

IFC Format (Teil 1)

Technologie

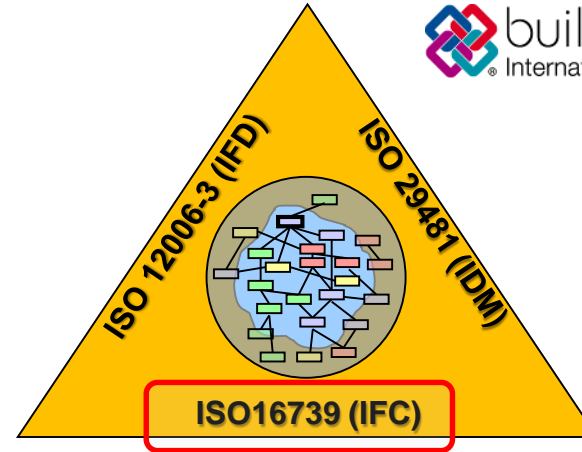
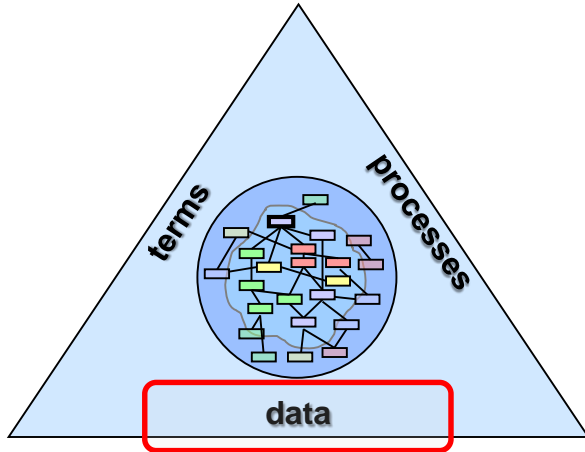
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AEC3 Deutschland GmbH

OKSTRA/IFC-Workshop (19./20.12.2017)



Einordnung des IFC-Standards von buildingSMART



- **IFC Schema** (IFC2x3, IFC4 Add.2, IFC4.1 (Alignment), IFC5, ...)
Objekt-orientierte Datenstruktur für den BIM-Datenaustausch
- **MVD – Model View Definitions** (Coordination View, FM Handover View, ..)
Implementierung und Prüfung des Datenaustauschs
- **IDM – Information Delivery Manual**
Anwendung von IFC im Projekt (Wer, was, wann, wie und an wen)
- **IFD/bsDD – International Framework for Dictionaries/buildingSMART Data Dictionary**
Begriffsdefinition
- **BCF – BIM Collaboration Format**
Aufgaben und Änderungsmanagement für die Steuerung der Zusammenarbeit

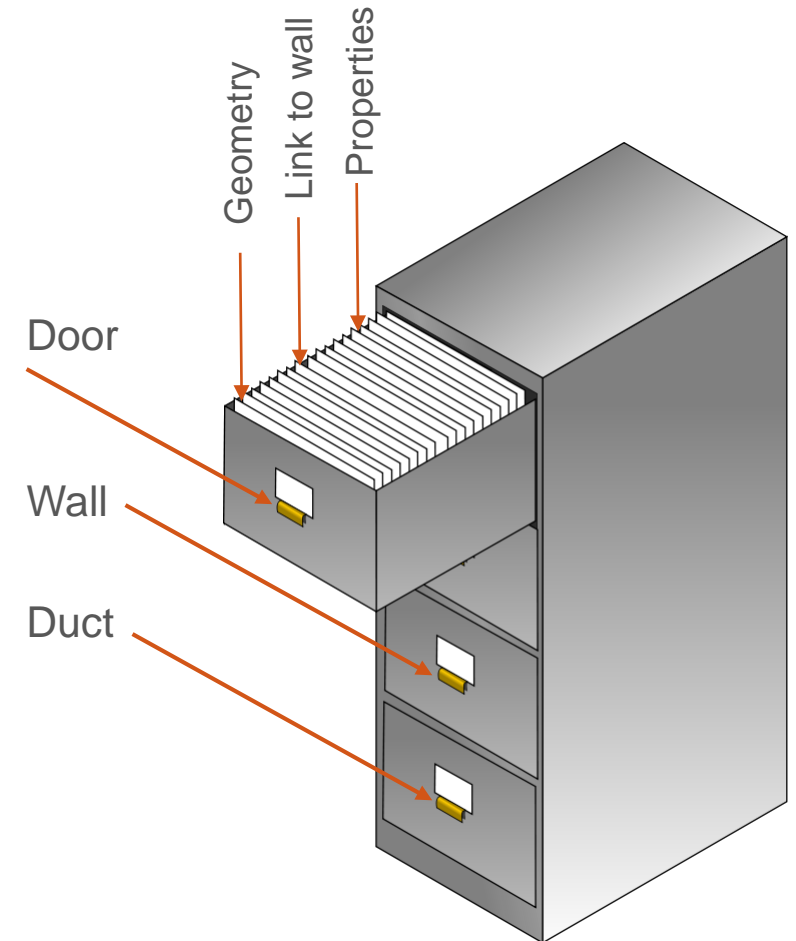
Bestandteile der IFC-Datenstruktur

■ IFC (IFC2x3, IFC4)

