

FIG WORKING WEEK 2017

BIM FOR SURVEYORS

Helsinki Finland Sunday 28 May 2017

Collaboration –

Standards for BIM information exchange and process management

Part 1: Management

Part 2: Data



Christian Clemen (Germany): „Standards for BIM data exchange and process management”

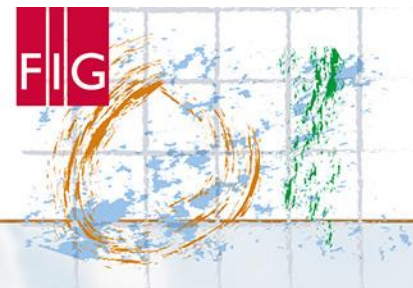
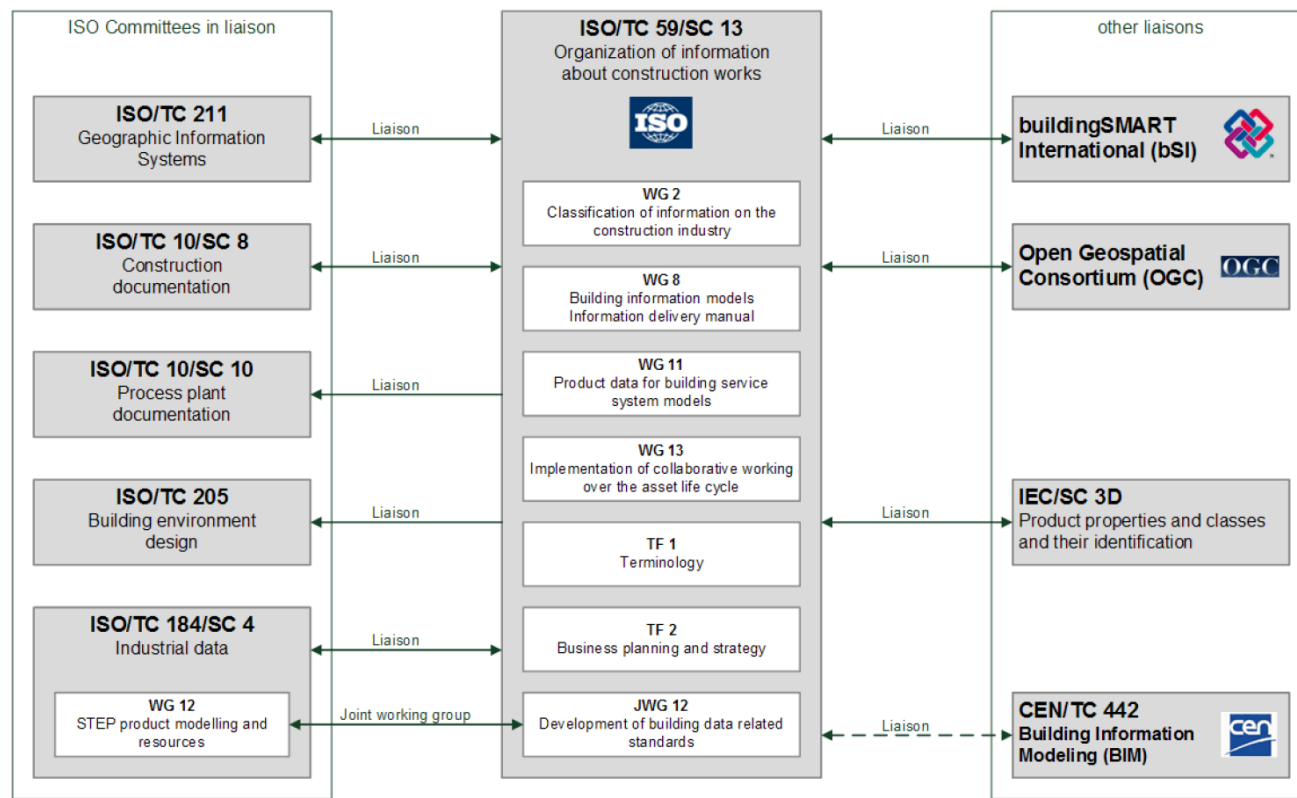


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Who writes the BIM standards?



ISO:
TC 59 - Buildings and civil engineering works

SC 13 – Organization of information about construction work

- Liaison to**
- ISO/TC 211 GIS
 - OGC
 - buildingSmart !!!!!!!

König et al, "Wissenschaftliche Begleitung der BMVI Pilotprojekte zur Anwendung von Building Information Modeling im Infrastrukturbau" BMVI, 2016, Source: Thomas Liebich

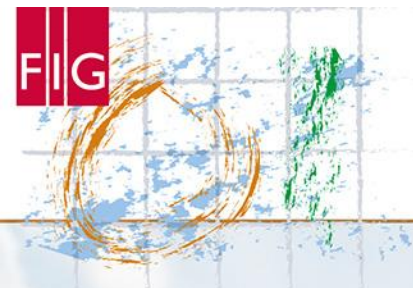
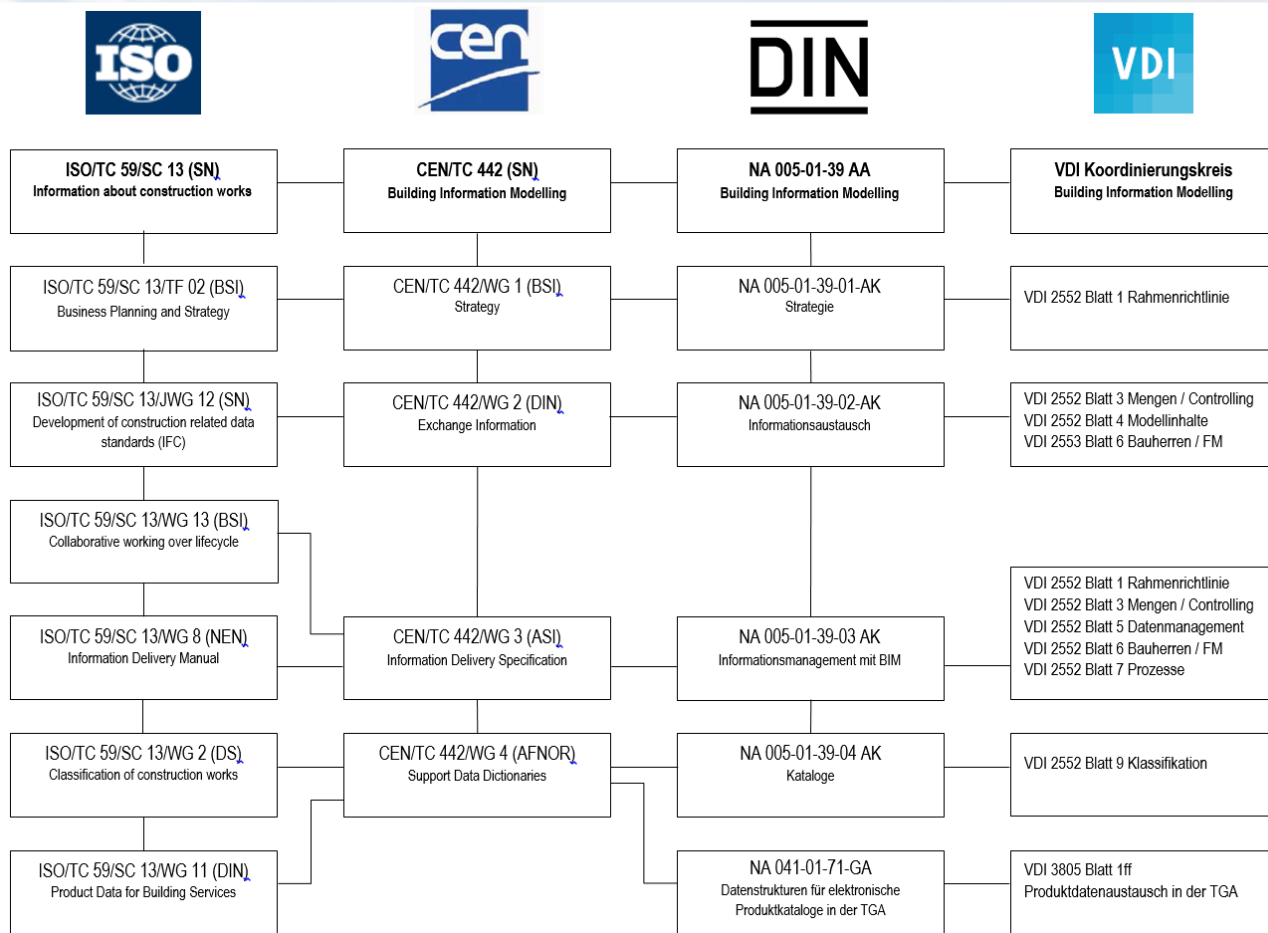


