Study on electronic submission technologies for building certification on technical standards conformity “3”

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Summary

- In Japanese building certification, there are two major requirements of confirmation bodies; they are digitize of application documents and improvement of compatibility between application documents.

- BRI executed R&D on BIM Based e-submission system on building confirmation and inspection to fulfill these requirements for these 3 years.

- In this R&D, we define the “development step” for BIM based e-submission system, and develop IFC, IDM/MVD and prototype system for “step 2+” defined by the development step.

- In development of prototype, we find out these problems as follows;
  - archiving IFC and usage itself
  - merging 2D view into IFC model
  - expression “visible annotation” as IFC objects

- We hope to share, discuss and resolve about these problems on RR.
0. Outline of Japanese Building Confirmation and BRI’s R&D
Typical Procedure of building certification

Applicant

Application drawings and its contents
- 各階平面図
- 断面図
- 仕上表

Confirmation body
- local Gov.
- Designated confirmation body (=private company)

Architect (Substitution)

Application form
- 確認申請書
- 設計概要、設計者

Client (Representation)

Architect’s seal is needed.

The mismatching sometimes arises between documents.

Client’s seal is needed.

Certificate of building conformity

confirmation by paper based documents

archive application documents
The aim of this research

To develop the technology of the electronic application of the building confirmation for achieving the following aims:

(1) Digitize the document for application preserved by the confirmation body.

(2) Improve the compatibility of the descriptive content of documents for mitigating a labor required for confirming work.
1. Definition of “development step” for BIM based e-submission system
Perspective of development step

Applicant

Application documents and its contents

配置図
各階平面図
断面図
仕上表 〇〇××㊞

Confirmation body

confirmation by paper based documents

CAD

Photo scanned image
method of compatibility reservation

PDF
DXF etc.
XML etc.
é-documents contents data

confirmation by e-documents w/ contents data

BIM

3D Building model
definition of Property sets and model view

BIM model data (unified)

confirmation by BIM model data

Viewers

Conventional

Step 1
Conventional confirmation by paper based documents

Step 2
confirmation by scanned image

Step 3
confirmation by e-documents w/ contents data

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・・・
# 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 photo 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>
What is expected to BIM/IFC on each step?

<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>
Step1+ solution with footprint of BIM certification

Example of indication

Used software: ABC-BIMpro.v17
Filename of Model: teishutu-1
Created: 20YY.MM.DD
Corrected final: 20yy.mm.dd
Checking-CODE: ◆WBRXcNtpf.

2D View (required regally)

The display which shows generated “AT ONCE” from the “ONE”, “Unified” BIM file

<issue from 1 model at once>
R&D targets on Step2+

Applicant

Application documents and its contents

Confirmation body

CAD

Photo scanned image

method of compatibility reservation

e-documents contents data

Application documents and its contents

confirmation by paper based documents

Conventional

Confirmation by Scanned image

confirmation by e-documents w/ contents data

Today’s focus

Photo scanned image

e-documents contents data

document formats / workflow

confirmation by BIM model data

Viewer

Step 1

Step 2

Step 3

3D Building model

definition of Property sets and model view

BIM model data (unified)

IFC XML etc.

3D Building model

BIM

Highness of roads and street width...

Floor plan of each floor

Room use, floor area...

Cross section

Ceiling height of room...

Confirmation body

Year 129 regulation part...