- Schemadefinitionen und Datenaustauschformate
 - ISO 10303-11/21 (EXPRESS + SPF)
 - W3C XSD/XML (XSD nach ISO 10303-28 + ifcXML)
 - W3C OWL (ifcOWL, RDF)
- Vordefinierten Eigenschaften und Basismengen (Pset/Qto)
 - Eigenes XML-Format (XSD für IFC2x3, IFC4)
 - Ab IFC4 auch als IFC-Templatedatei abbildbar (z.B. ifcXML)

■ Implementierungsvereinbarungen

- Implementer Agreements (allgemein und anwendungsspezifisch)
- Model View Definitionen (Untermenge von IFC, als mvdXML)



Verfügbar als Online-Dokumentation auf www.buildingsmart-tech.org

IFC-Architektur

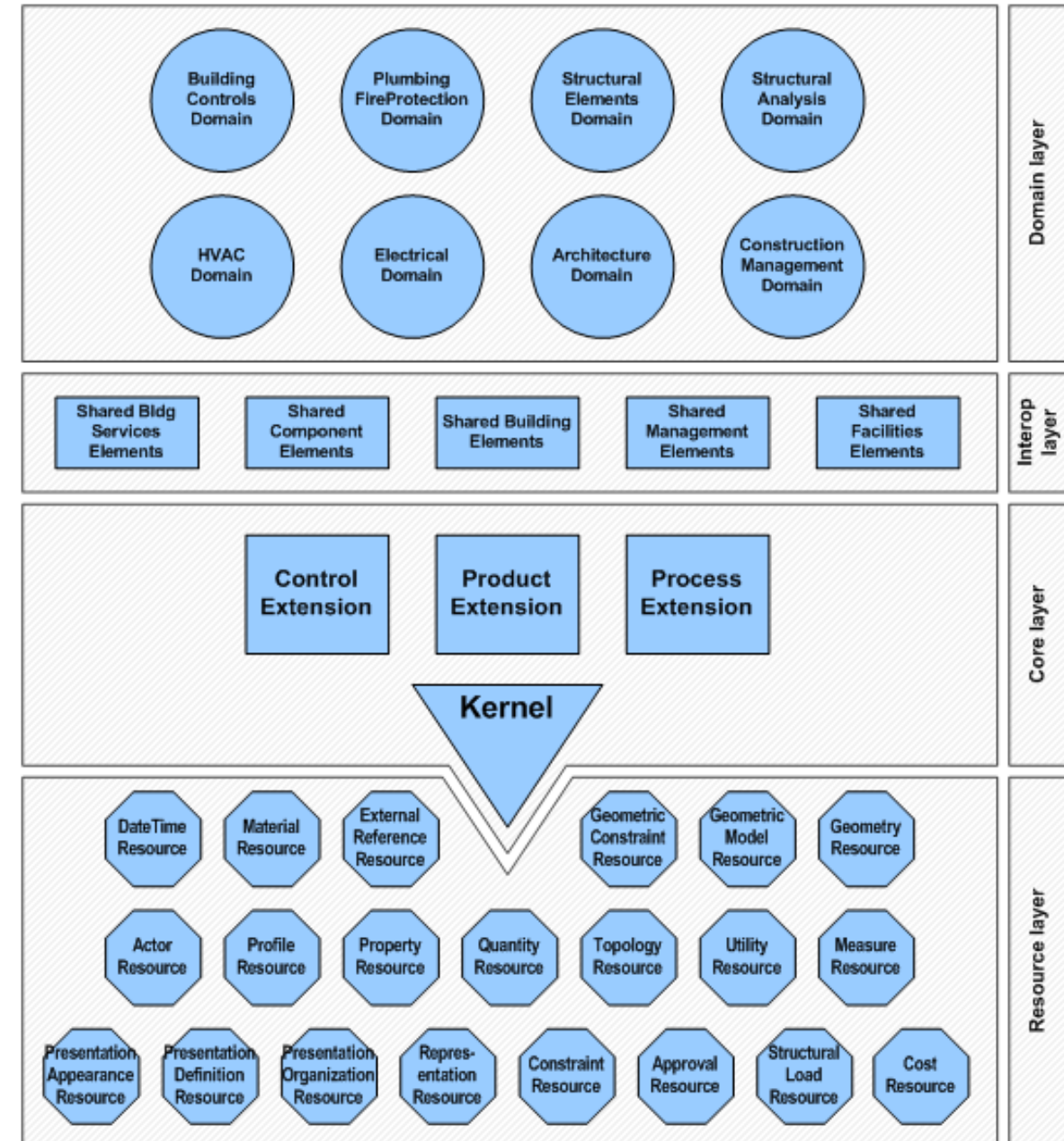
Ziel: einfach, erweiterbar, widerspruchsfrei

