 1..?
IsDecomposedBy	SIO: 1..?					IfcLabel	Clearance
Decomposes	SIO: 1..?					IfcLabel	
HasAssociations	SIO: 1..?					IfcBoundedSurface	(ABS)
ObjectType	SIO: 1..?					LayerAssignment	SIO: 1..?
IsDeclaredBy	SIO: 1..?					StyledByItem	SIO: 1..?
Declares	SIO: 1..?						
IsTypedBy	SIO: 1..?						
IsDefinedBy	SIO: 1..?						
ObjectPlacement							
Representation							
ReferencedBy	SIO: 1..?						
Tag							
FillsVoids	SIO: 1..?						
ConnectedTo	SIO: 1..?						
IsInterferedByElements	SIO: 1..?						
InterferesElements	SIO: 1..?						
HasProjections	SIO: 1..?						
ReferencedInStructures	SIO: 1..?						
HasOpenings	SIO: 1..?						
IsConnectionRealization	SIO: 1..?						
ProvidesBoundaries	SIO: 1..?						
ConnectedFrom	SIO: 1..?						
ContainedInStructure	SIO: 1..?						

Clearance Geometry

Elements requiring surrounding space for clearance provide a 'Clearance' representation. The reason for clearance space may be due to ventilation, maintenance, or other purpose. Examples of such elements include boilers and chillers. Such representation may be used for interference checks, where the 'Clearance' representation must not intersect with the 'Body' representation of other objects, though may intersect with the 'Clearance' representation of other objects.

IfcElement (ABS)		IfcProductDefinitionShape		IfcShapeRepresentation		IfcGeometricRepresentationContext	
GlobalId		Name		ContextOfItems		ContextIdentifier	
OwnerHistory		Description		RepresentationIdentifier		ContextType	
Name		Representations	LI: 1..?	RepresentationType		RepresentationsInContext	SIO: 1..?
Description	SIO: 1..?	ShapeOfProduct	SIO: 1..?	Items	SIO: 1..?	CoordinateSpaceDimension	
Nests	SIO: 1..?	HasShapeAspects	SIO: 1..?	RepresentationMap	SIO: 1..?	Precision	
IsNestedBy	SIO: 1..?			LayerAssignments	SIO: 1..?	WorldCoordinateSystem	
HasContext	SIO: 1..?			OfProductRepresentation	SIO: 1..?	TrueNorth	
IsDecomposedBy	SIO: 1..?			OfShapeAspect	SIO: 1..?	HasSubContexts	SIO: 1..?
Decomposes	SIO: 1..?					IfcLabel	Clearance
HasAssociations	SIO: 1..?					IfcLabel	
ObjectType	SIO: 1..?					IfcBoundedSurface	(ABS)
IsDeclaredBy	SIO: 1..?					LayerAssignment	SIO: 1..?
Declares	SIO: 1..?					StyledByItem	SIO: 1..?
IsTypedBy	SIO: 1..?						
IsDefinedBy	SIO: 1..?						
ObjectPlacement							
Representation							
ReferencedBy	SIO: 1..?						
Tag							
FillsVoids	SIO: 1..?						
ConnectedTo	SIO: 1..?						
IsInterferedByElements	SIO: 1..?						
InterferesElements	SIO: 1..?						
HasProjections	SIO: 1..?						
ReferencedInStructures	SIO: 1..?						
HasOpenings	SIO: 1..?						
IsConnectionRealization	SIO: 1..?						
ProvidesBoundaries	SIO: 1..?						
ConnectedFrom	SIO: 1..?						
ContainedInStructure	SIO: 1..?						

Interference

Elements may interfere with other elements, such as cable carriers going through walls. The interference relation enables precedence of interfering elements to be asserted.

IfcElement (ABS)		IfcElementInterferesElements		IfcElement (ABS)	
GlobalId		GlobalId		GlobalId	
OwnerHistory		OwnerHistory		OwnerHistory	
Name		Name		Name	
Description	SIO: 1..?	Description		Description	SIO: 1..?
Nests	SIO: 1..?	HasAssignments	SIO: 1..?	Nests	SIO: 1..?
IsNestedBy	SIO: 1..?	RelatedElement		IsNestedBy	SIO: 1..?
HasContext	SIO: 1..?	InterferenceGeometry		HasContext	SIO: 1..?
IsDecomposedBy	SIO: 1..?	InterferenceType		IsDecomposedBy	SIO: 1..?
Decomposes	SIO: 1..?	ImpliedOrder		Decomposes	SIO: 1..?
HasAssociations	SIO: 1..?			HasAssociations	SIO: 1..?
ObjectType	SIO: 1..?			ObjectType	SIO: 1..?
IsDeclaredBy	SIO: 1..?			IsDeclaredBy	SIO: 1..?
Declares	SIO: 1..?			Declares	SIO: 1..?
IsTypedBy	SIO: 1..?			IsTypedBy	SIO: 1..?
IsDefinedBy	SIO: 1..?			IsDefinedBy	SIO: 1..?
ObjectPlacement				ObjectPlacement	
Representation				Representation	
ReferencedBy	SIO: 1..?			ReferencedBy	SIO: 1..?
Tag				Tag	
FillsVoids	SIO: 1..?			FillsVoids	SIO: 1..?
ConnectedTo	SIO: 1..?			ConnectedTo	SIO: 1..?
IsInterferedByElements	SIO: 1..?			IsInterferedByElements	SIO: 1..?
InterferesElements	SIO: 1..?			InterferesElements	SIO: 1..?
HasProjections	SIO: 1..?			HasProjections	SIO: 1..?
ReferencedInStructures	SIO: 1..?			ReferencedInStructures	SIO: 1..?
HasOpenings	SIO: 1..?			HasOpenings	SIO: 1..?
IsConnectionRealization	SIO: 1..?			IsConnectionRealization	SIO: 1..?
ProvidesBoundaries	SIO: 1..?			ProvidesBoundaries	SIO: 1..?
ConnectedFrom	SIO: 1..?			ConnectedFrom	SIO: 1..?
ContainedInStructure	SIO: 1..?			ContainedInStructure	SIO: 1..?

Connectivity

Objects may participate in various connectivity relationships with other objects.

Element Connectivity

Elements may be connected to other elements, where the *RelatingElement* is of equal or higher priority, is generally constructed first, and/or anchors the *RelatedElement*.

IFCElement (ABS)	IFCRelConnectsElements	IFCElement (ABS)
GlobalId	GlobalId	GlobalId
OwnerHistory	OwnerHistory	OwnerHistory
Name	Name	Name
Description	Description	Description
HasAssignments	ConnectionGeometry	HasAssignments
Nests	RelatingElement	Nests
IsNestedBy	RelatedElement	IsNestedBy
HasContext		HasContext
IsDecomposedBy		IsDecomposedBy
Decomposes		Decomposes
HasAssociations		HasAssociations
ObjectType		ObjectType
IsDeclaredBy		IsDeclaredBy
Declares		Declares
IsTypedBy		IsTypedBy
IsDefinedBy		IsDefinedBy
ObjectPlacement		ObjectPlacement
Representation		Representation
ReferencedBy		ReferencedBy
Tag		Tag
FillsVoids		FillsVoids
ConnectedTo		ConnectedTo
IsInterferedByElements		IsInterferedByElements
InterferesElements		InterferesElements
HasProjections		HasProjections
ReferencedInStructures		ReferencedInStructures
HasOpenings		HasOpenings
IsConnectionRealization		IsConnectionRealization
ProvidesBoundaries		ProvidesBoundaries
ConnectedFrom		ConnectedFrom
ContainedInStructure		ContainedInStructure

4.9.6.4 Implementation

4.9.6.4.1 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
WSie.exp	EXPRESS schema definition
WSie.xsd	XML schema definition (XSD)
WSie.mvdxml	MVDXML schema transform
WSie.ifc	IFC dynamic schema definition

4.9.6.4.2 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.

4.9.6.4.3 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_ActorCommon

Property	Property Type	Data Type	Description
NumberOfActors	P_SINGLEVALUE	IfcCountMeasure	The number of actors that are to be dealt with together in the population.
Category	P_SINGLEVALUE	IfcLabel	Designation of the category into which the actors in the population belong.
SkillLevel	P_SINGLEVALUE	IfcLabel	Skill level exhibited by the actor and which indicates an extent of their capability to perform actions on the artefacts upon which they can act.

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

Property	Property Type	Data Type	Description
			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_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_SpaceOccupancyRequirements

Property	Property Type	Data Type	Description
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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_MemberCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), Also referred to as "construction type". It should be provided as an alternative to the name of the "object type", if the software does not support object types.
Status	P_ENUMERATED VALUE	IfcLabel/PEnum_ ElementStatus: N EW,EXISTING,D EMOLISH,TEMPO RARY,OTHER,NO TKNOWN,UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exists only temporary (like a temporary support structure).
Span	P_SINGLEVALUE	IfcPositiveLength Measure	Clear span for this object. The shape information is provided in addition to the shape representation and the geometric parameters used within. In cases of inconsistency between the geometric parameters and the shape properties, provided in the attached property, the geometric parameters take precedence.
Slope	P_SINGLEVALUE	IfcPlaneAngleMe asure	Slope angle - relative to horizontal (0.0 degrees). The shape information is provided in addition to the shape representation and the geometric parameters used within. In cases of inconsistency between the geometric parameters and the shape properties, provided in the attached property, the geometric parameters take precedence.
Roll	P_SINGLEVALUE	IfcPlaneAngleMe asure	Rotation against the longitudinal axis - relative to the global Z direction for all members that are non-vertical in regard to the global coordinate system (Profile direction equals global Z is Roll = 0.) The shape information is provided in addition to the shape representation and the geometric parameters used within. In cases of inconsistency between the geometric parameters and the shape properties, provided in the attached property, the geometric parameters take precedence. Note: new property in IFC4.
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.
ThermalTransmi ttance	P_SINGLEVALUE	IfcThermalTrans mittanceMeasure	Thermal transmittance coefficient (U-Value) of a material. Here the total thermal transmittance coefficient through the member within the direction of the thermal flow (including all materials). Note: new property in IFC4.
LoadBearing	P_SINGLEVALUE	IfcBoolean	Indicates whether the object is intended to carry loads (TRUE) or not (FALSE).

Property	Property Type	Data Type	Description
FireRating	P_SINGLEVALUE	IfcLabel	Fire rating for this object. It is given according to the national fire safety classification.

Pset_DistributionPortTypePipe

Property	Property Type	Data Type	Description
ConnectionType	P_ENUMERATEDVALUE	IfcLabel/PEnum_PipeEndStyleTreatment: BRAZED, COMPRESSION, FLANGED, GROOVED, OUTSIDESLEEVE, SOLDERED, SWEDGE, THREADED, WELDED, OTHER, NONE, UNSET	The end-style treatment of the pipe port: BRAZED: Brazed. COMPRESSION: Compression. FLANGED: Flanged. GROOVED: Grooved. OUTSIDESLEEVE: Outside Sleeve. SOLDERED: Soldered. SWEDGE: Swedge. THREADED: Threaded. WELDED: Welded. OTHER: Another type of end-style has been applied. NONE: No end-style has been applied. USERDEFINED: User-defined port connection type. NOTDEFINED: Undefined port connection type.
ConnectionSubType	P_SINGLEVALUE	IfcLabel	The physical port connection subtype that further qualifies the ConnectionType.
NominalDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal diameter of the pipe connection.
InnerDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The actual inner diameter of the pipe.
OuterDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The actual outer diameter of the pipe.
Temperature	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Temperature of the fluid.
VolumetricFlowRate	P_BOUNDEDVALUE	IfcVolumetricFlowRateMeasure	The volumetric flow rate of the fluid.
MassFlowRate	P_BOUNDEDVALUE	IfcMassFlowRateMeasure	The mass flow rate of the fluid.
FlowCondition	P_BOUNDEDVALUE	IfcPositiveRatioMeasure	Defines the flow condition as a percentage of the cross-sectional area.
Velocity	P_BOUNDEDVALUE	IfcLinearVelocityMeasure	The velocity of the fluid.
Pressure	P_BOUNDEDVALUE	IfcPressureMeasure	The pressure of the fluid.

Pset_DistributionSystemCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specific instance of a distribution system, or sub-system (e.g. 'WWS/VS1', which indicates the system to be WWS, subsystems VSI/400). The reference values depend on the local code of practice.

Pset_SystemFurnitureElementTypeCommon

Property	Property Type	Data Type	Description
IsUsed	P_SINGLEVALUE	IfcBoolean	Indicates whether the element is being used in a workstation (= TRUE) or not. (= FALSE).
GroupCode	P_SINGLEVALUE	IfcIdentifier	e.g. panels, worksurfaces, storage, etc.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal width of the system furniture elements of this type. The size information is provided in addition to the shape representation and the geometric parameters used within. In cases of inconsistency between the geometric parameters and the size properties, provided in the attached property set, the geometric parameters take precedence.

Property	Property Type	Data Type	Description
NominalHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal height of the system furniture elements of this type. The size information is provided in addition to the shape representation and the geometric parameters used within. In cases of inconsistency between the geometric parameters and the size properties, provided in the attached property set, the geometric parameters take precedence.
Finishing	P_SINGLEVALUE	IfcLabel	The finishing applied to system furniture elements of this type e.g. walnut, fabric.

