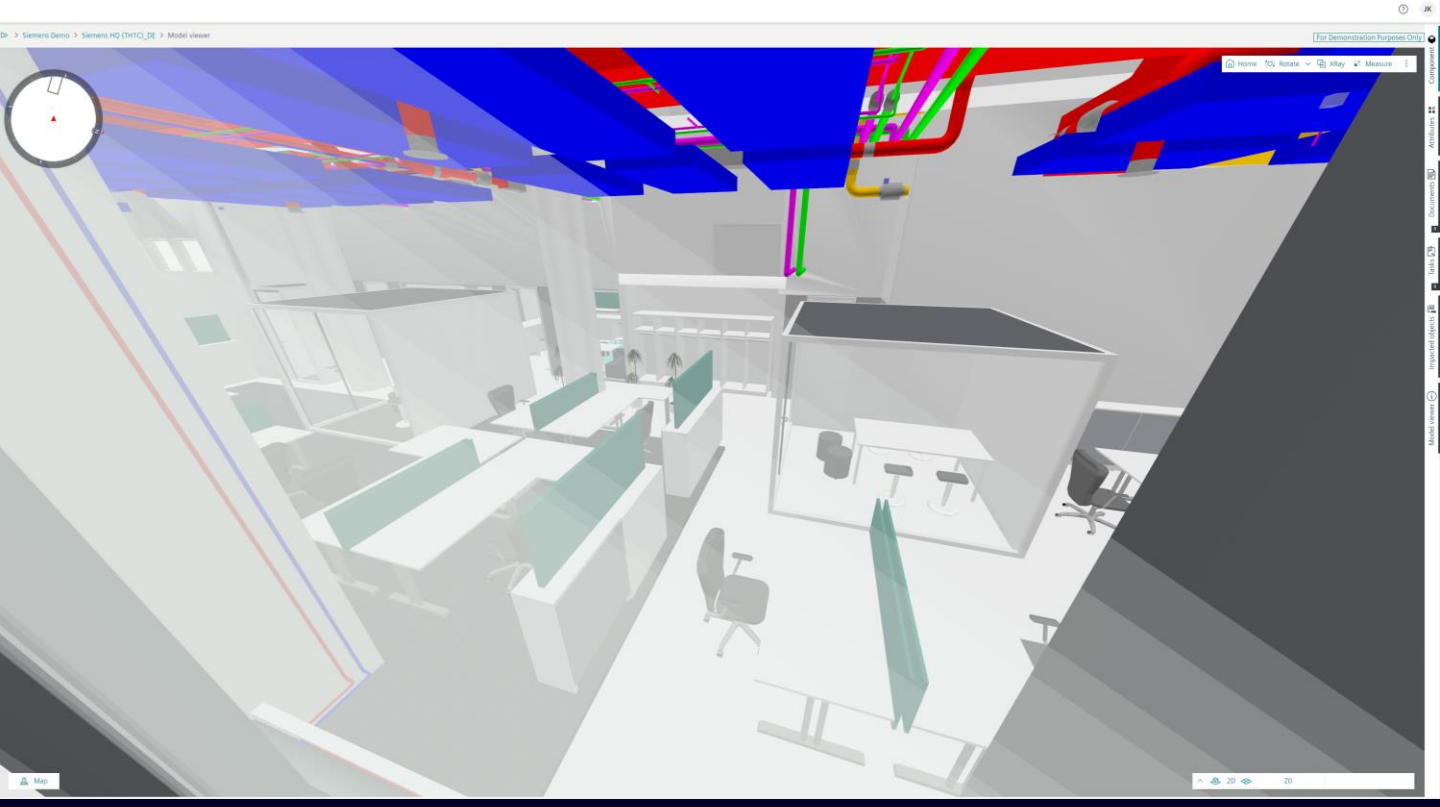
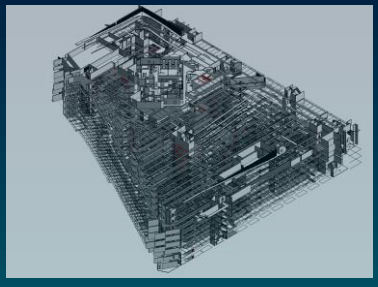


IFC Guideline & Data Management Principles for Facility Management

with Building X Lifecycle Twin (BxLT)

For IFC Files



Model Specifications & Best Practices Guide for producing a Building Twin in BxLT fit for Facilities Management (FM) and Operations

Version	Date Created	Status
1.0 DRAFT	18.12.2024	Version 1.0 DRAFT
1.0	16.07.2025	Reorganization to IFC Focus, Release

SIEMENS

ABOUT THESE SPECIFICATIONS

Audience

These specifications are designed for MEP planners, design consultants, construction consultants and BIM consultant companies, BIM professionals.

Purpose

To prepare your BIM files for using Building Information Models (BIM) for Facilities Management & Operations purposes.

- This requirement specification is designed to support the BIM-Project Team during startup phase for easier implementation with Building X Lifecycle Twin (BxLT).

- You can use this guide for your teams to specify relevant requirements into your BIM Execution Plans and Guidelines, and to execute your internal Quality Assurance & Control Plan to ensure these requirements are met.

These specifications are not built to any specific use-case. Its purpose is to form a strong basis for producing future use-cases, for which an Asset Information Requirement (AIR) will need to be further established.

To get your Model up and running in BX LT not all Specifications are mandatory, but could be very helpful. Therefore the specifications are liste as tables with an indication if they are required R, optional O or optional but very valuable V. Since the properties listed are not conclusive, you will find URLto go directly to the IFC 4.3 Documentation to see all standardized

Means and methods to achieve compliance to these specifications and the Information Requirements of your specific usecases are up to your BIM teams.

Content

The Information Requirements within this document can also be expressed as Information Delivery Specification (IDS).
It is highly recommended to use Industry Foundation Classes (IFC), implement (IDS) for quality checking, and to be aligned with ISO 19650.

CONTENTS

General Requirements

IFC Version

For digital building models, IFC provides an openly documented data model standardized as EN ISO 16739.

Even though version IFC2x3 TC1 still has the greatest market penetration, considerations regarding standardization and information requirements should be based on the latest version. If work must be done with an older version, one should orient themselves to the latest version regarding classes, PredefinedTypes or other enumerations.

Version	Name	ISO publication	Published	Status
4.3.2.0	IFC 4.3 ADD2	ISO 16739-1:2024	2024-04	Official
4.0.2.1	IFC4 ADD2 TC1	ISO 16739-1:2018	2017-10	Official
2.3.0.1	IFC2x3 TC1	ISO/PAS 16739:2005	2007-07	Official

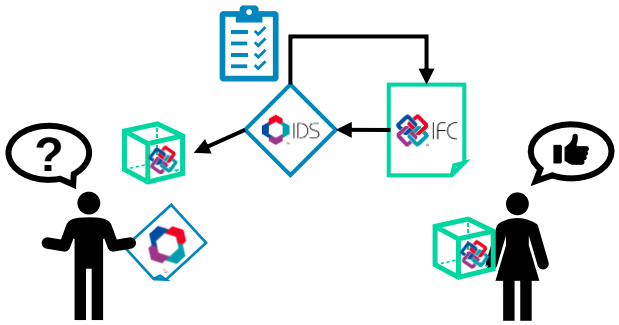
Quelle: https://technical.buildingsmart.org/standards/ifc/ifc-schema-specifications/

Model Validation (IDS)

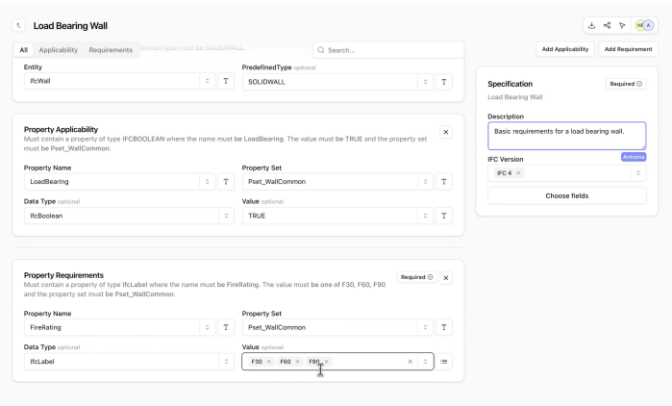
The «Level of Information Need» is a framework to help specify the Content of Modell. It adresses 3 Aspects (Geometry, Alphanumeric, Documentation) based on Data Exchanges within daily processes.

Before a modelbased Usecase starts the Models need to be validated (check if needed Information is present) and checked (for clashes, duplicates, inspection areas, regulations, …)

To validate a Model an «information requirement» is needed, which can be expressed as Information Delivery Specification (IDS) with IDS-Editors.



- Make sure that every Element is located on a Building Storey and that every relevant Asset has a relation to the Space conatining it.
- Always use the offered classes by the Datamodel (Entity with it's corresponding PredefinedType)
- Make sure all stakeholders agreed on the information requirements and use IDS
- Install a Preprocess for Validation based on IDS, best with automated Feedback for Model Authors



Quelle: https://ids-editor.com/

Human-friendly

All **walls** should have the property **FireRating** in the set **Pset_WallCommon** with a value being one of **REI30**, **REI60**, **REI90**.

Computer interpretable

```
<ids:ids xmlns:xs="http://www.w3.org/2001/XMLSchema" xm
<ids:info>
<ids:title>Example IDS</ids:title>
<ids:version>1.0</ids:version>
<ids:author>technical@buildingsmart.org</ids:author>
<ids:date>2024-01-06</ids:date>
</ids:info>
<ids:specifications>
<ids:specification ifcVersion="IFC4X3" name="Walls need
<ids:applicability minOccurs="0" maxOccurs="unbounded">
<ids:entity>
<ids:name>
<ids:simpleValue>IFCWALL</ids:simpleValue>
</ids:name>
```

Automated validation

☑ 7/10 walls passed the requirement.

☒ 2/10 walls don't have a FireRating property.

☒ 1/10 wall has a FireRating, but the value is "REI_60" which is not allowed.