■ 4 Ebenen

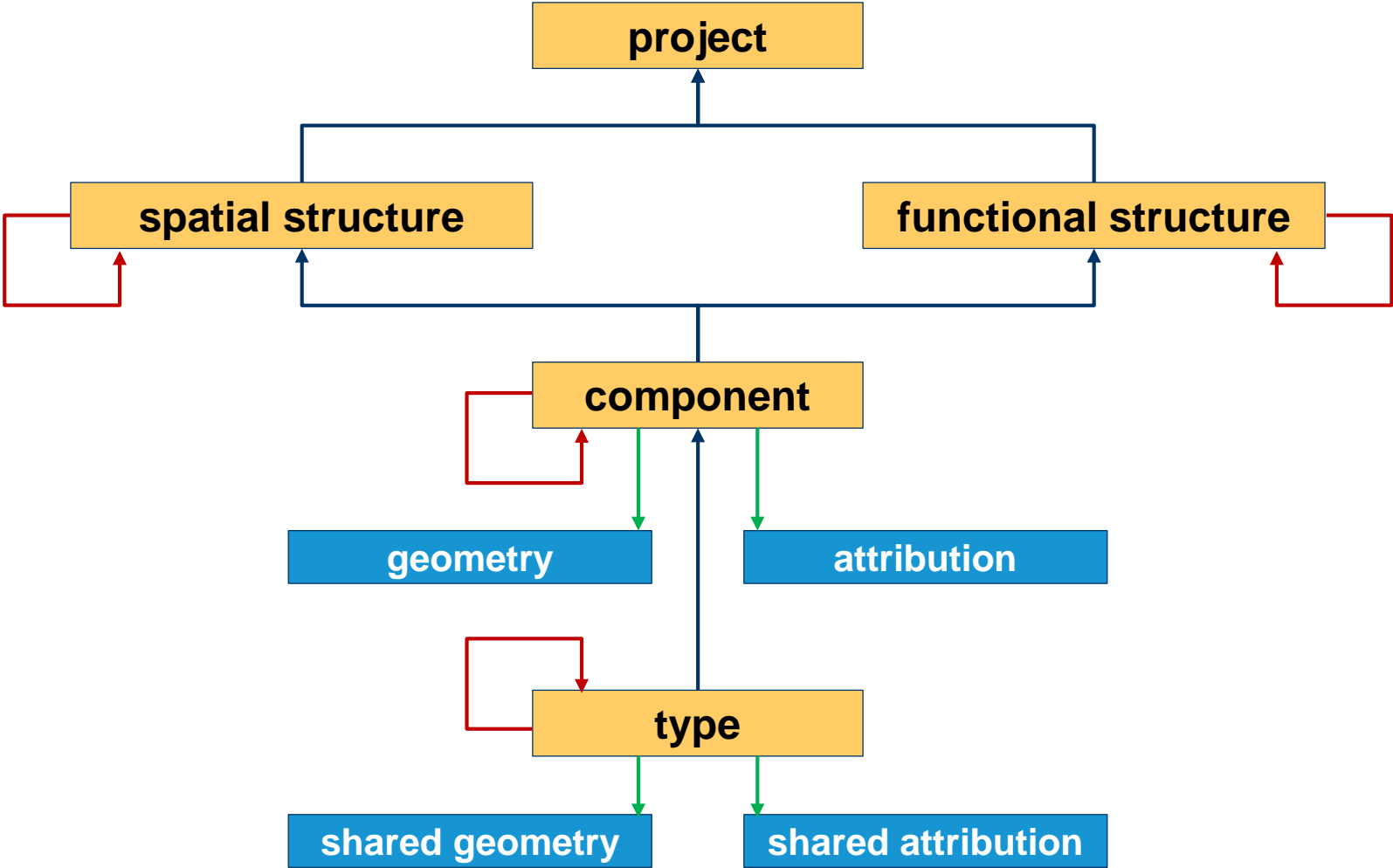
- Resource layer (teilweise aus ISO 10303)
- Core layer
- Interoperability layer
- Domain layer

