IFC-Software Certification & BIM-Workflow-Support with BCF

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Director, iabi

Deputy Chairman, buildingSMART International
ISG Chairman, buildingSMART International
Deputy Chairman, buildingSMART GS
Overview: Fields of current and future bSI-Certifications

- **Software-Interfaces**
  - Past Certification 1.0 (IFC2x)
  - Current Certification 2.0 (IFC2x3)
  - Future Certifications (IFC4)
  - Future BCF – BIM Collaboration Format

- **Design-Data**
  - Data transferred between disciplines and processes
  - Data drops

- **Product-Data**
  - IFC for products
  - bSDD

- **Individuals**
  - BIM-Know-How
  - Various roles

- **Companies**
  - BIM-Competence
  - Ability to operate BIM
OpenBIM IFC Software Certification on behalf of buildingSMART

AEC3 Germany
iabi (Institute for Applied Building Informatics) at Munich University

IAI (Institut for Applied Informatics) at KIT (Karlsruhe Institute for Technology)
Framework for IFC Software Certification

Exchange Requirements

IDM

MVD

SW - Certification

buildingSMART

BIM-Software

Product Catalogues

Core

IFC

Shared Building Elements

Common Building Components

Processes

Domain Extensions

Structural MEP Curtain

Spaces

Ownership

IDM

IFD

Ontology

Product-Types

Translation
Certification

• Import and export interfaces of applications
  – Examine
  – Evaluate
  – Document

• Basis: Various Model View Definitions
  – Current: CoordinationView_V2.0 (Coordination of different planning disciplines)

• Current Status
  – 15 certifications (export & import) finished
  – 30 certifications (14 export, 16 import) in progress

• Close cooperation between software developer <-> Certification Team
Coordination View 2.0

- **Scope of Coordination View 2.0**
  - Coordination between three disciplines
  - Coordination within these disciplines
  - Structure + Shape + Properties

- **Exchange requirements in Coordination View 2.0**
  - CV Architecture (to MEP, to Struct)
  - CV MEP (to Arch, to Struct)
  - CV Structural (to Arch, to MEP)
  - (no roundtrip data exchange!)
Test Instructions I

- Basic Test Instructions
  - Detailed instruction for the test-files to be built by vendors
  - All Root Concepts are covered

- Random Tests
  - Individual Test Cases of the candidates
  - Specifics of each applications within the framework of CV 2.0
  - Tricky / strange examples from end-users

- Replacement Tests
  - Alternative test cases in case of not applicable basic tests instructions
BEAM 01

Beam 01 tests the architectural and structural exchange requirements for beams. The test file consists of 18 beams. Seven of them are in the ground floor, the other 11 are in the first floor.

This test file is used to verify the following test purpose:

- Beam geometry: arbitrary, rectangle, rectangle hollow, I shape, L shape, Z shape and U shape profiles, beams with clippings, all beams with straight extrusions
- Beam material: different materials
- Beam orientation: slanted beams and one rotated beam
- Beam presentation: different material colors or different surface color
- Pset_BeamCommon: IsExternal and LoadBearing
- Beams in different storeys

The units of the IFC file have to be metric, if possible in metre. All naming, like the names of the materials, the names of the floors, the profiles names should be given exactly as provided.

Name of IFC export file shall be "Beam_01_<software abbreviation>.ifc"
<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
<th>Profile</th>
<th>Material</th>
<th>Color</th>
<th>Top Edge (m)</th>
<th>Total Width (mm)</th>
<th>Total Height (mm)</th>
<th>Length (m)</th>
<th>Angle (°)</th>
<th>Rotation</th>
<th>IFC Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam_1-01</td>
<td>Arbitrary Profile</td>
<td>reinforced concrete</td>
<td>RGB 148-149-142</td>
<td>3.6</td>
<td>200</td>
<td>420</td>
<td>9.6</td>
<td>0°</td>
<td>0°</td>
<td>Is External False</td>
<td>LoadBearing True</td>
</tr>
<tr>
<td>Beam_1-02</td>
<td>Arbitrary Profile</td>
<td>reinforced concrete</td>
<td>RGB 148-149-142</td>
<td>3.6</td>
<td>300</td>
<td>480</td>
<td>9.6</td>
<td>0°</td>
<td>0°</td>
<td>Is External False</td>
<td>LoadBearing True</td>
</tr>
<tr>
<td>Beam_1-03</td>
<td>I Shape Profile</td>
<td>IPE 200 (DIN 1025-5)</td>
<td>steel</td>
<td>RGB 98-106-125</td>
<td>3.8</td>
<td>100</td>
<td>8.4</td>
<td>0°</td>
<td>0°</td>
<td>Is External False</td>
<td>LoadBearing False</td>
</tr>
<tr>
<td>Beam_1-04</td>
<td>Rectangle Hollow Profile</td>
<td>QRO 200x16 (EN 10210-2)</td>
<td>steel</td>
<td>RGB 98-106-125</td>
<td>3.8</td>
<td>200</td>
<td>200</td>
<td>8.4</td>
<td>0°</td>
<td>Is External False</td>
<td>LoadBearing False</td>
</tr>
</tbody>
</table>
Test Instructions IV
Test Instructions V