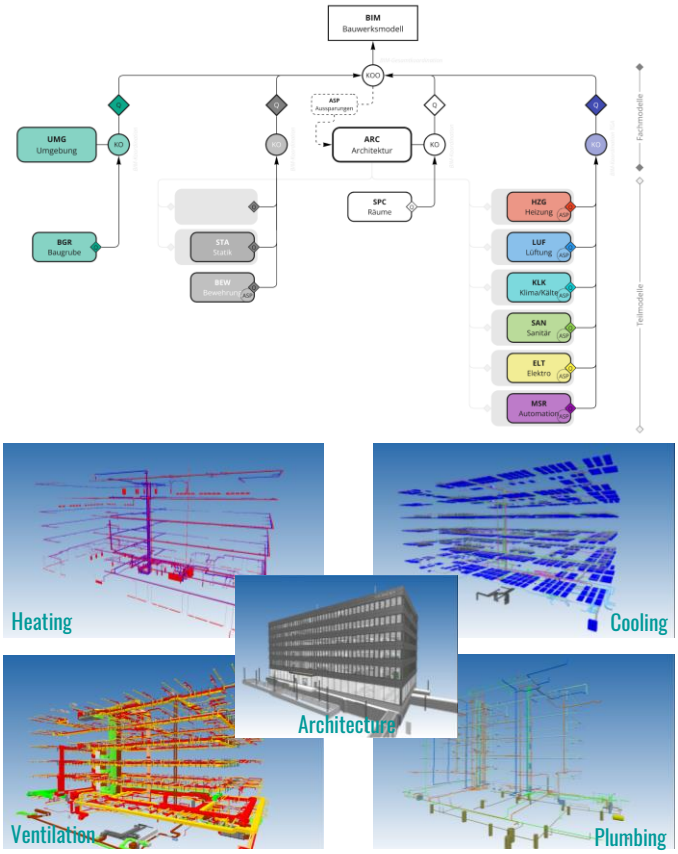
Quelle: https://www.buildingsmart.org/standards/bsi-standards/information-delivery-specification-ids/

SIEMENS

Federated Models

Das IFC-Datenmodell würde mehrere Gebäude in einem File unterstützen. Dies wird von den Autorensystemen aber kaum unterstützt, weshalb von einem Gebäude pro File auszugehen ist. Zudem ist es bewährte best-practice je Disziplin ein Fachmodell bereitzustellen. Öffnet man alle Fachmodelle gleichzeitig in einem Viewer, betrachtet man das «federated model».

- ✓ Organize files to contain one discipline per file, or use the System Concept specify Disciplines
- ✓ Choose the Naming Convention Accordingly
- ✓ Keep an eye on the File Size
- ✓ Do not split files by storeys, since a lot of related information (f.e. the elements Building ID or it's membership to the system) could get lost.
- ✓ If the client ask for splitting by storeys, ask back what was the source for this and try to fix that – the building as a unit is much easier handled in one file within every tool, not only BX LT.

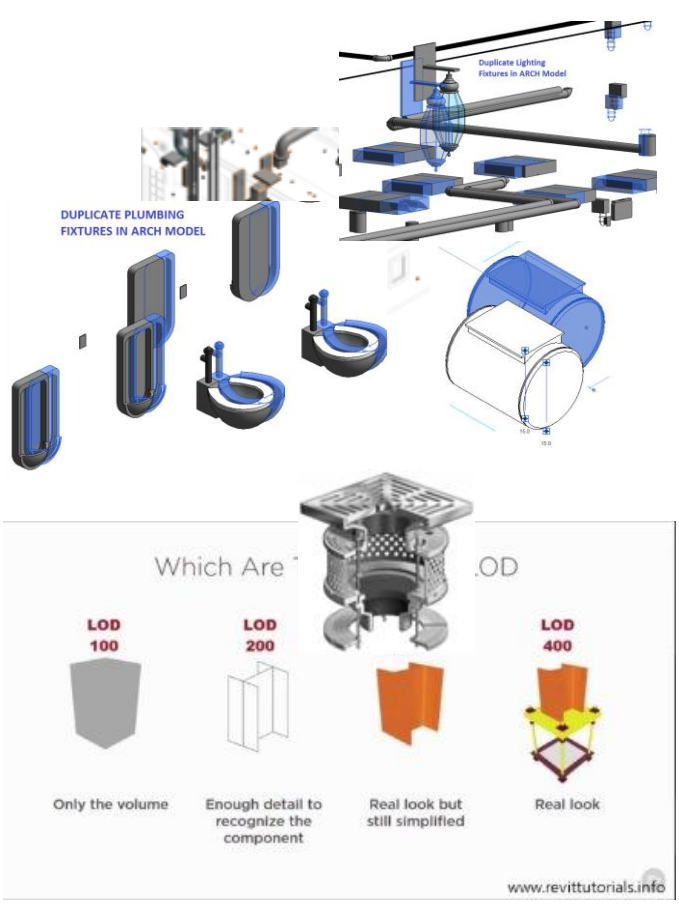


General Model Checking

As mentioned above Model Checking can have different aproaches, starting from visual checks over clash detection to more complex checks accroding to building codes etc. For these checks you will need to create your own Checking Methodology within Model Checkers like Solibri, BIMcollab, …

This is the core work to be done by BIM Coordination and BIM Management

- ✓ Make sure all files are have the same Reference Point and orientation to each other. Specify the georeferencing coordinates to that Reference Point (f.e. IfcMapConversion)
- ✓ Ensure that there are no duplicated objects for as built documentation (not within the same model and within the federated models)
- ✓ Ensure objects du not have unnecessary geometrical details, limit the number of vertices
- ✓ Turn off unneeded Objects before exporting to IFC
- ✓ Install a Preprocess for Checking, best with BCF based Feedback.



SIEMENS

Project

The project is considered as a container without geometric representation and serves for context and location purposes. For identification, one should refer to the project scope (e.g., order number). Thus, it is conceivable that a building may go through multiple projects during its operational lifetime.

The exact position is specified at this level by a project reference point, which should also be georeferenced. Even if a building is partially rotated orthogonally for efficient project planning, there is always a need to consider it oriented to true north for infrastructure, civil engineering, or operational purposes. The simplest handling is made possible through IfcMapConversion V from IFC4 onwards and should be used whenever possible (see also LoGeoRef 50).

Projektreferenzpunkt LV95	Projektreferenzpunkt WGS84
X = Ost = 2681470.472	Längengrad = 8.513425290° (Longitude)
Y = Nord = 1225866.003	Breitengrad = 47.178732648° (Latitude)
Z = Höhe = 421.804 m.ü.M	Höhe = 469.283 m

Example is converted with NAVREF

IfcProject	https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcProject.htm		
R ID	Attribute 3	Name	*BX Demo*
O Beschreibung	Attribute 4	Description	*…*
R Bezeichnung	Attribute 6	LongName	*Building X LifeCycle Twin Demo Project*
O Phase	Attribute 7	Phase	*Leistungsphasen nach HOAI, SIA, …*
V Projektart	Pset_ProjectCommon	ProjectType	*PEnum_ProjectType*

Site

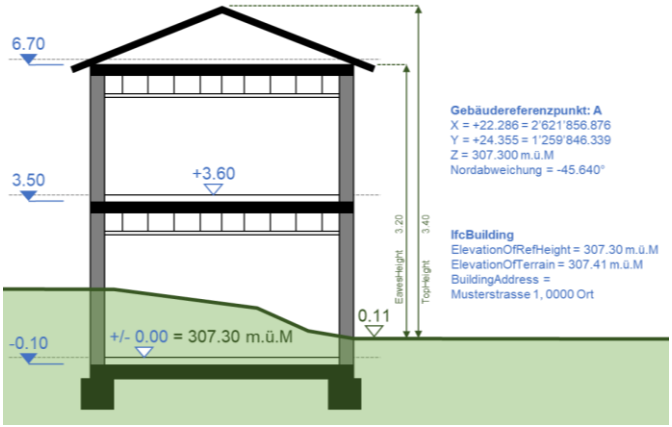
The parcel is considered as a container without geometric representation and in most projects is supplemented by a geometric terrain model (IfcGeographicElement). For identification purposes, it is worthwhile to consult national GIS services and supplement them with project-specific designations.

If no georeferencing of the location (see project) has taken place, longitude and latitude as well as address can optionally be specified on the parcel. This Address may vary from the Building Addresses.

IfcSite	https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcSite.htm		
R ID	Attribute 3	Name	*SI-CH-HQ*
O Beschreibung	Attribute 4	Description	*Zug HQ Campus*
R Bezeichnung	Attribute 8	LongName	*Siemens Campus Zug*
O Breitengrad	Attribute 10	RefLatitude	*47.178732648°*
O Längengrad	Attribute 11	RefLongitude	*8.513425290°*
R Höhenlage	Attribute 12	RefElevation	*469.283 m.ü.M*
V Parzellen ID	Pset_LandRegistration	LandID	*CH116599067457 (E-GRID)*
O Parzellen Name	Pset_LandRegistration	LandTitleID	*2179 / Zug (1711)*
O Adresse	Pset_Address	AddressLines	*Theilerstrasse 1*
O Ort	Pset_Address	Town	*6300*
O PLZ	Pset_Address	PostalCode	*Zug*

Building

The building is treated as a container without geometric representation and should consistently have uniform IDs and designations across all discipline-specific models. In addition to identification, it is important to consider the correct building reference coordinates (usually according to the national coordinate system) and reference heights. This is particularly relevant when multiple buildings are to be arranged within a project perimeter. Information such as the final address and type of usage is also significant.

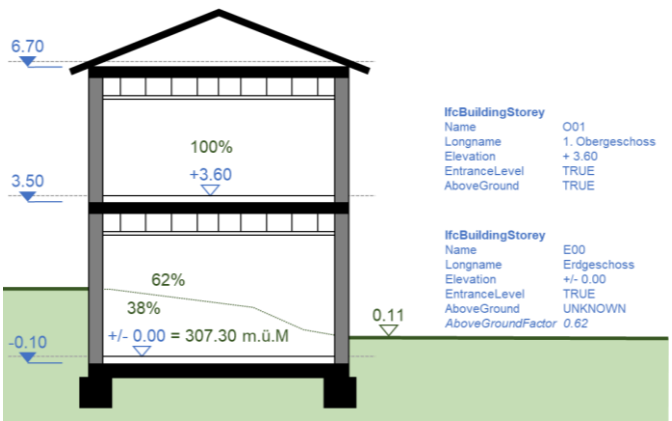


	IfcBuilding	https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcBuilding.htm		
R	ID	Attribute	Name	*TH1c*
O	Beschreibung	Attribute	Description	*Gebäude Theilerstrasse Süd*
R	Bezeichnung	Attribute	LongName	*Zug TH1c Office*
V	EGID	Pset_BuildingCommon	BuildingID	*190042697 (EGID)*
V	Nutzung Gebäude	Pset_BuildingCommon	OccupancyType	*…*
R	Referenzhöhe Gebäude	Pset_BuildingCommon	ElevationOfRefHeight	*0.00 m.ü.M*
O	Referenzhöhe Terrain	Pset_BuildingCommon	ElevationOfTerrain	*0.00 m.ü.M*
V	Adresse	Pset_Address	AddressLines	*Theilerstrasse 1c*
V	Ort	Pset_Address	Town	*6300*
V	PLZ	Pset_Address	PostalCode	*Zug*

Floor / Level

The floor/level is considered as a container without geometric representation and should be assigned a uniform ID and designation across all discipline-specific models. Additionally, the correct elevation levels (top of structural slab or finished floor) must be observed. Important information also includes the specification of whether it is the entrance level or underground floors/levels.

- There is also a possibility to use a geometric object as a representation of the floor. This is common practice particularly for calculating key figures with floor areas (see IfcSpace.GFA).



