Introduction of BRI’s study on BIM based building confirmation and inspection and its’ outcomes

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Topics

1. BRI R&D project on computerization of building confirmation and inspection with BIM technology (FY 2011-2014)
   • Backgrounds of R&D
   • Outputs of R&D
     - Definition of development step
     - BRI Step2+ Prototype

2. Outcomes of BRI R&D Project
1. BRI R&D project on computerization of building confirmation and inspection with BIM technology (FY 2011-2014)
Backgrounds of R&D
Typical Procedure of Paper based building certification

Application drawings and its contents

- 各階平面図
- 断面図
- 配置図
- 仕上表

Confirmation body

Application form

- 確認申請書
- 設計概要、設計者

Architect’s seal is needed.

Client’s seal is needed.

Architect (Substitution)

Client (Representation)

The mismatching sometimes arises between documents.

Confirmation by paper based documents

Certificate of building conformity

Archive application documents
Typical Procedure of Paper based building certification

Confirmation body

Application drawings and its contents

Architect’s seal is needed.

The mismatching sometimes arises between documents.

Application form

Client’s seal is needed.

Needs for improvement of compatibility

Certificate of building conformity

Needs for digital archiving

confirmation by paper based documents

archive application documents

Application form

客戶’s seal is needed.

Applicant

Confirmation body

Architect (Substitution)

Client (Representation)

Applicant drawings and its contents

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Application form

客戶’s seal is needed.
Outputs of R&D
Definition of development step
Perspective of development step

Applicant

Application documents and its contents

高さ、道路幅員...

各室の用途、床面積...

居室の天井高さ...

令129条規定部分...

Conformation body

confirmation by paper based documents

 Confirmation body

confirmation by Scanned image

confirmation by e-documents w/ contents data

confirmation by BIM model data

Viewe
## Detail of development steps

<table>
<thead>
<tr>
<th>Step</th>
<th>Level of development</th>
<th>Additional Contents from conventional application</th>
<th>Certain about Compatibility</th>
<th>In-service*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>CAD BIM</td>
<td>Conventional application</td>
<td>-</td>
<td>○</td>
</tr>
<tr>
<td>0+</td>
<td>CAD BIM</td>
<td>Added Some data contents with Step0 paper docs.</td>
<td>CVS/XML form data of application’s by data media</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>CAD BIM</td>
<td>Just scanned or e-published application forms and drawings</td>
<td>(same as conventional application)</td>
<td>-</td>
</tr>
<tr>
<td>1+</td>
<td>BIM</td>
<td>e-published application forms and drawings with BIM certification</td>
<td>Footprint of BIM certification for each view of e-documents</td>
<td>○</td>
</tr>
<tr>
<td>2</td>
<td>CAD BIM</td>
<td>Added Some data contents with Step1 docs.</td>
<td>CVS/XML form data of application’s</td>
<td>-</td>
</tr>
<tr>
<td>2+</td>
<td>BIM</td>
<td>Added essential IFC model data with Step1 docs.</td>
<td>IFC Model data incl. form data</td>
<td>○○</td>
</tr>
<tr>
<td>3-</td>
<td>BIM</td>
<td>Available partial auto code checking</td>
<td>IFC Model data compatible with partial ACC</td>
<td>○○</td>
</tr>
<tr>
<td>3</td>
<td>BIM</td>
<td>Available full auto code checking</td>
<td>IFC Model data compatible with full ACC</td>
<td>○○○</td>
</tr>
</tbody>
</table>

*In-service*: Indicates the start year of each step's implementation.
<table>
<thead>
<tr>
<th>Step</th>
<th>Conformation body expects…</th>
<th>How does jury check the documents?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+</td>
<td>Compatibility among application forms and drawing.</td>
<td>Jury check 2D drawing and forms manually <strong>with</strong> attention for lack of expression legally needed.</td>
</tr>
<tr>
<td>2+</td>
<td>Addition to 1+, to find lack of expression legally needed on application docs.</td>
<td>Jury check 2D drawing <strong>without</strong> attention for lack of expression legally needed.</td>
</tr>
<tr>
<td>3-3</td>
<td>Addition to 2+, to check building codes semi/full automatically.</td>
<td>Jury evaluate adequacy of code checking results.</td>
</tr>
</tbody>
</table>
BRI Step2+ Prototype
Definition of IFC based Model for Step2+

Contents: Plan, Specification, Performance-based requirements, incl. addendum, amendment, annotation in checking process

CAD/BIM supplement software for applicant
- making application data
  + Tables
  + 2D drawings
  + 3D model
- Self Checking function

ASP services system
- Electrical Signature attempt for
  + PDF
- Workflow design
- Communications support
- History Archive

Confirmation tools
- Checking function
- Applicant docs. Viewer + tables
  + 2D drawing required regally
  + 3D model for reference 2D Drawing
- Editing annotations / comments

Image of Prototype System
Definition of Property sets for application documents
The object which must specify an building certification item on application drawings is stored in IfcProperty (=“Pset_BSLJ_確認申請チェックリスト”) as the information which contents must be described.
Definition of IFC based model for Step2+
Screen shots of ASP service system for all steps
Screen shots of Confirmation tools

[Image of a screen shot with a note: "引出しが3Dシーンとリンクしている場合、ダブルクリックでシーンを表示します。"

[Image of a diagram with a note: "階段幅の確認"]
Screen shots of Inspection tools
2. Outcomes of BRI R&D Project
Outcomes of BRI Research Project

• The 1st achievement of BIM building certification
  • Building certification by accepting BIM model file has kicked off!
  • “Jyutaku seino hyouka center,” the designated confirmation and inspection body executed building certification by accepting BIM model as the 1st achievement in Japan.