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WG1:
Strategy (Roadmap)

WG2:
Exchange Information
(Data, Adoption of IFC, LOD,
Information Container for
Data Drops)

WG3:
Information Delivery
Specification (Process, IDM,
MVD)

WG4:
Data Dictionary (Property
Server)

König et al, "Wissenschaftliche Begleitung der BMVI Pilotprojekte zur Anwendung von Building Information Modeling im Infrastrukturbau" BMVI, 2016, Source: Thomas Liebich

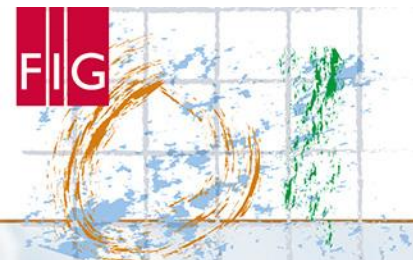
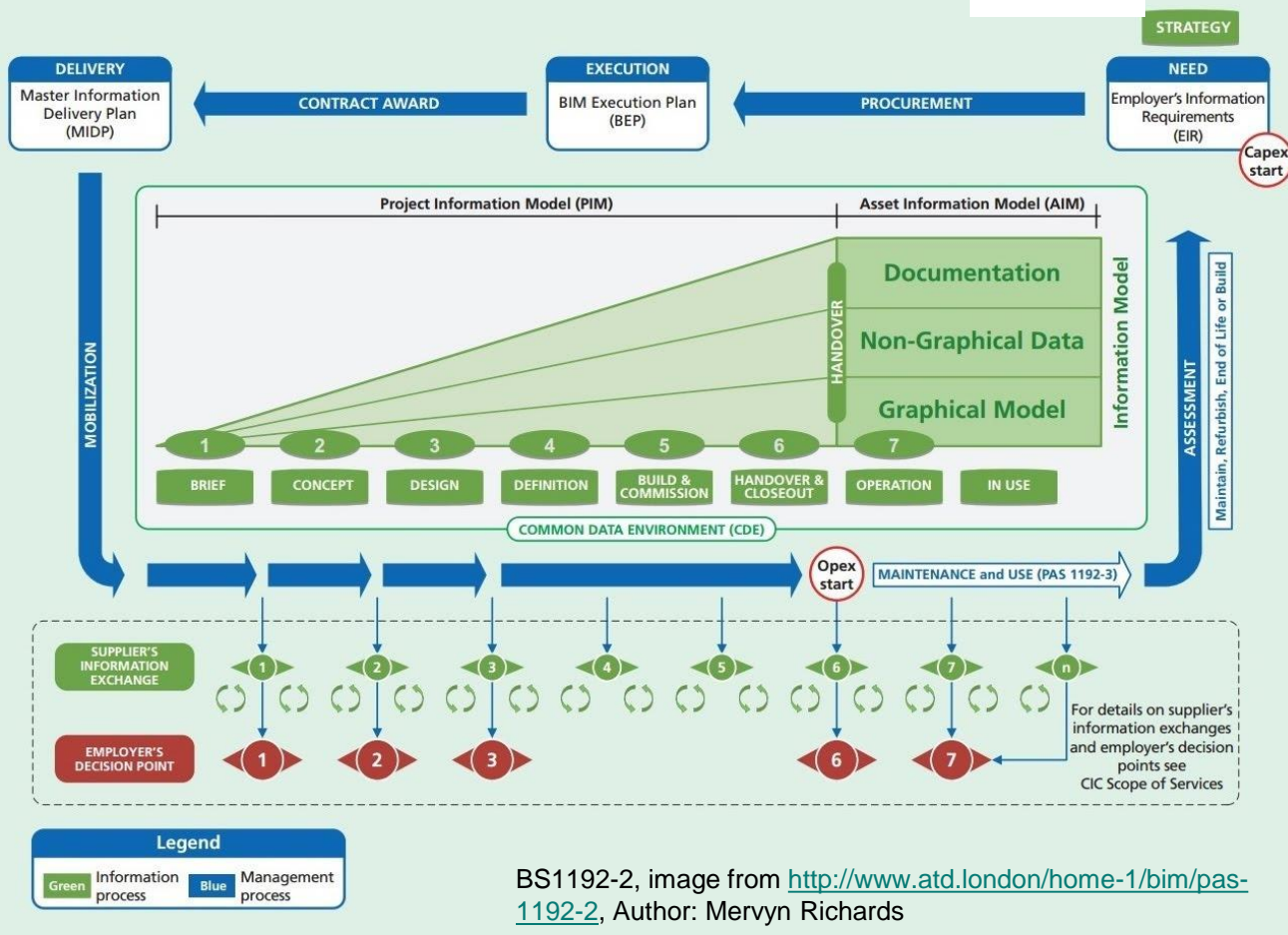


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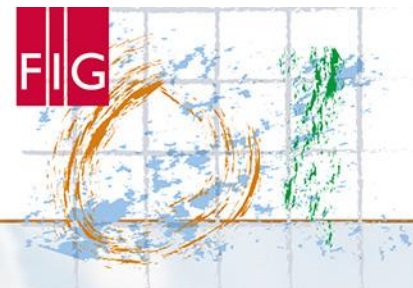
The BIM Process ("Race Track")



BS1192-2 will be the base for ISO19650 !