x = 0.00; y = 0.00

A
Test Instructions VI

Duplex House - Electrical

- Project Name: "Neues-Bauen-am-Horn"
- Building Name: "Duplex-House"
- Electrical components with correct geometry and colour
- Electrical types with correct type information
- Assignment of electrical components to systems
- Assignment of electrical components to the appropriate room
- Electrical components: ports, properties, names and type names
- Correct origin for model merging

The units of the IFC file have to be metric, if possible in metre.
Name of IFC export files shall be "DuplexHouse_Electrical_<software abbreviation>.ifc" & "DuplexHouse_Electrical Void_<software abbreviation>.ifc"
IFC & PDF files are provided: DuplexHouse_Electrical_V1.0.ifc, DuplexHouse_Electrical_FirstFloor.pdf, DuplexHouse_Electrical_GroundFloor.pdf, DuplexHouse_Electrical_Basement.pdf, DuplexHouse_Electrical_FirstFloor_1.pdf (without spaces), DuplexHouse_Electrical_GroundFloor_1.pdf (without spaces), DuplexHouse_Electrical_Basement_1.pdf (without spaces)

1. Import IFC File
2. Create the electrical systems according to the PDF files in the attachment for both flats, maintain the origin
   - Create separate electric circuits for sockets and lights, connect the whole system together so that it would actually work
   - Coordinate the electrical system with the sanitary, heating and ventilation system
3. Create the provisions for void for the main distributor
4. Export the IFC file for electrical system only - one file including all storeys
5. Export the provisions for void only
Certification platform I (GTDS)

GTDS-Server (hosted Windows Server 64bit)

- Jasper Server (PDF)
- Oracle 11.2 g Database
- Oracle Apex 4.1 Webanwendungen
- Oracle Apex Listener 1.0 http://gtds.buildingsmart.com/
- IfcCheckingTool
- Open IFC-Viewer

ODBC connections:
- Jasper Server (PDF) to Oracle 11.2 g Database
- Oracle 11.2 g Database to Oracle Apex 4.1 Webanwendungen
- Oracle 11.2 g Database to Oracle Apex Listener 1.0
- Oracle 11.2 g Database to IfcCheckingTool
- Oracle 11.2 g Database to Open IFC-Viewer
Certification platform II (GTDS)

- Services of GTDS
  - For everyone
    - Online Checking (automated checking of IFC-Files (IFC2x3-CV1))
    - IFC viewer with IFC-debugger
    - Checking report
  - For bSI-Members
    - Messaging Function (Email between members)
    - File Sharing
    - Meeting Organisation
    - BIM-Projects (Documentation of running BIM-Projects)
    - Discussion Tool
  - For bSI-Members + Certification participants
    - Certification Centre
      - Online Checking (automated checking of IFC-Dateien (IFC2x3-CV2.0))
      - Test Cases
      - Monitoring of progress
      - Documentation
      - Reports
      - Business Centre
Certification platform IV (IfcCheckingTool)

IfcChecking Framework

IFC File (SPF and ifcXML)

Implementer Agreements (Express)
- Manually edited

Rules for Coordination View (Schema Extension)
- Generated automatically from attribute tables

Rules for AddOn Views (Express)

IFC 2x3 Schema (CoordinationView 2.0)

Implementer Agreements (Express)
- Manally edited

IFC 2x3 Schema

IFC4 Schema (RC4)

Automated Checking

XML Report
Certification platform IV (IfcCheckingTool)