	IfcBuildingStorey	https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcBuildingStorey.htm		
R	ID	Attribute	Name	*…, U02, U01, E00, O01, O02, …*
O	Beschreibung	Attribute	Description	*…*
R	Bezeichnung	Attribute	LongName	*…, 2. Untergeschoss, …*
O	Höhenlage	Attribute	Elevation	*0.00 m.ü.M*
V	Obergeschoss?	Pset_BuildingStoreyCommon	AboveGround	*true; false; unknown;*
V	Eingangsebene?	Pset_BuildingStoreyCommon	EntranceLevel	*true; false;*
V	OK-Rohdecke	Pset_BuildingStoreyCommon	ElevationOfSSLRelative	*0.00 m*
R	OK-Fertigboden	Pset_BuildingStoreyCommon	ElevationOfFFLRelative	*0.00 m*
O	Bruttohöhe	Qto_BuildingStoreyBaseQuantities	GrossHeight	*0.00 m*
O	Nettohöhe	Qto_BuildingStoreyBaseQuantities	NetHeight	*0.00 m*

● = required | ○ = optional | × = not permitted

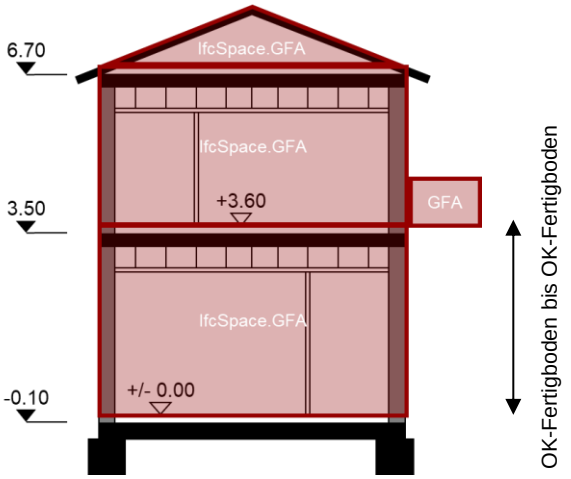
SIEMENS

Storeyvolume

Rooms/spaces are geometrically represented as volume-bodies and have specific characteristics.

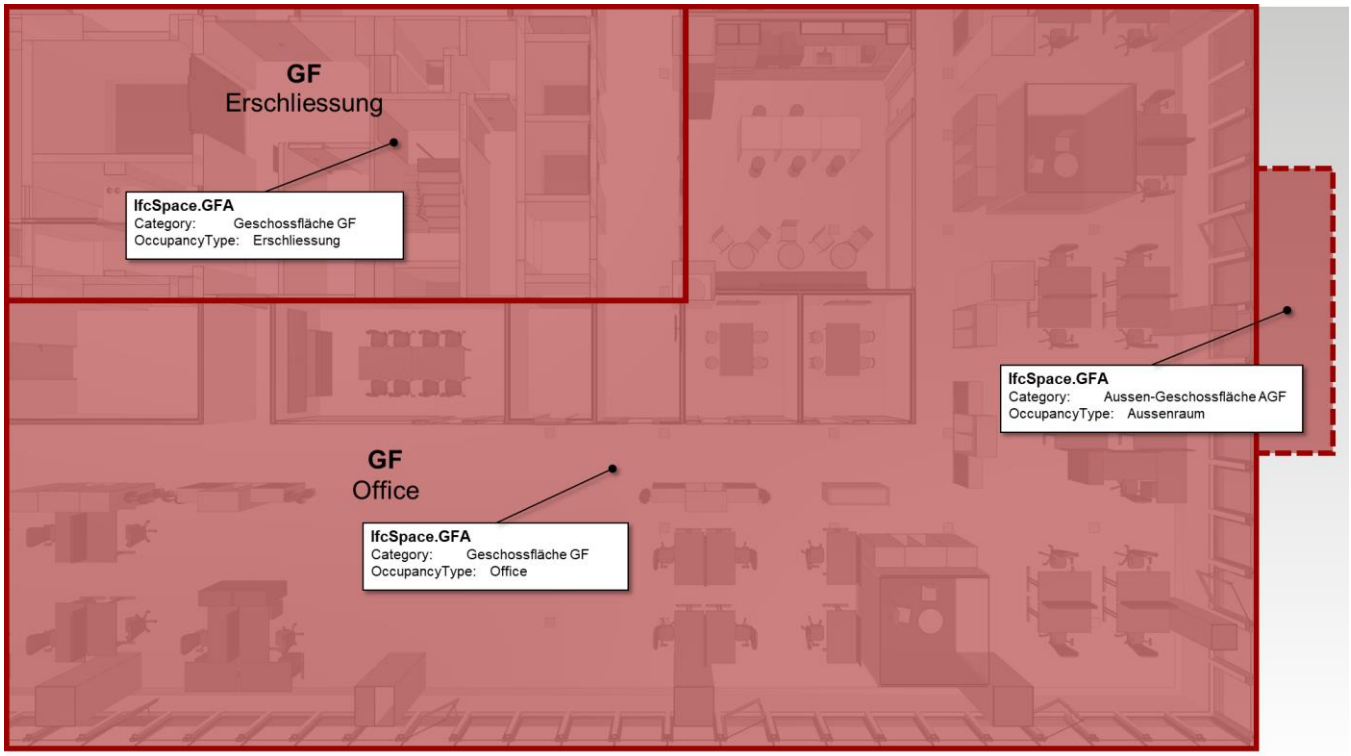
- Room (PredefinedType = SPACE)
- **Storeyvolume (PredefinedType = GFA)**
- Parking Spot (PredefinedType = PARKING)
- Berthing Spot (PredefinedType = BERTH)
- Airspace (PredefinedType = USERDEFINED:AIRSPACE)

The floor space serves for simple representation of floor area & volume. In addition to the usual information, simplified usage zones per floor can also optionally be depicted on the floor space.



	IfcSpace.GFA	https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcSpace.htm		
O	ID	Attribute 3	Name	*(Raumnummer)*
O	Beschreibung	Attribute 4	Description	*…*
V	Bezeichnung	Attribute 8	LongName	*(Raumname)*
R	Vordefinierter Typ	Attribute 10	PredefinedType	***GFA***
V	Aussenraum	Pset_SpaceCommon	IsExternal	*true; false;*
V	Nutzungsart	Pset_SpaceOccupancyRequirements	OccupancyType	*DIN277, SIA0165*
V	Fläche	Qto_SpaceBaseQuantities	GrossFloorArea	*… m^2*
O	Volumen	Qto_SpaceBaseQuantities	GrossVolume	*… m^3*
O	Umfang	Qto_SpaceBaseQuantities	GrossPerimeter	*… m*
O	Höhe	Qto_SpaceBaseQuantities	Height	*… m*

IfcSpace.GFA

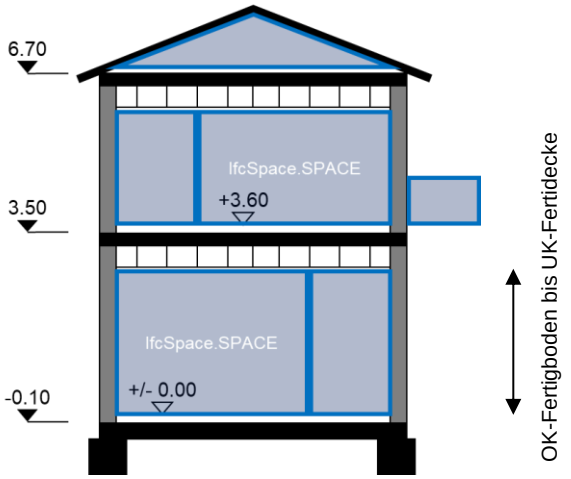


Room / Space

Rooms/spaces are geometrically represented as volume-bodies and have specific characteristics.

- **Room (PredefinedType = SPACE)**
- Storeyvolume (PredefinedType = GFA)
- Parking Spot (PredefinedType = PARKING)
- Berthing Spot (PredefinedType = BERTH)
- Airspace (PredefinedType = USERDEFINED:AIRSPACE)

The room/space serves to represent the actual room program as well as to specify all requirements for the rooms/spaces.



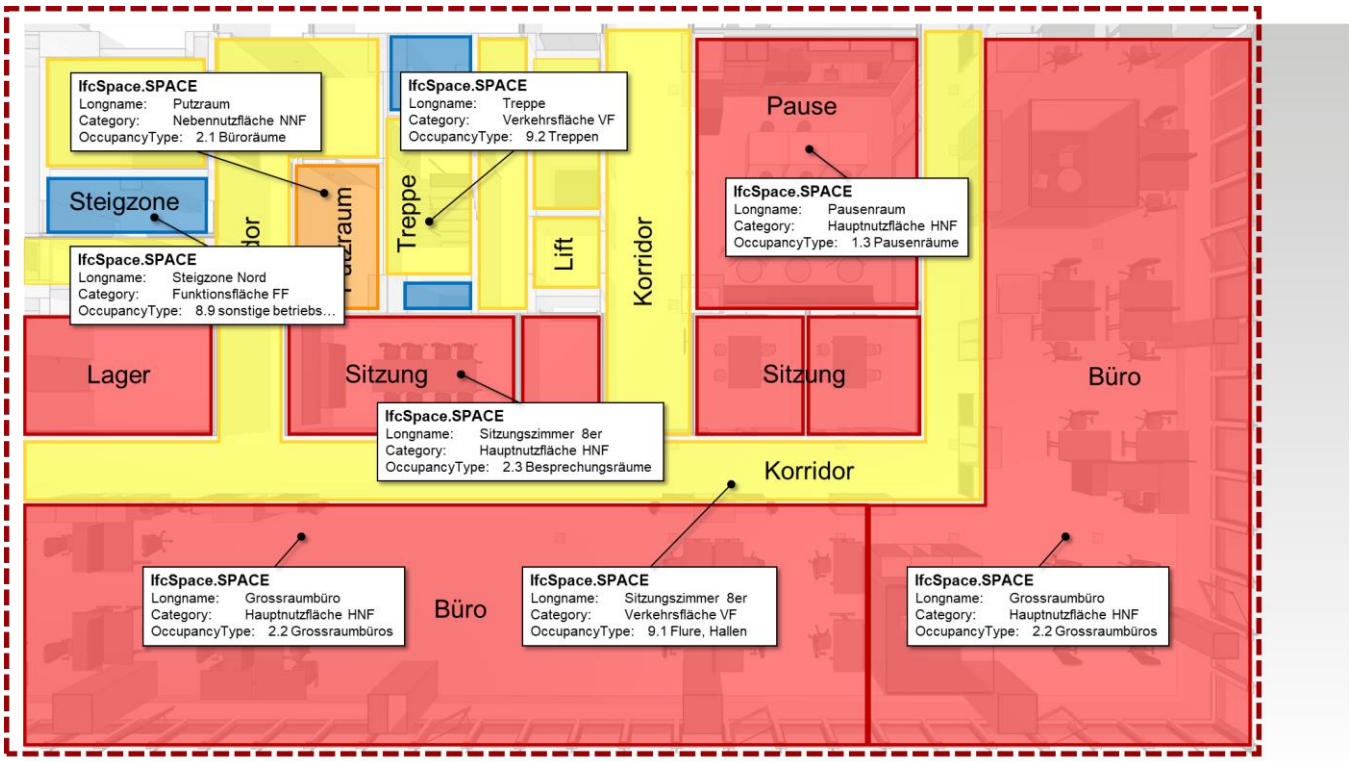
IfcSpace.SPACE

https://ifc43-docs.standards.buildingsmart.org/IFC/RELEASE/IFC4x3/HTML/lexical/IfcSpace.htm