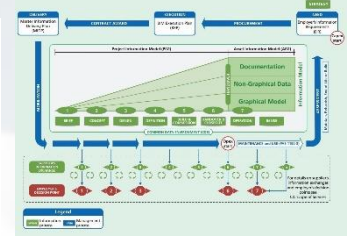
- project- and asset information model (PIM, AIM)
- Information
 - Graphical Model
 - Non-Graphical Data
 - Documentation
- Management
 - EIR
 - BEP
 - MIDP
- Sequential Stages 1-7

BS1192-2, image from <http://www.atd.london/home-1/bim/pas-1192-2>, Author: Mervyn Richards



EIR → BEP → MIDP

Employer's Information Requirements



Pre tender: The employer sets standards and processes to be adopted by the supplier as part of the project delivery process

PAS 1192-2 gives information types that have at least to be defined. E.g. Levels of Detail of BIM-Models, milestones, data formats (including version numbers), and

- coordinate systems and project base point
- Necessity of pre-construction survey

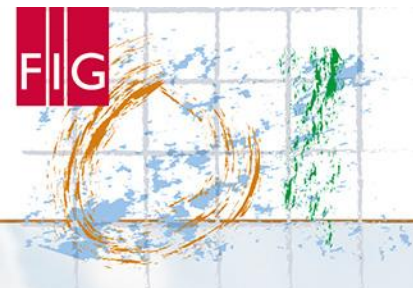


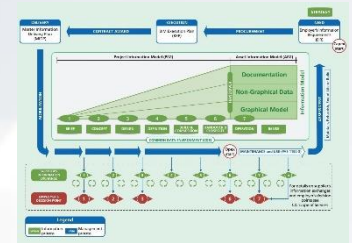
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EIR → BEP → MIDP

BIM Execution Plan



Pre contract: The bidder/supplier shows that he meets the capability, capacity and competence to meet the EIR with a suggested BEP

Post contract: All parties agree and committed to the refined BEP

Master/Task Information Delivery Plan: Detailed list of information deliverables

The BEP e.g. contains agreements on

- Surveying strategy (pointclouds, LIDAR, GNSS)
- Origin and Orientation of the project base point, related to geodetic datum and projection
- „as-constructed“-survey: handover for operation stage

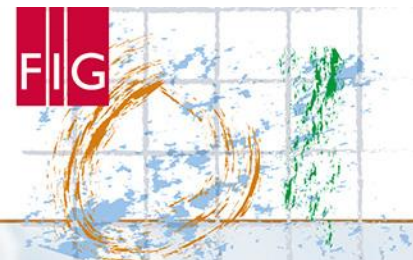
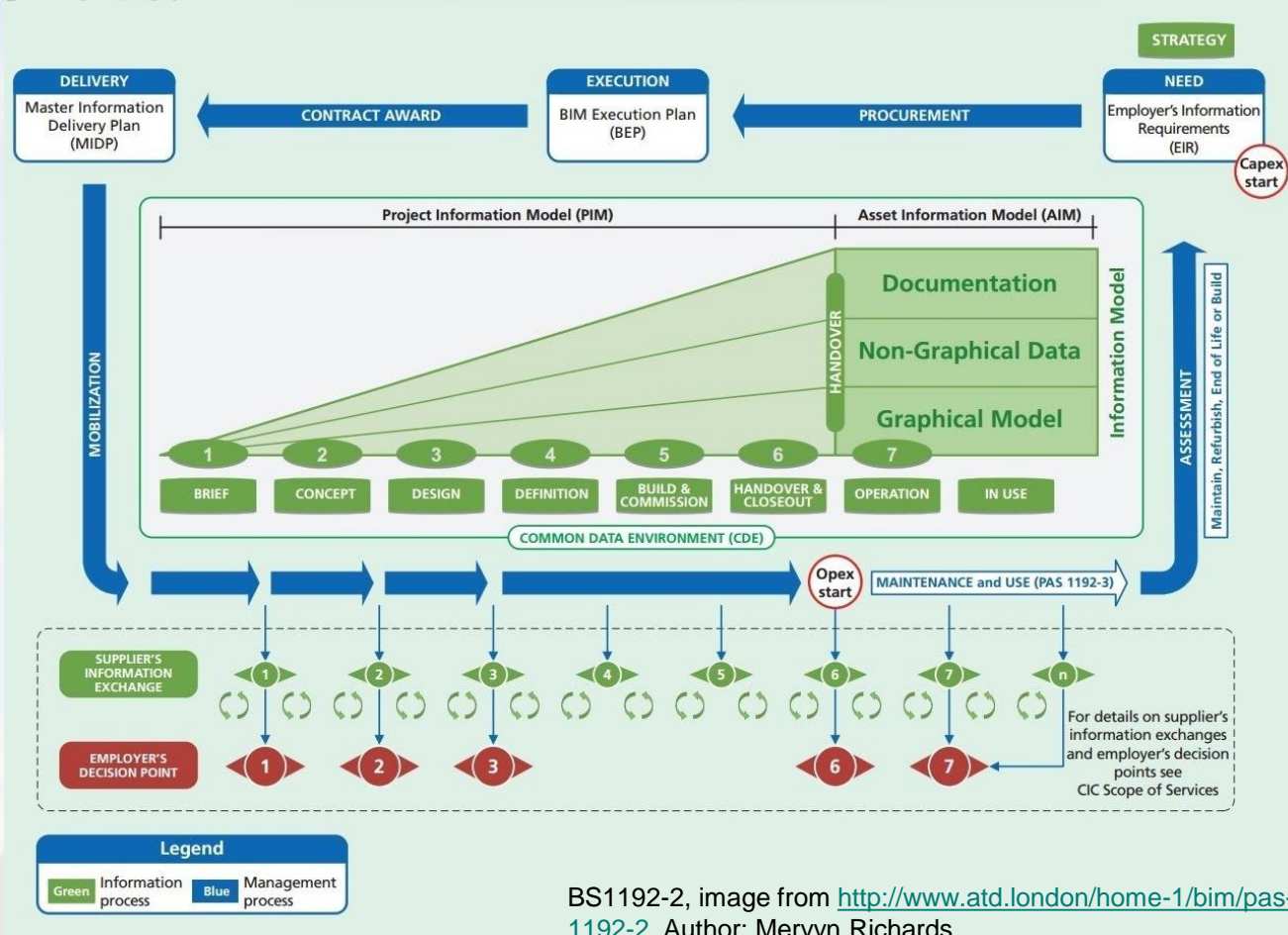


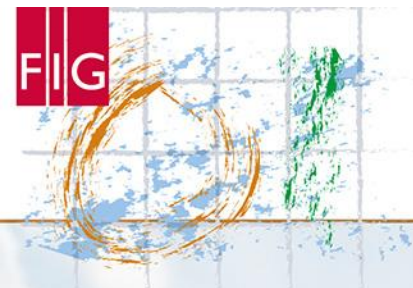
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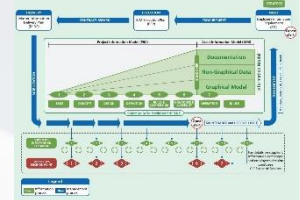
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BS1192-2, image from <http://www.atd.london/home-1/bim/pas-1192-2>, Author: Mervyn Richards