■ Modellierungsregeln

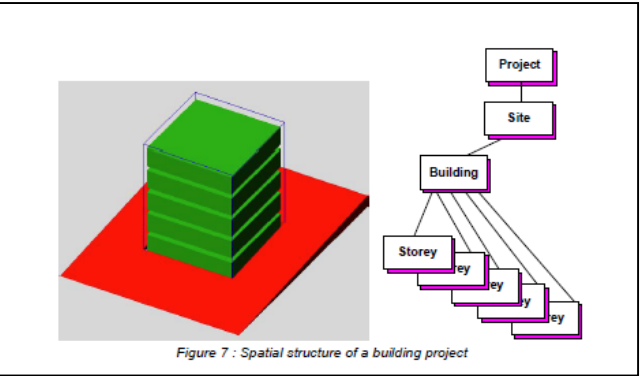
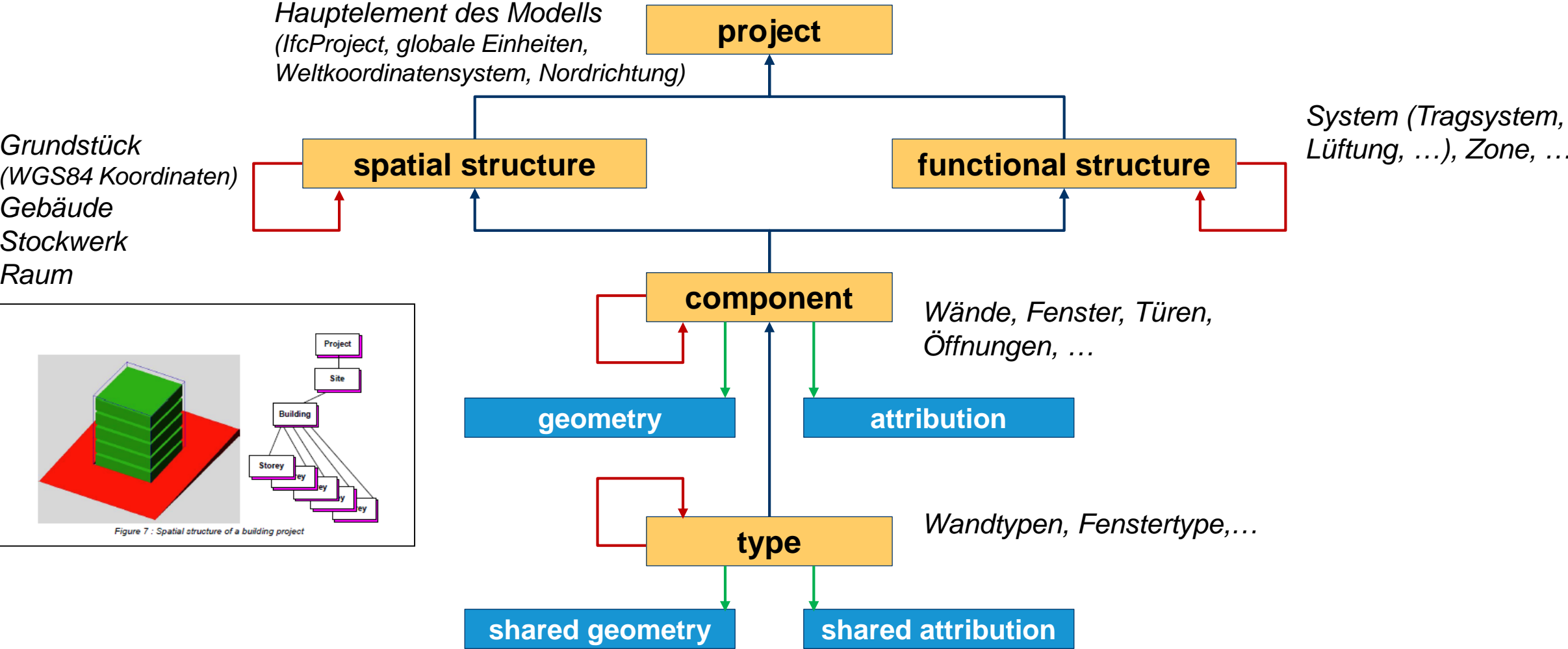
- Einfachvererbung
- Relationsobjekte
- allgemeingültige Integrationsbedingungen
(optionale/erforderliche Informationen, Kardinalitäten, inverse Beziehungen, abgeleitete Attribute, einfache Regeln)



Grundlegende Datenstruktur von IFC (Funktionalität des Core Layer)



Grundlegende Datenstruktur von IFC (Funktionalität des Core Layer)



Grundlegende IFC-Funktionalitäten

Herausforderungen bei der Umsetzung von IFC

- **hohe Schachtelungstiefe**
in Bezug auf Vererbung und Objektreferenzen
- **Vielzahl von Definitionen**
IFC4: 776 Klassen + weitere Untertypen und 397 Typdefinitionen
(zur Abbildung von Architektur, Haustechnik, Statik, Bauablaufplanung, ...)

Grundlegende IFC-Funktionalitäten

Hohe Schachtelungstiefe - Beispiel Vererbung

ENTITY IfcSpace

1

```
ENTITY IfcRoot
  GlobalId      : IfcGloballyUniqueId;
  OwnerHistory  : OPTIONAL IfcOwnerHistory;
  Name          : OPTIONAL IfcLabel;
  Description    : OPTIONAL IfcText;
```

2

```
ENTITY IfcObjectDefinition
  INVERSE
  ..
```

3

```
ENTITY IfcObject
  ObjectType    : OPTIONAL IfcLabel;
  INVERSE
  ..
```

4

```
ENTITY IfcProduct
  ObjectPlacement : OPTIONAL IfcObjectPlacement;
  Representation  : OPTIONAL IfcProductRepresentation;
  INVERSE
  ..
```

5

```
ENTITY IfcSpatialElement
  LongName       : OPTIONAL IfcLabel;
  INVERSE
  ..
```

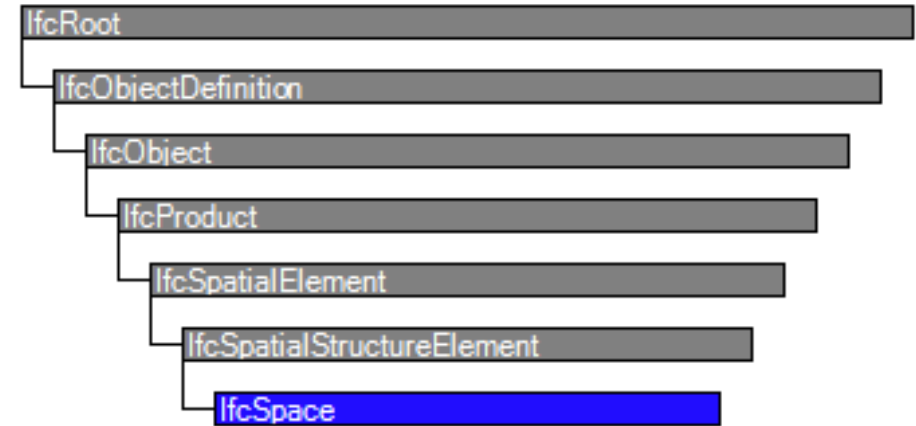
6

```
ENTITY IfcSpatialStructureElement
  CompositionType : OPTIONAL IfcElementCompositionEnum;
  INVERSE
  ..
```