R	ID	Attribute 3	Name	*Raumnummer*
O	Beschreibung	Attribute 4	Description	*…*
R	Bezeichnung	Attribute 8	LongName	*Raumname*
R	Vordefinierter Typ	Attribute 10	PredefinedType	***SPACE***
V	Aussenraum	Pset_SpaceCommon	IsExternal	*true; false;*
V	Nutzungsart	Pset_SpaceOccupancyRequirements	OccupancyType	*DIN277, SIA0165*
O	Bodenbelag, …	Pset_SpaceCoveringRequirements	FloorCovering, …	*…*
V	Beheizte Fläche, …	Pset_SpaceHVACDesign	DiscontinuedHeating, …	*true; false;*
V	Fläche	Qto_SpaceBaseQuantities	GrossFloorArea	*… m^2*
O	Volumen	Qto_SpaceBaseQuantities	GrossVolume	*… m^3*
O	Umfang	Qto_SpaceBaseQuantities	GrossPerimeter	*… m*
O	Höhe	Qto_SpaceBaseQuantities	Height	*… m*

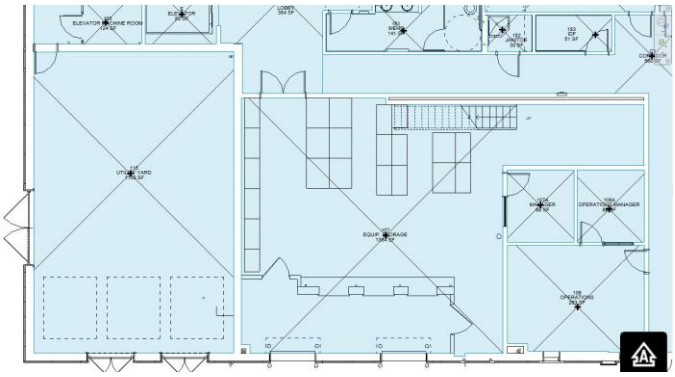
… follow link above for more valueable Psets

IfcSpace.SPACE



COMPLETE ROOMS REGISTER

Ensure that rooms **geometry** (room objects), **name** and **numbers** are created for all rooms and are acurate at each export.



Facility management personnel needs to be able to track locations and assets in all spaces that contain equipment and devices, and not only in locations that are traditionally occupied by humans. Therefore, it is important that all room records are created to include service areas outside the building, and inside the building.

- ✓ Create rooms for all spaces that contain equipment and devices in all parts of the building (internal and external)
- ✓ Ensure all rooms are placed properly with no duplicates, overlaps, unenclosed rooms or redundant rooms.

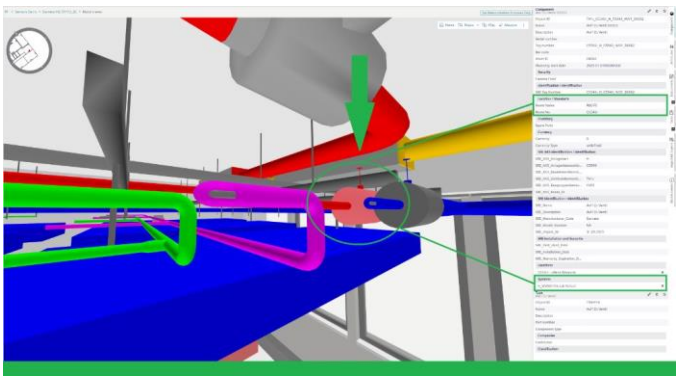
<Room Schedule- LEVEL 01>

A	B	C	D
	Name	Area	Room Catego
B1-001	VENTILATION PLANT	Not Enclosed	MEP
B1-002	ETS DROP	Not Enclosed	MEP
B1-003	NE	Not Enclosed	MEP
B1-004	ES	Not Enclosed	MEP
B1-005	IT ROOM	Not Enclosed	MEP
B1-006	KIOSK 01	6.42 m²	FM
B1-007	ELC ROOM	5.08 m²	MEP
B1-008	ELC ROOM	Not Enclosed	MEP
B1-009	VENTILATION PLANT	Not Enclosed	MEP
B1-010	ES	8.01 m²	MEP
B1-011	NE	5.67 m²	MEP
B1-013	KIOSK 02	5.60 m²	FM
B1-015	LV SWITCHROOM	Not Enclosed	MEP
B1-016	VENTILATION PLANT	Not Enclosed	MEP
B1-017	NS	4.51 m²	MEP
B1-018	ES	4.98 m²	MEP
B1-019	PODIUM AND LL LV SWITCH	Not Enclosed	MEP
B1-020	GAS SUP	15.96 m²	MEP
B1-021	IT ROOM	Not Enclosed	MEP
B1-022	ES	7.52 m²	MEP
B1-023	NE	7.80 m²	MEP
B1-024	VENTILATION PLANT	Not Enclosed	MEP
B1-025	ELEC Ltg SMALL POWER ROOM	75.64 m²	MEP
B1-026	PASS LOBBY	20.41 m²	CIRCULATIO
B1-027	TENANT LV SWITCHROOM	Redundant Room	MEP
B1-028	DRIVERS REST AREA	Redundant Room	FM

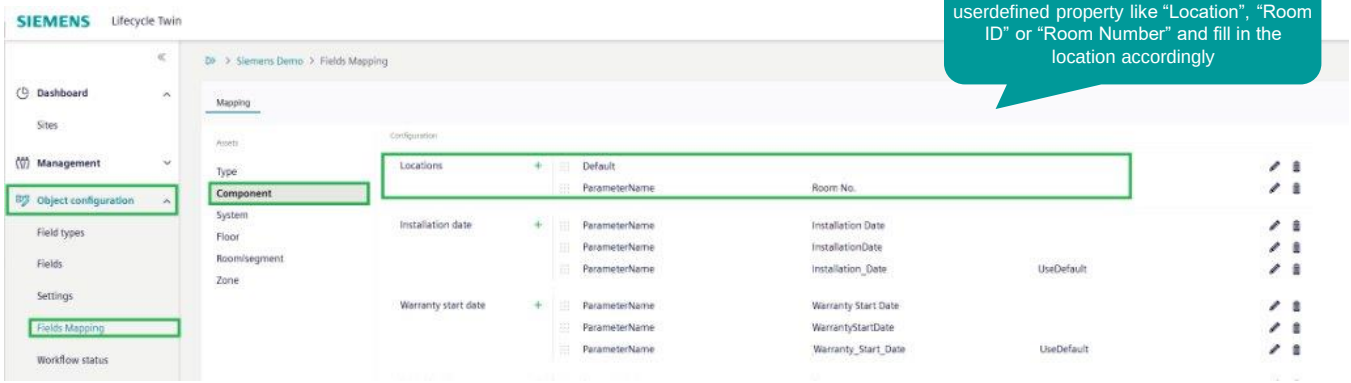
ACCURATE LOCATION REGISTER

Include locations for all critical assets. For example, for shut-off valve, “Shut-off Valve DK002” that shuts of heating supply system, “H_WV004 Fire Lab Supply”

- ✓ If the asset is included in a Space, the Concept Spatial Container makes sure a this relation gets exported and you can read the location information via this relation.
- ✓ Then, map this property to BxLT using the BxLT Field Mapping Tool.



As a workaround, you could still add a userdefined property like “Location”, “Room ID” or “Room Number” and fill in the location accordingly

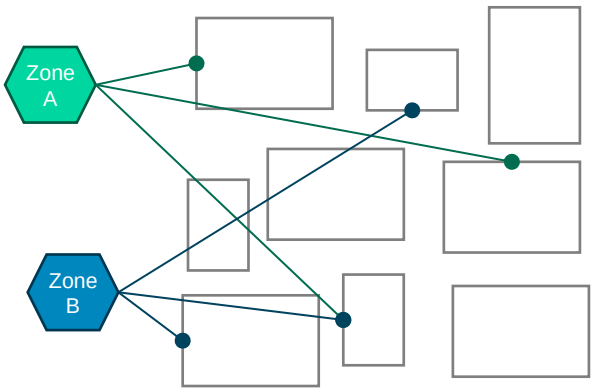


SIEMENS

Group of Spaces (Zone)

A zone in IFC is a group of spaces, partial spaces or other zones. These spaces may or may not be adjacent. A zone does not have its own shape representation. Zone structures may not be hierarchical (in contrary to the spatial structure of a project - see IfcSpatialStructureElement), i.e. one individual IfcSpace may be associated with zero, one, or several IfcZone's. For example, a zone might be used to represent an apartment as a group of spaces.

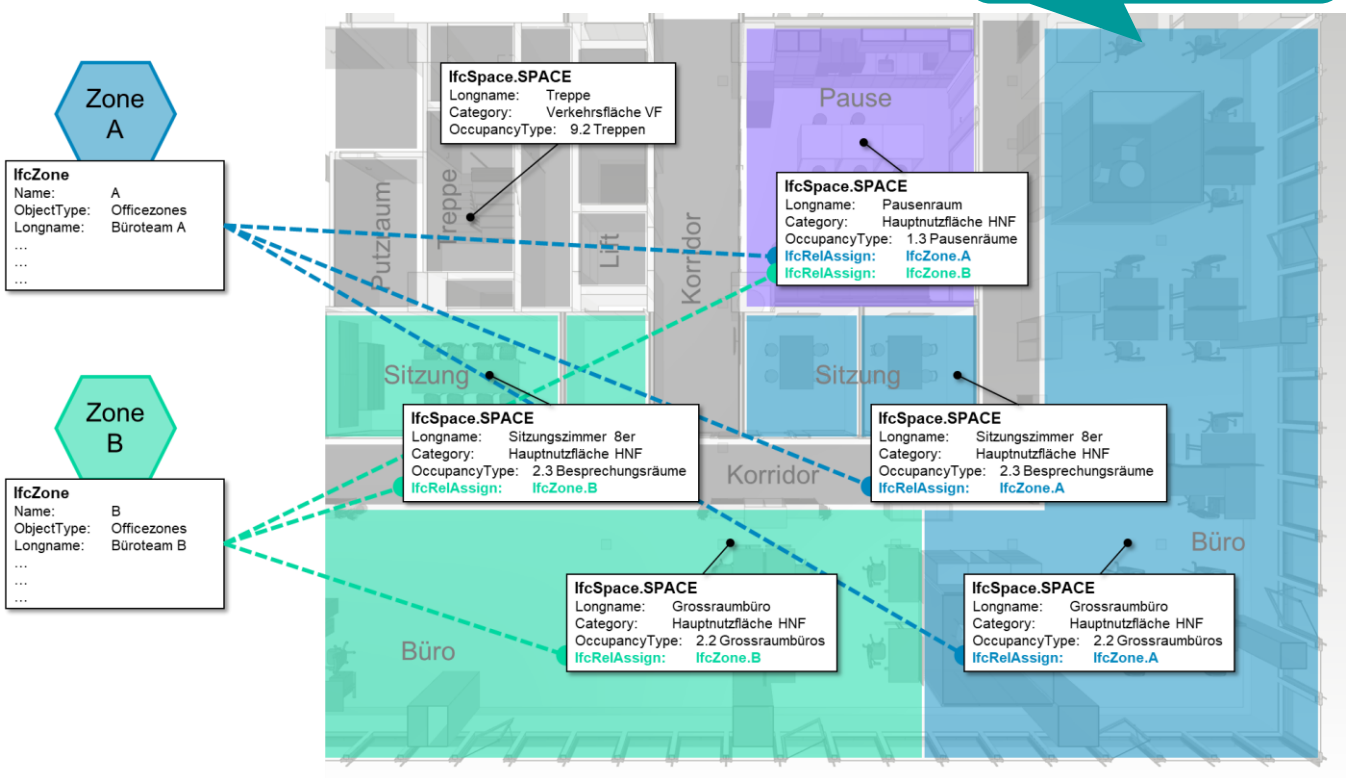
- Room groups or zones can also be created initially in BXLT. However, if these are already used during planning & realization in the BIM model, this would be the correct concept in IFC.