Production: CDE (common data environment)



Implementation: As central model (data base) or feautured model (seperated files/documents/models)

BS1192-2 also defines

- Work in Progress codes (WIP) that show the status (e.g. checked, published,..)
- File and layer naming conventions
- The necessity of LOD (level of development)

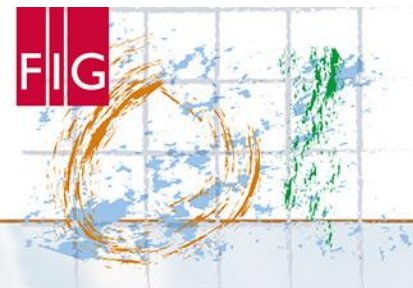


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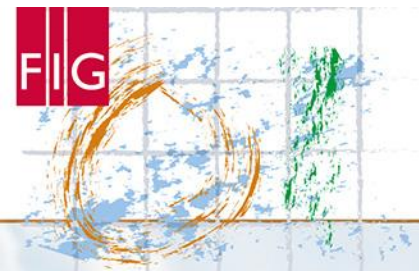
Collaboration –

Standards for BIM information exchange and process management

Part 2: Data



Christian Clemen (Germany): „Standards for BIM data exchange and process management”



Industry Foundation Classes (IFC, ISO 16739)

Industry Foundation Classes (IFC) are the open and neutral data format for openBIM.

- schema for sharing construction and facility management data
- across various applications and software used in the AEC/FM industry domain
- object-oriented (building elements, spaces, properties, shapes, etc.)



<http://www.buildingsmart-tech.org/implementation/faq/faq-general-questions#Q3>



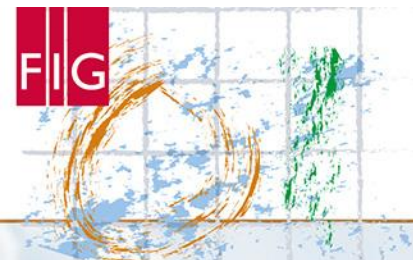


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IFC schema is specified with

EXPRESS
EXPRESS-G
XML-Schema

IFC Documentation

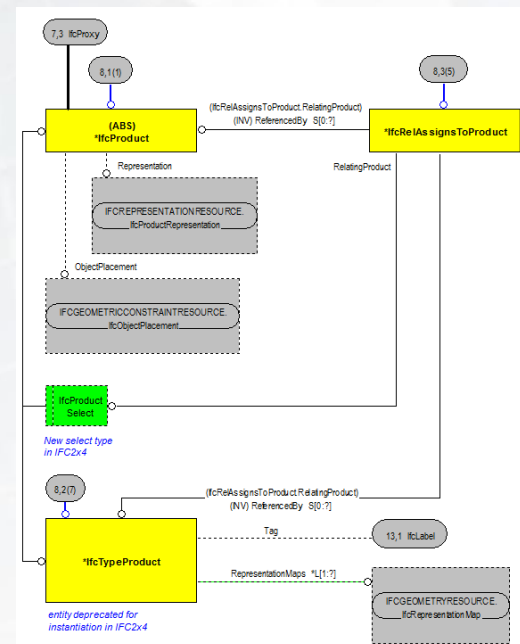
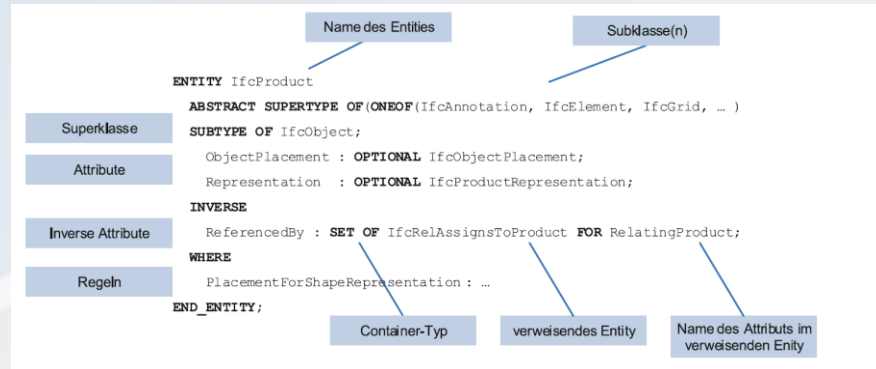
<http://www.buildingsmart-tech.org/ifc/IFC2x3/TC1/html/>

<http://www.buildingsmart-tech.org/ifc/IFC4/final/html/>

<http://www.buildingsmart-tech.org/ifc/IFC4x1/RC3/html/>

XSD Specification:

```
<xs:element name="IfcProduct" type="ifc:IfcProduct" abstract="true" substitutionGroup="ifc:IfcObject" nillable="true"/>
<xs:complexType name="IfcProduct" abstract="true">
  <xs:complexContent>
    <xs:extension base="ifc:IfcObject">
      <xs:sequence>
        <xs:element name="ObjectPlacement" type="ifc:IfcObjectPlacement" nillable="true" minOccurs="0"/>
        <xs:element name="Representation" type="ifc:IfcProductRepresentation" nillable="true" minOccurs="0"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
```