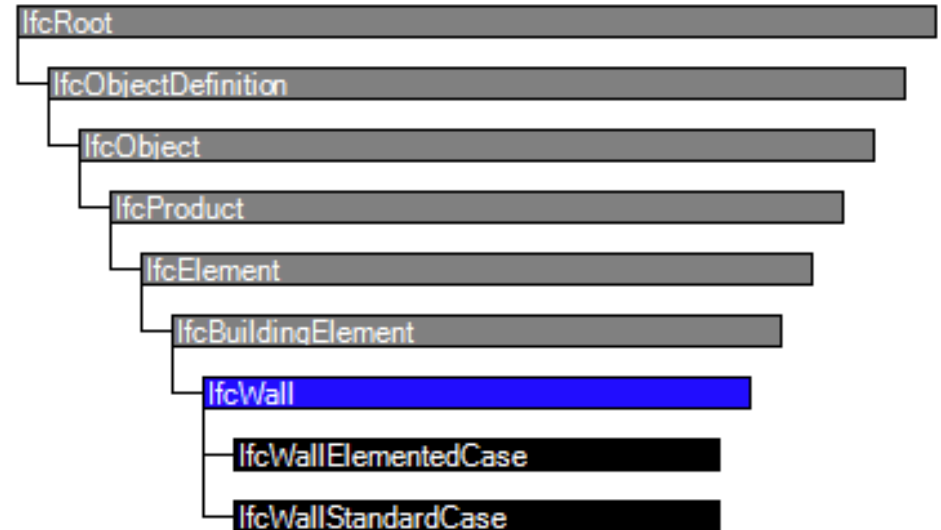
7

```
ENTITY IfcSpace
  PredefinedType : OPTIONAL IfcSpaceTypeEnum;
  ElevationWithFlooring : OPTIONAL IfcLengthMeasure;
  INVERSE
  ..
```