Header:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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<tbody>
<tr>
<td>Filename</td>
<td>C:\user\geiger\tests\ifcColumn.ifc</td>
</tr>
<tr>
<td>File Description</td>
<td>ViewDefinition [CoordinationView_V2.0]</td>
</tr>
<tr>
<td>Creation Date of Step</td>
<td>2012-07-24T17:19:32</td>
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<tr>
<td>PhysicalFile</td>
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<td>Originating System</td>
<td>Development Build</td>
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<td>Creation Date of Report</td>
<td>25 September 2012, 10:10:45</td>
</tr>
<tr>
<td>MVD Version Number</td>
<td>0.8.10 - 18-July-2012</td>
</tr>
<tr>
<td>View Definition</td>
<td>CoordinationView_V2.0</td>
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<tr>
<td>Schema</td>
<td>IFC2X3</td>
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Messages:

<table>
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<tr>
<th>Message Type</th>
<th>Rule Type</th>
<th>Message Code</th>
<th>Concept</th>
<th>Object Instance</th>
<th>Specification Link</th>
<th>Message String</th>
</tr>
</thead>
</table>
Certification-Workflow I (Export)

1. Download Test Instruction from GTDS
2. Model Test Cases
3. Export Test Cases as IFC 2x3 CV 2.0
4. Upload IFC-file of Test Cases to GTDS
5. Automated Checking
6. Checking of Test-Concepts
7. Manual Checking
8. OK?
   - Yes
   - No
9. 0 Error?
   - Yes
   - No
10. Tasks of participants
11. Tasks of auditors
Certification-Workflow II (Export)
Certification-Workflow III (Export)

<table>
<thead>
<tr>
<th>Root</th>
<th>Name</th>
<th>Status</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>General</td>
<td>DA Remains</td>
<td>Supported</td>
<td>Accepted, 15.11.2011 KMH</td>
</tr>
<tr>
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</tr>
<tr>
<td>IteBeam</td>
<td>010 Noring</td>
<td>Supported</td>
<td>Accepted, 15.11.2011, KMH</td>
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<tr>
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<tr>
<td>IteBeam</td>
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<td>Supported</td>
<td>Accepted, 15.11.2011, KMH</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Accepted, 15.11.2011, KMH</td>
</tr>
<tr>
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<tr>
<td>IteBeam</td>
<td>030-4-1 Geometry</td>
<td>Supported</td>
<td>Accepted, 08.12.2011</td>
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<td>Beam</td>
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<td>IteBeam</td>
<td>030-5-2 Geometry</td>
<td>Restricted</td>
<td>Not accepted, 15.11.2011</td>
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<td>Beam</td>
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</tbody>
</table>

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Institut für angewandte Bauinformatik

AEC3
Certification-Workflow IV (Import)

1. Download calibration file from GTDS
2. Import of Calibr. File as IFC 2x3 CV 2.0
3. Checking the Test Concepts
4. Upload the native model data
5. Manual Checking
6. OK?

Tasks of participants

Tasks of auditors
Certification-Workflow V

• Results
  – Documentation of manual / automated Checking
  – Monitoring of progress
  – Status of Test Cases / Concepts
  – Comparing applications on the level of concepts

• Add-ons for Certification
  – Discussion forum
  – Bi-weekly telecons
  – ISG-Meetings

Global Testing Documentation Server
http://gtds.buildingsmart.org/
What this certification means

<table>
<thead>
<tr>
<th>Process</th>
<th>Type of Test</th>
<th>Certificate</th>
<th>Process</th>
<th>Type of Test</th>
<th>Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>Software development</td>
<td>InternVAQ</td>
<td>Development</td>
<td>Simulation</td>
<td>Paddle</td>
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<td></td>
<td>Navi-Cloud</td>
<td>Training</td>
<td></td>
<td></td>
<td>TestSystem</td>
</tr>
<tr>
<td></td>
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<td>Testing</td>
<td></td>
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<tr>
<td></td>
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<td>Quality Assurance</td>
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<td>Quality Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Validation - Product + User</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping Product</td>
<td>Shipping software release</td>
<td>Certification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quality Assurance</td>
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<tr>
<td></td>
<td></td>
<td>Quality Control</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Validation - Product + User</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product used</td>
<td>Shipping software release being used</td>
<td>Certification</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Quality Assurance</td>
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<tr>
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<td>Quality Control</td>
<td></td>
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<td></td>
<td></td>
<td>Validation - Product + User</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Prof. Rasso Steinmann
April 2010

www.iabi.eu

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Institut für angewandte Bauinformatik
Specific Certifications and Logos

- Export / Import / Export&Import
- Model View Definition
- Sub View Definition
The Certification Team

Prof. Rasso Steinmann
Dr. Thomas Liebich
Karl-Heinz Häfele
Klaus Linhard
Bernd Wiesmeier
Kerstin Hausknecht
Dr. Matthias Weise
Andreas Geiger
Summary:
Software-Interface Certification 2.0 – Current status