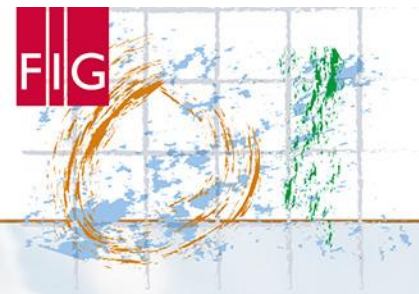


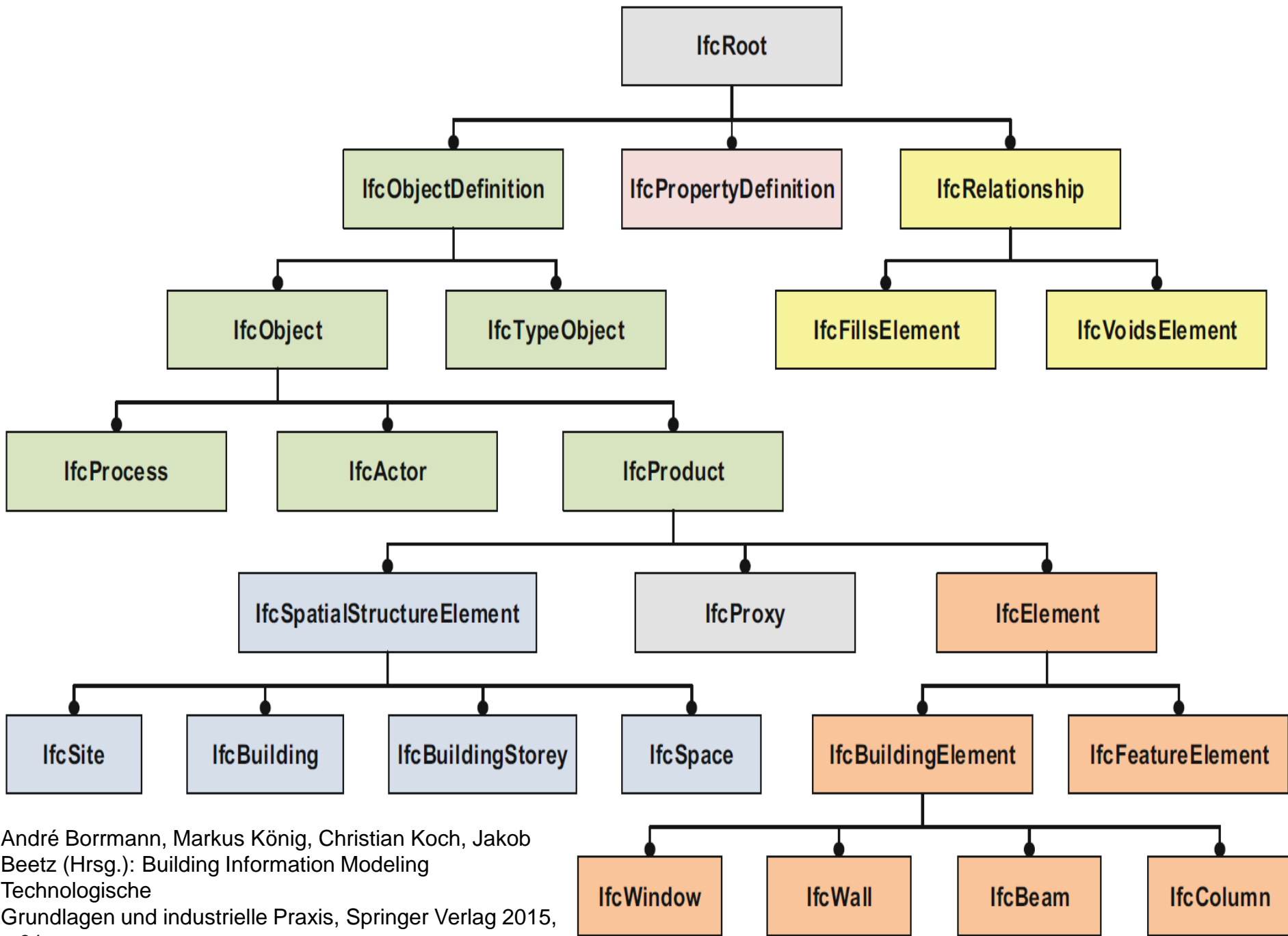
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- **Standard for the Exchange of Product Model Data**
- **Begin:** ISO-10303-21
- **Header:** Metadata (description,name,schema)
- **Data Section:** DATA, ENDSEC
- **Instances start with # and number, followed by name of class**
- **\$:** optional attributes
- **References with # and number**
- **End:** END-ISO-10303-21

```
ISO-10303-21;  
HEADER;  
FILE_DESCRIPTION (('Testfile'));  
FILE_NAME (('example_file'));  
FILE_SCHEMA (('example_schema'));  
ENDSEC;  
DATA;  
#1 = POINT (10.0, 5.0, $);  
#2 = POINT (10.0, 15.0, $);  
#3 = POINT (30.0, 10.0, $);  
#4 = TRIANGLE(#1, #2, #3);  
ENDSEC;  
END-ISO-10303-21;
```



André Borrmann, Markus König, Christian Koch, Jakob Beetz (Hrsg.): Building Information Modeling
 Technologische Grundlagen und industrielle Praxis, Springer Verlag 2015, p.91

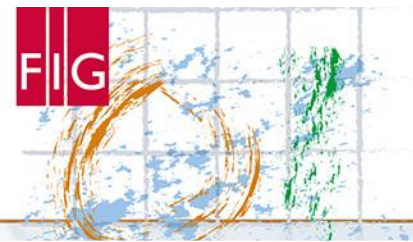
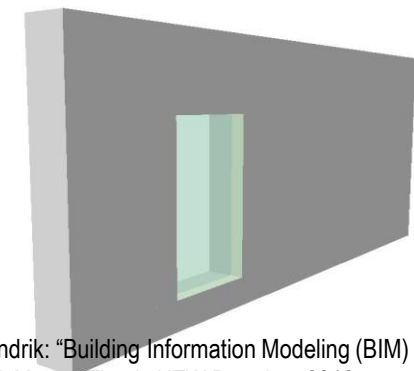
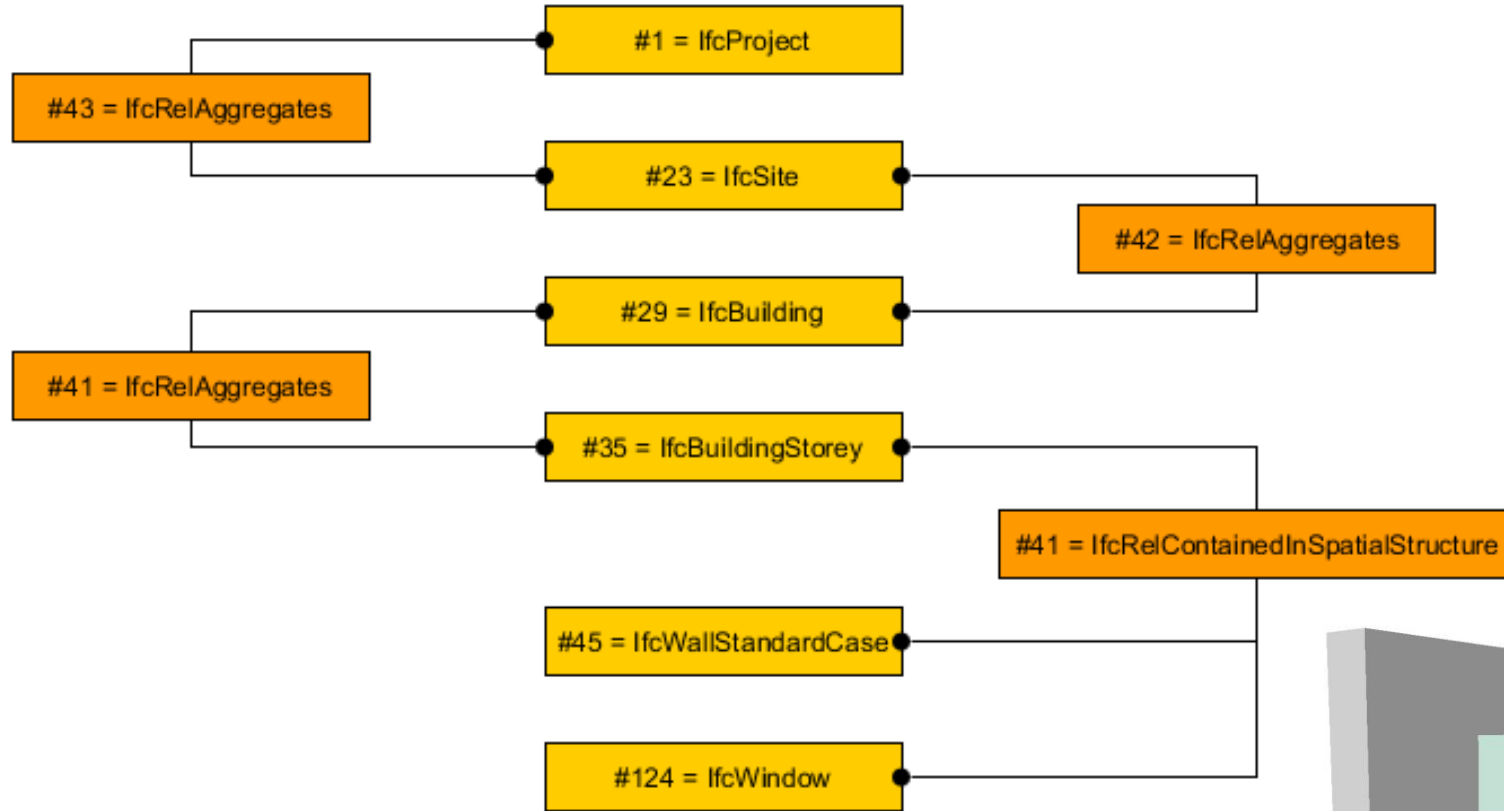