	IfcZone	https://standards.buildingsmart.org/IFC/RELEASE/IFC4_3/HTML/lexical/IfcZone.htm		
R	ID	Attribute 3	Name	*O01, O02, O03*
O	Beschreibung	Attribute 4	Description	*…*
V	Benutzerdefinierter Typ	Attribute 5	ObjectType	*Apartments, **Officezones**…*
O	Bezeichnung	Attribute 6	LongName	*…*
O	Öffentlich zugänglich?	Pset_ZoneCommon	PubliclyAccessible	*true; false;*
O	Hindernisfrei?	Pset_ZoneCommon	HandicapAccessible	*true; false;*
O	Sprinklerschutz?	Pset_SpaceFireSafetyRequirements	SprinklerProtection	*true; false;*
O	Beheizte Fläche, …	Pset_SpaceHVACDesign	DiscontinuedHeating, …	*true; false;*
		… follow link above for more valueable Psets		

IfcZone

To assign Spaces to a specific Zone with a relation, check your Modeling Software how to do so. As a workaround, you could still add a userdefined property with the Name of the Zone.

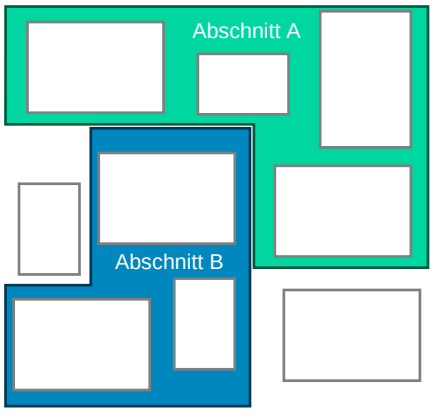


Compartment

A spatial zone in IFC is a subdivision or section of the building. The section represents a coherent area from a functional perspective and can have a geometric representation. A section can be used, for example, to represent a thermal area, a construction area, a lighting section, or a fire compartment.

The *IfcSpatialZone* is different to the *IfcZone* entity by allowing an own placement and shape representation, whereas IfcZone is only a grouping of IfcSpace's.

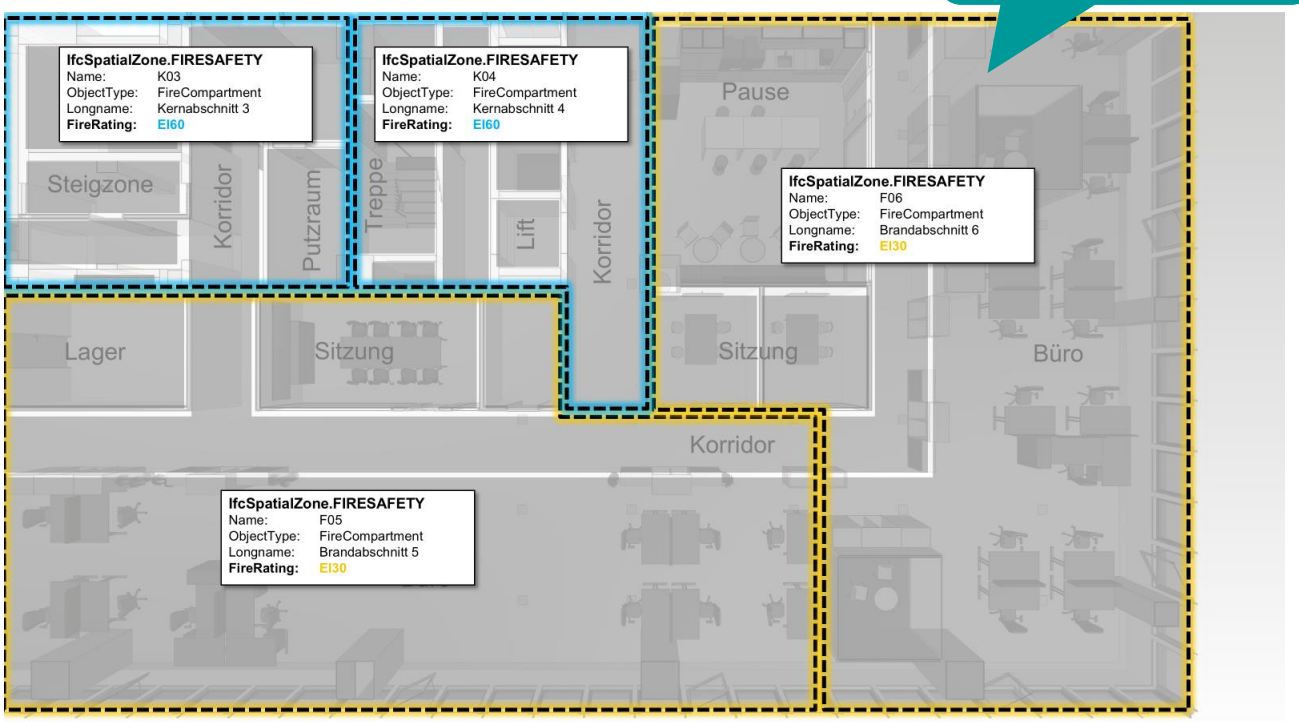
- Room groups or zones can also be created initially in BXLT. However, if these are already used during planning & realization in the BIM model, this would be the correct concept in IFC.



	IfcSpatialZone	https://standards.buildingsmart.org/IFC/RELEASE/IFC4_3/HTML/lexical/IfcSpatialZone.htm		
R	ID	Attribute 3	Name	*BRS01, BRS02, BRS03…*
O	Beschreibung	Attribute 4	Description	*…*
O	Benutzerdefinierter Typ	Attribute 5	ObjectType	*…*
O	Bezeichnung	Attribute 8	LongName	*Brandabschnitt 01, Brandabschnitt 02, …*
V	Vordefinierter Typ	Attribute 9	PredefinedType	***FIRESAFETY**, LIGHTING, SECURITY, THERMAL, VENTILATION, …*
O	Sprinklerschutz?	Pset_SpaceFireSafetyRequirements	SprinklerProtection	*true; false;*
O	Brandgefahrenklasse	Pset_SpaceFireSafetyRequirements	FireRiskFactor*	*EI30, EI60, …*
		… follow link above for more valueable Psets		

IfcSpatialZone

The Concpet of Compartments and Zones in IFC can also be combined. You could combine multiple Fire Compartments (IfcSpatialZone) by a Relation to a Fire Zone (IfcZone) if needed.



Classes

Building **elements** or **components** are referred to in data technology as classes. Authoring tools (Revit, ArchiCAD, Allplan, Vectorworks, ...), checking tools (Solibri, BIMcollab Zoom, ...), or operational tools like BXLT each have their own logic for how these classes are named and handled. IFC serves as a mediator between all these tools as a standardized data model and exchange format. IFC also describes such classes with an *Entity* and a corresponding *PredefinedType* (standardized type enumeration).

Therefore, to ensure that all tools are referring to the same building element or component, the correct assignment of these classes must be maintained. Thus, it is necessary to ensure both correct export mapping from the authoring tool, as well as correct import mapping in BXLT.

- ✓ Ensure that the class (Entity) and it's corresponding child-class (PredefinedType) is correctly mapped correctly.

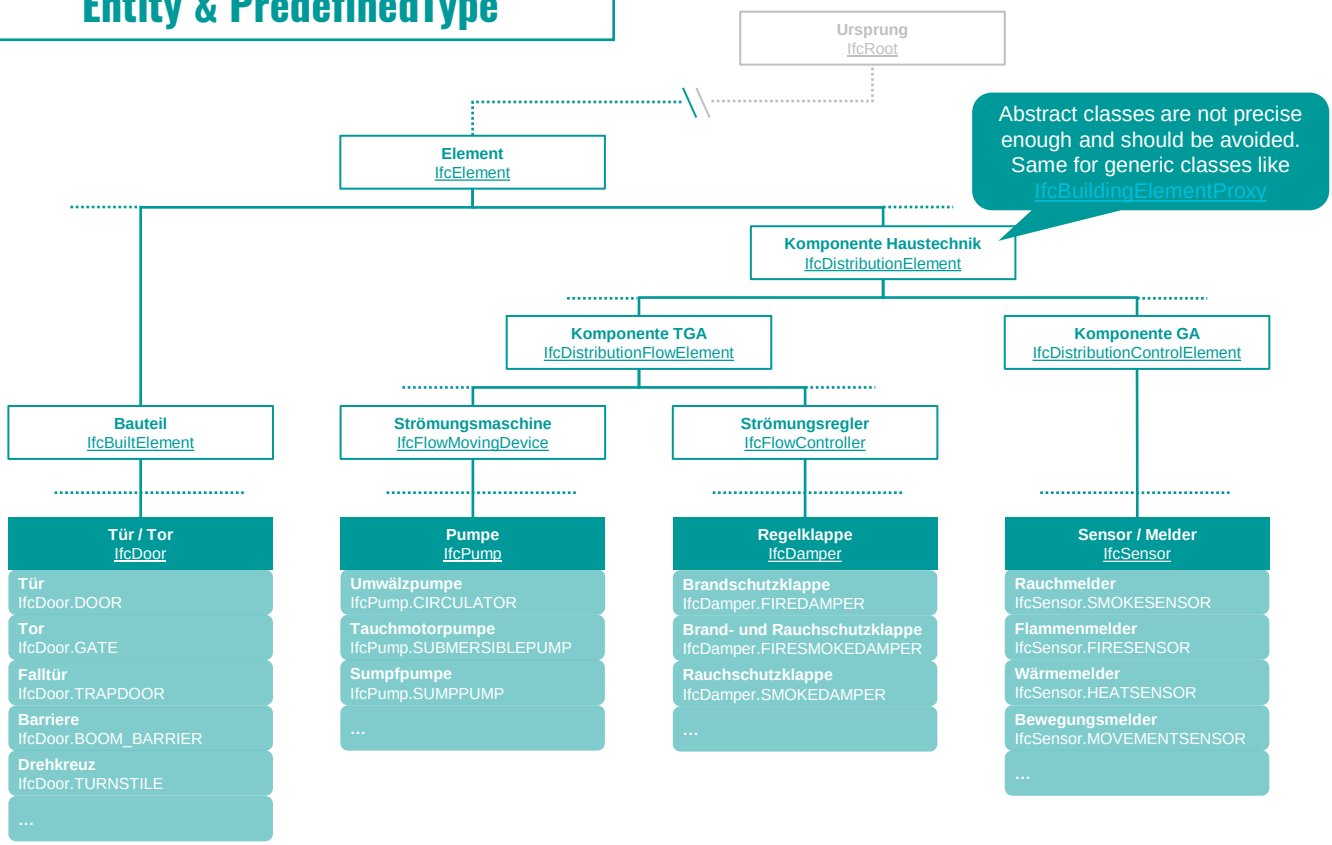
In addition to that, it's very effective to ensure that each object has a relationship to systems (e.g., supply air), which helps for leaner data management (see Systems).