Entity inheritance

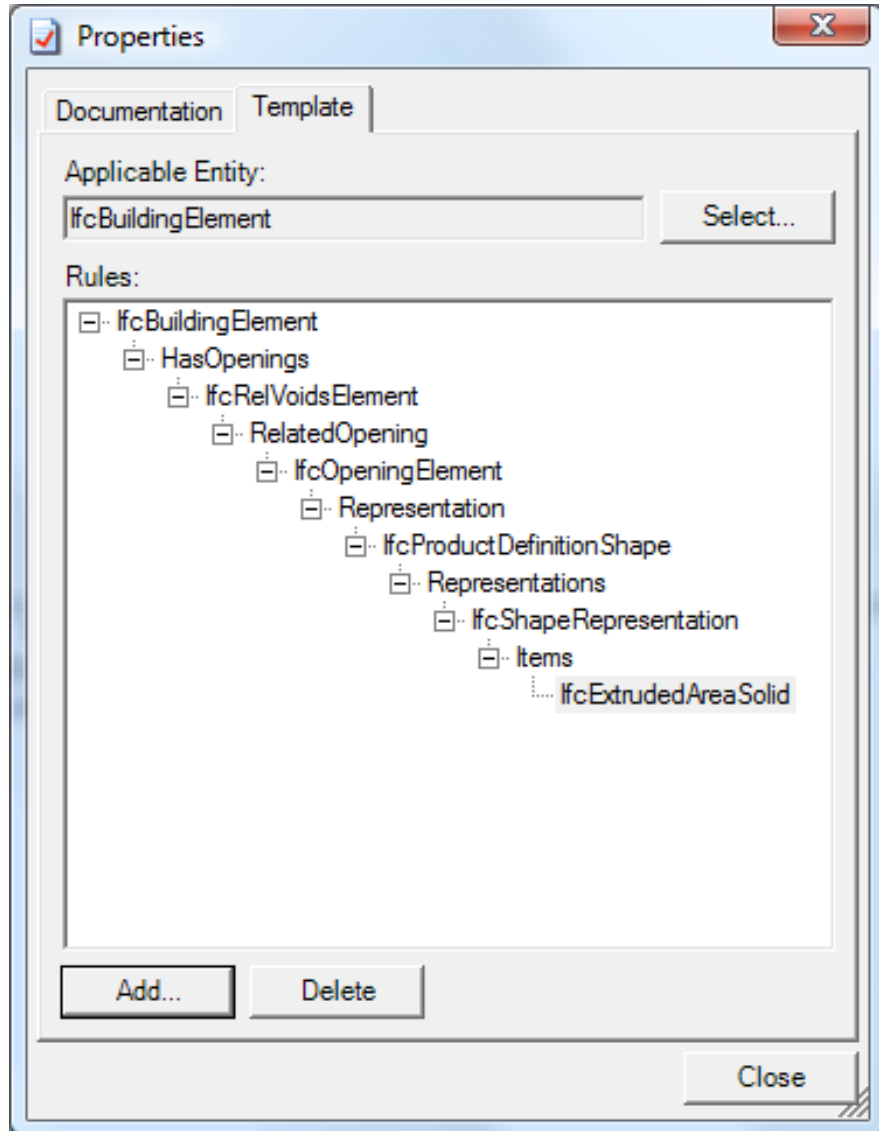


Entity inheritance



Grundlegende IFC-Funktionalitäten

Hohe Schachtelungstiefe - Beispiel Referenzierung



```
ENTITY IfcBuildingElement
  ABSTRACT SUPERTYPE OF (ONEOF
    (..
      ,IfcWall
      ,..))
  SUBTYPE OF (IfcElement);
END_ENTITY;
```

```
ENTITY IfcExtrudedAreaSolid
  SUBTYPE OF (IfcSweptAreaSolid);
  ExtrudedDirection : IfcDirection;
  Depth : IfcPositiveLengthMeasure;
WHERE
  WR31 : IfcDotProduct(IfcRepresentationItem() ||
    IfcGeometricRepresentationItem() ||
    IfcDirection([0.0,0.0,1.0]),
    SELF.ExtrudedDirection) <> 0.0;
END_ENTITY;
```

Grundlegende IFC-Funktionalitäten (Fundamental concepts)

Lage und geometrische Darstellung(en)

1. Scope
2. Normative references
3. Terms, definitions, and abbreviated terms
4. Fundamental concepts and assumptions

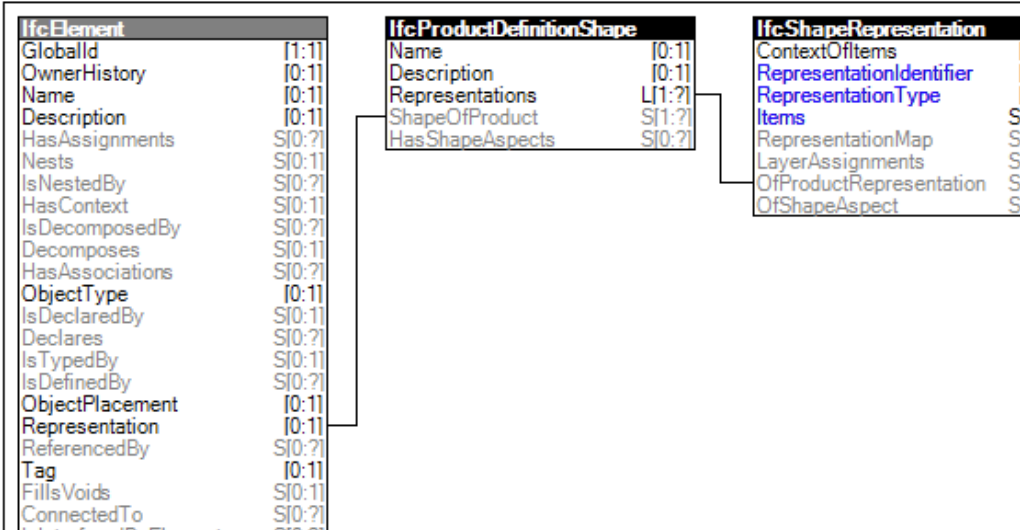
4.8.2.9.6 Body Brep Geometry

The **Body Brep Geometry** is the representation of the 3D shape of a product by faceted boundary

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

- **IfcShapeRepresentation.RepresentationIdentifier** = 'Body'
- **IfcShapeRepresentation.RepresentationType** = 'Brep'
- **IfcShapeRepresentation.Items** = **IfcFacetedBrep**

Figure 80 illustrates an instance diagram.



4.8.1.1 Product Local Placement

Product occurrences can be placed in 3D space relative to where they are contained. Placement is defined by a relative +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 with its own placement.
- for building elements, positioning is relative to the containing spatial structure. For example, a building storey may contain multiple rooms, each with its own placement.
- for aggregated parts, positioning is relative to aggregation. For example, a staircase may aggregate one or more stairs, each with its own placement.
- for feature elements, positioning is relative to the affected building element. For example, an opening element is positioned relative to the building element it is an opening in.
- for fillings, positioning is relative to the filled opening. For example, a door is positioned relative to an opening which it fills.
- for distribution ports, positioning is relative to the containing distribution element. For example, an air terminal may be positioned relative to a junction box.
- for distribution elements, positioning is relative to the containing spatial structure, however may be constrained by position. For example, an air terminal may fill a ceiling covering which is placed relative to the junction box.

If a containing spatial structure contains a grid, then placement may also be based relative to grid coordinates. In certain cases, the placement may be based on the grid coordinates.

Figure 57 illustrates an instance diagram.