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Example for Spatial Aggregation

HelloWall.ifc from BuildingSmart, Fig from: Görne, Hendrik: "Building Information Modeling (BIM) – Standards der BIM-Methode für vermessungstechnische Leistungen", Master Thesis HTW Dresden, 2016

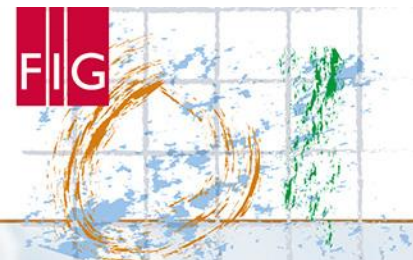
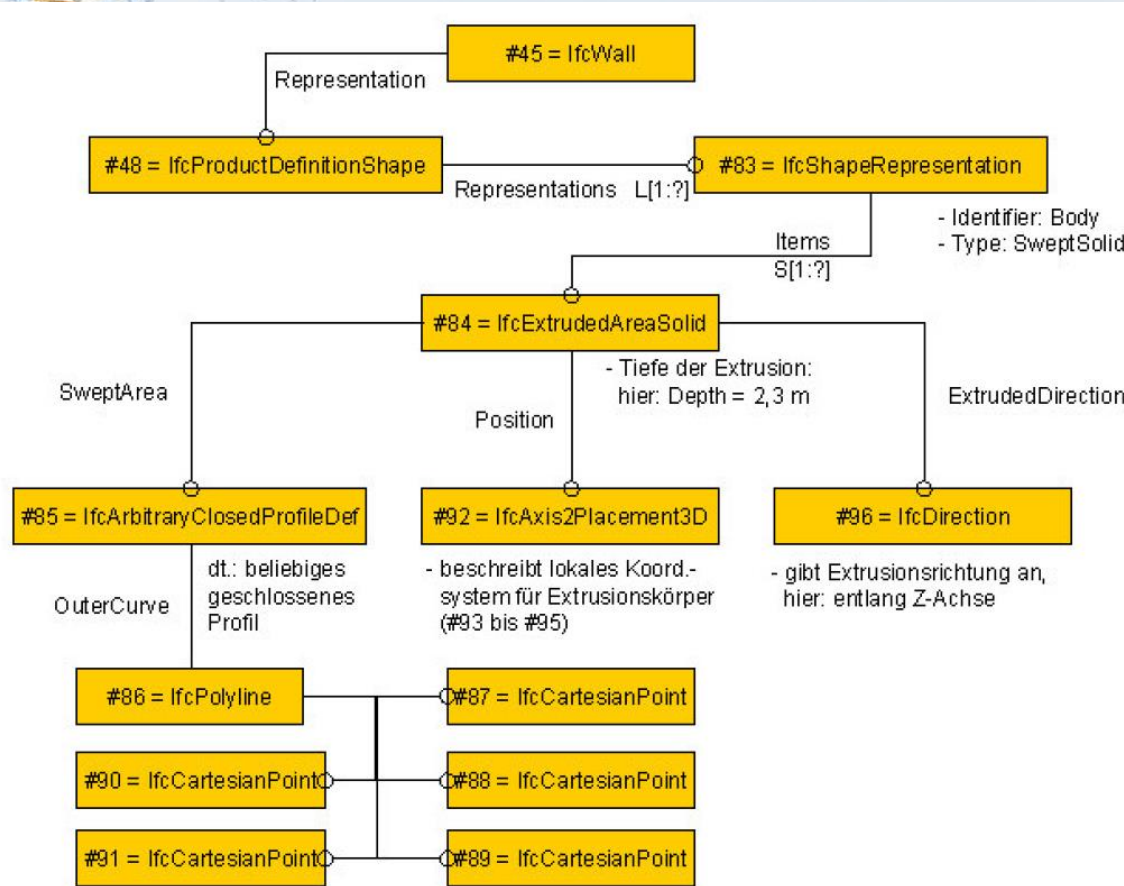


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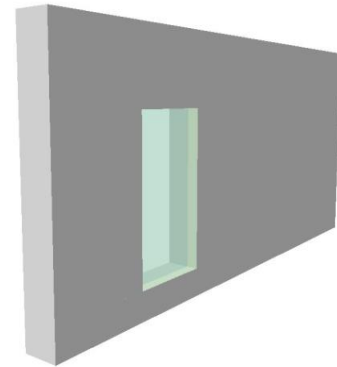


Wall

Extrusion

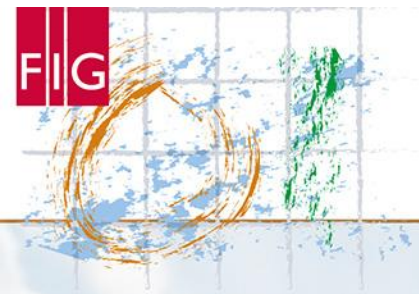
Polygon / CS / Direction

Points



Example for Geometry of a wall

HelloWall.ifc from BuildingSmart, Fig from: Görne, Hendrik: "Building Information Modeling (BIM) – Standards der BIM-Methode für vermessungstechnische Leistungen", Master Thesis HTW Dresden, 2016



Information Delivery Manual / ISO29484-1

Documentation that describes

1. the **business process** and
2. the detailed **business process requirement** for a “data drop” as input/output requirements
3. **Technical requirements** such as data format and used IFC classes

needed to provide at a particular point within a BIM project



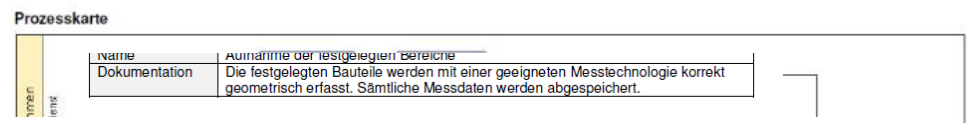
Information Delivery Manual / ISO29484-1