For all Entities see *Annex B1: Alphabetical listings – Entities*
For all Types see: *Annex B2: Alphabetical listings - Types*

Entity Type Enumeration	PredefinedType	Bezeichnung
IfcSensor IfcSensorTypeEnum	SMOKESENSOR	Brandmelder
	FIRESENSOR	Flammenmelder
	HEATSENSOR	Wärmemelder
	GASSENSOR	Gasmelder
	TEMPERATURESENSOR	Temperaturmelder
	HUMIDITYSENSOR	Feuchtigkeitsmelder
	FROSTSENSOR	Frostsensor
	MOVEMENTSENSOR	Bewegungsmelder
	IDENTIFIERSENSOR	Leser (RFID)
	…	…
IfcAlarm IfcAlarmTypeEnum	BREAKGLASSBUTTON	Handfeuermelder
	LIGHT	Alarmindikator
	SIREN	Sirene
	MANUALPULLBOX	Handalarmtaster
	…	…
IfcUnitaryControlElement IfcUnitaryControlElementTypeEnum	CONTROLPANEL	Bedienpanel
	ALARMPANEL	Zentrale
	…	…
IfcDamper IfcDamperTypeEnum	CONTROLDAMPER	Lüftungsklappe
	FIREDAMPER	Brandschutzklappe
	…	…
IfcValve IfcValveTypeEnum	MIXING	Mischventil
	…	…
IfcDistributionBoard IfcDistributionBoardTypeEnum	DISTRIBUTIONBOARD	Unterverteilung in Wand
	MOTORCONTROLCENTRE	Motorschutzschalter
	SWITCHBOARD	Systemverteiler
	DISTRIBUTIONFRAME	Server-Rack
IfcAudioVisualAppliance IfcAudioVisualApplianceTypeEnum	CAMERA	Kamera
	SPEAKER	Lautsprecher
…	…	…

It's good practice to use PredefinedTypes from newer Versions like IFC4.3 within older Versions like IFC2x3, where some might be missing.

Entity & PredefinedType



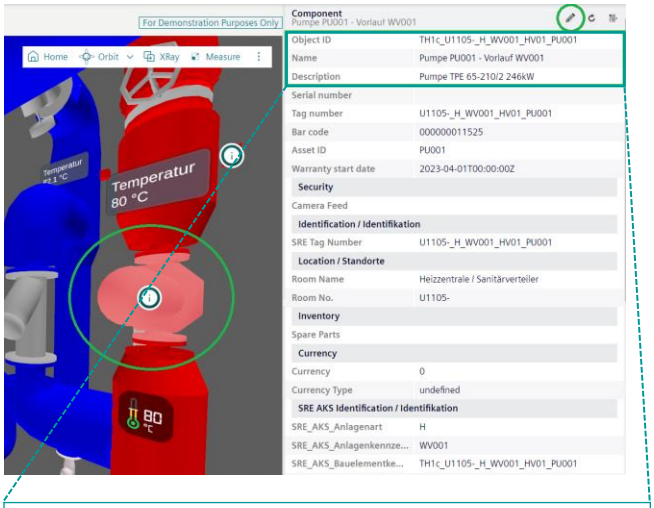
Extract of entity inheritance with highlighted classes that can be determined as components (physical element of a building we can touch)

SIEMENS

Elements

For the representation of building elements or components of a real building, concrete classes are applied. Special focus is placed on those elements that require maintenance (Assets). It is important to ensure continuous and systematic identification of elements for both humans and machines. In this context, ID, name, and description are important properties and essential for intuitive use of a Twin during operations.

- ✓ Name maintenance-relevant elements and assets uniformly and readably.
- ✓ Describe Components properly so that assets are easily recognized and searchable
- ✓ Ensure that only information serving a purpose is included in the model. If this information is transferred to the Twin, it must be maintained and kept up to date over the whole lifecycle.



Object ID	TH1c_U1105-_H_WV001_HV01_PU001
Name	Pumpe PU001 – Vorlauf WV001
Description	Pumpe TPE 65-210/2 246kW

Refer to «Unique Object Identifiers» for further explanation of the ID

Additional properties from the model can be used in the Twin but must be correctly mapped using "Fields Mapping". These properties should be derived from information requirements, based on use cases during operation and maintenance (refer to Model Validation, IDS).

The example of an asset shown below is representative of all concrete classes from IFC. Since properties such as ID, name, and description occur in all elements, these are inherited from the abstract class IfcElement. The additional properties are then specific to each building element or component. The list of possible Properties is just a selection, refer to IFC Documentation for all standardized properties.

IfcElement — IfcDoor, IfcDamper, IfcSensor, …

	IfcPump	https://standards.buildingsmart.org/IFC/RELEASE/IFC4_3/HTML/lexical/IfcPump.htm		
R	ID	Attribute 3	Name	*PU001*
V	Beschreibung	Attribute 4	Description	*Umwälzpumpe TPE 65-210/2 246kW*
V	Vordefinierter Typ	Attribute 9	PredefinedType	*CIRCULATOR, **VERTICALINLINE**, …*
O	Volumenstrom	Pset_PumpTypeCommon	FlowRateRange	
O	Strömungswiderstand	Pset_PumpTypeCommon	FlowResistanceRange	
O	Anschlussgröße	Pset_PumpTypeCommon	ConnectionSize	
O	Temperaturbereich	Pset_PumpTypeCommon	TemperatureRange	
O	Nenndrehzahl	Pset_PumpTypeCommon	NominalRotationSpeed	
O	Datum Installation	Pset_ConstructionOccurence	InstallationDate	
O	Modell Nummer	Pset_ConstructionOccurence	ModelNumber	
O	Tag Nummer	Pset_ConstructionOccurence	TagNumber	
V	Asset ID	Pset_ConstructionOccurence	AssetIdentifier	
O	Datum Installation	Pset_InstallationOccurrence	InstallationDate	
O	Datum Abnahme	Pset_InstallationOccurrence	AcceptanceDate	
O	Datum Inbetriebnahme	Pset_InstallationOccurrence	PutIntoOperationDate	
O	Artikel Nummer	Pset_ManufacturerTypeInformation	ArticleNumber	
O	Modell Label	Pset_ManufacturerTypeInformation	ModelLabel	
O	Hersteller	Pset_ManufacturerTypeInformation	Manufacturer	
O	Betriebsdokumentation	Pset_ManufacturerTypeInformation	OperationalDocument	
O	Sicherheitsdokumentation	Pset_ManufacturerTypeInformation	SafetyDocument	
O	Leistungsnachweis	Pset_ManufacturerTypeInformation	PerformanceCertificate	

… follow link above for more valueable Psets

This information particularly describes what the component must achieve in the overall context and what it was designed for. When it needs to be replaced, this information can be used to procure an equivalent product. If the information applies to multiple instances, typing concept should be used. (see also Element Typing)

The Information of Construction and Installation Occurrences may be needed to set the initial baseline for warranty and service life topics. (see also Systems)

In near future manufacturer specific information will no longer be written into IFC but linked! Follow the Topic about Digital Product Passports (DPP). The Industrial Digital Twin Association provides the Technology for such DPP's with it's Asset Administration Shell (AAS).

SIEMENS

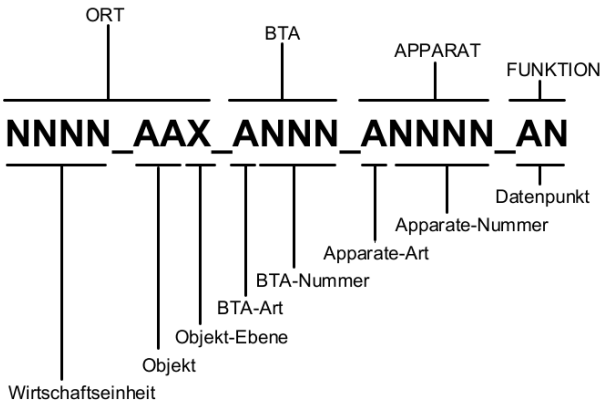
Unique Object Identifiers

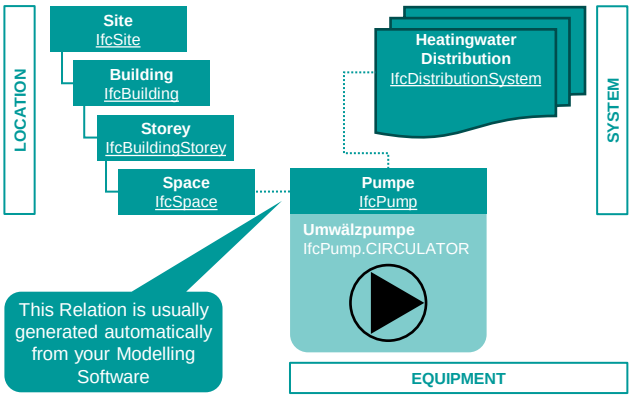
Generally, the focus is on building elements or components (assets) that are maintenance-relevant or need to be integrated into third-party systems (BAS, CMMS, CAFM, PMS, EDMS). However, the identification systematic can be used for all building elements and components.

Examples of such identification systematics (AKS) are particularly published by public clients (e.g., KBOB, BBL, ...) and are partially based on the principles of EN IEC 81346. Common identification systematics usually have a combination of information about LOCATION, SYSTEM, EQUIPMENT, and FUNCTION.

In a digital building model, the LOCATION is typically already defined by the spatial placement of an object. Through the proper use of classes, the EQUIPMENT is also defined, and the connection to the distribution system then determines the SYSTEM affiliation.

- Clarify with the client, operators, and project team which identification system must be used.
- Use automation possibilities, particularly through spatial positioning and system/equipment affiliations.
- Keep the same identifiers throughout all tools.