• Information
  – http://www.buildingsmart.org/certification
  – http://www.buildingsmart-tech.org/certification/ifc-certification-2.0

• Background
  – Based on IFC2x3
  – Coordination View 2.0
    • 3 Sub-views to support coordination between disciplines: Arch / Struct / MEP
  – Export- / Import-Certification

• Resources
  – GTDS-Web-platform
  – Automated Checking-Tool for Export
  – Team of Auditors (Currently from Germany, any other country possible)
  – 2-weekly consulting telecons

• Status
  – http://www.buildingsmart.org/certification/currently-certified-software-products
  – This table becomes updated automatically out of GTDS
Data Round Trip

• Is it really necessary? Or more an academic exercise?
  – Usually not
    • Important is:
      – Information exchange for a specific purpose
    – Real Bulk-IFC-Data Round Trip is only required in very few cases
• Checking Data Round Trip
  – Good idea for identifying issues
• Certifying Data Round Trip
  – Bad idea
  – Not achievable for certification
    • Applications are too different internally
    • Just think about wall-intersection in various BIM-CAD applications
    • Even updates of one software package cannot achieve downward compatibility
• There is a better solution for workflow-support:
  – => BCF + IFC
Where buildingSMART (former IAI) started in 1995

The painful reality

The theoretical dream
Lessons learnt from the automotive industry:
The product model is evolutionary

=> Data Synchronization and Consolidation at certain milestones

Something like this seems to be more realistic
Synchronous Processes
- 1 Team
- 24 h in 1 Project
- Inside 1 Company

Asynchronous Processes
- Different Teams
- Do not work simultaneously
- Different Software
- Between Companies

Native Model

Evolutionary Reference-Model

1:100
Problemsolving in Merged Models from Partial Models of Special Engineers
Approach for a BIM-Workflow: The PCC© BIM-Method (Developed by iabi)
The PCC© BIM-Method

What it means

Setting up: Share your disciplinary BIM-Models

Team Work: Identify and solve issues with team and partners

Home Work: Clean-up your disciplinary BIM-Model

Next project phase: Evolve your BIM-Model

Prepare

Collaborate

Consolidate
Challenge 1: Communication and localisation of issues
Solution 1: BCF - BIM Collaboration Format

BCF

BIM-Manager

Special Planner
BCF - BIM Collaboration Format
www.buildingsmart-tech.org

• XML-Format to communicate BIM-related issues between Software
  – Zip-Container
    • Markup.bcf
    • Viewpoint.bcfv
    • Snapshot.png

• Version 1 (2010)
  – Developed by Solibri and Tekla

• Version 2 of XML-Format + Webservice (2014) (moderated by iabi)
  – Under development at buildingSMART
  – Catenda, DDS, iabi, bSI-ISG, Nemetschek-Scia, Solibri, Tekla, Graphisoft, bim+, ...
  – Improvements
    • Multiple snapshots/viewports
    • Provision for voids and BinSnippet (ifcXML, Ifc2x4, Ifc4, ...)
    • Associations and document references (file or URL)
    • Better process-support: Author identification, clearer status, classification

https://github.com/BuildingSMART/
Erfahrung aus „gescheiterter“ Gesamtmodell – Herangehensweise (DD Haikou)
- „sequentielle Bearbeitung“ – der parallelen Modelle
- „systemischer Datenaustausch“ – direkter Austausch zwischen den Modellen

- Zusammenführung und Prüfung der parallelen Modelle
- Abstimmungstermine
e.g.: BIM@HENN

1. Objektplanung
   -> erstellt 3D Geometrie

2. TGA 3D Planung
   -> erstellt Durchbrüche

3. Objektplanung
   Integriert Durchbrüche in Objektplanungsmodell

Ziel:
Übertrag von Bauteil - Teilinformationen
-> Verantwortung für Durchbruch verbleibt bei TGA
e.g.: BCF@HENN

BCF im Planungsverlauf

Planungsaktivität
- BCF Austausch
- IFC Teilabgleich
- IFC Abgleich

BCF Verantwortlichkeiten

Architekt

Geometrie

Fachplaner

Brandschutz

Austausch von Parametern, nicht von Elementen
Challenge 2: Communication via E-Mail Chaos
Solution 2: BCF Web-Service
Standard under development at buildingSMART
Challenge 3: Various model/issue releases
Solution 3: New Software
e.g. BIM--it© a BIM-Worflow-Cloud-Application
Join the journey
There are already folks at the other side
BIM

Still more to explore
but it is exciting