Pset_SystemFurnitureElementTypePanel

Property	Property Type	Data Type	Description
HasOpening	P_SINGLEVALUE	IfcBoolean	indicates whether the panel has an opening (= TRUE) or not (= FALSE).
FurniturePanelType	P_ENUMERATEDVALUE	IfcLabel/PEnum_FurniturePanelType: ACOUSTICAL, GLAZED, HORIZONTAL, MONOLITHIC, OPEN, ENDS, DOOR, SCREEN, OTHER, NOTKNOWN, UNSET	Available panel types from which that required may be selected.
NominalThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal thickness of the panel.

Pset_SystemFurnitureElementTypeWorkSurface

Property	Property Type	Data Type	Description
UsePurpose	P_SINGLEVALUE	IfcLabel	The principal purpose for which the work surface is intended to be used e.g. writing/reading, computer, meeting, printer, reference files, etc.
SupportType	P_ENUMERATEDVALUE	IfcLabel/PEnum_FurniturePanelType: FREESTANDING, SUPPORTED, OTHER, NOTKNOWN, UNSET	Available support types from which that required may be selected.
HangingHeight	P_SINGLEVALUE	IfcPositiveLengthMeasure	The hanging height of the worksurface.
NominalThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal thickness of the work surface.
ShapeDescription	P_SINGLEVALUE	IfcLabel	A description of the shape of the work surface e.g. corner square, rectangle, etc.

Pset_ElectricAppliancePHistory

Property	Property Type	Data Type	Description
PowerState	P_REFERENCEVALUE	IfcTimeSeries/IfcBoolean	Indicates the power state of the device where True is on and False is off.

Pset_ElectricApplianceTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), provided, if there is no classification reference to a recognized classification system used.
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status: NEW, EXISTING, DEMOLISH, TEMPORARY, OTHER, NOTKNOWN, UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists

Property	Property Type	Data Type	Description
		NOWN,UNSET	and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exists only temporary (like a temporary support structure).

Pset_ElectricApplianceTypeDishwasher

Property	Property Type	Data Type	Description
DishwasherType	P_ENUMERATEDVALUE	IfcLabel/PEnum_ElectricApplianceDishwasherType:POTWASHER,TRAYWASHER,DISHWASHER,BOTTLEWASHER,CUTLERYWASHER,OTHER,UNKNOWN,UNSET	Type of dishwasher.

Pset_SolarDeviceTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), provided, if there is no classification reference to a recognized classification system used.
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status:NEW,EXISTING,DEMOLISH,TEMPORARY,OTHER,NOTKNOWN,UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exists only temporary (like a temporary support structure).

Pset_BoilerPHistory

Property	Property Type	Data Type	Description
EnergySourceConsumption	P_REFERENCEVALUE	IfcTimeSeries/IfcEnergyMeasure	Energy consumption.
OperationalEfficiency	P_REFERENCEVALUE	IfcTimeSeries/IfcNormalisedRatioMeasure	Operational efficiency: boiler output divided by total energy input (electrical and fuel).
CombustionEfficiency	P_REFERENCEVALUE	IfcTimeSeries/IfcNormalisedRatioMeasure	Combustion efficiency under nominal condition.
WorkingPressure	P_REFERENCEVALUE	IfcTimeSeries/IfcPressureMeasure	Boiler working pressure.
CombustionTemperature	P_REFERENCEVALUE	IfcTimeSeries/IfcThermodynamicTemperatureMeasure	Average combustion chamber temperature.
PartLoadRatio	P_REFERENCEVALUE	IfcTimeSeries/IfcNormalisedRatioMeasure	Ratio of the real to the nominal capacity.
Load	P_REFERENCEVALUE	IfcTimeSeries/IfcPowerMeasure	Boiler real load.
PrimaryEnergyConsumption	P_REFERENCEVALUE	IfcTimeSeries/IfcPowerMeasure	Boiler primary energy source consumption (i.e., the fuel consumed for changing the thermodynamic state of the fluid).
AuxiliaryEnergyConsumption	P_REFERENCEVALUE	IfcTimeSeries/IfcPowerMeasure	Boiler secondary energy source consumption (i.e., the electricity consumed by electrical devices such as fans and pumps).

Pset_BoilerTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLE VALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), provided, if there is no classification reference to a recognized classification system used.
Status	P_ENUMERATED VALUE	IfcLabel/PEnum_Status: NEW,EXISTING,DEMOLISH,TEMPORARY,OTHER, NOTKNOWN,UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exists only temporary (like a temporary support structure).
PressureRating	P_SINGLE VALUE	IfcPressureMeasure	Nominal pressure rating of the boiler as rated by the agency having jurisdiction.
OperatingMode	P_ENUMERATED VALUE	IfcLabel/PEnum_BoilerOperatingMode: FIXED, T WOSTEP, MODULATING, OTHER, NOTKNOWN, UN SET	Identifies the operating mode of the boiler.
HeatTransferSurfaceArea	P_SINGLE VALUE	IfcAreaMeasure	Total heat transfer area of the vessel.
NominalPartLoadRatio	P_BOUNDED VALUE	IfcReal	Allowable part load ratio range.
WaterInletTemperatureRange	P_BOUNDED VALUE	IfcThermodynamicTemperatureMeasure	Allowable water inlet temperature range.
WaterStorageCapacity	P_SINGLE VALUE	IfcVolumeMeasure	Water storage capacity.
IsWaterStorageHeater	P_SINGLE VALUE	IfcBoolean	This is used to identify if the boiler has storage capacity (TRUE). If FALSE, then there is no storage capacity built into the boiler, such as an instantaneous hot water heater.
PartialLoadEfficiencyCurves	P_TABLE VALUE	IfcPositiveRatioMeasure /IfcNormalisedRatioMeasure	Boiler efficiency as a function of the partial load factor; $E = f$ (partialLoadfactor).
OutletTemperatureRange	P_BOUNDED VALUE	IfcThermodynamicTemperatureMeasure	Allowable outlet temperature of either the water or the steam.
NominalEnergyConsumption	P_SINGLE VALUE	IfcPowerMeasure	Nominal fuel consumption rate required to produce the total boiler heat output.
EnergySource	P_ENUMERATED VALUE	IfcLabel/PEnum_EnergySource: COAL, COAL_PUL VERIZED, ELECTRICITY, GAS, OIL, PROPANE, WO OD, WOOD_CHIP, WOOD _PELLET, WOOD_PULVE RIZED, OTHER, NOTKNOW N, UNSET	Enumeration defining the energy source or fuel cumbusted to generate heat.

Pset_BoilerTypeSteam

Property	Property Type	Data Type	Description
MaximumOutletPressure	P_SINGLE VALUE	IfcLabel	Maximum steam outlet pressure.
NominalEfficiency	P_TABLE VALUE	IfcThermodynamicTemperatureMeasure	The nominal efficiency of the boiler as defined by the manufacturer. For steam boilers, a function of inlet temperature versus steam

Property	Property Type	Data Type	Description
		re/IfcNormalisedRatioMeasure	pressure. Note: as two variables are used, DefiningValues and DefinedValues are null, and values are stored in IfcTable in the following order: InletTemperature(IfcThermodynamicTemperatureMeasure) and OutletTemperature(IfcThermodynamicTemperatureMeasure) in DefiningValues, and NominalEfficiency(IfcNormalisedRatioMeasure) in DefinedValues. For example, DefininfValues(InletTemp, OutletTemp), DefinedValues(null, NominalEfficiency). The IfcTable is related to IfcPropertyTableValue using IfcMetric and IfcPropertyConstraintRelationship.
HeatOutput	P_TABLEVALUE	IfcThermodynamicTemperatureMeasure/IfcEnergyMeasure	Total nominal heat output as listed by the Boiler manufacturer. For steam boilers, it is a function of inlet temperature versus steam pressure. Note: as two variables are used, DefiningValues and DefinedValues are null, and values are stored in IfcTable in the following order: InletTemperature(IfcThermodynamicTemperatureMeasure) and OutletTemperature(IfcThermodynamicTemperatureMeasure) in DefiningValues, and HeatOutput(IfcEnergyMeasure) in DefinedValues. For example, DefiningValues(InletTemp, OutletTemp), DefinedValues(null, HeatOutput). The IfcTable is related to IfcPropertyTableValue using IfcMetric and IfcPropertyConstraintRelationship.

Pset_BoilerTypeWater

Property	Property Type	Data Type	Description
NominalEfficiency	P_TABLEVALUE	IfcThermodynamicTemperatureMeasure/IfcNormalisedRatioMeasure	The nominal efficiency of the boiler as defined by the manufacturer. For water boilers, a function of inlet versus outlet temperature. Note: as two variables are used, DefiningValues and DefinedValues are null, and values are stored in IfcTable in the following order: InletTemperature(IfcThermodynamicTemperatureMeasure), OutletTemperature(IfcThermodynamicTemperatureMeasure), NominalEfficiency(IfcNormalizedRatioMeasure). The IfcTable is related to IfcPropertyTableValue using IfcMetric and IfcPropertyConstraintRelationship.
HeatOutput	P_TABLEVALUE	IfcThermodynamicTemperatureMeasure/IfcEnergyMeasure	Total nominal heat output as listed by the Boiler manufacturer. For water boilers, it is a function of inlet versus outlet temperature. For steam boilers, it is a function of inlet temperature versus steam pressure. Note: as two variables are used, DefiningValues and DefinedValues are null, and values are stored in IfcTable in the following order: InletTemperature(IfcThermodynamicTemperatureMeasure), OutletTemperature(IfcThermodynamicTemperatureMeasure), HeatOutput(IfcEnergyMeasure). The IfcTable is related to IfcPropertyTableValue using IfcMetric and IfcPropertyConstraintRelationship.

Pset_FilterPHistory

Property	Property Type	Data Type	Description
CountedEfficiency	P_REFERENCEVALUE	IfcTimeSeries/IfcReal	Filter efficiency based the particle counts concentration before and after filter against particles with certain size distribution.
WeightedEfficiency	P_REFERENCEVALUE	IfcTimeSeries/IfcReal	Filter efficiency based the particle weight concentration before and after filter against particles with certain size distribution.
ParticleMassHolding	P_REFERENCEVALUE	IfcTimeSeries/IfcMassMeasure	Mass of particle holding in the filter.

Pset_FilterTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1').
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status: NEW, EXISTING, DEMOLISH, TEMPORARY, OTHER, NOTKNOWN, UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exist only temporary (like a temporary support structure).
Weight	P_SINGLEVALUE	IfcMassMeasure	Weight of filter.
InitialResistance	P_SINGLEVALUE	IfcPressureMeasure	Initial new filter fluid resistance (i.e., pressure drop at the maximum air flowrate across the filter when the filter is new per ASHRAE Standard 52.1).
FinalResistance	P_SINGLEVALUE	IfcPressureMeasure	Filter fluid resistance when replacement is required (i.e., Pressure drop at the maximum air flowrate across the filter when the filter needs replacement per ASHRAE Standard 52.1).
OperationTemperatureRange	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Allowable operation ambient fluid temperature range.
FlowRateRange	P_BOUNDEDVALUE	IfcVolumetricFlowRateMeasure	Possible range of fluid flowrate that can be delivered.
NominalFilterFaceVelocity	P_SINGLEVALUE	IfcLinearVelocityMeasure	Filter face velocity.
NominalMediaSurfaceVelocity	P_SINGLEVALUE	IfcLinearVelocityMeasure	Average fluid velocity at the media surface.
NominalPressureDrop	P_SINGLEVALUE	IfcPressureMeasure	Total pressure drop across the filter.
NominalFlowrate	P_SINGLEVALUE	IfcVolumetricFlowRateMeasure	Nominal fluid flow rate through the filter.
NominalParticleGeometricMeanDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	Particle geometric mean diameter associated with nominal efficiency.
NominalParticleGeometricStandardDeviation	P_SINGLEVALUE	IfcReal	Particle geometric standard deviation associated with nominal efficiency.

Pset_FilterTypeWaterFilter

Property	Property Type	Data Type	Description
WaterFilterType	P_ENUMERATEDVALUE	IfcLabel/PEnum_FilterWaterFilterType: FILTRATION_DIATOMACEOUSEARTH, FILTRATION_SAND, PURIFICATION_DEIONIZING, PURIFICATION_REVERSEOSMOSIS, SOFTENING_ZEOLITE, OTHER, NOTKNOWN, UNSET	Further qualifies the type of water filter. Filtration removes undissolved matter; Purification removes dissolved matter; Softening replaces dissolved matter.

Pset_FlowMeterOccurrence

Property	Property Type	Data Type	Description
Purpose	P_ENUMERATEDVALUE	IfcLabel/PEnum_FlowMeterPurpose: MASTER, SUBMASTER, SUBMETER, OTHER, NOTKNOWN, UNSET	Enumeration defining the purpose of the flow meter occurrence.