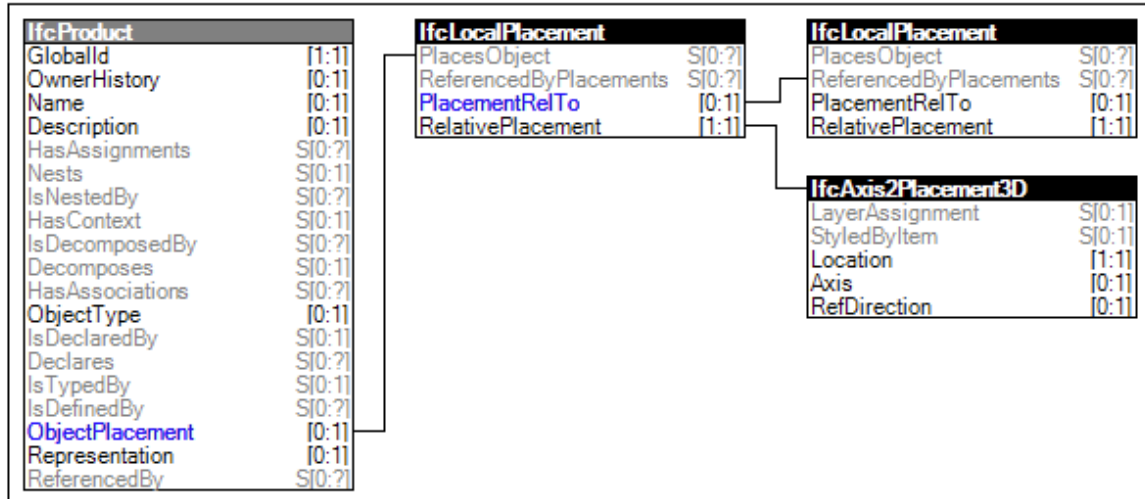


Figure 57 — Product Local Placement

Grundlegende IFC-Funktionalitäten (Fundamental concepts)

Eigenschaften/Mengen

- Schlüssel-Wert-Paar
- individuell erweiterbar

4.2.2.1 Property Sets for Objects

The concept template [Property Sets for Objects](#) describes how an object occurrence can be related to a single or multiple property sets. A occurrences.

Property sets can also be related to an object type, see concept [Property Sets for Types](#). They then define the common properties for all o type.

Figure 9 illustrates an instance diagram.

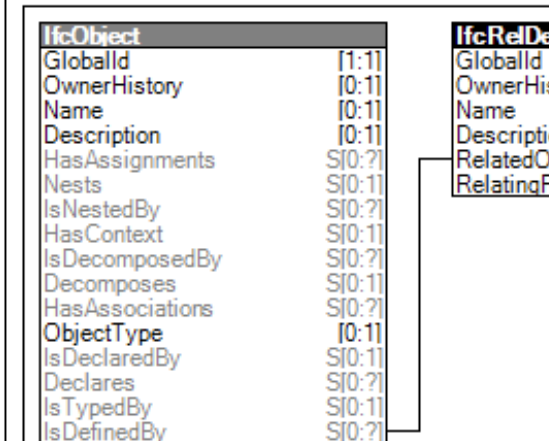
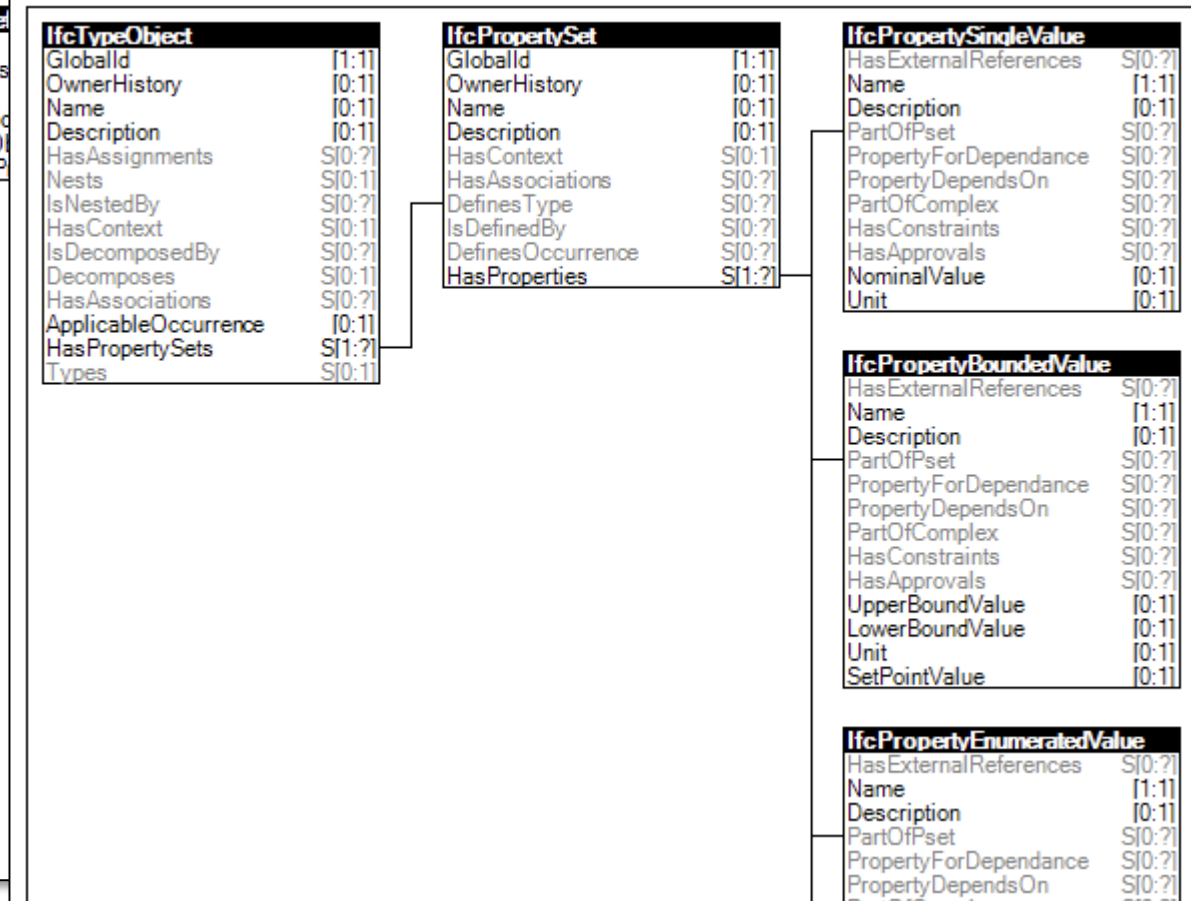


Figure 10 illustrates an instance diagram.



