

Study on application BIM technologies for building certification on technical standards conformity

-Introduction of research of the BIM technology
in the Building Research Institute



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Summary

- To introduce electronic submission for building certificate procedure including BIM technology are expected for streamlining on confirmation of building technical standards. And some countries already started electronic submission with BIM technology now, e.g. Singapore.
- Building Research Institute executes the R&D project which is aimed to clarify bottlenecks in conventional building certificate procedure, subjects of introduction electronic submission and application possibilities of BIM on the procedure from FY2012 to FY2014. This topic gives a progress report of our R&D.

BRI 's R&D Activities

The Building Research Institute (BRI) has been conducting various research and development from the fair and neutral perspective of a public-sector research institute.

国土交通大臣が示す研究開発の目標
Targets of R&D shown by the Minister

建築研究所の研究開発
Implementation of R&D by BRI

国の技術基準、ガイドライン等への反映
Reflected in the National Technical Standards,
Guidelines, etc.

民間の技術開発や設計・施工の現場における活用
Utilized for Technology Development, Design and
Construction in Private Sectors

住宅・建築・都市の質の確保・向上
Improvement of Housing, Buildings and Urban
Communities in Japan

4 Targets of R&D shown by the MLIT

Realization of Sustainable Housing,
1) Buildings and Urban Communities by
Green Innovations

Realization of Secure and Safe
2) Housing, Buildings and Urban
Communities

Maintenance and Revitalization of
Existing Housing, Buildings and Urban
3) Communities Coping with the
Declining and Aging Population

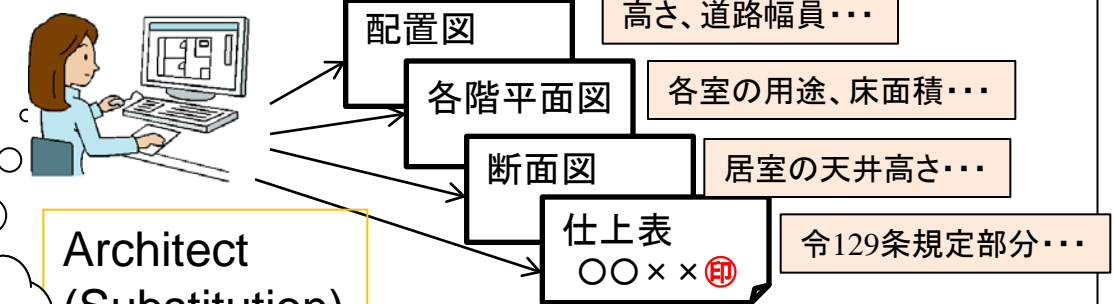
International Contributions by Building
4) and City Planning Technology and
Response to Informatization

Typical Procedure of building certification

Applicant

Confirmation body

Application drawings and its contents



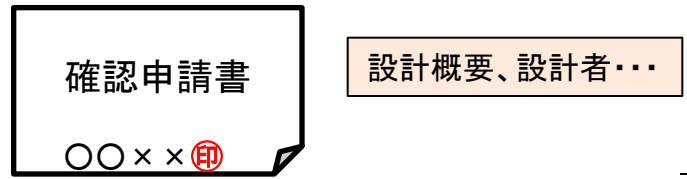
Architect
(Substitution)

Architect's seal is needed.



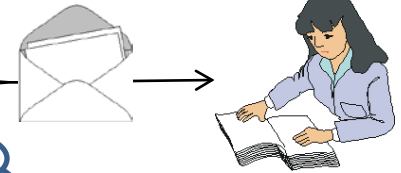
The mismatching sometimes arises between documents.

Application form

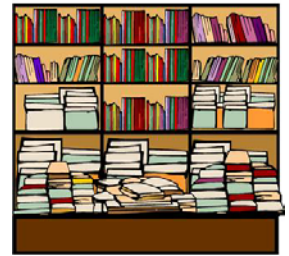


Client's seal is needed.

Client
(Representation)



confirmation by paper based documents



archive application documents




Certificate of building conformity



Backgrounds 1/2

By the legal revision in 2007, a duty of preservation of the application documents on building confirmation for 15 years was imposed upon the confirmation body.




Since the application is made on the basis of paper medium, confirmation body is regarding as problems the preservation place and its cost, or documents lost.



Since CAD is generally used, is submitting digitized application documents and confirming possible?

Backgrounds 2/2

After the incident which camouflaged earthquake resistance (called “Aneha” incident), the procedure of the building confirmation tightened and change of the contents in the procedure became difficult.



Therefore, the preliminary consultation before a “formal reception” is prolonging the confirmation period so that there may be no inconsistency in the contents of application documents.



Is the BIM technology which can unify building properties inapplicable?