Pset_FlowMeterTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1').
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status:NEW,EXISTING,DEMOLISH,TEMPORARY,OTHER,NOTKNOWN,UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exist only temporary (like a temporary support structure).
ReadOutType	P_ENUMERATEDVALUE	IfcLabel/PEnum_MeterReadOutType:DIAL,DIGITAL,OTHER,NOTKNOWN,UNSET	Indication of the form that readout from the meter takes. In the case of a dial read out, this may comprise multiple dials that give a cumulative reading and/or a mechanical odometer.
RemoteReading	P_SINGLEVALUE	IfcBoolean	Indicates whether the meter has a connection for remote reading through connection of a communication device (set TRUE) or not (set FALSE).

Pset_FlowMeterTypeEnergyMeter

Property	Property Type	Data Type	Description
NominalCurrent	P_SINGLEVALUE	IfcElectricCurrentMeasure	The nominal current that is designed to be measured.
MaximumCurrent	P_SINGLEVALUE	IfcElectricCurrentMeasure	The maximum allowed current that a device is certified to handle.
MultipleTarriff	P_SINGLEVALUE	IfcBoolean	Indicates whether meter has built-in support for multiple tariffs (variable energy cost rates).

Pset_PipeConnectionFlanged

Property	Property Type	Data Type	Description
FlangeTable	P_SINGLEVALUE	IfcLabel	Designation of the standard table to which the flange conforms.
FlangeStandard	P_SINGLEVALUE	IfcLabel	Designation of the standard describing the flange table.
BoreSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal bore of the pipe flange.
FlangeDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	Overall diameter of the flange.
FlangeThickness	P_SINGLEVALUE	IfcPositiveLengthMeasure	Thickness of the material from which the pipe bend is constructed.
NumberOfBoltholes	P_SINGLEVALUE	IfcInteger	Number of boltholes in the flange.
BoltSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the bolts securing the flange.
BoltholePitch	P_SINGLEVALUE	IfcPositiveLengthMeasure	Diameter of the circle along which the boltholes are placed.

Pset_PipeFittingOccurrence

Property	Property Type	Data Type	Description
InteriorRoughnessCoefficient	P_SINGLEVALUE	IfcPositiveLengthMeasure	The interior roughness coefficient of the pipe segment.
Color	P_SINGLEVALUE	IfcLabel	The color of the pipe segment. Note: This is typically used only for plastic pipe segments. However, it may be used for any pipe segments

Property	Property Type	Data Type	Description
			with a painted surface which is not otherwise specified as a covering.

Pset_PipeFittingPHistory

Property	Property Type	Data Type	Description
LossCoefficient	P_REFERENCEVALUE	IfcTimeSeries/IfcReal	Dimensionless loss coefficient used for calculating fluid resistance representing the ratio of total pressure loss to velocity pressure at a referenced cross-section.
FlowrateLeakage	P_REFERENCEVALUE	IfcTimeSeries/IfcVolumetricFlowRateMeasure	Leakage flowrate versus pressure difference.

Pset_PipeFittingTypeBend

Property	Property Type	Data Type	Description
BendAngle	P_SINGLEVALUE	IfcPositivePlaneAngleMeasure	The change of direction of flow.
BendRadius	P_SINGLEVALUE	IfcPositiveLengthMeasure	The radius of bending if circular arc or zero if sharp bend.

Pset_PipeFittingTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1').
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status:NEW,EXISTING,DEMOLISH,TEMPORARY,OTHER,NOTKNOWN,UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exist only temporary (like a temporary support structure).
PressureClass	P_SINGLEVALUE	IfcPressureMeasure	The test or rated pressure classification of the fitting.
PressureRange	P_BOUNDEDVALUE	IfcPressureMeasure	Allowable maximum and minimum working pressure (relative to ambient pressure).
TemperatureRange	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Allowable maximum and minimum temperature.
FittingLossFactor	P_SINGLEVALUE	IfcReal	A factor that determines the pressure loss due to friction through the fitting.

Pset_PipeFittingTypeJunction

Property	Property Type	Data Type	Description
JunctionType	P_ENUMERATEDVALUE	IfcLabel/PEnum_PipeFittingJunctionType:TEE,CROSS,OTHER,NOTKNOWN,UNSET	The type of junction. TEE=3 ports, CROSS = 4 ports.
JunctionLeftAngle	P_SINGLEVALUE	IfcPositivePlaneAngleMeasure	The change of direction of flow for the left junction.
JunctionLeftRadius	P_SINGLEVALUE	IfcPositiveLengthMeasure	The radius of bending for the left junction.
JunctionRightAngle	P_SINGLEVALUE	IfcPositivePlaneAngleMeasure	The change of direction of flow for the right junction where 0 indicates straight segment.
JunctionRightRadius	P_SINGLEVALUE	IfcPositiveLengthMeasure	The radius of bending for the right junction where 0 indicates sharp bend.

Pset_PipeSegmentOccurrence

Property	Property Type	Data Type	Description
InteriorRoughnessCoefficient	P_SINGLEVALUE	IfcPositiveLengthMeasure	The interior roughness coefficient of the pipe segment.
Color	P_SINGLEVALUE	IfcLabel	The color of the pipe segment. Note: This is typically used only for plastic pipe segments. However, it may be used for any pipe segments with a painted surface which is not otherwise specified as a covering.
Gradient	P_SINGLEVALUE	IfcPositiveRatioMeasure	The gradient of the pipe segment.
InvertElevation	P_SINGLEVALUE	IfcLengthMeasure	The invert elevation relative to the datum established for the project.

Pset_PipeSegmentPHistory

Property	Property Type	Data Type	Description
LeakageCurve	P_REFERENCEVALUE	IfcTimeSeries	Leakage per unit length curve versus working pressure.
FluidFlowLeakage	P_REFERENCEVALUE	IfcTimeSeries/IfcVolumetricFlowRateMeasure	Volumetric leakage flow rate.

Pset_PipeSegmentTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1').
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status: NEW, EXISTING, DEMOLISH, TEMPORARY, OTHER, NOTKNOWN, UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exist only temporary (like a temporary support structure).
WorkingPressure	P_SINGLEVALUE	IfcPressureMeasure	Working pressure.
PressureRange	P_BOUNDEDVALUE	IfcPressureMeasure	Allowable maximum and minimum working pressure (relative to ambient pressure).
TemperatureRange	P_BOUNDEDVALUE	IfcThermodynamicTemperatureMeasure	Allowable maximum and minimum temperature.
NominalDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The nominal diameter of the pipe segment.
InnerDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The actual inner diameter of the pipe.
OuterDiameter	P_SINGLEVALUE	IfcPositiveLengthMeasure	The actual outer diameter of the pipe.

Pset_PipeSegmentTypeCulvert

Property	Property Type	Data Type	Description
InternalWidth	P_SINGLEVALUE	IfcLengthMeasure	The internal width of the culvert.
ClearDepth	P_SINGLEVALUE	IfcLengthMeasure	The clear depth of the culvert.

Pset_PipeSegmentTypeGutter

Property	Property Type	Data Type	Description
Slope	P_SINGLEVALUE	IfcPlaneAngleMeasure	Angle of the gutter to allow for drainage.
FlowRating	P_SINGLEVALUE	IfcVolumetricFlowRateMeasure	Actual flow capacity for the gutter. Value of 0.00 means this value has not been set.

Pset_ValvePHistory

Property	Property Type	Data Type	Description
PercentageOpen	P_REFERENCEVALUE	IfcTimeSeries/IfcPositiveRatioMeasure	The ratio between the amount that the valve is open to the full open position of the valve.
MeasuredFlowRate	P_REFERENCEVALUE	IfcTimeSeries/IfcMassFlowRateMeasure	The rate of flow of a fluid measured across the valve.
MeasuredPressureDrop	P_REFERENCEVALUE	IfcTimeSeries/IfcPressureMeasure	The actual pressure drop in the fluid measured across the valve.

Pset_ValveTypeAirRelease

Property	Property Type	Data Type	Description
IsAutomatic	P_SINGLEVALUE	IfcBoolean	Indication of whether the valve is automatically operated (TRUE) or manually operated (FALSE).

Pset_ValveTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1').
ValvePattern	P_ENUMERATE DVALUE	IfcLabel/PEnum_ValvePattern: SINGLEPORT, ANGLED_2_PORT, STRAIGHT_2_PORT, STRAIGHT_3_PORT, CROSSOVER_4_PORT, OTHER, NOTKNOWN, UNSET	The configuration of the ports of a valve according to either the linear route taken by a fluid flowing through the valve or by the number of ports where: SINGLEPORT: Valve that has a single entry port from the system that it serves, the exit port being to the surrounding environment. ANGLED_2_PORT: Valve in which the direction of flow is changed through 90 degrees. STRAIGHT_2_PORT: Valve in which the flow is straight through. STRAIGHT_3_PORT: Valve with three separate ports. CROSSOVER_4_PORT: Valve with 4 separate ports.
ValveOperation	P_ENUMERATE DVALUE	IfcLabel/PEnum_ValveOperation: DROPWEIGHT, FLOAT, HYDRAULIC, LEVER, LOCKSHIELD, MOTORIZED, PNEUMATIC, SOLENOID, SPRING, THERMOSTATIC, WHEEL, OTHER, NOTKNOWN, UNSET	The method of valve operation where: DROPWEIGHT: A valve that is closed by the action of a weighted lever being released, the weight normally being prevented from dropping by being held by a wire, the closure normally being made by the action of heat on a fusible link in the wire. FLOAT: A valve that is opened and closed by the action of a float that rises and falls with water level. The float may be a ball attached to a lever or other mechanism. HYDRAULIC: A valve that is opened and closed by hydraulic actuation. LEVER: A valve that is opened and closed by the action of a lever rotating the gate within the valve. LOCKSHIELD: A valve that requires the use of a special lockshield key for opening and closing, the operating mechanism being protected by a shroud during normal operation. MOTORIZED: A valve that is opened and closed by the action of an electric motor on an actuator. PNEUMATIC: A valve that is opened and closed by pneumatic actuation. SOLENOID: A valve that is normally held open by a magnetic field in a coil acting on the gate but that is closed immediately if the electrical current generating the magnetic field is removed. SPRING: A valve that is normally held in position by the pressure of a spring on a plate but that may be caused to open if the pressure of the fluid is sufficient to overcome the spring pressure. THERMOSTATIC: A valve in which the ports are opened or closed to maintain a required predetermined temperature. WHEEL: A valve that is opened and closed

Property	Property Type	Data Type	Description
			by the action of a wheel moving the gate within the valve.
ValveMechanism	P_ENUMERATEDVALUE	IfcLabel/PEnum_ValveMechanism: BALL, BUTTERFLY, CONFIGURED GATE, GLAND, GLOBE, LUBRICATED PLUG, NEEDLE, PARALLEL SLIDE, PLUG, WEDGE GATE, OTHER, NOT KNOWN, UNSET	The mechanism by which the valve function is achieved where: BALL: Valve that has a ported ball that can be turned relative to the body seat ports. BUTTERFLY: Valve in which a streamlined disc pivots about a diametric axis. CONFIGURED GATE: Screwdown valve in which the closing gate is shaped in a configured manner to have a more precise control of pressure and flow change across the valve. GLAND: Valve with a tapered seating, in which a rotatable plug is retained by means of a gland and gland packing. GLOBE: Screwdown valve that has a spherical body. LUBRICATED PLUG: Plug valve in which a lubricant is injected under pressure between the plug face and the body. NEEDLE: Valve for regulating the flow in or from a pipe, in which a slender cone moves along the axis of flow to close against a fixed conical seat. PARALLEL SLIDE: Screwdown valve that has a machined plate that slides in formed grooves to form a seal. PLUG: Valve that has a ported plug that can be turned relative to the body seat ports. WEDGE GATE: Screwdown valve that has a wedge shaped plate fitting into tapered guides to form a seal.
Size	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the connection to the valve (or to each connection for faucets, mixing valves, etc.).
BodyMaterial	P_REFERENCEVALUE	IfcMaterialDefinition	Material from which the body of the valve is constructed.
TestPressure	P_SINGLEVALUE	IfcPressureMeasure	The maximum pressure to which the valve has been subjected under test.
WorkingPressure	P_SINGLEVALUE	IfcPressureMeasure	The normally expected maximum working pressure of the valve.
FlowCoefficient	P_SINGLEVALUE	IfcReal	Flow coefficient (the quantity of fluid that passes through a fully open valve at unit pressure drop), typically expressed as the Kv or Cv value for the valve.
CloseOffRating	P_SINGLEVALUE	IfcPressureMeasure	Close off rating.

Pset_ValveTypeDrawOffCock

Property	Property Type	Data Type	Description
HasHoseUnion	P_SINGLEVALUE	IfcBoolean	Indicates whether the drawoff cock is fitted with a hose union connection (= TRUE) or not (= FALSE).