• bSJapane Regulatory WG
  • Regulatory WG under the Architectural & Cross Domain Group is settled by buildingSMART Japan.
The 1\textsuperscript{st} achievement of BIM building certification

Applicant: FREEDOM ARCHITECTS DESIGN

Confirmation body: Jyutaku seino hyouka center, KK

BIM software/solution bender: Otsuka Corporation, Autodesk

Freedom Architects design, the applicant and Jyutaku seino hyouka center, the designated confirmation and inspection body developed a “Revit based” BIM building certification solution in collaboration with Otsuka Corp. and Autodesk. In Aug. 2016, 2 building certification was issued using by this solution, These 4 companies jointly issued a press release announcing the outline at Sep. 1\textsuperscript{st}, and Freedom Architects design made the speech at Autodesk University Japan 2016 about the detail at Set. 6\textsuperscript{th}.
The 1st achievement of BIM building certification

There is no inconsistency between drawings as long as they are issued from BIM DATA.

DATAからであれば「図面間の不整合は無い」
There is no inconsistency between drawings as long as they are issued from BIM DATA.
The 1st achievement of BIM building certification

6 essential drawings and calculation figure issued from BIM model data by Revit

Revit を用いた6種の図面 + 各種申請書 計算書類
The 1st achievement of BIM building certification

Freedom architect design, Otsuka corp. and Autodesk streamlined the workflow of making regally required drawings.

Supplemental Information that regally required put on semi-automatically using by “Revit Template”.

BIM model with 2D drawings view

Regally Required Drawings
The 1st achievement of BIM building certification

Jutaku seino hyouka center, KK, Otsuka corp. and Autodesk streamlined the workflow of consistency check by accepting BIM model file.

Conventional e-submission (BRI Step 1)

BIM building certification (BRI Step 1+)

Drawings generated by BIM but unknown about its consistency...
The 1st achievement of BIM building certification

Scheme of whole building certification on this case (with BRI Step 1+ Concept)
## Detail of development steps

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<td>○</td>
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<tr>
<td>0+</td>
<td>CAD BIM</td>
<td>Added Some data contents with Step0 paper docs.</td>
<td>-</td>
<td>○ (1993~)</td>
</tr>
<tr>
<td>1</td>
<td>CAD BIM</td>
<td>Just scanned or e-published application forms and drawings</td>
<td>-</td>
<td>○ (2015.1~)</td>
</tr>
<tr>
<td>1+</td>
<td>BIM</td>
<td>e-published application forms and drawings with BIM certification</td>
<td>○</td>
<td>△ (2016.8~)</td>
</tr>
<tr>
<td>2</td>
<td>CAD BIM</td>
<td>Added Some data contents with Step1 docs.</td>
<td>-</td>
<td>○ (2015.1~)</td>
</tr>
<tr>
<td>2+</td>
<td>BIM</td>
<td>Added essential IFC model data with Step1 docs.</td>
<td>○○</td>
<td>-</td>
</tr>
<tr>
<td>3-</td>
<td>BIM</td>
<td>Available partial auto code checking</td>
<td>○○</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>BIM</td>
<td>Available full auto code checking</td>
<td>○○○</td>
<td>-</td>
</tr>
</tbody>
</table>

(* ○: in general, △: as trial*)
bSJapan Regulatory WG

- bSJ Reg. WG has three missions as follows;
  - Inspection of MVD certification for BCC IFC inspection
  - Study on BIM use technology in a Building confirmation and inspection in practical affair
  - Corresponding to bSI RR’s projects in bSJ

- Convener and Participants
  - Convener:
    Masaki MUTO / Building Research Institute
  - Constitution of participants:
    confirmation body, architectural design office, general contractor, home builder, software solution vendor and interested individuals
Resolutions from Regulatory Room

- Appoint Masaki Muto and Hans Lif as co-chairs in WG1 - e-submission.
- Thank Nick Nisbet and the contributors to WG2 on interoperability and look forward to reviewing the final report and recommendations ready for Barcelona.
- Elect Inhan Kim, Hans Lif, Øivind Rooth, Masaki Muto and Nick Nisbet as the RR steering committee.
- Elect Inhan Kim and Øivind Rooth to continue to co-chair.
- Thanks to buildingSMART Korea for their hospitality.