The aim of this research

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

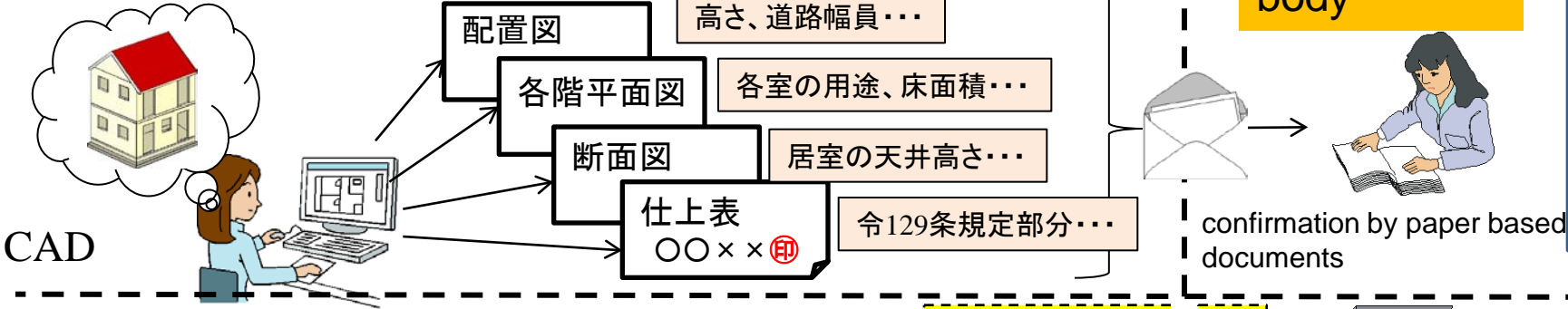
- (1) Digitize the document for application preserved by the confirmation body.
- (2) Improve the compatibility of the descriptive content of documents for mitigating a labor required for confirming work.

Perspective of development

Applicant

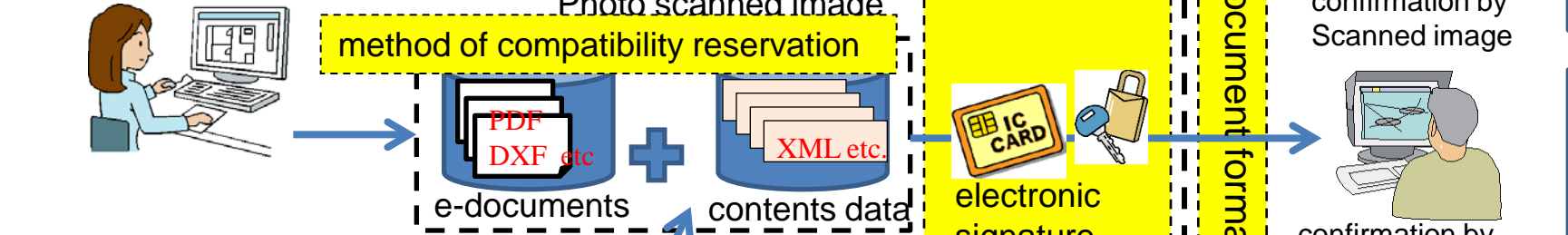
Application documents and its contents

Confirmation body



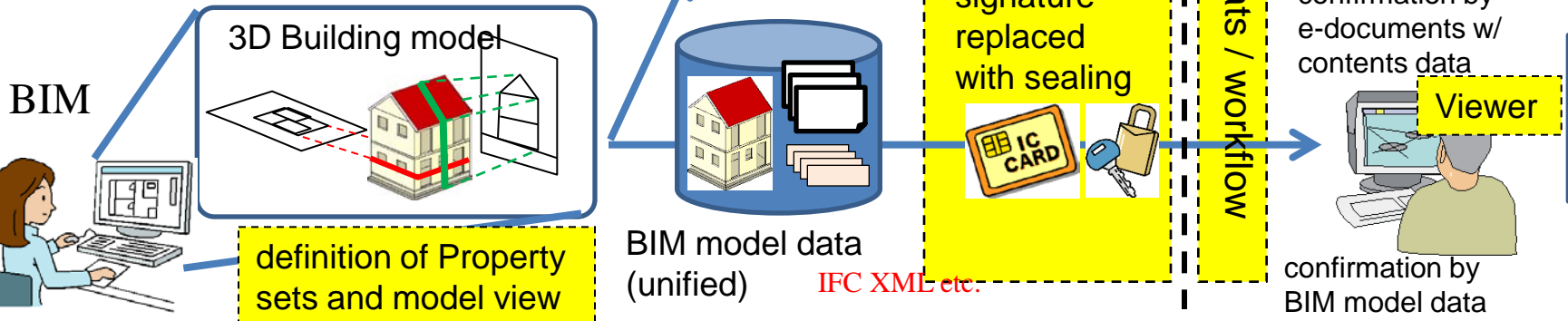
Conventional

CAD



Step 1

BIM



Step 2

Step 3

Perspective of development

Applicant

Application documents and its contents

Confirmation body

Co

Development of the data structure of a building design
Product Model = IFC, IFD

Development of the information use process in building confirmation
Process Model = IDM, MVD

CAD



method of compatibility reservation

BIM



3D Building model

definition of Property sets and model view



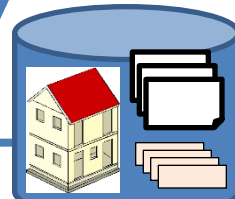
Photo Scanned image



e-documents



contents data



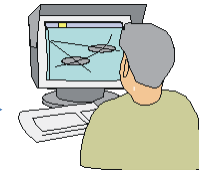
BIM model data (unified)

IFC XML etc.