Pset_ValveTypeFaucet

Property	Property Type	Data Type	Description
FaucetType	P_ENUMERATEDVALUE	IfcLabel/PEnum_Faucet Type: BIB, GLOBE, DIVERter, DIVIDED FLOW COMBINATION, PILLAR, SINGLE OUTLET COMBINATION, SPRAY, SPRAY MIXING, OTHER, NOT KNOWN, UNSET	Defines the range of faucet types that may be specified where: Bib: Faucet with a horizontal inlet and a nozzle that discharges downwards. Globe: Faucet fitted through the end of a bath, with a horizontal inlet, a partially spherical body and a vertical nozzle. Diverter: Combination faucet assembly with a valve to enable the flow of mixed water to be transferred to a showerhead. Divided Flow Combination: Combination faucet assembly in which hot and cold water are kept separate until emerging from a common nozzle. Pillar: Faucet that has a vertical inlet and a nozzle that discharges downwards. Single Outlet Combination = Combination faucet assembly in which hot and cold water mix before emerging from a common nozzle. Spray: Faucet with a spray outlet. Spray Mixing: Spray faucet connected to hot and cold water supplies that delivers water at a temperature determined during use.
FaucetOperation	P_ENUMER	IfcLabel/PEnum_Faucet	Defines the range of ways in which a faucet can be operated that may

Property	Property Type	Data Type	Description
ration	ATEDVALUE	Operation: CERAMICDISC, LEVERHANDLE, NONCONCUSSIVESELF CLOSING, QUARTERTURN, QUICKACTION, SCREWDOWN, SELF CLOSING, TIMEDSELF CLOSING, OTHER, NOT KNOWN, UNSET	be specified where: CeramicDisc: Quick action faucet with a ceramic seal to open or close the orifice . LeverHandle: Quick action faucet that is operated by a lever handle . NonConcussiveSelfClosing: Self closing faucet that does not induce surge pressure . QuarterTurn: Quick action faucet that can be fully opened or shut by turning the operating mechanism through 90 degrees. QuickAction: Faucet that can be opened or closed fully with a single small movement of the operating mechanism . ScrewDown: Faucet in which a plate or disc is moved, by the rotation of a screwed spindle, to close or open the orifice. SelfClosing: Faucet that is opened by pressure of the top of an operating spindle and is closed under the action of a spring or weight when the pressure is released. TimedSelfClosing: Self closing faucet that discharges for a predetermined period of time .
FaucetFunction	P_ENUMERATEDVALUE	IfcLabel/PEnum_FaucetFunction: COLD, HOT, MIXED, OTHER, NOT KNOWN, UNSET	Defines the operating temperature of a faucet that may be specified.
Finish	P_SINGLEVALUE	IfcText	Description of the finish applied to the faucet.
FaucetTop Description	P_SINGLEVALUE	IfcText	Description of the operating mechanism/top of the faucet.

Pset_ValveTypeFlushing

Property	Property Type	Data Type	Description
FlushingRate	P_SINGLEVALUE	IfcVolumetricFlowRateMeasure	The predetermined quantity of water to be flushed.
HasIntegralShutOffDevice	P_SINGLEVALUE	IfcBoolean	Indication of whether the flushing valve has an integral shut off device fitted (set TRUE) or not (set FALSE).
IsHighPressure	P_SINGLEVALUE	IfcBoolean	Indication of whether the flushing valve is suitable for use on a high pressure water main (set TRUE) or not (set FALSE).

Pset_ValveTypeGasTap

Property	Property Type	Data Type	Description
HasHoseUnion	P_SINGLEVALUE	IfcBoolean	Indicates whether the gas tap is fitted with a hose union connection (= TRUE) or not (= FALSE).

Pset_ValveTypeIsolating

Property	Property Type	Data Type	Description
IsNormally Open	P_SINGLEVALUE	IfcBoolean	If TRUE, the valve is normally open. If FALSE is is normally closed.
IsolatingPurpose	P_ENUMERATEDVALUE	IfcLabel/PEnum_IsolatingPurpose: LANDING, LANDINGWITHPRESSUREREGULATION, OTHER, NOT KNOWN, UNSET	Defines the purpose for which the isolating valve is used since the way in which the valve is identified as an isolating valve may be in the context of its use. Note that unless there is a contextual name for the isolating valve (as in the case of a Landing Valve on a rising fire main), then the value assigned should be UNSET.

Pset_ValveTypeMixing

Property	Property Type	Data Type	Description
MixerControl	P_ENUMERATED VALUE	IfcLabel/PEnum_MixingValveControl: MANUAL, PREDEFINED, THERMOSTATIC, OTHER, NOTKNOWN, UNSET	Defines the form of control of the mixing valve.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the pipework connection from the mixing valve.

Pset_ValveTypePressureReducing

Property	Property Type	Data Type	Description
UpstreamPressure	P_SINGLEVALUE	IfcPressureMeasure	The operating pressure of the fluid upstream of the pressure reducing valve.
DownstreamPressure	P_SINGLEVALUE	IfcPressureMeasure	The operating pressure of the fluid downstream of the pressure reducing valve.

Pset_ValveTypePressureRelief

Property	Property Type	Data Type	Description
ReliefPressure	P_SINGLEVALUE	IfcPressureMeasure	The pressure at which the spring or weight in the valve is set to discharge fluid.

Pset_SanitaryTerminalTypeBath

Property	Property Type	Data Type	Description
BathType	P_ENUMERATED VALUE	IfcLabel/PEnum_BathType: DOMESTIC, DOMESTICCORNER, FOOT, JACUZZI, PLUNGE, SITZ, TREATMENT, WHIRLPOOL, OTHER, NOTKNOWN, UNSET	The property enumeration defines the types of bath that may be specified within the property set where. Domestic: Bath, for one person at a time, into which the whole body can be easily immersed. DomesticCorner: Bath, for one person at a time, into which the whole body can be easily immersed and in which the immersion trough is at an angle. Foot: Shallow bath for washing the feet. Jacuzzi: Whirlpool bath for more than one person Plunge: Bath, usually for more than one person at a time, into which the whole body can be easily immersed. Sitz: Bath in which a bather sits as in a chair. Treatment: Bath used for hydrotherapy purposes. Whirlpool: Bath in which an integrated device agitates the water by pumped circulation or induction of water and/or air.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Principal color of the object.

Property	Property Type	Data Type	Description
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.
HasGrab Handles	P_SINGLEVALUE	IfcBoolean	Indicates whether the bath is fitted with handles that provide assistance to a bather in entering or leaving the bath.

Pset_SanitaryTerminalTypeBidet

Property	Property Type	Data Type	Description
Mounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTERTOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	The property enumeration Pset_SanitaryMountingEnum defines the forms of mounting or fixing of the sanitary terminal that may be specified within property sets used to define sanitary terminals (WC's, basins, sinks, etc.) where: - BackToWall: A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections . Pedestal: A floor mounted sanitary terminal that has an integral base . CounterTop: A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung: A sanitary terminal cantilevered clear of the floor. Note that BackToWall, Pedestal and WallHung are allowable values for a bidet.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
Nominal Width	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Color selection for this object.
SpilloverLevel	P_SINGLEVALUE	IfcPositiveLengthMeasure	The level at which water spills out of the object.
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.

Pset_SanitaryTerminalTypeCistern

Property	Property Type	Data Type	Description
CisternHeight	P_ENUMERATEDVALUE	IfcLabel/PEnum_CisternHeight: HIGHLEVEL, LOWLEVEL, NONE, OTHER, NOTKNOWN, UNSET	Enumeration that identifies the height of the cistern or, if set to 'None' if the urinal has no cistern and is flushed using mains or high pressure water through a flushing valve.
CisternCapacity	P_SINGLEVALUE	IfcVolumeMeasure	Volumetric capacity of the cistern
IsSingleFlush	P_SINGLEVALUE	IfcBoolean	Indicates whether the cistern is single flush = TRUE (i.e. the same amount of water is used for each and every flush) or dual flush = FALSE (i.e. the amount of water used for a flush may be selected by the user to be high or low depending on the waste material to be removed).
FlushType	P_ENUMERATEDVALUE	IfcLabel/PEnum_FlushType: LEVER, PULL, PUSH, SENSOR, OTHER, NOTKNOWN, UNSET	The property enumeration Pset_FlushTypeEnum defines the types of flushing mechanism that may be specified for cisterns and sanitary terminals where: - Lever: Flushing is achieved by twisting a lever that causes a predetermined flow of water to be passed from a cistern to the sanitary terminal. Pull: Flushing is achieved by pulling a handle or knob vertically upwards that causes a predetermined flow of water

Property	Property Type	Data Type	Description
			to be passed from a cistern to the sanitary terminal. Push: Flushing is achieved by pushing a button or plate that causes a predetermined flow of water to be passed from a cistern to the sanitary terminal. Sensor: Flush is activated through an automatic sensing mechanism.
FlushRate	P_BOUNDEDVALUE	IfcVolumeMeasure	The minimum and maximum volume of water used at each flush. Where a single flush is used, the value of upper bound and lower bound should be equal. For a dual flush toilet, the lower bound should be used for the lesser flush rate and the upper bound for the greater flush rate. Where flush is achieved using mains pressure water through a flush valve, the value of upper and lower bound should be equal and should be the same as the flush rate property of the flush valve (see relevant valve property set). Alternatively, in this case, do not assert the flush rate property; refer to the flush rate of the flush valve.
IsAutomaticFlush	P_SINGLEVALUE	IfcBoolean	Boolean value that determines if the cistern is flushed automatically either after each use or periodically (TRUE) or whether manual flushing is required (FALSE).
CisternColor	P_SINGLEVALUE	IfcText	Color of the object.

Pset_SanitaryTerminalTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), provided, if there is no classification reference to a recognized classification system used.

Pset_SanitaryTerminalTypeSanitaryFountain

Property	Property Type	Data Type	Description
FountainType	P_ENUMERATEDVALUE	IfcLabel/PEnum_FountainType: DRINKINGWATER, EYEWASH, OTHER, NOTKNOWN, UNSET	Selection of the type of fountain from the enumerated list of types where: - DrinkingWater: Sanitary appliance that provides a low pressure jet of drinking water. Eyewash: Waste water appliance, usually installed in work places where there is a risk of injury to eyes by solid particles or dangerous liquids, with which the user can wash the eyes without touching them.
Mounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTERTOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	Selection of the form of mounting of the fountain from the enumerated list of mountings where: - BackToWall: A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections. Pedestal: A floor mounted sanitary terminal that has an integral base. CounterTop: A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung: A sanitary terminal cantilevered clear of the floor.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Color selection for this object.
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.

Pset_SanitaryTerminalTypeShower

Property	Property Type	Data Type	Description
ShowerType	P_ENUMERATEDVALUE	IfcLabel/PEnum_ShowerType: DRENCH, INDIVIDUAL, TUNNEL, OTHER, NOTKNOWN, UNSET	Selection of the type of shower from the enumerated list of types where: - Drench: Shower that rapidly gives a thorough soaking in an emergency. Individual: Shower unit that is typically enclosed and is for the use of one person at a time. Tunnel: Shower that has a succession of shower heads or spreaders that operate simultaneously along its length.
HasTray	P_SINGLEVALUE	IfcBoolean	Indicates whether the shower has a separate receptacle that catches the water in a shower and directs it to a waste outlet.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Color selection for this object.
ShowerHeadDescription	P_SINGLEVALUE	IfcText	A description of the shower head(s) that emit the spray of water.
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.

Pset_SanitaryTerminalTypeSink

Property	Property Type	Data Type	Description
SinkType	P_ENUMERATEDVALUE	IfcLabel/PEnum_SinkType: BELFAST, BUCKET, CLEANERS, COMBINATION_LEFT, COMBINATION_RIGHT, COMBINATION_DOUBLE, DRIP, LABORATORY, LONDON, PLASTER, POT, RINSING, SHELF, VEGETABLEPREPARATION, OTHER, NOTKNOWN, UNSET	Selection of the type of sink from the enumerated list of types where: - Belfast: Deep sink that has a plain edge and a weir overflow . Bucket: Sink at low level, with protected front edge, that facilitates filling and emptying buckets, usually with a hinged grid on which to stand them. Cleaners: Sink, usually fixed at normal height (900mm), with protected front edge. Combination_Left: Sink with integral drainer on left hand side . Combination_Right: Sink with integral drainer on right hand side . Combination_Double: Sink with integral drainer on both sides . Drip: Small sink that catches drips or flow from a faucet . Laboratory: Sink, of acid resisting material, with a top edge shaped to facilitate fixing to the underside of a desktop . London: Deep sink that has a plain edge and no overflow . Plaster: Sink with sediment receiver to prevent waste plaster passing into drains . Pot: Large metal sink, with a standing waste, for washing cooking utensils . Rinsing: Metal sink in which water can be heated and culinary utensils and tableware immersed at high temperature that destroys most harmful bacteria and allows subsequent self drying. . Shelf: Ceramic sink with an integral back shelf through which water fittings are mounted . VegetablePreparation: Large metal sink, with a standing waste, for washing and preparing vegetables .
Mounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTERTOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	Selection of the form of mounting of the sink from the enumerated list of mountings where: - BackToWall: A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections. Pedestal: A floor mounted sanitary terminal that has an integral base. CounterTop: A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the

Property	Property Type	Data Type	Description
			term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung: A sanitary terminal cantilevered clear of the floor.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Color selection for this object.
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.
MountingOffset	P_SINGLEVALUE	IfcLengthMeasure	For counter top mounted sinks, the vertical offset between the top of the sink and the counter top.