Process and Interaction Map

Description of Processes and Data

Information Requirements business and technical

Technical implementation of communication (MVD)



Austauschanforderungen (ER) für den Austausch von Vermessungsdaten				IFC-Implementierung	
Objekt	Attributkategorie	Definition	Beispiel und weiterführende Erklärungen	Support	IFC-Modell Repräsentation
	Attribut				
Metadaten				HEADER-Section	
	Datenaustausch				
	Zweck des Austausches	Nennung der beteiligten MVD's	"Survey_Data_View"	M	file_description
	Author	Angabe des Urhebers	"Hendrik Goerne"	M	file_name: author
	Form	Form des Urhebers	"Beispielform"	M	file_name: organisation
	Appl. Instanz				
			<ConceptRoot uuid="26da4d19-42e5-40fb-b3fe-98c4b05d029a" name="IfcSpace" status="sample" applicableRootEntity="IfcSpace">		
			<Concepts>		
			<Concept uuid="b8991dc6-d5b2-40be-ba70-db7beed4c93a" name="Space Boundaries with Face Connection" status="sample" override="true">		
			<Template ref="6ae2d514-e2bd-4a24-b984-9b11725fc7db" />		
			<Requirements>		
			<Requirement applicability="import" requirement="mandatory" exchangeRequirement="ff0fc488-03af-4db6-818a-c8cb2bdb01eb" />		
			<Requirement applicability="export" requirement="mandatory" exchangeRequirement="ff0fc488-03af-4db6-818a-c8cb2bdb01eb" />		
			</Requirements>		
			</Concept>		

erstellt. Soweit wie möglich, werden alle zu kontrollierenden Bauteile, welche zweifelsfrei erfasst werden konnten, modelliert. Die Messdaten werden ebenfalls im Modell erfasst. Schließlich erfolgt die Übernahme des As-built-Modells samt Messdaten an den BIM-Manager

P13: Einpflegen in das Gesamtmo **BuildingSmart + ISO 29481-1**

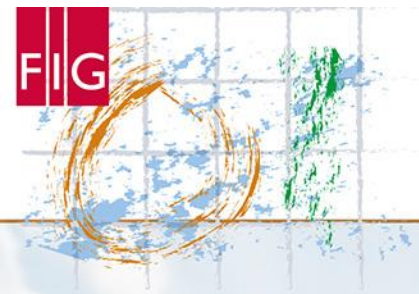


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LOD = LOG + LOI

Level of Development = Level of Geometry + Level of Information

Level of Detail = Too CADy, to much related to scale

Hausknecht, K. und Liebich, T. (2016)

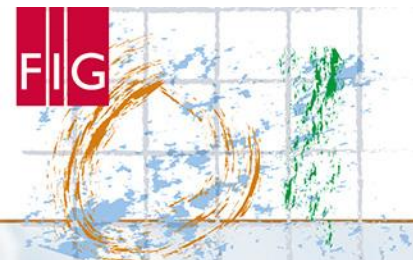


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LOD = Level of development for BIM objects (not models):

LOD 100: graphically represented, Information can be derived from other sources.

LOD 200: generic object with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached.

LOD 300: + Model as a specific object in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached

LOD 400: + with detailing, fabrication and installation information.

LOD 500. + field verified representation. As-built

2016 LEVEL OF DEVELOPMENT SPECIFICATION October 19, 2016 BIMFORUM

Milestones/Deliverables

Model Elements	SD	DD	CD	Constr Coord	Fabrication
Building Systems					

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2016 LEVEL OF DEVELOPMENT SPECIFICATION October 19, 2016 **BIMFORUM**

		100	200	300	350	400
Building Systems	Model Elements					

Milestones/Deliverables

PARTICIPATING ORGANIZATIONS

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The Specification is not a set of requirements as to what is modeled when or by whom. Rather it is a language by which users can define these requirements for their own firms or projects!

200 Generic model element with simplified treads and risers.

350 Secondary stair support elements are modeled (hangers, brackets, etc.).

400 All stair elements are modeled to support fabrication and installation.

Milestones shown here are examples only ->

Uniformat Level	Omniclass Level					Use on this project	Relevant Attribute Tables	SD			DD						
	1	2	3	4	5			Table	1	2	3	4	5	LOD	MEA	Notes	LOD
A						21-01 00 00 00 00	SUBSTRUCTURE										
A 10						21-01 10 00 00 00	Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 10 10						21-01 10 10 00 00	Standard Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 10 10 ,10						21-01 10 10 10 00	Wall Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 10 10 ,30						21-01 10 10 30 00	Column Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 10 10 ,90						21-01 10 10 90 00	Standard Foundation Supplementary Components										
A 10 20						21-01 10 20 00 00	Special Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 10 20 ,10						21-01 10 20 10 00	Driven Piles										
A 10 20 ,15						21-01 10 20 15 00	Bored Piles										
A 10 20 ,20						21-01 10 20 20 00	Caissons										
A 10 20 ,30						21-01 10 20 30 00	Special Foundation Walls										
A 10 20 ,40						21-01 10 20 40 00	Foundation Anchors										
A 10 20 ,50						21-01 10 20 50 00	Underpinning										
A 10 20 ,60						21-01 10 20 60 00	Raft Foundations										
A 10 20 ,70						21-01 10 20 70 00	Pile Caps										
A 10 20 ,80						21-01 10 20 80 00	Grade Beams	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 20						21-01 20 00 00 00	Subgrade Enclosures	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									
A 20 10						21-01 20 10 00 00	Walls for Subgrade Enclosures	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete									

Element Table | A, B Structural Steel | A, B Miscellaneous Steel | A, B Concrete | A, B Steel Joist | A, B Precast Concrete | A, B Metal Deck | A, B Cold Formed Metal Framing | A, B

Part 2: Spreadsheet with classification system, milestones, Model element author...

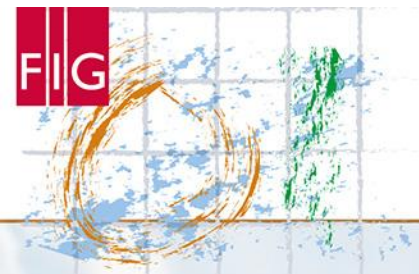


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Plowman Craven: BIM Survey Specification and Reference Guide

- Relates surveying deliverables to RIBA Stage 1-7
- Focus on **Terrestrial Laserscanning** for BIM
- **LOD** for „as-is-survey“
 - LOD1 – Mass Model
 - LOD2 – Shell and Core Model (standard families)
 - LOD3 – Standard Survey Model (adapted families)
 - LOD4 – Detailed Survey Model (+ installation)
- **LOI** – for „as-is-survey“
 - LOI100 Category „standard wall“
 - LOI200 + Parametric Dimensions
 - LOI300 + detailed type „interior wall“
 - LOI400 + visual inspection und documentation (non intrusiv)
 - LOI500 + FM Data (third party)



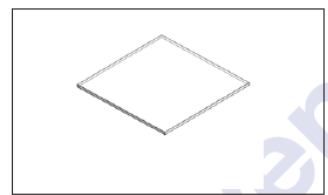
7 Appendix B – Detailed Modelling Methods and Considerations

This Appendix provides a more detailed description of the modelling techniques used for the primary surveyed building components specified in the LOD or otherwise agreed with the Client. It also contains a description of more detailed aspects of BIM modelling that need to be considered as part of the BIM Survey Specification. Examples are also given for typical parameters which would be included at each LOI.

