Introduction of BRI’s R&D on BIM Based e-submission system on building confirmation and inspection

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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

**Application**
- Applicant
- Architect (Substitution)
- Client (Representation)

**Application drawings and its contents**
- 各階平面図
- 断面図
- 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

**Application form**
- 確認申請書
- 設計概要、設計者
- ○○ × × ㊞

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

**Certificate of building conformity**
- Architect’s seal is needed.
- Client’s seal is needed.

The mismatching sometimes arises between documents.

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
  - 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

**Confirmation body**

- confirmation by paper based documents

**Conventional**

**Step 1** Conventional confirmation by paper based documents
- Photo scanned image
- Application documents and its contents data

**Step 2** confirmation by scanned image
- Photo scanned image
- e-documents contents data

**Step 3** confirmation by e-documents w/ contents data
- e-documents contents data

**Viewer**

- confirmation by BIM model data

**CAD**

- PDF

**BIM**

- PDF, DXF, etc.
- IFC, XML, etc.

**Definition of Property sets and model view**

**BIM model data (unified)**

**Document formats / workflow**

- Electronic signature replaced with sealing
- Document formats / workflow

**Perspective of development step**

- Step 1 Conventional confirmation by paper based documents
- Step 2 confirmation by scanned image
- Step 3 confirmation by e-documents w/ contents data
## 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>-</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>
<tr>
<td>Step</td>
<td>Conformation body expects…</td>
<td>How does jury check the documents?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------------------------</td>
<td>-----------------------------------</td>
<td></td>
<td></td>
</tr>
<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>
<td></td>
<td></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>
<td></td>
<td></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>
<td></td>
<td></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>
2. Definition of Property sets
Application documents
(development on IFC)
How to define Property sets for Application documents

Making of data structure

Definition of IfcPropertySets

IfcPropertySet > IfcComplexProperty
### Definition of Property sets for Description on drawings

#### (一) 申请の種類

<table>
<thead>
<tr>
<th>(一)</th>
<th>(二)</th>
<th>(三)</th>
</tr>
</thead>
<tbody>
<tr>
<td>付近見取図 01</td>
<td>方位、道路及び目標となる地物</td>
<td>明示すべき事項</td>
</tr>
<tr>
<td>配置図 02</td>
<td>土地の高低、敷地及び建築物の位置及び高さ</td>
<td>申請に係る建築物の各部分の高さ</td>
</tr>
<tr>
<td>各階平面図 03</td>
<td>申請に係る建築物の建築基準法（昭和25年法律第201号。以下「法」という。）第3条第2項の規定により法第339号。以下「令」という。）第137条の4の2に規定する基準に係る部分に限る。</td>
<td>申請に係る建築物の各部分の高さ</td>
</tr>
<tr>
<td>床面積求積図 04</td>
<td>申请に係る建築物の各階床面積及び床面積の求積に必要な建築物の各部分の寸法及び算式</td>
<td></td>
</tr>
<tr>
<td>二面以上の立面図 05</td>
<td>延焼のおそれのある部分の外壁及び軒裏の構造 (法第109条の3第1号に係る認定書の写し)</td>
<td>申請に係る建築物の各部分の高さ</td>
</tr>
<tr>
<td>各階平面図 06</td>
<td>申請に係る建築物の建築基準法（昭和25年法律第201号。以下「法」という。）第3条第2項の規定により法第339号。以下「令」という。）第137条の4の2に規定する基準に係る部分に限る。</td>
<td>申請に係る建築物の各部分の高さ</td>
</tr>
<tr>
<td>地盤面算定表 07</td>
<td>建築物が周囲の地盤及び基壇に係る各位置の高さ</td>
<td></td>
</tr>
</tbody>
</table>

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

Step 2+

2D drawing images with description as required for application

BIM software’s Native

3D-Building model data

2D drawing images with description as required for application

BIM software’s Native

3D-Building model data
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 by IfcAnnotation, because of connecting 2D drawings and the model.
The scenario of Step 2+ BIM building certification

- **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
- **Formality self-checking program**
- **ASP Server**
- **PDF Viewer**
- **IfcAnnotation**
- **IfcProperty Viewer**

**Step 2+**

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The scenario of Step 2 + BIM building certification

3

How about BCF?

3D-Building model data

ASP Server

PDF Viewer

IfcAnnotation

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

Formality self-checking program

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

出力表示の座標は、出力側で維持
Screen shots of Confirmation tools
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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Thank you for your attention!

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