Pset_SanitaryTerminalTypeToiletPan

Property	Property Type	Data Type	Description
ToiletType	P_ENUMERATEDVALUE	IfcLabel/PEnum_ToiletType: BEDPAN, WASHER, CHEMICAL, CLOSECOUPLED, LOOSECUPLED, SLOPHOPPER, OTHER, NOTKNOWN, UNSET	Enumeration that defines the types of toilet (water closet) arrangements that may be specified where: - BedPanWasher: Enclosed soil appliance in which bedpans and urinal bottles are emptied and cleansed. Chemical: Portable receptacle or soil appliance that receives and retains excrement in either an integral or a separate container, in which it is chemically treated and from which it has to be emptied periodically. CloseCoupled: Toilet suite in which a flushing cistern is connected directly to the water closet pan. LooseCoupled: Toilet arrangement in which a flushing cistern is connected to the water closet pan through a flushing pipe. SlopHopper: Hopper shaped soil appliance with a flushing rim and outlet similar to those of a toilet pan, into which human excrement is emptied for disposal.
ToiletPanType	P_ENUMERATEDVALUE	IfcLabel/PEnum_ToiletPanType: SIPHONIC, SQUAT, WASHDOWN, WASHOUT, OTHER, NOTKNOWN, UNSET	The property enumeration Pset_ToiletPanTypeEnum defines the types of toilet pan that may be specified within the property set Pset_Toilet: - Siphonic: Toilet pan in which excrement is removed by siphonage induced by the flushing water. Squat: Toilet pan with an elongated bowl installed with its top edge at or near floor level, so that the user has to squat. WashDown: Toilet pan in which excrement is removed by the momentum of the flushing water. WashOut: A washdown toilet pan in which excrement falls first into a shallow water filled bowl.
PanMounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTER TOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	The property enumeration Pset_SanitaryMountingEnum defines the forms of mounting or fixing of the sanitary terminal that may be specified within property sets used to define sanitary terminals (WC's, basins, sinks, etc.) where: - BackToWall: A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections. Pedestal: A floor mounted sanitary terminal that has an integral base. CounterTop: A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung: A sanitary terminal cantilevered clear of the floor.

Property	Property Type	Data Type	Description
Color	P_SINGLEVALUE	IfcLabel	Color selection for this object
SpilloverLevel	P_SINGLEVALUE	IfcPositiveLengthMeasure	The level at which water spills out of the terminal.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.

Pset_SanitaryTerminalTypeUrinal

Property	Property Type	Data Type	Description
UrinalType	P_ENUMERATEDVALUE	IfcLabel/PEnum_UrinalType: BOWL, SLAB, STALL, TROUGH, OTHER, NOTKNOWN, UNSET	Selection of the type of urinal from the enumerated list of types where: - Bowl: Individual wall mounted urinal. Slab: Urinal that consists of a slab or sheet fixed to a wall and down which urinal flows into a floor channel. Stall: Floor mounted urinal that consists of an elliptically shaped sanitary stall fixed to a wall and down which urine flows into a floor channel. Trough: Wall mounted urinal of elongated rectangular shape on plan, that can be used by more than one person at a time.
Mounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTERTOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	Selection of the form of mounting from the enumerated list of mountings where: - BackToWall = A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections Pedestal = A floor mounted sanitary terminal that has an integral base CounterTop = A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung = A sanitary terminal cantilevered clear of the floor . Note that BackToWall, Pedestal and WallHung are allowable values for a urinal.
Color	P_SINGLEVALUE	IfcLabel	Color of the urinal.
SpilloverLevel	P_SINGLEVALUE	IfcPositiveLengthMeasure	The level at which water spills out of the object.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.

Pset_SanitaryTerminalTypeWashHandBasin

Property	Property Type	Data Type	Description
WashHandBasinType	P_ENUMERATEDVALUE	IfcLabel/PEnum_WashHandBasinType: DENTALCUSPIDOR, HANDRINSE, HOSPITAL, TIPUP, WASHFOUNTAIN, WASHINGTROUGH, OTHER, NOTKNOWN, UNSET	Defines the types of wash hand basin that may be specified where: DentalCuspidor: Waste water appliance that receives and flushes away mouth washings . HandRinse: Wall mounted wash hand basin that has an overall width of 500mm or less . Hospital: Wash hand basin that has a smooth easy clean surface without tapholes or overflow slot

Property	Property Type	Data Type	Description
			for use where hygiene is of prime importance. Tipup: Wash hand basin mounted on pivots so that it can be emptied by tilting. Vanity: Wash hand basin for installation into a horizontal surface. Washfountain: Wash hand basin that is circular, semi-circular or polygonal on plan, at which more than one person can wash at the same time. WashingTrough: Wash hand basin of elongated rectangular shape in plan, at which more than one person can wash at the same time.
Mounting	P_ENUMERATEDVALUE	IfcLabel/PEnum_SanitaryMounting: BACKTOWALL, PEDESTAL, COUNTERTOP, WALLHUNG, OTHER, NOTKNOWN, UNSET	Selection of the form of mounting from the enumerated list of mountings where: - BackToWall: A pedestal mounted sanitary terminal that fits flush to the wall at the rear to cover its service connections. Pedestal: A floor mounted sanitary terminal that has an integral base CounterTop: A sanitary terminal that is installed into a horizontal surface that is installed into a horizontal surface. Note: When applied to a wash hand basin, the term more normally used is 'vanity'. See also Wash Hand Basin Type specification. WallHung: A sanitary terminal cantilevered clear of the floor.
NominalLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length of the object.
NominalWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted width of the object.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object.
Color	P_SINGLEVALUE	IfcLabel	Color of the object.
DrainSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	The size of the drain outlet connection from the object.
MountingOffset	P_SINGLEVALUE	IfcLengthMeasure	For counter top mounted basins the vertical offset between the top of the sink and the counter top.

Pset_WasteTerminalTypeCommon

Property	Property Type	Data Type	Description
Reference	P_SINGLEVALUE	IfcIdentifier	Reference ID for this specified type in this project (e.g. type 'A-1'), provided, if there is no classification reference to a recognized classification system used.
Status	P_ENUMERATEDVALUE	IfcLabel/PEnum_Status: NEW, EXISTING, DEMOLISH, TEMPORARY, OTHER, NOTKNOWN, UNSET	Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as "New" - element designed as new addition, "Existing" - element exists and remains, "Demolish" - element existed but is to be demolished, "Temporary" - element will exist only temporary (like a temporary support structure).

Pset_WasteTerminalTypeFloorTrap

Property	Property Type	Data Type	Description
NominalBodyLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the chamber of the trap.
NominalBodyWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the y-axis in the local coordinate system of the chamber of the trap.
NominalBodyDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the z-axis in the local coordinate system of the chamber of the trap.

Property	Property Type	Data Type	Description
IsForSullageWater	P_SINGLEVALUE	IfcBoolean	Indicates if the purpose of the floor trap is to receive sullage water, or if that is amongst its purposes (= TRUE), or not (= FALSE). Note that if TRUE, it is expected that an upstand or kerb will be placed around the floor trap to prevent the ingress of surface water runoff; the provision of the upstand or kerb is not dealt with in this property set.
SpilloverLevel	P_SINGLEVALUE	IfcPositiveLengthMeasure	The level at which water spills out of the terminal.
TrapType	P_ENUMERATEDVALUE	IfcLabel/PEnum_TrapType: NONE, P_TRAP, Q_TRAP, S_TRAP, OTHER, NOTKNOWN, UNSET	Identifies the predefined types of waste trap used in combination with the floor trap from which the type required may be set.
HasStrainer	P_SINGLEVALUE	IfcBoolean	Indicates whether the gully trap has a strainer (= TRUE) or not (= FALSE).
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
InletPatternType	P_ENUMERATEDVALUE	IfcLabel/PEnum_InletPatternType: NONE, 1, 2, 3, 4, 12, 13, 14, 23, 24, 34, 123, 124, 134, 234, 1234	Identifies the pattern of inlet connections to a trap. A trap may have 0, 1, 2, 3 or 4 inlet connections and the pattern of their arrangement may vary. The enumeration makes the convention that an outlet is either vertical or is placed at the bottom (south side) of the trap (when viewed in plan). Position 1 is to the left (west), position 2 is to the top (north), position 3 is to the right (east) and position 4 is to the bottom (south).
InletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the inlet connection(s), where used, of the inlet connections. Note that all inlet connections are assumed to be the same size.
CoverLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the cover of the trap.
CoverWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the y-axis in the local coordinate system of the cover of the trap.
CoverMaterial	P_REFERENCEVALUE	IfcMaterialDefinition	Material from which the cover or grating is constructed.

Pset_WasteTerminalTypeFloorWaste

Property	Property Type	Data Type	Description
NominalBodyLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the waste.
NominalBodyWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the y-axis in the local coordinate system of the waste.
NominalBodyDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the z-axis in the local coordinate system of the waste.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
CoverLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the cover of the waste.
CoverWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the y-axis in the local coordinate system of the cover of the waste.

Pset_WasteTerminalTypeGullySump

Property	Property Type	Data Type	Description
NominalSumpLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the sump.
NominalSumpWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the y-axis in the local coordinate system of the sump.
NominalSumpDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the z-axis in the local coordinate system of the sump.
GullyType	P_ENUMERATED VALUE	IfcLabel/PEnum_GullyType: VERTICAL, BACKINLET, OTHER, NOTKNOWN, UNSET	Identifies the predefined types of gully from which the type required may be set.
TrapType	P_ENUMERATED VALUE	IfcLabel/PEnum_TrapType: NONE, P_TRAP, Q_TRAP, S_TRAP, OTHER, NOTKNOWN, UNSET	Identifies the predefined types of trap from which the type required may be set.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
BackInletPatternType	P_ENUMERATED VALUE	IfcLabel/PEnum_BackInletPatternType: NONE, 1, 2, 3, 4, 12, 13, 14, 23, 24, 34, 123, 124, 134, 234, 1234	Identifies the pattern of inlet connections to a gully trap. A gully trap may have 0, 1, 2, 3 or 4 inlet connections and the pattern of their arrangement may vary. The enumeration makes the convention that an outlet is either vertical or is placed at the bottom (south side) of the gully trap (when viewed in plan). Position 1 is to the left (west), position 2 is to the top (north), position 3 is to the right (east) and position 4 is to the bottom (south). 2 ----- ! 1- -3 ! ----- 4
InletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the inlet connection(s), where used, of the inlet connections. Note that all inlet connections are assumed to be the same size.
CoverLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the cover of the gully trap.
CoverWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the y-axis in the local coordinate system of the cover of the gully trap.

Pset_WasteTerminalTypeGullyTrap

Property	Property Type	Data Type	Description
NominalBodyLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the chamber of the gully trap.
NominalBodyWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the y-axis in the local coordinate system of the chamber of the gully trap.
NominalBodyDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the z-axis in the local coordinate system of the chamber of the gully trap.
GullyType	P_ENUMERATED VALUE	IfcLabel/PEnum_GullyType: VERTICAL, BACKINLET, OTHER, NOTKNOWN, UNSET	Identifies the predefined types of gully from which the type required may be set.
HasStrainer	P_SINGLEVALUE	IfcBoolean	Indicates whether the gully trap has a strainer (= TRUE) or not (= FALSE).
TrapType	P_ENUMERATED	IfcLabel/PEnum_TrapType: N	Identifies the predefined types of trap from which the

Property	Property Type	Data Type	Description
	VALUE	ONE,P_TRAP,Q_TRAP,S_TRAP,OTHER,NOTKNOWN,UNSET	type required may be set.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
BackInletPatternType	P_ENUMERATED VALUE	IfcLabel/PEnum_BackInletPatternType: NONE,1,2,3,4,12,13,14,23,24,34,123,124,134,234,1234	Identifies the pattern of inlet connections to a gully trap. A gully trap may have 0,1,2,3 or 4 inlet connections and the pattern of their arrangement may vary. The enumeration makes the convention that an outlet is either vertical or is placed at the bottom (south side) of the gully trap (when viewed in plan). Position 1 is to the left (west), position 2 is to the top (north), position 3 is to the right (east) and position 4 is to the bottom (south).
InletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the inlet connection(s), where used, of the inlet connections. Note that all inlet connections are assumed to be the same size.
CoverLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the cover of the gully trap.
CoverWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the y-axis in the local coordinate system of the cover of the gully trap.

Pset_WasteTerminalTypeRoofDrain

Property	Property Type	Data Type	Description
NominalBodyLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the drain.
NominalBodyWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the y-axis in the local coordinate system of the drain.
NominalBodyDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted length measured along the z-axis in the local coordinate system of the drain.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
CoverLength	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the x-axis in the local coordinate system or the radius (in the case of a circular shape in plan) of the cover of the drain.
CoverWidth	P_SINGLEVALUE	IfcPositiveLengthMeasure	The length measured along the y-axis in the local coordinate system of the cover of the drain.

Pset_WasteTerminalTypeWasteDisposalUnit

Property	Property Type	Data Type	Description
DrainConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the drain connection inlet to the waste disposal unit.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the waste disposal unit.
NominalDepth	P_SINGLEVALUE	IfcPositiveLengthMeasure	Nominal or quoted depth of the object measured from the inlet drain connection to the base of the unit.