Grundlegende IFC-Funktionalitäten (Fundamental concepts)

Klassifikation und Verknüpfung mit Dokumenten

4.4.1 Classification Association

The concept **Classification Association** describes how objects and object types 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;
- any service that combine the above features.

An individual item within the external source of information

NOTE The classification system or dictionary server that is used with

The main attributes to be provided for a **Classification Association**

- **Identification**: holds the key provided for a specific reference
- **Name**: allows for a human interpretable designation of the

Figure 18 illustrates an instance diagram.

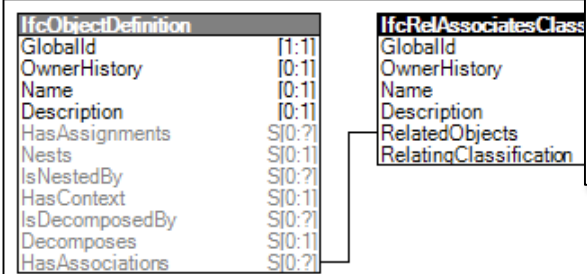


Figure 18 — Classification Association

4.4.2 Document Association

The concept **Document Association** describes how objects or object types can have associated documents indicating external files. Documents synchronize information in other files such as work schedules for project management applications.

Typical document meta data, such as issue date, editor, and similar, can be captured with the association, the document content however remains

Figure 19 illustrates an instance diagram.

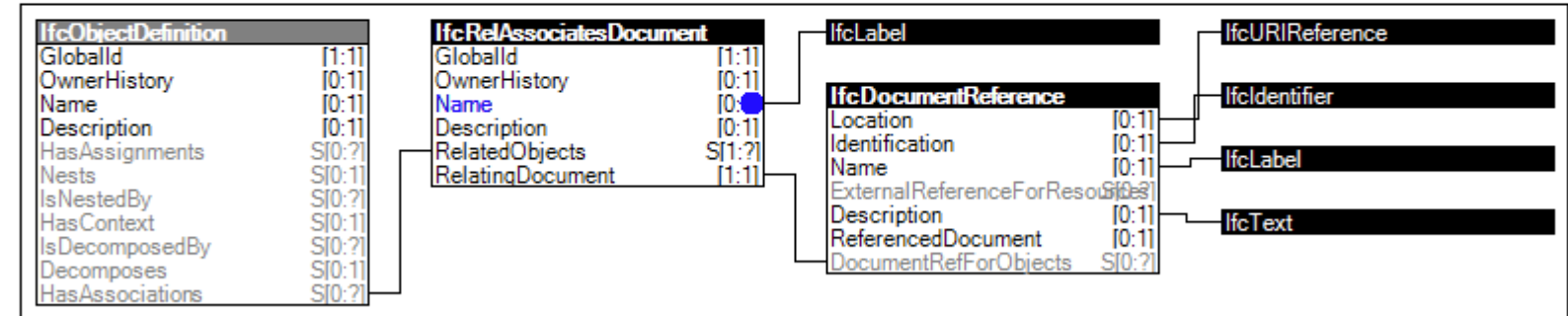


Figure 19 — Document Association

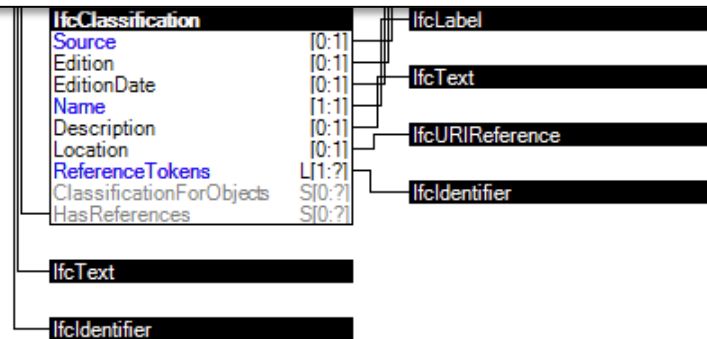


Figure 18 — Classification Association

Grundlegende IFC-Funktionalitäten (Fundamental concepts)

Weitere Funktionalitäten

- Aggregationen (räumliche Struktur, Bauteile)
- Verbindung von Elementen (Element Connectivity)
- Öffnungen (Element Voiding, Element Filling)
- Materialdefinitionen (ein- und mehrschalig)
- Elementgruppierung
- Verschiedene Geometriedefinitionen (Box, Axis, Annotation, Profile, Surface, Body, ...)
- Geometry Styles
- Texturen
-

Danke für Ihre Aufmerksamkeit!