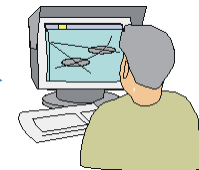


electronic signature replaced with sealing

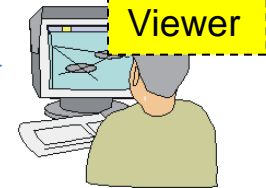
document formats / workflow



confirmation by Scanned image



confirmation by e-documents w/ contents data



confirmation by BIM model data

Step 1

Step 2

Step 3

Detail of development steps

Step	Target of development step	Core technology needed	contribution to problem solving	
			(1) Digitize the document for application	(2) Improve the compatibility of the descriptive content of documents
1	confirmation by Scanned image	<ul style="list-style-type: none"> •electronic signature (= long term signature and multiple signature) corresponding to <u>image file format</u> •workflow diagrams or document formats corresponding to electronic submission 	Good	n/a
2	confirmation by e-documents w/ contents data	(Add to Step 1.) <ul style="list-style-type: none"> •electronic signature (= long term signature and multiple signature) corresponding to <u>data file format</u> •method of compatibility reservation between e-document and contents data 	Excellent	Good
3	confirmation by BIM model data	(Add to Step 1.) <ul style="list-style-type: none"> •electronic signature (= long term signature and multiple signature) corresponding to <u>BIM model file format</u> •Definition the data structure of a building design (=IFC, IFD) •Development of the information use process in building confirmation(=IDM, MVD and Viewer Application) 	Excellent	Excellent

Research procedure / targets of development

FY
2012

Fix the development steps
and select the target of
building classification

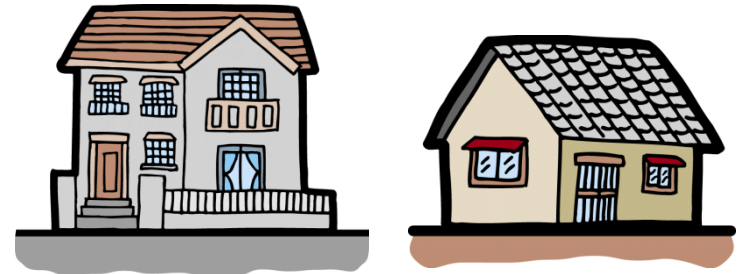


Targets: general buildings

FY
2013

A design and trial production
of an electronic submission
prototype system

Targets: ONLY small wooden houses



FY
2014

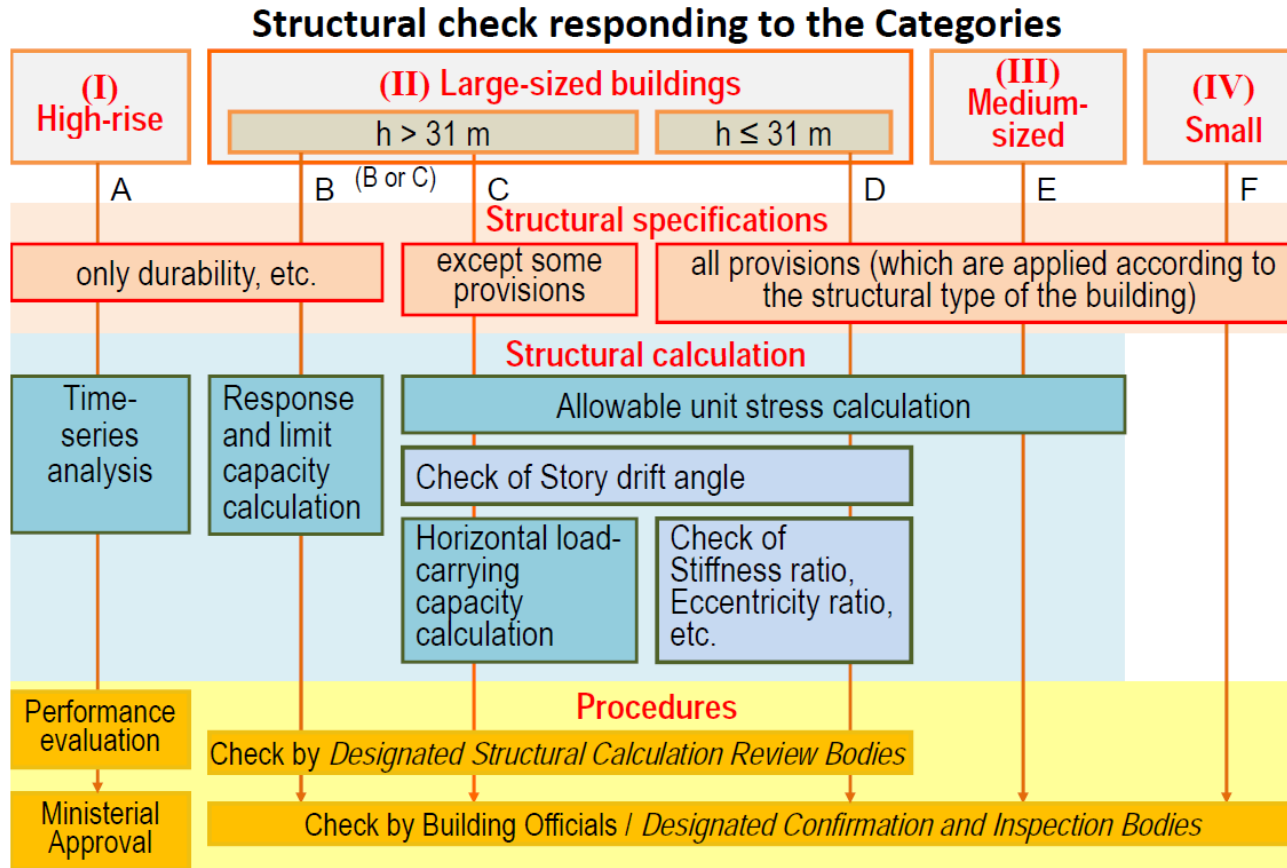
Trial of a prototype system,
and decision of technical
specification for electronic
submission