Pset_WasteTerminalTypeWasteTrap

Property	Property Type	Data Type	Description
WasteTrapType	P_ENUMERATEDVALUE	IfcLabel/PEnum_TrapType : NONE, P_TRAP, Q_TRAP, S_TRAP, OTHER, NOTKNOWN, UNSET	Identifies the predefined types of trap from which the type required may be set.
OutletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the outlet connection from the object.
InletConnectionSize	P_SINGLEVALUE	IfcPositiveLengthMeasure	Size of the inlet connection(s), where used, of the inlet connections. Note that all inlet connections are assumed to be the same size.

4.9.6.4.4 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	IfcActor ; IfcComplexPropertyTemplate; IfcContext ; IfcControl ; IfcGroup ; IfcObject ; IfcObjectDefinition ; IfcPreDefinedPropertySet; IfcProcess ; IfcProduct ; IfcProject ; IfcProjectLibrary; IfcPropertyDefinition ; IfcPropertySet ; IfcPropertySetDefinition ; IfcPropertySetTemplate; IfcPropertyTemplate; IfcPropertyTemplateDefinition; IfcProxy; IfcQuantitySet ; IfcRelAggregates ; IfcRelAssigns ; IfcRelAssignsToActor ; IfcRelAssignsToControl ; IfcRelAssignsToGroup ; IfcRelAssignsToGroupByFactor; IfcRelAssignsToProcess ; IfcRelAssignsToProduct ; IfcRelAssignsToResource ; IfcRelAssociates ; IfcRelAssociatesClassification ; IfcRelAssociatesDocument; IfcRelAssociatesLibrary; IfcRelationship ; IfcRelConnects ; IfcRelDeclares ; IfcRelDecomposes ; IfcRelDefines ; IfcRelDefinesByObject ; IfcRelDefinesByProperties ; IfcRelDefinesByTemplate; IfcRelDefinesByType ; IfcRelNests ; IfcResource ; IfcRoot ; IfcSimplePropertyTemplate; IfcTypeObject ; IfcTypeProcess; IfcTypeProduct ; IfcTypeResource ; IfcPropertySetDefinitionSet; IfcComplexPropertyTemplateTypeEnum; IfcObjectTypeEnum; IfcPropertySetTemplateTypeEnum; IfcSimplePropertyTemplateTypeEnum; IfcDefinitionSelect ; IfcProcessSelect ; IfcProductSelect ; IfcPropertySetDefinitionSelect ; IfcResourceSelect ;	42/60 (70%)
IfcControlExtension	IfcPerformanceHistory ; IfcRelAssociatesApproval; IfcRelAssociatesConstraint; IfcPerformanceHistoryTypeEnum;	1/4 (25%)
IfcProcessExtension	IfcEvent; IfcEventType; IfcProcedure; IfcProcedureType; IfcRelSequence; IfcTask ; IfcTaskType; IfcWorkCalendar ; IfcWorkControl ; IfcWorkPlan ; IfcWorkSchedule; IfcEventTriggerTypeEnum; IfcEventTypeEnum; IfcProcedureTypeEnum; IfcSequenceEnum; IfcTaskTypeEnum; IfcWorkCalendarTypeEnum; IfcWorkPlanTypeEnum; IfcWorkScheduleTypeEnum;	4/19 (21%)
IfcProductExtension	IfcAnnotation; IfcBuilding ; IfcBuildingElement ; IfcBuildingElementType ; IfcBuildingStorey ; IfcCivilElement; IfcCivilElementType; IfcDistributionElement ; IfcDistributionElementType ; IfcElement ; IfcElementAssembly; IfcElementAssemblyType; IfcElementQuantity ; IfcElementType ; IfcExternalSpatialElement; IfcExternalSpatialStructureElement; IfcFeatureElement ; IfcFeatureElementAddition; IfcFeatureElementSubtraction ; IfcFurnishingElement ; IfcFurnishingElementType ; IfcGeographicElement; IfcGeographicElementType; IfcGrid; IfcOpeningElement ; IfcOpeningStandardCase ; IfcPort ; IfcProjectionElement;	36/71 (51%)

Namespace	Definitions	Usage
	IfcRelAssociatesMaterial; IfcRelConnectsElements; IfcRelConnectsPorts; IfcRelConnectsPortToElement; IfcRelConnectsWithRealizingElements; IfcRelContainedInSpatialStructure; IfcRelFillsElement; IfcRelInterferesElements; IfcRelProjectsElement; IfcRelReferencedInSpatialStructure; IfcRelServicesBuildings; IfcRelSpaceBoundary; IfcRelSpaceBoundary1stLevel; IfcRelSpaceBoundary2ndLevel; IfcRelVoidsElement; IfcSite; IfcSpace; IfcSpaceType; IfcSpatialElement; IfcSpatialElementType; IfcSpatialStructureElement; IfcSpatialStructureElementType; IfcSpatialZone; IfcSpatialZoneType; IfcSystem; IfcTransportElement; IfcTransportElementType; IfcVirtualElement; IfcZone; IfcAssemblyPlaceEnum; IfcElementAssemblyTypeEnum; IfcElementCompositionEnum; IfcExternalSpatialElementTypeEnum; IfcGeographicElementTypeEnum; IfcGridTypeEnum; IfcInternalOrExternalEnum; IfcOpeningElementTypeEnum; IfcPhysicalOrVirtualEnum; IfcProjectionElementTypeEnum; IfcSpaceTypeEnum; IfcSpatialZoneTypeEnum; IfcTransportElementTypeEnum; IfcSpaceBoundarySelect;	
IfcSharedBldgElements	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; IfcDoorTypeEnumOperationEnum; IfcMemberTypeEnum; IfcPlateTypeEnum; IfcRailingTypeEnum; IfcRampFlightTypeEnum; IfcRampTypeEnum; IfcRoofTypeEnum; IfcShadingDeviceTypeEnum; IfcSlabTypeEnum; IfcStairFlightTypeEnum; IfcStairTypeEnum; IfcWallTypeEnum; IfcWindowTypeEnum; IfcWindowTypePartitioningEnum;	18/75 (24%)
IfcSharedBldgServiceElements	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; IfcDistributionChamberTypeEnum; IfcDistributionPortTypeEnum; IfcDistributionSystemEnum; IfcFlowDirectionEnum;	22/30 (73%)
IfcSharedComponentElements	IfcBuildingElementPart; IfcBuildingElementPartType; IfcDiscreteAccessory; IfcDiscreteAccessoryType; IfcElementComponent; IfcElementComponentType; IfcFastener; IfcFastenerType; IfcMechanicalFastener; IfcMechanicalFastenerType; IfcBuildingElementPartTypeEnum; IfcDiscreteAccessoryTypeEnum; IfcFastenerTypeEnum; IfcMechanicalFastenerTypeEnum;	2/14 (14%)
IfcSharedFacilitiesElements	IfcAsset; IfcFurniture; IfcFurnitureType; IfcInventory; IfcOccupant; IfcSystemFurnitureElement; IfcSystemFurnitureElementType;	4/11 (36%)

Namespace	Definitions	Usage
	IfcFurnitureTypeEnum; IfcInventoryTypeEnum; IfcOccupantTypeEnum; IfcSystemFurnitureElementTypeEnum;	
IfcSharedMgmtElements	IfcActionRequest; IfcCostItem; IfcCostSchedule; IfcPermit; IfcProjectOrder; IfcActionRequestTypeEnum; IfcCostItemTypeEnum; IfcCostScheduleTypeEnum; IfcPermitTypeEnum; IfcProjectOrderTypeEnum;	2/10 (20%)
IfcArchitectureDomain	IfcDoorLiningProperties; IfcDoorPanelProperties; IfcDoorStyle; IfcPermeableCoveringProperties; IfcWindowLiningProperties; IfcWindowPanelProperties; IfcWindowStyle; IfcDoorPanelOperationEnum; IfcDoorPanelPositionEnum; IfcDoorStyleConstructionEnum; IfcDoorStyleOperationEnum; IfcPermeableCoveringOperationEnum; IfcWindowPanelOperationEnum; IfcWindowPanelPositionEnum; IfcWindowStyleConstructionEnum; IfcWindowStyleOperationEnum;	0/16 (0%)
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;	6/20 (30%)
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;	6/66 (9%)
IfcHvacDomain	IfcAirTerminal; IfcAirTerminalBox; IfcAirTerminalBoxType; IfcAirTerminalType; IfcAirToAirHeatRecovery; IfcAirToAirHeatRecoveryType; IfcBoiler; IfcBoilerType; IfcBurner; IfcBurnerType; IfcChiller; IfcChillerType; IfcCoil; IfcCoilType; IfcCompressor; IfcCompressorType; IfcCondenser; IfcCondenserType;	21/99 (21%)

Namespace	Definitions	Usage
	<p>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; IfcPumpTypeEnum; IfcSpaceHeaterTypeEnum; IfcTankTypeEnum; IfcTubeBundleTypeEnum; IfcUnitaryEquipmentTypeEnum; IfcValveTypeEnum; IfcVibrationIsolatorTypeEnum;</p>	
IfcPlumbingFireProtectionDomain	<p>IfcFireSuppressionTerminal; IfcFireSuppressionTerminalType; IfcInterceptor; IfcInterceptorType; IfcSanitaryTerminal; IfcSanitaryTerminalType; IfcStackTerminal; IfcStackTerminalType; IfcWasteTerminal; IfcWasteTerminalType; IfcFireSuppressionTerminalTypeEnum; IfcInterceptorTypeEnum; IfcSanitaryTerminalTypeEnum; IfcStackTerminalTypeEnum; IfcWasteTerminalTypeEnum;</p>	6/15 (40%)
IfcStructuralAnalysisDomain	<p>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;</p>	0/39 (0%)
IfcStructuralElementsDomain	<p>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;</p>	1/27 (4%)

Namespace	Definitions	Usage
IfcActorResource	IfcActorRole; IfcAddress; IfcOrganization; IfcOrganizationRelationship; IfcPerson; IfcPersonAndOrganization; IfcPostalAddress; IfcTelecomAddress; IfcAddressTypeEnum; IfcRoleEnum; IfcActorSelect;	9/11 (82%)
IfcApprovalResource	IfcApproval; IfcApprovalRelationship; IfcResourceApprovalRelationship;	0/3 (0%)
IfcConstraintResource	IfcConstraint; IfcMetric; IfcObjective; IfcReference; IfcResourceConstraintRelationship; IfcBenchmarkEnum; IfcConstraintEnum; IfcLogicalOperatorEnum; IfcObjectiveEnum; IfcMetricValueSelect;	0/10 (0%)
IfcCostResource	IfcAppliedValue; IfcCostValue; IfcCurrencyRelationship; IfcArithmeticOperatorEnum; IfcAppliedValueSelect;	3/5 (60%)
IfcDateTimeResource	IfcEventTime; IfcIrregularTimeSeries; IfcIrregularTimeSeriesValue; IfcLagTime; IfcRecurrencePattern; IfcRegularTimeSeries; IfcResourceTime; IfcSchedulingTime; IfcTaskTime; IfcTaskTimeRecurring; IfcTimePeriod; IfcTimeSeries; IfcTimeSeriesValue; IfcWorkTime; IfcDate; IfcDateTime; IfcDayInMonthNumber; IfcDayInWeekNumber; IfcDuration; IfcMonthInYearNumber; IfcTime; IfcTimeStamp; IfcDataOriginEnum; IfcRecurrenceTypeEnum; IfcTaskDurationEnum; IfcTimeSeriesDataTypeEnum; IfcTimeOrRatioSelect;	14/27 (52%)
IfcExternalReferenceResource	IfcClassification; IfcClassificationReference; IfcDocumentInformation; IfcDocumentInformationRelationship; IfcDocumentReference; IfcExternalInformation; IfcExternalReference; IfcExternalReferenceRelationship; IfcLibraryInformation; IfcLibraryReference; IfcResourceLevelRelationship; IfcLanguageId; IfcURIReference; IfcDocumentConfidentialityEnum; IfcDocumentStatusEnum; IfcClassificationReferenceSelect; IfcClassificationSelect; IfcDocumentSelect; IfcLibrarySelect; IfcResourceObjectSelect;	6/20 (30%)
IfcGeometricConstraintResource	IfcConnectionCurveGeometry; IfcConnectionGeometry; IfcConnectionPointEccentricity; IfcConnectionPointGeometry; IfcConnectionSurfaceGeometry; IfcConnectionVolumeGeometry; IfcGridAxis; IfcGridPlacement; IfcLocalPlacement; IfcObjectPlacement; IfcVirtualGridIntersection; IfcCurveOrEdgeCurve; IfcGridPlacementDirectionSelect; IfcPointOrVertexPoint; IfcSolidOrShell; IfcSurfaceOrFaceSurface;	5/16 (31%)
IfcGeometricModelResource	IfcAdvancedBrep; IfcAdvancedBrepWithVoids; IfcBlock; IfcBooleanClippingResult; IfcBooleanResult; IfcBoundingBox; IfcBoxedHalfSpace; IfcCartesianPointList; IfcCartesianPointList3D; IfcCsgPrimitive3D; IfcCsgSolid; IfcExtrudedAreaSolid; IfcExtrudedAreaSolidTapered; IfcFaceBasedSurfaceModel; IfcFacetedBrep; IfcFacetedBrepWithVoids; IfcFixedReferenceSweptAreaSolid; IfcGeometricCurveSet; IfcGeometricSet; IfcHalfSpaceSolid; IfcManifoldSolidBrep; IfcPolygonalBoundedHalfSpace; IfcRectangularPyramid; IfcRevolvedAreaSolid; IfcRevolvedAreaSolidTapered; IfcRightCircularCone; IfcRightCircularCylinder; IfcSectionedSpine; IfcShellBasedSurfaceModel; IfcSolidModel; IfcSphere; IfcSurfaceCurveSweptAreaSolid; IfcSweptAreaSolid; IfcSweptDiskSolid; IfcSweptDiskSolidPolygonal; IfcTessellatedFaceSet; IfcTessellatedItem; IfcTriangulatedFaceSet; IfcBooleanOperator; IfcBooleanOperand; IfcCsgSelect; IfcGeometricSetSelect;	20/42 (48%)
IfcGeometryResource	IfcAxis1Placement; IfcAxis2Placement2D; IfcAxis2Placement3D; IfcBoundaryCurve; IfcBoundedCurve; IfcBoundedSurface; IfcBSplineCurve; IfcBSplineCurveWithKnots; IfcBSplineSurface; IfcBSplineSurfaceWithKnots; IfcCartesianPoint; IfcCartesianTransformationOperator; IfcCartesianTransformationOperator2D; IfcCartesianTransformationOperator2DnonUniform; IfcCartesianTransformationOperator3D;	21/63 (33%)