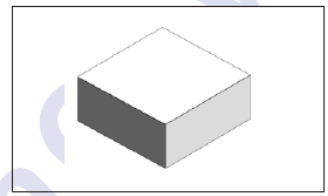
This section should be used for reference by the Client's BIM Manager or Technical Team in order to agree and understand the precise method used to model the building. It is imperative to agree modelling methods prior to a survey being taken as re-work of the model can incur significant costs and delays.

7.1 Floors/Slab

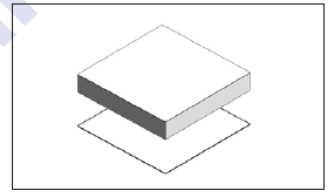
All floors and slabs will be modelled using the Revit® System Family: Floors. In some instances, or where appropriate, floors may have to be modelled In-Place. The floor will be referenced to the appropriate Level and given an overall thickness from Finished Floor Level (FFL) to Underside of Slab - or to that which was measured or visible at the time of survey. In many instances floor thicknesses cannot be ascertained from a survey due to finishes, etc., therefore a floor will be given a nominal thickness and named as 'undefined'.



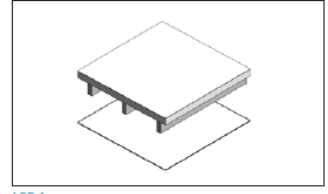
LOD 1



LOD 2



LOD 3



LOD 4

Typical Levels of Information

LOI 100	Conceptual Mass
LOI 200	Floor: SURVEY 180mm
LOI 300	Floor: SURVEY STRUCTURAL 180mm
LOI 400	Floor: SURVEY STRUCTURAL 180mm [Carpet]
LOI 500	Floor: SURVEY STRUCTURAL 180mm [75mm Sand/Cement Screed]

DOORS AND WINDOWS		LEVEL OF INFORMATION					
LEVEL OF DETAIL	Not Required		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
	LOD 1		<input type="checkbox"/>	N/A			
LOD 2		Structural openings shown only		<input type="checkbox"/>			
LOD 3		Modelled using generic families with basic detail			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LOD 4		Modelled using generic families showing detail such as sills, frames and architraves			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

SITE TOPOGRAPHY		LEVEL OF INFORMATION						
LEVEL OF DETAIL	Not Required	Linked AutoCAD		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
	LOD 1			<input type="checkbox"/>	<input type="checkbox"/>	Topography shown as simplified contour Revit® surface	<input type="checkbox"/>	
LOD 2			As LOD 1, with roads shown as sub-regions	<input type="checkbox"/>				
LOD 3			As LOD 2, with all hard surfaces identified, including car parks and pavements	<input type="checkbox"/>				
LOD 4			As LOD 3, with street furniture, lighting and surface evidence of underground services modelled in basic form		<input type="checkbox"/>			

Comments:

UNDERGROUND SERVICES		LEVEL OF INFORMATION					
LEVEL OF DETAIL	Not Required		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
	LOD 1		<input type="checkbox"/>	N/A			
LOD 2		3D CAD underground services and topographic survey as linked AutoCAD DWG		<input type="checkbox"/>	<input type="checkbox"/>		
LOD 3		Underground services modelled as intelligent Revit® objects		<input type="checkbox"/>	<input type="checkbox"/>		
LOD 4		N/A					

Comments:

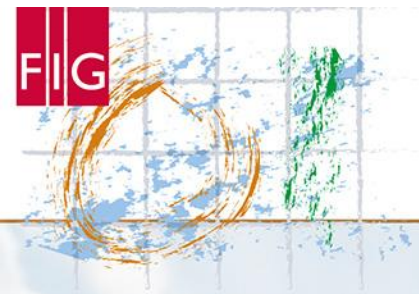


FIG WORKING WEEK 2017


BIM FOR SURVEYORS

Helsinki Finland Sunday 28 May 2017

- Accuracy classes from DIN18710 😊
- Measured accuracy (cloud) vs. represented accuracy (model)
- Absolute vs. relative accuracy
- Use cases (normal, heritage, metric, imperial)
- LOA for each UniFormat Building element type!
- Simple method of validation (A,B,C)


LOA10	User defined	- 5 cm
LOA20	5 cm	- 15 mm
LOA30	15 mm	- 5 mm
LOA40	5 mm	- 1 mm
LOA50	1 mm	- 0

USIBD Level of Accuracy (LOA) Specification Guide



Document C120™ [Guide] Version 2.0 - 2016

Guide for USIBD Document C220™: Level of Accuracy (LOA) Specification for Building Documentation



USIBD U.S. Institute of BUILDING DOCUMENTATION

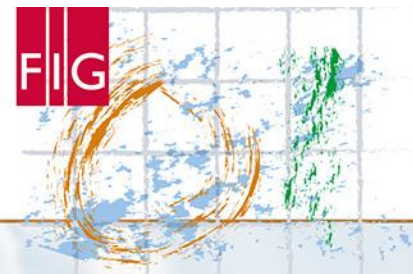


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12									\$	Measured Accuracy				\$\$\$\$\$
13		Field of application	<input checked="" type="radio"/> Standard	<input type="radio"/> Heritage					X	Absolute	If Absolute - desc			
14		Dimensional units	<input type="radio"/> Imperial	<input checked="" type="radio"/> Metric						Relative	If Relative - desc			
15										Level of Accuracy (2 σ std dev)				
16									-	5cm	15mm	5mm	1mm	
17									5cm	15mm	5mm	1mm	0	
18		Level 1	Level 2	Level 3	CSI UniFormat™ 2010					LOA10	LOA20	LOA30	LOA40	LOA50
19		A SUBSTRUCTURE												
20		A10	Foundations								X			
23		A20	Subgrade Enclosures								X			
25		A40	Slabs-on-Grade								X			
28														
29		B SHELL												
30		B10	Superstructure								X			
34		B20	Exterior Vertical Enclosures								X			
41		B30	Exterior Horizontal Enclosures								X			
47														
48		C INTERIORS												
49		C10	Interior Construction								X			
57		C20	Interior Finishes								X			
63														

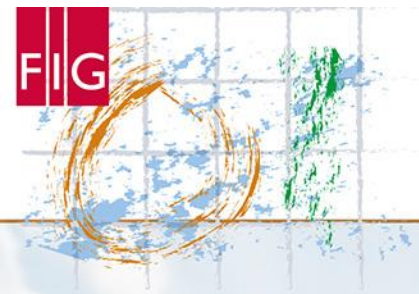


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BIM FOR SURVEYORS

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Collaboration –

Standards for BIM information exchange and process management

Part 1: Management

Part 2: Data



Christian Clemen (Germany): „Standards for BIM data exchange and process management”