Categorize IV* at Building Standards Act

*Number of stories ≤ 2 ;
Total floor area $\leq 500\text{m}^2$;
Building height $\leq 13\text{m}$;
Eave height $\leq 9\text{m}$

Why we chose small wooden houses?

Reason 1: Compared with the building of other categories, structural checking is simple and suitable for modeling the whole procedure of the application.

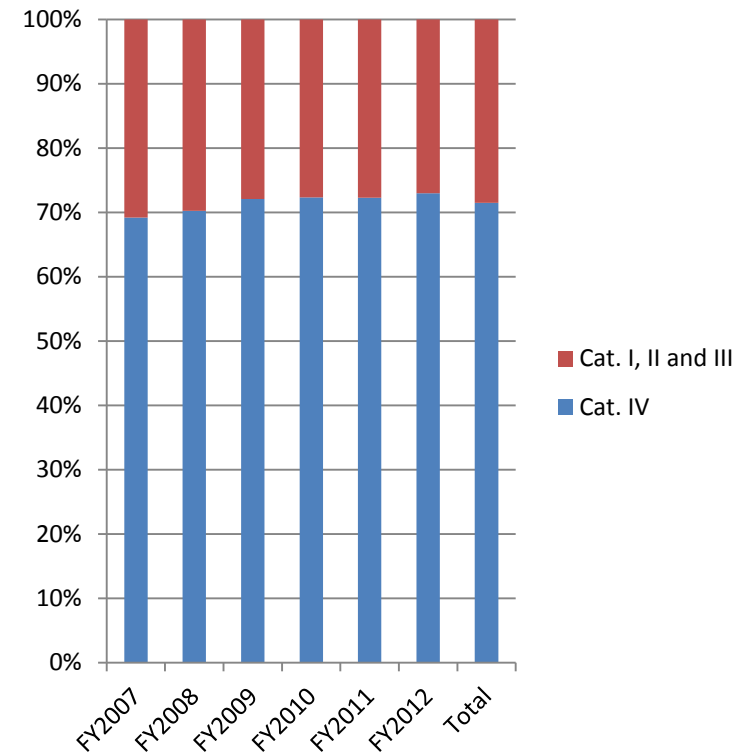
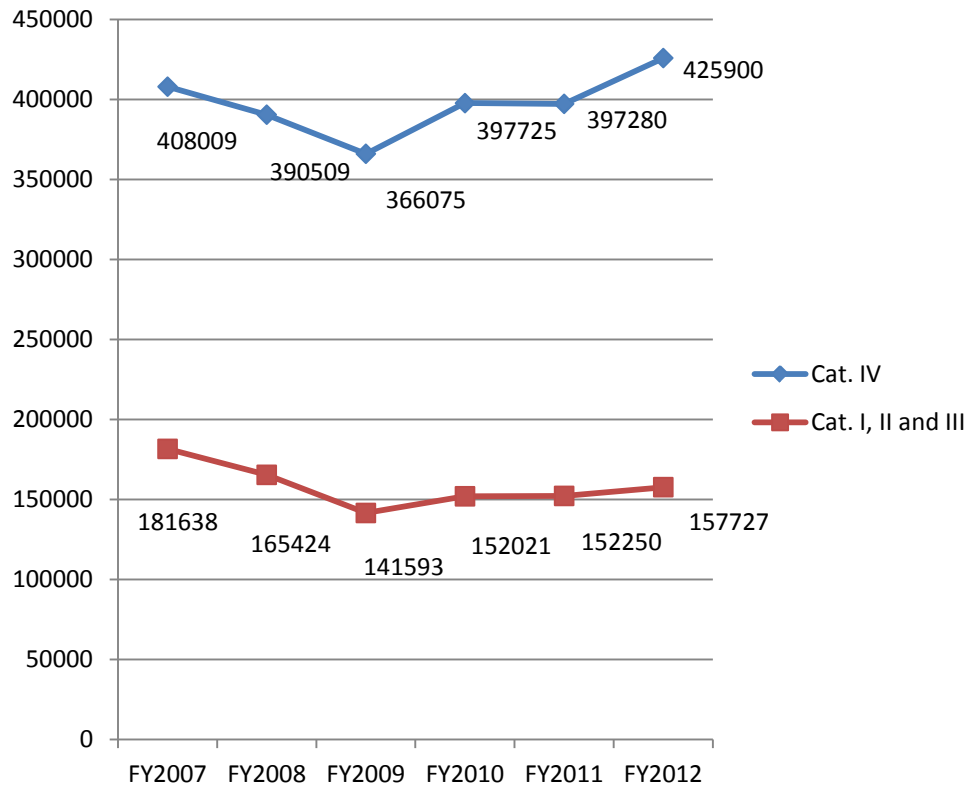