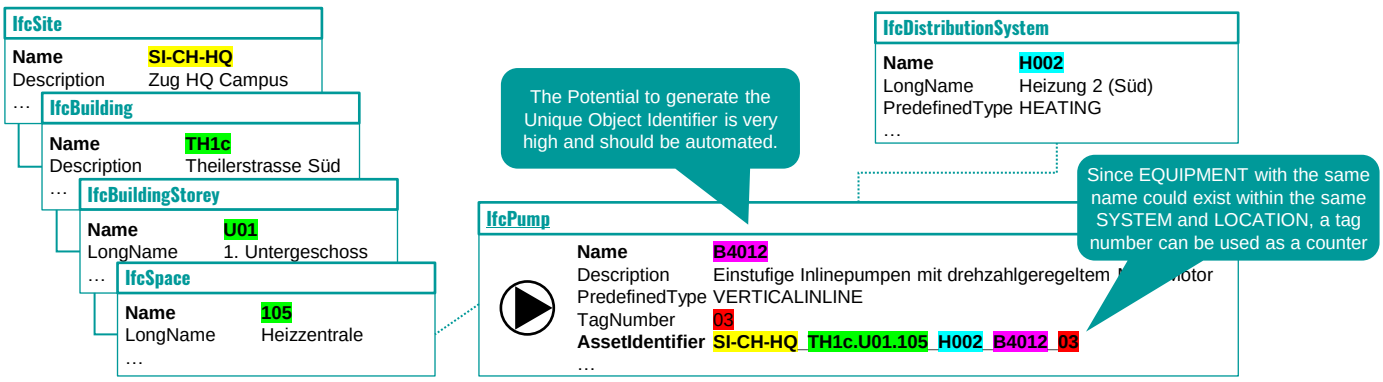




Element

	IfcElement	https://standards.buildingsmart.org/IFC/RELEASE/IFC4_3/HTML/lexical/IfcElement.htm		
R	ID	Attribute 3	Name	B4012
V	Beschreibung	Attribute 4	Description	…
V	Vordefinierter Typ	Attribute 9	PredefinedType	…
R	**Asset ID**	Pset_ConstructionOccurence	**AssetIdentifier**	**SI-CH-HQ_TH1c.U01.105_H002_B4012**
R	*Parzellen Nummer*	*Relation to IfcSite*	*Name*	*SI-CH-HQ*
R	*Gebäude Nummer*	*Relation to IfcBuilding*	*Name*	*TH1c*
R	*Stockwerk Nummer*	*Relation to IfcBuildingStorey*	*Name*	*U01*
R	*Raum Nummer*	*Relation to IfcSpace*	*Name*	*105*
R	*Anlage Nummer*	*Relation to IfcDistributionSystem*	*Name*	*H002*
V	*Anlageart*	*Relation to IfcDistributionSystem*	*PredefinedType*	*HEATING*

This Information is not stored on the Element itself, but can always be gathered by parsing the relation to another element and it's information.



SIEMENS

Element Typing

The IFC schema uses a typing concept based on the distinction between **occurrence and type**. This concept enables efficient modeling through the reuse of common properties. The connection between an occurrence (e.g., IfcPump) and its type (e.g., IfcPumpType) is established through the relationship IfcRelDefinesByType.

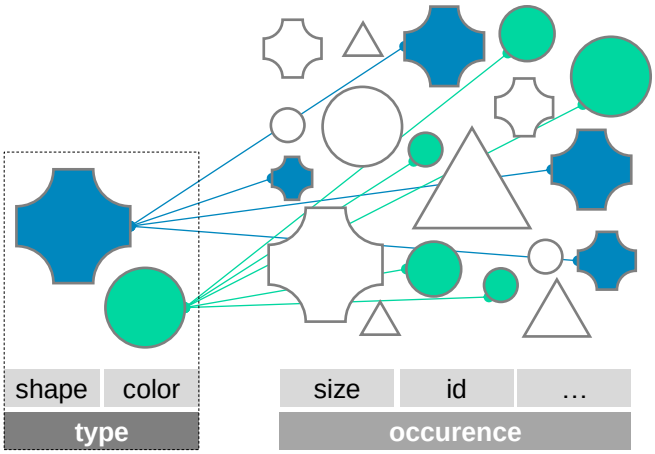
➢ This concept is supported by most authoring tools (families, types, styles) and should be exported.

The **occurrence** represents a concrete element placed in the model with:

- Specific installation location (coordinates)
- Individual characteristics (e.g., installation date)
- Concrete connections to other elements
- A PredefinedType (e.g., CIRCULATOR,...)

The **type** defines common properties for multiple elements of the same type:

- Geometric representation (shape, format)
- Technical specifications (performance, flow rate)
- Manufacturer information
- Material specifications
- Also a PredefinedType, which should match that of the occurrence



In typing, it is always crucial which characteristics are defined in the type and which are left "free" and thus left to the instance.

The example above, shows the following aspects:

- There are two typed elements (/), in which the shape and color are fixed.
- The elements are found in different sizes, so the size is left to the instance.
- There are non-typed elements with the same shape; these would not be adjusted if the type's color or shape changes. Conversely, the color or shape of the instances cannot be changed.

IfcElementType — IfcDoorType, IfcDamperTyp, IfcSensorType ...

IfcPumpType — type

Name	B4012
Description	Einstufige Inlinepumpen mit …
PredefinedType	VERTICALINLINE

Pset_PumpTypeCommon

• FlowRateRange	45.3 m3/h
• FlowResistanceRange	16.8 m
• ConnectionSize	DN 65
• TemperatureRange	-25 .. 120 °C
• NetPositiveSuctionHead	
• NominalRotationSpeed	360-4000 U/min [2910 U/min]

Pset_ManufacturerTypeInformation

• GlobalTradeItemNumber	5712607020033
• ArticleNumber	99113941
• ModelReference	TPE 65-210/2 A-F-A-BQQE-JWB
• ModelLabel	TPE 65-210
• Manufacturer	Grundfos Pumpen AG
• ProductionYear	2023
• AssemblyPlace	FACTORY
• OperationalDocument	https://productselection.grundfos...
• SafetyDocument	…
• PerformanceCertificate	…

Pset_ElectricalDeviceCommon

• RatedCurrent	5.80-4.80 A
• RatedVoltage	3 x 380-500 V
• NominalFrequencyRange	50 Hz
• PowerFactor	0.91-0.86
• ConductorFunction	
• NumberOfPoles	2
• HasProtectiveEarth	TRUE
• InsulationStandardClass	F (IEC 85)
• IP_Code	IP55
• IK_Code	
• EarthingStyle	
• HeatDissipation	155°C
• Power	3 kW
• NominalPowerConsumption	
• NumberOfPowerSupplyPorts	

…

IfcPump — occurence

Name	*B4012*
Description	*Einstufige Inlinepumpen mit …*
PredefinedType	*VERTICALINLINE*
Relation to IfcSite	SI-CH-HQ
Relation to IfcBuilding	TH1c
Relation to IfcBuildingStorey	U01
Relation to IfcSpace	105
Relation to IfcDistributionSystem	H002

Pset_PumpOccurrence

• ImpellerDiameter	127 mm
• BaseType	
• DriveConnectionType	

Pset_ConstructionOccurence

• InstallationDate	31.03.2013
• ModelNumber	B4012
• TagNumber	03
• AssetIdentifier	SI-CH-HQ_TH1c.U01.105_H002_B4012_03

Pset_ManufacturerOccurrence

- AcquisitionDate
- BarCode
- SerialNumber
- BatchReference
- AssemblyPlace
- ManufacturingDate

…

As mentioned, manufacturer-specific properties should be linked in the future (e.g., via AAS). The main part of them can be treated as type-related, so it makes sense to set up the link also at the type level. Be advised, that there will always be some properties on occurrence level, like serial number, batch reference, dates, etc.

With the Equipment Name as a typed property and a tag number as its counter, the AssetIdentifier can still be mainly automated (refer to Unique Object Identifiers)

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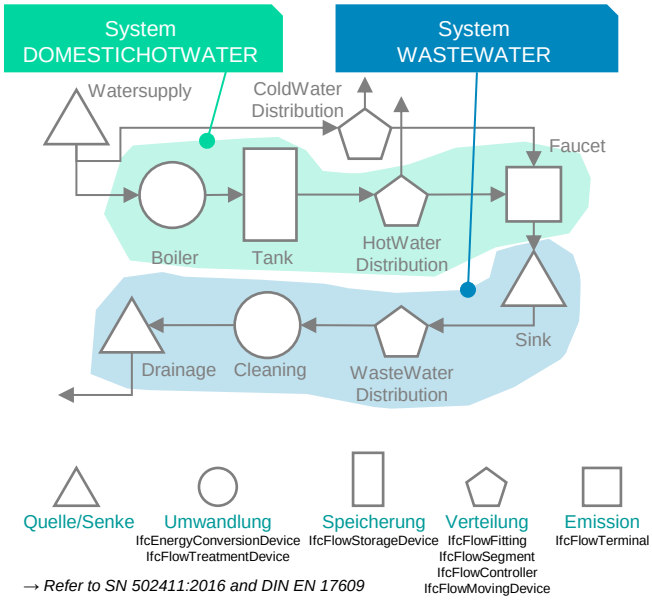
Systems

A system is a functionally coherent aggregation of elements. In IFC, a distinction is made between the systems of the building (IfcBuiltSystem) like façade, foundation, interiors, etc. and the building services distribution systems (IfcDistributionSystem). A distribution system is a network that is used to receive, store, maintain, distribute or control the flow of a medium.

- ✓ Manage the relations from elements to different systems within your Authoring Tool since it is much easier than later within BX LT.
- ✓ Name systems systematically
- ✓ Clarify which information is stored on the element or on the system, do not duplicate information.



→ *Refer to SN 502411:2016 and DIN EN 17609*

IfcDistributionSystem https://standards.buildingsmart.org/IFC/RELEASE/IFC4_3/HTML/lexical/IfcDistributionSystem.htm

R	ID	Attribute 3	Name	*H001, H002, H003, …*
O	Beschreibung	Attribute 4	Description	*…*
O	Benutzerdefinierter Typ	Attribute 5	ObjectType	*…*
O	Bezeichnung	Attribute 6	LongName	*Heizung 2 (Süd)*
V	Vordefinierter Typ	Attribute 7	PredefinedType	*AIRCONDITIONING, AUDIOVISUAL, COMMUNICATION, CONTROL, DATA, EXHAUST, FIREPROTECTION, … IfcDistributionSystemEnum*
O	Datum Installation	Pset_InstallationOccurrence	InstallationDate	
O	Datum Abnahme	Pset_InstallationOccurrence	AcceptanceDate	
O	Datum Inbetriebnahme	Pset_InstallationOccurrence	PutIntoOperationDate	