Namespace	Definitions	Usage
	<p>IfcCartesianTransformationOperator3DnonUniform; IfcCircle; IfcCompositeCurve; IfcCompositeCurveOnSurface; IfcCompositeCurveSegment; IfcConic; IfcCurve; IfcCurveBoundedPlane; IfcCurveBoundedSurface; IfcCylindricalSurface; IfcDirection; IfcElementarySurface; IfcEllipse; IfcGeometricRepresentationItem; IfcLine; IfcMappedItem; IfcOffsetCurve2D; IfcOffsetCurve3D; IfcOuterBoundaryCurve; IfcPcurve; IfcPlacement; IfcPlane; IfcPoint; IfcPointOnCurve; IfcPointOnSurface; IfcPolyline; IfcRationalBSplineCurveWithKnots; IfcRationalBSplineSurfaceWithKnots; IfcRectangularTrimmedSurface; IfcReparametrisedCompositeCurveSegment; IfcRepresentationItem; IfcRepresentationMap; IfcSurface; IfcSurfaceOfLinearExtrusion; IfcSurfaceOfRevolution; IfcSweptSurface; IfcTrimmedCurve; IfcVector; IfcDimensionCount; IfcBSplineCurveForm; IfcBSplineSurfaceForm; IfcKnotType; IfcTransitionCode; IfcTrimmingPreference; IfcAxis2Placement; IfcCurveOnSurface; IfcTrimmingSelect; IfcVectorOrDirection;</p>	
IfcMaterialResource	<p>IfcMaterial; IfcMaterialClassificationRelationship; IfcMaterialConstituent; IfcMaterialConstituentSet; IfcMaterialDefinition; IfcMaterialLayer; IfcMaterialLayerSet; IfcMaterialLayerSetUsage; IfcMaterialLayerWithOffsets; IfcMaterialList; IfcMaterialProfile; IfcMaterialProfileSet; IfcMaterialProfileSetUsage; IfcMaterialProfileSetUsageTapering; IfcMaterialProfileWithOffsets; IfcMaterialProperties; IfcMaterialRelationship; IfcMaterialUsageDefinition; IfcCardinalPointReference; IfcDirectionSenseEnum; IfcLayerSetDirectionEnum; IfcMaterialSelect;</p>	15/22 (68%)
IfcMeasureResource	<p>IfcContextDependentUnit; IfcConversionBasedUnit; IfcConversionBasedUnitWithOffset; IfcDerivedUnit; IfcDerivedUnitElement; IfcDimensionalExponents; IfcMeasureWithUnit; IfcMonetaryUnit; IfcNamedUnit; IfcSIUnit; IfcUnitAssignment; IfcAbsorbedDoseMeasure; IfcAccelerationMeasure; IfcAmountOfSubstanceMeasure; IfcAngularVelocityMeasure; IfcAreaDensityMeasure; IfcAreaMeasure; IfcBoolean; IfcComplexNumber; IfcCompoundPlaneAngleMeasure; IfcContextDependentMeasure; IfcCountMeasure; IfcCurvatureMeasure; IfcDescriptiveMeasure; IfcDoseEquivalentMeasure; IfcDynamicViscosityMeasure; IfcElectricCapacitanceMeasure; IfcElectricChargeMeasure; IfcElectricConductanceMeasure; IfcElectricCurrentMeasure; IfcElectricResistanceMeasure; IfcElectricVoltageMeasure; IfcEnergyMeasure; IfcForceMeasure; IfcFrequencyMeasure; IfcHeatFluxDensityMeasure; IfcHeatingValueMeasure; IfcIdentifier; IfcIlluminanceMeasure; IfcInductanceMeasure; IfcInteger; IfcIntegerCountRateMeasure; IfcIonConcentrationMeasure; IfcIsothermalMoistureCapacityMeasure; IfcKinematicViscosityMeasure; IfcLabel; IfcLengthMeasure; IfcLinearForceMeasure; IfcLinearMomentMeasure; IfcLinearStiffnessMeasure; IfcLinearVelocityMeasure; IfcLogical; IfcLuminousFluxMeasure; IfcLuminousIntensityDistributionMeasure; IfcLuminousIntensityMeasure; IfcMagneticFluxDensityMeasure; IfcMagneticFluxMeasure; IfcMassDensityMeasure; IfcMassFlowRateMeasure; IfcMassMeasure; IfcMassPerLengthMeasure; IfcModulusOfElasticityMeasure; IfcModulusOfLinearSubgradeReactionMeasure; IfcModulusOfRotationalSubgradeReactionMeasure; IfcModulusOfSubgradeReactionMeasure; IfcMoistureDiffusivityMeasure; IfcMolecularWeightMeasure; IfcMomentOfInertiaMeasure; IfcMonetaryMeasure; IfcNonNegativeLengthMeasure; IfcNormalisedRatioMeasure; IfcNumericMeasure; IfcParameterValue; IfcPHMeasure; IfcPlanarForceMeasure; IfcPlaneAngleMeasure; IfcPositiveLengthMeasure; IfcPositivePlaneAngleMeasure; IfcPositiveRatioMeasure; IfcPowerMeasure; IfcPressureMeasure; IfcRadioActivityMeasure; IfcRatioMeasure; IfcReal; IfcRotationalFrequencyMeasure; IfcRotationalMassMeasure; IfcRotationalStiffnessMeasure; IfcSectionalAreaIntegralMeasure;</p>	43/121 (36%)

Namespace	Definitions	Usage
	<p>IfcSectionModulusMeasure; IfcShearModulusMeasure; IfcSolidAngleMeasure; IfcSoundPowerLevelMeasure; IfcSoundPowerMeasure; IfcSoundPressureLevelMeasure; IfcSoundPressureMeasure; IfcSpecificHeatCapacityMeasure; IfcTemperatureGradientMeasure; IfcTemperatureRateOfChangeMeasure; IfcText; IfcThermalAdmittanceMeasure; IfcThermalConductivityMeasure; IfcThermalExpansionCoefficientMeasure; IfcThermalResistanceMeasure; IfcThermalTransmittanceMeasure; IfcThermodynamicTemperatureMeasure; IfcTimeMeasure; IfcTorqueMeasure; IfcVaporPermeabilityMeasure; IfcVolumeMeasure; IfcVolumetricFlowRateMeasure; IfcWarpingConstantMeasure; IfcWarpingMomentMeasure; IfcDerivedUnitEnum; IfcSI Prefix; IfcSI UnitName; IfcUnitEnum; IfcDerivedMeasureValue; IfcMeasureValue; IfcSimpleValue; IfcUnit; IfcValue;</p>	
IfcPresentationAppearanceResource	<p>IfcBlobTexture; IfcColourRgb; IfcColourRgbList; IfcColourSpecification; IfcCurveStyle; IfcCurveStyleFont; IfcCurveStyleFontAndScaling; IfcCurveStyleFontPattern; IfcDraughtingPreDefinedColour; IfcDraughtingPreDefinedCurveFont; IfcExternallyDefinedHatchStyle; IfcExternallyDefinedSurfaceStyle; IfcExternallyDefinedTextFont; IfcFillAreaStyle; IfcFillAreaStyleHatching; IfcFillAreaStyleTiles; IfcImageTexture; IfcIndexedColourMap; IfcIndexedTextureMap; IfcIndexedTriangleTextureMap; IfcPixelTexture; IfcPreDefinedColour; IfcPreDefinedCurveFont; IfcPreDefinedItem; IfcPreDefinedTextFont; IfcPresentationStyle; IfcPresentationStyleAssignment; IfcStyledItem; IfcSurfaceStyle; IfcSurfaceStyleLighting; IfcSurfaceStyleRefraction; IfcSurfaceStyleRendering; IfcSurfaceStyleShading; IfcSurfaceStyleWithTextures; IfcSurfaceTexture; IfcTextStyle; IfcTextStyleFontModel; IfcTextStyleForDefinedFont; IfcTextStyleTextModel; IfcTextureCoordinate; IfcTextureCoordinateGenerator; IfcTextureMap; IfcTextureVertex; IfcTextureVertexList; IfcFontStyle; IfcFontVariant; IfcFontWeight; IfcPresentableText; IfcSpecularExponent; IfcSpecularRoughness; IfcTextAlignment; IfcTextDecoration; IfcTextFontName; IfcTextTransformation; IfcNullStyle; IfcReflectanceMethodEnum; IfcSurfaceSide; IfcColour; IfcColourOrFactor; IfcCurveFontOrScaledCurveFontSelect; IfcCurveStyleFontSelect; IfcFillStyleSelect; IfcHatchLineDistanceSelect; IfcPresentationStyleSelect; IfcSizeSelect; IfcSpecularHighlightSelect; IfcStyleAssignmentSelect; IfcSurfaceStyleElementSelect; IfcTextFontSelect;</p>	10/69 (14%)
IfcPresentationDefinitionResource	<p>IfcAnnotationFillArea; IfcPlanarBox; IfcPlanarExtent; IfcPresentationItem; IfcTextLiteral; IfcTextLiteralWithExtent; IfcBoxAlignment; IfcTextPath;</p>	3/8 (38%)
IfcPresentationOrganizationResource	<p>IfcLightDistributionData; IfcLightIntensityDistribution; IfcLightSource; IfcLightSourceAmbient; IfcLightSourceDirectional; IfcLightSourceGoniometric; IfcLightSourcePositional; IfcLightSourceSpot; IfcPresentationLayerAssignment; IfcPresentationLayerWithStyle; IfcLightDistributionCurveEnum; IfcLightEmissionSourceEnum; IfcLayeredItem; IfcLightDistributionDataSourceSelect;</p>	2/14 (14%)
IfcProfileResource	<p>IfcArbitraryClosedProfileDef; IfcArbitraryOpenProfileDef; IfcArbitraryProfileDefWithVoids; IfcAsymmetricIShapeProfileDef; IfcCenterLineProfileDef; IfcCircleHollowProfileDef; IfcCircleProfileDef; IfcCompositeProfileDef; IfcCShapeProfileDef; IfcDerivedProfileDef; IfcEllipseProfileDef; IfcIShapeProfileDef; IfcLShapeProfileDef; IfcMirroredProfileDef; IfcParameterizedProfileDef; IfcProfileDef; IfcProfileProperties; IfcRectangleHollowProfileDef; IfcRectangleProfileDef; IfcReinforcementBarProperties; IfcRoundedRectangleProfileDef; IfcSectionProperties; IfcSectionReinforcementProperties; IfcTrapeziumProfileDef; IfcTShapeProfileDef; IfcUShapeProfileDef; IfcZShapeProfileDef; IfcProfileTypeEnum; IfcReinforcingBarRoleEnum; IfcReinforcingBarSurfaceEnum; IfcSectionTypeEnum;</p>	3/31 (10%)
IfcPropertyResource	<p>IfcComplexProperty; IfcExtendedProperties; IfcPreDefinedProperties; IfcProperty; IfcPropertyAbstraction; IfcPropertyBoundedValue; IfcPropertyDependencyRelationship; IfcPropertyEnumeratedValue;</p>	10/16 (63%)

Namespace	Definitions	Usage
	IfcPropertyEnumeration; IfcPropertyListValue; IfcPropertyReferenceValue; IfcPropertySingleValue; IfcPropertyTableValue; IfcSimpleProperty; IfcCurveInterpolationEnum; IfcObjectReferenceSelect;	
IfcQuantityResource	IfcPhysicalComplexQuantity; IfcPhysicalQuantity; IfcPhysicalSimpleQuantity; IfcQuantityArea; IfcQuantityCount; IfcQuantityLength; IfcQuantityTime; IfcQuantityVolume; IfcQuantityWeight;	3/9 (33%)
IfcRepresentationResource	IfcCoordinateOperation; IfcCoordinateReferenceSystem; IfcGeometricRepresentationContext; IfcGeometricRepresentationSubContext; IfcMapConversion; IfcMaterialDefinitionRepresentation; IfcProductDefinitionShape; IfcProductRepresentation; IfcProjectedCRS; IfcRepresentation; IfcRepresentationContext; IfcShapeAspect; IfcShapeModel; IfcShapeRepresentation; IfcStyledRepresentation; IfcStyleModel; IfcTopologyRepresentation; IfcGeometricProjectionEnum; IfcGlobalOrLocalEnum; IfcCoordinateReferenceSystemSelect; IfcProductRepresentationSelect;	11/21 (52%)
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;	7/21 (33%)
IfcUtilityResource	IfcApplication; IfcOwnerHistory; IfcTable; IfcTableColumn; IfcTableRow; IfcGloballyUniqueId; IfcChangeActionEnum; IfcStateEnum;	5/8 (63%)

4.9.7 Conformance Testing Procedures

4.9.7.1 Format and Content Requirements

4.9.7.1.1. Test Rule List

The list of test rules is defined in the mvdXML file referenced herein.