The order of sophistication of the combinations is from A (the highest), down to F. It is allowed to use more sophisticated combinations than the required combination.

(Source: "Introduction to the Building Standard Law" / The Building Center of Japan <www.bcj.or.jp>)

Why we chose small wooden houses?

Reason 2: There are many rates of the confirmation number of Cat. IV (it accounts for 70%) and the use of the technology developed is huge.



Situations of the latest building confirmation (FY2007-FY2012)

(Source: MILT < http://www.mlit.go.jp/jutakukentiku/build/jutakukentiku_house_fr_000032.html >)

Study on the product model

The aims of this study are as follows:

1. Exploring the storing method of required information by getting to know the creation procedure of the actual confirming application documents using BIM authoring software.
2. Exploring about the compatibility of a building model which made for wooden house.

Exploring the storing method

- Some guidelines of the drawing manner for paper based applicant documents printing are prepared.
- These guidelines are made for the purpose of obtaining the form output which is sufficient for the requirements for application, making full use of a function peculiar to software.

Exploring the storing method

Store data relating in building project and export to application form using BIM authoring software

【自動テキストのリンクについて】

下図はガイドライン確認申請書第三面の一部抜粋である。

第三面

建築物及びその敷地に對する事項

1. 地名地番 大塚町00市0区00-00, 00-00

2. 住居表示 未定

3. 都市計画区域及び都市計画区域外の除外等
 都市計画区域外(■市街化調整区画 ■市街化調整区域 ■区域区分非設定)
 都市計画区域内(□都市計画区域及び都市計画区域外)

4. 防火地域 ■防火地域 □準防火地域 □指定なし

5. その他の区域、地帯、地区又は街区 *****

6. 道路

【イ】幅員 9.910 m 11

【ロ】敷地と接している部分の長さ 4.10 m 11

7. 敷地面積

同じ説明の自動テキストなので情報がリンクしている。

下図はガイドライン設計概要書の一部抜粋である。

1. 工事名称

工事名称 丸の内線 B1M 昇降機

建設地 大塚町00市0区00-00, 00-00

主要用途 事務所

工事種別 ■新築 □増築 □改築 □増設 □用途変更 □大規模の修繕 □大規模の模様替

建築主 *****株式会社

住所・氏名 大塚町00市0区

電話番号 *****

工期 専工予定 ** **

竣工予定 ** **

2. 敷地状況

「敷地面積」 121.53㎡ (第1種用途)

「許容最大面積」 建築面積 *****㎡ 延床面積 *****㎡

「防火地域」 防火地域 *****㎡ □指定なし □特定行政庁の指定地域

「道路」 幅員 9.910m 幅員長さ 4.10m

「その他の区域」 白影地区

平均地盤からの高さ 敷地面積より10mを超える範囲

【プロジェクト情報】とは？

現在開いているプロジェクトに関する情報を入力するところ。あらかじめ設定されている項目もあるが、カスタムな情報を新たに入力することが可能。
また一度入力されたプロジェクト情報は、ファイルとして保存可能で、別プロジェクトでも利用可能。

【新たなプロジェクト情報を入力する】

① 【ファイル】メニューより →【情報】→【プロジェクト情報】を選択する。

説明のところ右側黒矢印ボタンをクリックすると下図のようにフィールドが編集出来るようになる。そして入力後最後に必ずOKボタンをクリックすること。入力内容を破棄したい場合はキャンセルボタンをクリックする。