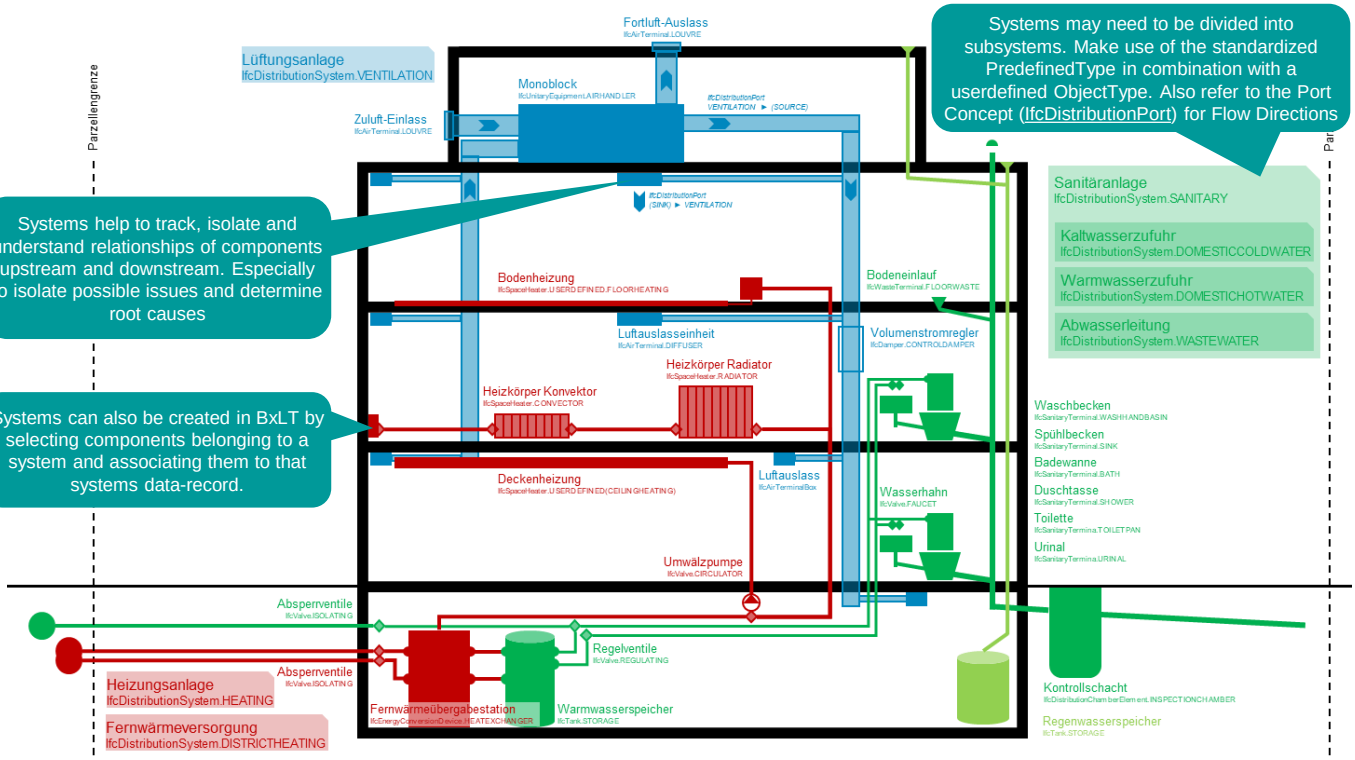
It can be very efficient to specify Information on the level of a system instead on each of it's members. Adding to the Properties from Installation and Maintanance, IFC offers standardized properties for electrical systems

IfcDistributionSystem

Systems may need to be divided into subsystems. Make use of the standardized PredefinedType in combination with a userdefined ObjectType. Also refer to the Port Concept (IfcDistributionPort) for Flow Directions

Systems help to track, isolate and understand relationships of components upstream and downstream. Especially to isolate possible issues and determine root causes

Systems can also be created in BxLT by selecting components belonging to a system and associating them to that systems data-record.



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Appendix – Environmental Properties

Pset_EnvironmentalCondition	
ReferenceAirRelativeHumidity	Measurement of the ratio of water vapor in the air.
ReferenceEnvironmentTemperature	Ideal temperature range.
MaximumAtmosphericPressure	Maximum level of atmospheric pressure that the equipment can operate effectively in.
StorageTemperatureRange	Allowed storage temperature range that the element complies with.
MaximumWindSpeed	Maximum resistance to wind load exposure.
OperationalTemperatureRange	The temperature range in which the device operates normally.Allowable operation ambient air temperature range.
MaximumRainIntensity	Maximum level of rain intensity that the equipment can operate effectively in. It is usually measured in millimeter per hour (mm/h).
SaltMistLevel	Maximum level of salt mist that the equipment can operate effectively in. It is provided according to an international or national standard.
SeismicResistance	Maximum magnitude of earthquake that the equipment complies with. The value indicates earthquake intensity measured in Richter scale.
SmokeLevel	Maximum level of smoke that the equipment complies with. It is provided according to an international or national standard.
MaximumSolarRadiation	Maximum level of solar irradiance that the equipment can operate effectively in. This is usually tested and measured by a national or international standard. The value indicates power density measured in watt per square meter (w/m2).

Pset_EnvironmentalEmissions	
CarbonDioxideEmissions	Rate of emission of carbon dioxide
SulphurDioxideEmissions	Rate of emission of sulphur dioxide
NitrogenOxidesEmissions	Rate of emission of nitrogen oxides
ParticulateMatterEmissions	Rate of emission of particulate matter
NoiseEmissions	Level of sound emission

Pset_EnvironmentalImpactIndicators	
FunctionalUnitReference	Reference to a database or a classification
IndicatorsUnit	The unit of the quantity the environmental indicators values are related with.
LifeCyclePhase	The whole life cycle or only a given phase from which environmental data are valid.
ExpectedServiceLife	Expected service life in years.
TotalPrimaryEnergyConsumptionPerUnit	Quantity of energy used as defined in ISO21930:2007.
WaterConsumptionPerUnit	Quantity of water used.
HazardousWastePerUnit	Quantity of hazardous waste generated
NonHazardousWastePerUnit	Quantity of non hazardous waste generated
ClimateChangePerUnit	Quantity of greenhouse gases emitted calculated in equivalent CO2
AtmosphericAcidificationPerUnit	Quantity of gases responsible for the atmospheric acidification calculated in equivalent SO2
RenewableEnergyConsumptionPerUnit	Quantity of renewable energy used as defined in ISO21930:2007
NonRenewableEnergyConsumptionPerUnit	Quantity of non-renewable energy used as defined in ISO21930:2007
ResourceDepletionPerUnit	Quantity of resources used calculated in equivalent antimony
InertWastePerUnit	Quantity of inert waste generated
RadioactiveWastePerUnit	Quantity of radioactive waste generated
StratosphericOzoneLayerDestructionPerUnit	Quantity of gases destroying the stratospheric ozone layer calculated in equivalent CFC-R11
PhotochemicalOzoneFormationPerUnit	Quantity of gases creating the photochemical ozone calculated in equivalent ethylene
EutrophicationPerUnit	Quantity of eutrophicating compounds calculated in equivalent PO4

Pset_EnvironmentalImpactValues	
TotalPrimaryEnergyConsumption	Quantity of energy used as defined in ISO21930:2007.
WaterConsumption	Quantity of water used.
HazardousWaste	Quantity of hazardous waste generated.
NonHazardousWaste	Quantity of non hazardous waste generated.
ClimateChange	Quantity of greenhouse gases emitted calculated in equivalent CO2.
AtmosphericAcidification	Quantity of gases responsible for the atmospheric acidification calculated in equivalent SO2.
RenewableEnergyConsumption	Quantity of renewable energy used as defined in ISO21930:2007
NonRenewableEnergyConsumption	Quantity of non-renewable energy used as defined in ISO21930:2007
ResourceDepletion	Quantity of resources used calculated in equivalent antimony.
InertWaste	Quantity of inert waste generated .
RadioactiveWaste	Quantity of radioactive waste generated.
StratosphericOzoneLayerDestruction	Quantity of gases destroying the stratospheric ozone layer calculated in equivalent CFC-R11.
PhotochemicalOzoneFormation	Quantity of gases creating the photochemical ozone calculated in equivalent ethylene.
Eutrophication	Quantity of eutrophicating compounds calculated in equivalent PO4.
LeadInTime	Lead in time before start of process.
Duration	Duration. Duration of process.
LeadOutTime	Lead out time after end of process.

Appendix – Maintanance Properties

Pset_MaintenanceStrategy	
AssetCriticality	Rating of the asset's criticality to the operation of the facility
AssetFrailty	Rating of the asset's frailty to breakage or deterioration
AssetPriority	Combined criticality and frailty rating indicating the operational and maintenance priority of the asset
MonitoringType	Monitoring strategy chosen for the asset
AccidentResponse	Accident response chosen for the asset

Pset_MaintenanceTriggerCondition	
ConditionTargetPerformance	Target condition of the asset
ConditionMaintenanceLevel	Condition that will trigger maintenance
ConditionReplacementLevel	Condition that will trigger a replacement process
ConditionDisposalLevel	Condition that will trigger a disposal process

Pset_MaintenanceTriggerDuration	
DurationTargetPerformance	Target time to failure of the asset
DurationMaintenanceLevel	Duration interval at which maintenance is performed
DurationReplacementLevel	Duration interval at which replacement is performed
DurationDisposalLevel	Duration interval at which disposal is performed

Pset_MaintenanceTriggerPerformance	
TargetPerformance	Target capacity or performance of the asset. Units of the performance value are specified through the propertyValue units attribute.
PerformanceMaintenanceLevel	Performance level at which maintenance takes place
ReplacementLevel	Performance level at which replacement takes place
DisposalLevel	Performance level at which disposal takes place

Pset_Risk	
RiskName	A locally unique identifier for the risk entry that can be used to track the development and mitigation of the risk throughout the project life cycle
RiskType	Identifies the predefined types of risk from which the type required may be set.
NatureOfRisk	A description of the generic nature of the context or hazard that might be encountered.
RiskAssessmentMethodology	An indication or link to the chosen risk assessment methodology, for example PAS1192-6 or a chosen ISO13100 annex.
UnmitigatedRiskLikelihood	Identifies the likelihood of the hazard prior to any specific mitigation.
UnmitigatedRiskConsequence	Identifies the consequence of the hazard prior to any specific mitigation.
UnmitigatedRiskSignificance	Identifies the significance of the risk given the likelihood and consequence prior to any specific mitigation.
MitigationPlanned	The planned (agreed and irrevocable) mitigation of the likelihood and consequences of the hazard.
MitigatedRiskLikelihood	Identifies the likelihood of the hazard given the planned mitigation.
MitigatedRiskConsequence	Identifies the consequence of the hazard given the planned mitigation.
MitigatedRiskSignificance	Identifies the significance of the risk given the mitigation of likelihood and consequence.
MitigationProposed	Any proposed, but not yet agreed and irrevocable, mitigation of the likelihood and consequences of the hazard.
AssociatedProduct	An indication or link to any associated product or material that may trigger the hazard. If used directly on an annotation or semantic object. for an alternative see group use encoding template
AssociatedActivity	An indication or link to any associated activity or process that may trigger the hazard. If used directly on an annotation or semantic object. for an alternative see group use encoding template
AssociatedLocation	An indication or link to any associated location or space that may trigger the hazard. If used directly on an annotation or semantic object. for an alternative see group use encoding template

Pset_RepairOccurrence	
RepairContent	Content of repair, reason and nature can be given, e.g. display faults, communication failure, display exchange.
RepairDate	Date on which the last repair is done on the asset.
MeanTimeToRepair	Mean time to repair.

Pset_ServiceLife	
ServiceLifeDuration	The length or duration of a service life. The lower bound indicates pessimistic service life, the upper bound indicates optimistic service life, and the setpoint indicates the typical service life.
MeanTimeBetweenFailure	The average time duration between instances of failure of a product.

Pset_Warranty	
WarrantyIdentifier	The identifier assigned to a warranty.
WarrantyStartDate	The date on which the warranty commences.
IsExtendedWarranty	Indication of whether this is an extended warranty whose duration is greater than that normally assigned to an artefact (=TRUE) or not (= FALSE).
WarrantyPeriod	The time duration during which a manufacturer or supplier guarantees or warrants the performance of an artefact.
WarrantyContent	The content of the warranty.
PointOfContact	The organization that should be contacted for action under the terms of the warranty. Note that the role of the organization (manufacturer, supplier, installer etc.) is determined by the IfcActorRole attribute of IfcOrganization.
Exclusions	Items, conditions or actions that may be excluded from the warranty or that may cause the warranty to become void.

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Version Update Details

Version	Date Created	Status
1.0 DRAFT	18.12.2024	Version 1.0 Draft
1.0	16.07.2025	Version 1.0 Release