4.9.7.1.2. Test Rule Definition

The definitions of test rules are included in the mvdXML file referenced herein.

4.9.7.1.3 Test Rules Formatting

Formatting documentation for MVDXML is available at <http://www.buildingsmart-tech.org/specifications/mvd-overview/mvd-overview-summary>.

4.9.7.1.4 Test Rule Coverage Analysis

Coverage of test rules for a given IFC file may be evaluated by using the mvdXML file referenced herein with the IfcDoc tool available at <http://www.buildingsmart-tech.org/specifications/specification-tools/ifcdoc-tool/ifcdoc-beta-summary>.

4.9.7.2 Examples and Mapping Requirements

4.9.7.2.1 Example File List

The list of example files is available at http://www.nibs.org/?page=bsa_commonbimfiles.

4.9.7.2.2 Example File Description

File descriptions are available at the website identified.

4.9.7.2.3 Common BIM File Reuse

Common BIM files are re-used at the website identified.

4.9.7.2.4 Implementers' Agreements

Implementers agreements are available at <http://www.buildingsmart-tech.org/implementation/ifc-implementation/ifc-impl-agreements/ifc-impl-agreements-summary>.

4.9.7.2.5 Transformations/Mapping Allowed

Transformations are defined in the MVDXML file referenced herein.

4.9.7.2.6 Transformation/Mapping Documentation

Transformation documentation for MVDXML is available at <http://www.buildingsmart-tech.org/specifications/mvd-overview/mvd-overview-summary>.

4.9.7.3 Testing Tools and Procedures

4.9.7.3.1 Testing Tool List

IFCDOC is a Windows application that provides functionality for validating files against model view definitions, as well as authoring model view definitions. It is published by BuildingSMART International Ltd and is freely available at <http://www.buildingsmart-tech.org/specifications/specification-tools/ifcdoc-tool/ifcdoc-beta-summary>

4.9.7.3.2 Testing Tool Algorithm

The algorithm for testing files is shown in the following C# source code for IFCDOC.

4.9.7.3.2.1 Model View Validation Algorithm

The core algorithm iterates through selected model views, iterates through concept roots (applying to an entity), finds all instances of the applicable entity, iterates through concepts on each entity, and validates each concept.

```
// iterate through each concept root
foreach (DocModelView docView in this.m_project.ModelViews)
{
    if (docView.Visible)
    {
        foreach (DocConceptRoot docRoot in docView.ConceptRoots)
        {
            Type typeEntity = null;
            if (typemap.TryGetValue(docRoot.ApplicableEntity.Name.ToUpper(), out typeEntity))
            {
                // build list of instances
                List<SEntity> list = new List<SEntity>();
                foreach (SEntity instance in format.Instances.Values)
                {
                    if (typeEntity.IsInstanceOfType(instance))
                    {
                        list.Add(instance);
                    }
                }

                foreach (DocTemplateUsage docUsage in docRoot.Concepts)
                {
                    bool eachresult = true; // assume passing unless something fails

                    // if no template parameters defined, then evaluate generically
                    if (docUsage.Items.Count == 0)
                    {
                        int fail = 0;
                        int pass = 0;
                        foreach (SEntity ent in list)
                        {
                            // check with parameters plugged in
                            bool? result = true;
                            foreach (DocModelRule rule in docUsage.Definition.Rules)
                            {
                                result = rule.Validate(ent, null, typemap);
                                if (result != null && !result.Value)
                                    break;
                            }

                            if (result == null)

```



```

/// <returns></returns>
public override bool? Validate(object target, DocTemplateItem docItem, Dictionary<string, Type> typemap)
{
    if (target == null)
        return false;

    // (1) check if field is defined on target object; if not, then this rule does not apply.
    FieldInfo fieldInfo = target.GetType().GetField(this.Name);
    if (fieldInfo == null)
        return false;

    // (2) extract the value
    object value = fieldInfo.GetValue(target); // may be null

    if (value is System.Collections.IList)
    {
        System.Collections.IList list = (System.Collections.IList)value;
        int pass = 0;
        int fail = 0;
        foreach (object o in list)
        {
            bool? result = ValidateItem(o, docItem, typemap);
            if (result != null)
            {
                if (result.Value)
                {
                    pass++;
                }
                else
                {
                    fail++;
                }
            }
        }

        if (this.CardinalityMin == 0 && this.CardinalityMax == 0)
        {
            return (pass == 0);
        }
        else if (this.CardinalityMin == 0 && this.CardinalityMax == 1)
        {
            return (pass == 0 || pass == 1);
        }
        else if (this.CardinalityMin == 1 && this.CardinalityMax == 1)
        {
            return (pass == 1);
        }
        else if (this.CardinalityMin == 1)
        {
            return (fail == 0);
        }
        else
        {
            return true;
        }
    }
    else
    {
        // validate single
        return ValidateItem(value, docItem, typemap);
    }
}

```

```

/// <summary>
/// Checks a value to see if it matches the parameter value.
/// </summary>
/// <param name="value"></param>
/// <param name="docItem"></param>
/// <param name="typemap"></param>
/// <returns>True if passing, False if failing, or Null if inapplicable.</returns>
private bool? ValidateItem(object value, DocTemplateItem docItem, Dictionary<string, Type> typemap)
{
    // (3) if parameter is defined, check for match
    if (!String.IsNullOrEmpty(this.Identification))
    {
        if (docItem == null)
            return true; // parameter must be specified in order to check this rule

        string match = docItem.GetParameterValue(this.Identification);
        if (value == null && String.IsNullOrEmpty(match))
        {
            return true;
        }
        else if (value is SEntity)
        {
            if (match != null && value.GetType().Name.Equals(match))
            {
                return true;
            }
            else
            {
                return false;
            }
        }
        else if (value != null)
        {
            // pull out internal value type
            FieldInfo fieldInfo = value.GetType().GetField("Value");
            if (fieldInfo != null)
            {
                object innervalue = fieldInfo.GetValue(value);
                if (innervalue == null)
                {
                    return false;
                }
                else if (match != null && innervalue.ToString().Equals(match.ToString(), StringComparison.Ordinal))
                {
                    return true;
                }
                else if (this.IsCondition())
                {
                    // condition didn't match, so chain of rules does not apply -- return null.
                    return null;
                }
                else
                {
                    // constraint evaluated to false and conditioned applied.
                    return false;
                }
            }
            else
            {
                return false;
            }
        }
        else
        {
            return false;
        }
    }
}

```



```

    }
}

// (4) recurse through constraints or entity rules
if (this.Rules != null && this.Rules.Count > 0)
{
    foreach (DocModelRule rule in this.Rules)
    {
        // attribute rule is true if at least one entity filter matches or one constraint filter matches
        bool? result = rule.Validate(value, docItem, typemap);
        if (result != null && result.Value)
            return result;
    }

    return false;
}

return true;
}

```

4.9.7.3.2.3 Entity Rule Validation Algorithm

These support routines validate entity rules.

```

/// <summary>
/// Validates rules for an entity.
/// </summary>
/// <param name="target">Required object to validate.</param>
/// <param name="docItem">Template item to validate.</param>
/// <param name="typemap">Map of type names to type definitions.</param>
/// <returns>True if passing, False if failing, or Null if inapplicable.</returns>
public override bool? Validate(object target, DocTemplateItem docItem, Dictionary<string, Type> typemap)
{
    // checking for matching cast
    Type t = null;
    if (!typemap.TryGetValue(this.Name.ToUpper(), out t))
        return false;

    if (!t.IsInstanceOfType(target))
        return false;

    if (target is SEntity)
    {
        foreach (DocModelRule rule in this.Rules)
        {
            bool? result = rule.Validate((SEntity)target, docItem, typemap);

            // entity rule is inapplicable if any attribute rules are inapplicable
            if (result == null)
                return null;

            // entity rule fails if any attribute rules fail
            if (!result.Value)
                return false;
        }
    }

    return true;
}

```

4.9.7.3.3 Testing Tools Sample Files

Sample IFC files are available at the following URL: http://www.nibs.org/?page=bsa_commonbimfiles

4.9.7.3.4 Testing Tool Software Availability

The IFCDOC tool for testing is available at the following URL: <http://www.buildingsmart-tech.org/specifications/specification-tools/ifcdoc-tool/ifcdoc-beta-summary9>

4.9.8 Implementation Resources

4.9.8.1 Implementation Resources list

4.9.8.1.1 Implementation Guides

Implementation guides are available at buildingsmart-tech.org/downloads.

4.9.8.2 Implementation Resources Completeness

4.9.8.2.1 Workflow Coverage Methodology

Implementation resources for various BIM platform workflows are available at <http://www.buildingsmart-tech.org/implementation>. Additional platforms and workflows may be added as indicated on the web page.

4.9.8.2.2 Workflow Coverage Analysis

A map of software applications, platforms, and supported model views is available at <http://www.buildingsmart-tech.org/implementation/implementations>.

4.9.9 Revision Plans

4.9.9.1 Revision Plans List

4.9.9.1.1 Revision Management Process

No revisions to this version 1.0 standard have been identified at this time. Revisions will be identified, evaluated and introduced based on initial uses of LCie exchanges that will begin as part of 2015 bSa Challenge events.

4.9.9.1.2 Revision Management Notification

Revisions will be proposed through a new LinkedIn LCie Group.

4.9.9.2 Proposed Revision Deployment Methods

4.9.9.2.1 Revision Management Process

No revisions to this version 1.0 standard have been identified at this time. Revisions will be identified, evaluated and introduced based on initial uses of LCie exchanges that will begin as part of 2015 bSa Challenge events.

4.9.9.2.2 Revision Management Notification

Revisions will be proposed through a new LinkedIn LCie Group.

[Annex A](#)

The following electronic formats are attached herein:

WSie2013.exp – schema in EXPRESS format

WSie2013.xsd – schema in XSD format

WSie2013.mdxml – model view definition

WSie2013.ifc – property set templates

Bibliography

ISO 639-1, Codes for the representation of names of languages — Part 1: Alpha-2 code

ISO 639-2, Codes for the representation of names of languages — Part 2: Alpha-3 code

ISO 639-3, Codes for the representation of names of languages — Part 3: Alpha-3 code for comprehensive coverage of languages

ISO 6707-1, Building and civil engineering — Vocabulary — Part 1: General terms

ISO 8601, Data elements and interchange formats — Information Exchange — Representation of dates and times.

ISO 10303-1:1994, Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles

ISO 10303-11, Industrial automation systems and integration — Product data representation and exchange — Part 11: description methods: The EXPRESS Language Reference Manual

ISO 10303-21, Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure

ISO 10303-28, Industrial automation systems and integration — Product data representation and exchange — Part 28: Implementation methods: XML representations of EXPRESS schemas and data, using XML schemas

ISO 10303-41, Product data representation and exchange — Integrated generic resource — Fundamentals of product description and support

ISO 10303-42, Product data representation and exchange — Integrated generic resource — Geometric and topological representation

ISO 10303-43, Product data representation and exchange — Integrated generic resource — Representation structures

ISO 10303-46, Product data representation and exchange — Integrated generic resource — Visual presentation

ISO 10303-514, Product data representation and exchange — Application interpreted construct — Advanced boundary representation

ISO 12006-3, Building construction — Organization of information about construction works — Part 3: Framework for object-oriented information

ISO/IEC 8824-1, Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation.

ISO/IEC 14772-1, Information technology — Computer graphics and image processing — The Virtual Reality Modeling Language — Part 1: Functional specification and UTF-8 encoding

ISO/IEC 19775-1, Information technology — Computer graphics and image processing — Extensible 3D (X3D) — Part 1: Architecture and base components

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CSS-1, Cascading Style Sheets, level 1 — W3C Recommendation

XML Schema Part 2, XML Schema Part 2: Datatypes — W3C Recommendation

RFC 3986, Uniform Resource Identifier (URI): Generic Syntax — Network Working Group NWG Standard

RFC 5646, Tags for Identifying Languages — Internet Engineering Task Force IETF Best Current Practice 47