Hans Lif, bSI RR WG1 co-chairs (bS Nordic/RAMBOLL)

bSI Jeju summit
## Comparison of design process

<table>
<thead>
<tr>
<th>Project Stage</th>
<th>Pre-design</th>
<th>design</th>
<th>Procurement</th>
<th>Construction</th>
<th>Handover</th>
<th>Post construction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UK RIBA</strong></td>
<td>Inception and planning</td>
<td>Outline Proposal</td>
<td>Scheme design</td>
<td>Detail design</td>
<td>Production Information</td>
<td>Tender action &amp; contract award</td>
</tr>
<tr>
<td><strong>USA AIA</strong></td>
<td>Programming</td>
<td>Preliminary design</td>
<td>Schematic Design</td>
<td>Design Development</td>
<td>Construction documents</td>
<td>Bidding negotiation &amp; contract award</td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td>Research and Planning</td>
<td>Basic design</td>
<td>Detailed design</td>
<td>Optional service</td>
<td>Detailed design during construction</td>
<td>construction supervision</td>
</tr>
<tr>
<td><strong>Korea</strong></td>
<td>Concept Design</td>
<td>Schematic Design</td>
<td>Design Development</td>
<td>Construction Documents</td>
<td>Construction Administration</td>
<td>Construction Management</td>
</tr>
<tr>
<td><strong>China</strong></td>
<td>Schematic design</td>
<td>Preliminary Design Development Design</td>
<td>Working Drawing Construction preparation</td>
<td></td>
<td>Cooperate Construction</td>
<td>Acceptance Collation</td>
</tr>
</tbody>
</table>

**Concept approval** **Building approval**
Common understanding about building permit / confirmation procedure
-Difference of maturity of information by approval phases

<table>
<thead>
<tr>
<th>Application form</th>
<th>Map</th>
<th>Drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept approval</td>
<td></td>
<td>Increase maturity of information</td>
</tr>
<tr>
<td>To be build</td>
<td></td>
<td>Building approval</td>
</tr>
<tr>
<td>As build</td>
<td></td>
<td>Construction approval</td>
</tr>
</tbody>
</table>

Building Research Institute
Representation of procedure and information delivery to develop common understanding

Classification of information delivery could be classified from the kind of information format as legal requirement and its treatment during the procedure of BCC.
Proposal for the questionnaire for international comparison of information delivery

The questionnaire is to clear the facts about;

• Which approval is needed in each country?
• After which design process is it applied for the approval?
• What documents or drawings are needed legally on paper based, paperless and BIM based submission?
• What expressive elements are specified for each document or drawing?
• Which building code does each expressive element correspond to?
• What type is the criterion for adaptation of building code? (e.g. existence, text, numbers, numerical value or spatial/geometrical relation of targets, or results of calculation, simulation or analysis)
## Draft of the questionnaire format

### Japan/Building Approval after detail design

<table>
<thead>
<tr>
<th>documents or drawings are needed legally</th>
<th>specified expressive elements</th>
<th>paperless document file format</th>
<th>essential or as needed from building code of</th>
<th>criterion type</th>
</tr>
</thead>
<tbody>
<tr>
<td>map</td>
<td>Orientation, Scale, Road, Landscape</td>
<td>pdf</td>
<td>essential</td>
<td>geometrical</td>
</tr>
<tr>
<td>site plan</td>
<td>Orientation, Scale, Site boundary, Waste Water Piping...</td>
<td>pdf</td>
<td>essential</td>
<td>geometrical</td>
</tr>
<tr>
<td>floor plan</td>
<td>Room type, Location of opening, Location of structural elements...</td>
<td>pdf</td>
<td>essential</td>
<td>spatial</td>
</tr>
<tr>
<td>floor area calculation figure</td>
<td>Size of floor space, Calculation formula</td>
<td>pdf</td>
<td>essential</td>
<td>spatial, numerical</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Draft of Common Scale <Proposal>

<table>
<thead>
<tr>
<th>Level of Development</th>
<th>Conformation body expects...</th>
<th>Work object</th>
<th>IFC expression of legal issue</th>
</tr>
</thead>
</table>
| 1 <Manual checking w/o IFC> | a. Compatibility among application forms and drawing.  
   b. to recognize complicated shape easily by 3D view | a. 2D drawing issued from BIM model  
   b. 3D view of BIM model | (n/a) |
| 2 <Manual checking w/ IFC> | to find lack of expression legally needed on application docs. | 2D drawing and Model Data | Indication of legal objects |
| 3<Hybrid>  
3+<ACC> | to check building codes semi/full automatically.  
   a. Number of targets  
   b. Numerical value of targets  
   c. Spatial / Geometrical relation of targets  
   d. Simulation / Analysis | <Hybrid> 2D drawing and Model Data  
   <ACC> Model Data | Value of legal objects  
   a. Object Type  
   b. Numerical Value  
   c. Code checking Rule  
   d. Exporting to external program |
Thank you for your attention!

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