Step 1

Conventional confirmation by paper based documents

Photo scanned image

e-documents contents data

Application documents and its contents

Confirmation by Scanned image

e-documents with contents data

Confirmation by BIM model data

Viewer

Step 2

Today's focus

confirmation by Scanned image

confirmation by e-documents w/ contents data

confirmation by BIM model data

Conventional

Confirmation by Scanned image

e-documents with contents data

Confirmation by BIM model data

Viewer

Step 3

Today’s focus

photo scanned image

e-documents contents data

document formats / workflow

confirmation by BIM model data

Viewer

Step 3
2. Definition of Property sets
Application documents
(development on IFC)
How to define Property sets for Application documents

Making of data structure

description value

Definition of IfcPropertySets

IfcPropertySet
  >IfcComplexProperty

IfcPropertySingleValue
Definition of Property sets for Description on drawings

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.
3. Definition of model view
and
method of compatibility reservation
(development on IDM/MVD)
How to connect 2D drawings with IFC model data

2D drawing images with description as required for application

BIM software’s Native

3D-Building model data

IFC

Pset_BSLJ_第二号様式

Application Form #2

Pset_BSLJ_確認申請チェックリスト

Check-list of description on drawings as required

記載事項の形式
確認の省力化

Step 2+

各階平面図
断面図
配置図
仕上表

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...

設計図面と確認内容の情報

IfcAnnotation
When 2D drawing images with description as required for application are made, output positions of the objects which must be specified are stored in the BIM model using IfcAnnotation, because of connecting 2D drawings and the model.
The scenario of Step 2+ BIM building certification
The scenario of Step 2+ BIM building certification

How about BCF?

Formality self-checking program

Step 3 <Full BIM>
4. Developing Prototype System and detection of further challenges
Image of Prototype System

Benchmark 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
Screen shots of ASP service system for all steps
Benchmark of IFC based model for Step2+
Screen shots of Confirmation tools

[Description of the image: Screen shots showing different stages of a building plan and a table with details like date, file name, page, and content. Highlights on the images indicate features such as 3D models and verification notes.]
Screen shots of Inspection tools
## Further challenges

<table>
<thead>
<tr>
<th>Problems found out</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of archive pdf documents and IFC model together is not established.</td>
<td>- We hope to develop the method to archive IFC model data.</td>
</tr>
<tr>
<td>Consideration that confirmation body should utilize the archived IFC model after an actual building made is not enough.</td>
<td>- To maximize effects of BIM, we start to investigate the possibility of expansion of confirmation body’s affairs.</td>
</tr>
<tr>
<td>Position adjustments between model and detached pdf drawing are not completely.</td>
<td>- We hope to develop the method to merge 2D view into model by using BCF or IFC.</td>
</tr>
<tr>
<td>There are no way to store required descriptions (e.g. annotation on drawing) as IFC objects.</td>
<td>- We hope to extend IFC to be able to express “visible annotation” as IFC objects.</td>
</tr>
<tr>
<td>In this method, the usage of IFC limited to certify compatibility is insufficient to execute advanced code checking.</td>
<td>- To investigate the possibility of Step3-, we start to development the way to express code checking matter in IFC.</td>
</tr>
</tbody>
</table>
5. Conclusion
Conclusion (rept.)

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- BRI executed R&D on BIM Based e-submission system on building confirmation and inspection to fulfill these requirements for these 3 years.

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  - expression “visible annotation” as IFC objects

- We hope to share, discuss and resolve about these problems on RR.
Appendix.

Standardization of Level of Development (LOD) for Building Regulatory Checking on Reg.Com, bSI
Draft of Common Scale <Proposal>

It's classified by 2 viewpoints about the situation of each country.

Level of Development (LOD) for Building Regulatory Checking
<main classification>

indicates;
- What is expected legally by using of BIM/IFC?
- How much is the degree of automatic code checking?

Categories of Level of Development
$sub classification>

Indicates;
- What is the target on the LOD?
# 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 |
Draft of Common Scale <Proposal>

Usage of LOD for Building Regulatory Checking

*(Just a Sample)*

- BRI’s “Step1+” → LOD 1 category b.
- BRI’s “Step2+” → LOD 2
- BCA.sg /corenet → LOD 3 category a., b. ??
- MOLIT.kr u-SEUMTER → LOD 3+ category a., b., c. ??

↑  *Sorry, I don’t know correctly...*
Thank you for your attention!

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