② プロジェクト情報画面が表示される。

③ 画面上右の新規ボタンをクリックすると【名前】と【説明】を新たに入力するフィールドが追加される。

他のプロジェクト情報ファイルをロードする。

現在のプロジェクト情報をファイルとして保存する。

④ 画面右下のOKボタンをクリックする。

【プロジェクト情報を自動テキストで配置】

① 【ドキュメント】ツールの →【テキスト】ツールをONにする。

② テキストを配置した位置でダブルクリックする。

③ 次に自動テキストを挿入ボタンをクリックする。

名前の前の番号は裏の面の○項を示している。

プレビューには選択した自動テキストの内容が表示される。

④ 次に配置したい自動テキスト項目を選択。ここでは 3-7.敷地面積(1) を選択し挿入ボタンをクリックし、画面へ配置する。

下図はガイドライン申請書第二面の一部抜粋である。

①法により追加された文字または項目

②緑文字は自動テキストを示す

③黒文字は手入力でのテキストを示す

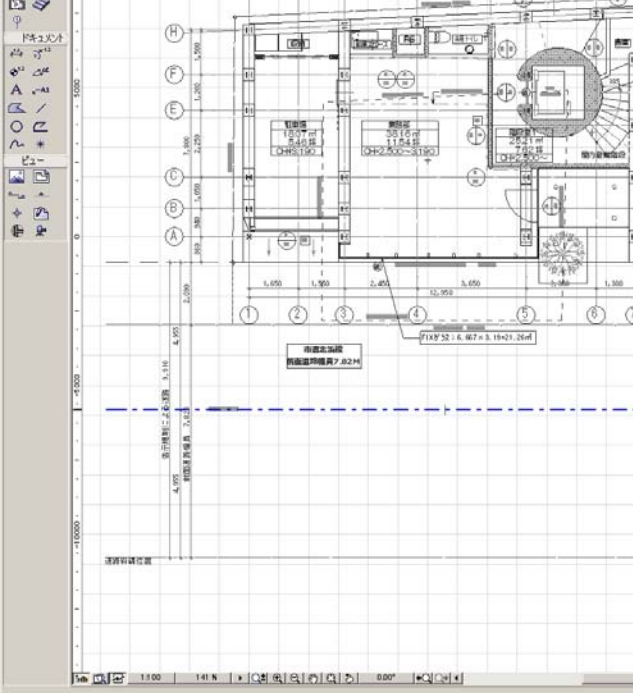
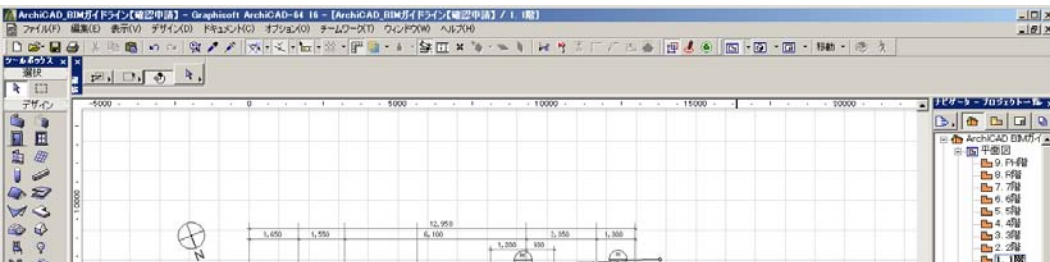
※ 詳しい内容については [4 確認申請]フォルダ → [01 確認申請書]フォルダ よりご参照ください。

(Source: Graphisoft Japan <<http://www.graphisoft.co.jp/>>)

※ 詳しい内容については [4 確認申請]フォルダ → [01 確認申請書]フォルダ よりご参照ください。

Exploring the storing method

Edit of the dimension line by 2D drawing function, and a drawer line label, and the output to a plan view



平面図 004

防火設備の凡例表示
 防火戸や網入りガラスなどの防火設備を示す凡例表示は、ドアや窓ツールのカスタム設定より行う。左図はドアツールの場合であるが、[カスタム設定] → [キープラン設定]より法規制マーカーにチェックを入れ、その下のプルダウンメニューよりその種類を選択する。

防火設備マークオブジェクトツールで配置

採光窓の面積ラベルツールで作成

2Dパレット
 歩行距離
 2Dパレットの中の経路で作成。デザインメニューから、[デザイン補助] → [2D機能] → [経路]で開く。またパレット自体を表示するには、[2Dパレット]を表示を選択する。

