Collaboration –

Standards for BIM information exchange and process management

Part 1: Management
Part 2: Data
### 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 !!!!!!!

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


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

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 featured model (separated 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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Part 2: Data
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
IFC schema is specified with

EXPRESS

EXPRESS-G

XML-Schema

IFC Documentation

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

XSD Specification:

```xml
<xsd:element name="IfcProduct" type="ifc:IfcProduct" abstract="true" substitutionGroup="ifc:IfcObject" nillable="true"/>
<xsd:complexType name="IfcProduct" abstract="true">
  <xsd:complexContent>
    <xsd:extension base="ifc:IfcObject">
      <xsd:sequence>
        <xsd:element name="ObjectPlacement" type="ifc:IfcObjectPlacement" nillable="true" minOccurs="0"/>
        <xsd:element name="Representation" type="ifc:IfcProductRepresentation" nillable="true" minOccurs="0"/>
      </xsd:sequence>
    </xsd:extension>
  </xsd:complexContent>
</xsd:complexType>
```
Christian Clemen (Germany): "Standards for BIM data exchange and process management"

- **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

```plaintext
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;
```
Christian Clemen (Germany): "Standards for BIM data exchange and process management"
Example for Geometry of a wall

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

- Distance Measures between Faces
- Polar Measures (Total Station) from Point to Face

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)

BuildingSmart + ISO 29481-1

Christian Clemen (Germany): "Standards for BIM data exchange and process management"
LOD = LOG + LOI

Level of Development = Level of Geometry + Level of Information

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

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

#### Example Table:

<table>
<thead>
<tr>
<th>Uniformat Level</th>
<th>Omniclass Level</th>
<th>Use on this project</th>
<th>Relevant Attribute Tables</th>
<th>SD</th>
<th>DD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 10</td>
<td>21-01 10 00 00 00</td>
<td>SUBSTRUCTURE</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 10 00 00</td>
<td>Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 10 10 00</td>
<td>Standard Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 10 30 00</td>
<td>Wall Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 10 90 00</td>
<td>Column Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 00 00</td>
<td>Standard Foundation Supplementary Components</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 10 00</td>
<td>Special Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 15 00</td>
<td>Bored Piles</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 20 00</td>
<td>Caissons</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 30 00</td>
<td>Special Foundation Walls</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 40 00</td>
<td>Foundation Anchors</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 50 00</td>
<td>Underpinning</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 60 00</td>
<td>Raft Foundations</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 70 00</td>
<td>Pile Caps</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 80 00</td>
<td>Grade Beams</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 10</td>
<td>21-01 10 20 00 00</td>
<td>Subgrade Enclosures</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 20</td>
<td>21-01 10 20 00 00</td>
<td>Walls for Subgrade Enclosures</td>
<td>A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 + visuel inspection und documentation (non intrusiv)
  - LOI500 + FM Data (third party)
7 Appendix B – Detailed Modelling Methods and Considerations

7.1 Floors/Slab

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

<table>
<thead>
<tr>
<th>LOD</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LOD 1</td>
</tr>
<tr>
<td>2</td>
<td>LOD 2</td>
</tr>
<tr>
<td>3</td>
<td>LOD 3</td>
</tr>
<tr>
<td>4</td>
<td>LOD 4</td>
</tr>
</tbody>
</table>

**Typical Levels of Information**

<table>
<thead>
<tr>
<th>LOI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Conceptual Mass</td>
</tr>
<tr>
<td>200</td>
<td>Floor: SURVEY 180mm</td>
</tr>
<tr>
<td>300</td>
<td>Floor: SURVEY STRUCTURAL 180mm</td>
</tr>
<tr>
<td>400</td>
<td>Floor: SURVEY STRUCTURAL 180mm (Detailed)</td>
</tr>
<tr>
<td>500</td>
<td>Floor: SURVEY STRUCTURAL 180mm (Framing/Concrete Details)</td>
</tr>
</tbody>
</table>

**DOORS AND WINDOWS**

<table>
<thead>
<tr>
<th>Level of Detail</th>
<th>LOD 1</th>
<th>LOD 2</th>
<th>LOD 3</th>
<th>LOD 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SITE TOPOGRAPHY**

<table>
<thead>
<tr>
<th>Level of Detail</th>
<th>LOD 1</th>
<th>LOD 2</th>
<th>LOD 3</th>
<th>LOD 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**UNDERGROUND SERVICES**

<table>
<thead>
<tr>
<th>Level of Detail</th>
<th>LOD 1</th>
<th>LOD 2</th>
<th>LOD 3</th>
<th>LOD 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOI 600</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:

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

<table>
<thead>
<tr>
<th>LOA</th>
<th>Description</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOA10</td>
<td>User defined</td>
<td>- 5 cm</td>
</tr>
<tr>
<td>LOA20</td>
<td>5 cm</td>
<td>- 15 mm</td>
</tr>
<tr>
<td>LOA30</td>
<td>15 mm</td>
<td>- 5 mm</td>
</tr>
<tr>
<td>LOA40</td>
<td>5 mm</td>
<td>- 1 mm</td>
</tr>
<tr>
<td>LOA50</td>
<td>1 mm</td>
<td>- 0</td>
</tr>
</tbody>
</table>
Christian Clemen (Germany): "Standards for BIM data exchange and process management"
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