ALVS表示と室名表示
 ソーンツールの詳細設定で入力

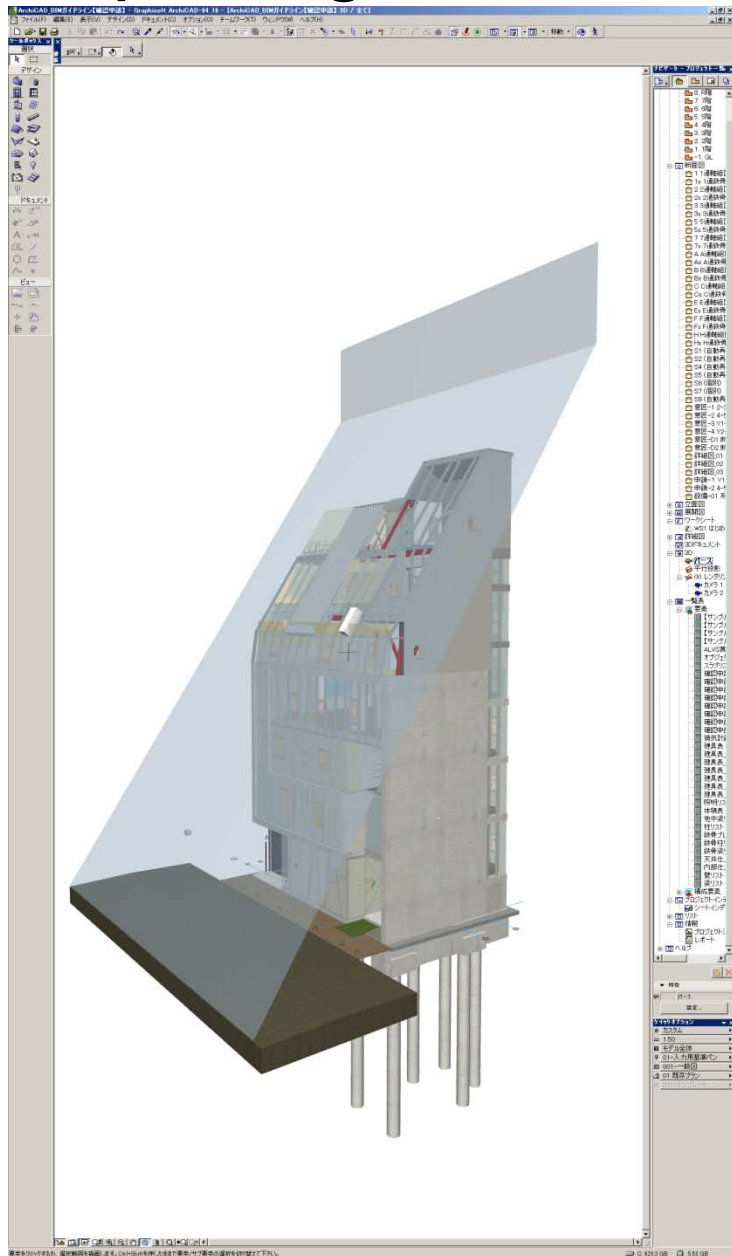
図面の凡例オブジェクト
 今回新たに確認申請図面によく使われそうな凡例をオブジェクトとして作成した。作成した凡例をお気に入りの登録している。右図がその内容である。

※ ALVS表示の詳しい説明については 確認申請編 005 ALVS をご覧ください。

階	専有面積名	面積 (㎡)	必要採光面積	有効採光面積	有効採光率	有効採光率
1階	専有部	38.16	8.45	21.39	56.08%	合格採光
2階	専有部	43.38	8.77	34.99	80.68%	合格採光
3階	専有部	51.16	7.31	30.29	59.20%	合格採光
4階	全館部	62.04	8.86	30.48	49.13%	合格採光
5階	全館部	11.24	1.61	8.82	78.56%	合格採光
6階	全館部	62.32	8.06	21.59	34.64%	合格採光
7階	全館部	48.48	6.93	21.17	43.67%	合格採光

(Source: Graphisoft Japan <<http://www.graphisoft.co.jp/>>)

Exploring the storing method



The output to the front road and regulation line which were linked to 3D building model, and a sectional view

立面図／断面図 006

進入口導線オブジェクト
※デフォルトライブラリのオブジェクトを使用しています。

【ビュー設定】

【ビュー設定】

【ビュー設定】

道路斜線オブジェクト

3D

モデル表示セット：005-確認申請図
確認申請図面を作成するにあたり
縦線したは防火区画のラインを在る際、
また凡例等を配置等した際に、
表現しやすいベースを在るということであった。
例えば、001一般図の場合は壁の塗りつぶし設定が
無地前壁（ベタ塗り）になっているので
上記の表現が難しくなる。
この辺り留意して、壁や床や屋根などの断面が
白抜きに表示されるよう塗りつぶしなしで設定した。

※ モデル表示の詳細な説明については 環境設定編_007-008.モデル表示の設定 をご覧ください。

(Source: Graphisoft Japan <<http://www.graphisoft.co.jp/>>)

Exploring about the compatibility

The model of the 2-story wooden house having the data for confirming application was created using two kinds of BIM authoring software, and it was verified whether the compatibility of information would be maintained by the IFC data format.

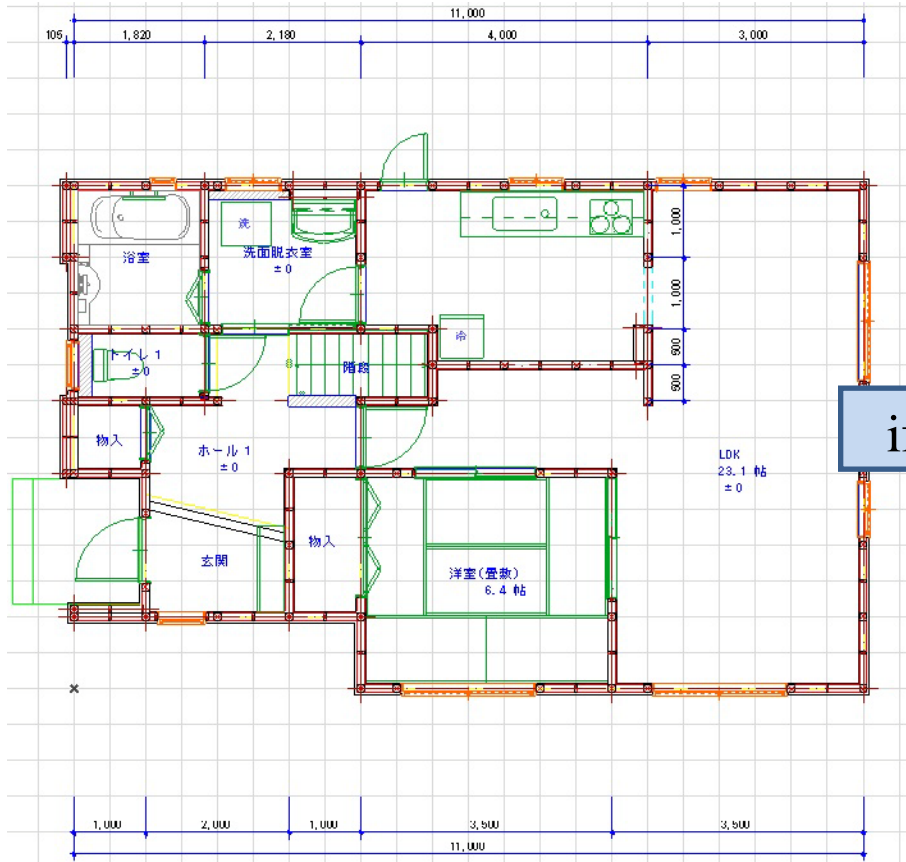
case1: ArchiCAD to Revit via ifc

case2: ArchiCAD to ArchiCAD via ifc

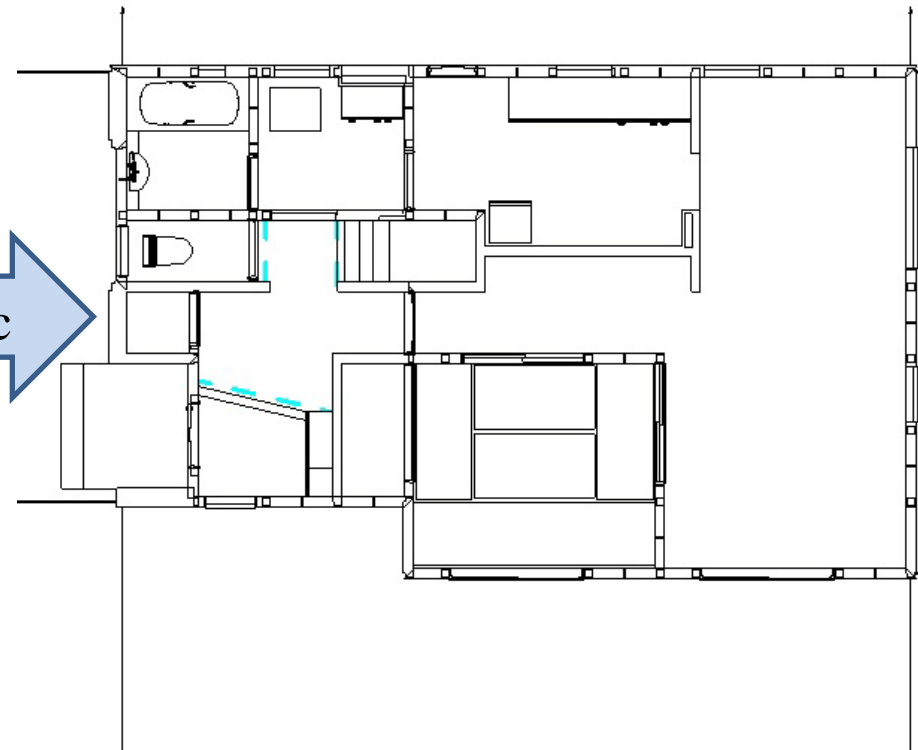
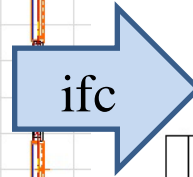
case3: Revit to ArchiCAD via ifc

Exploring about the compatibility

(ArchiCAD→Revit)



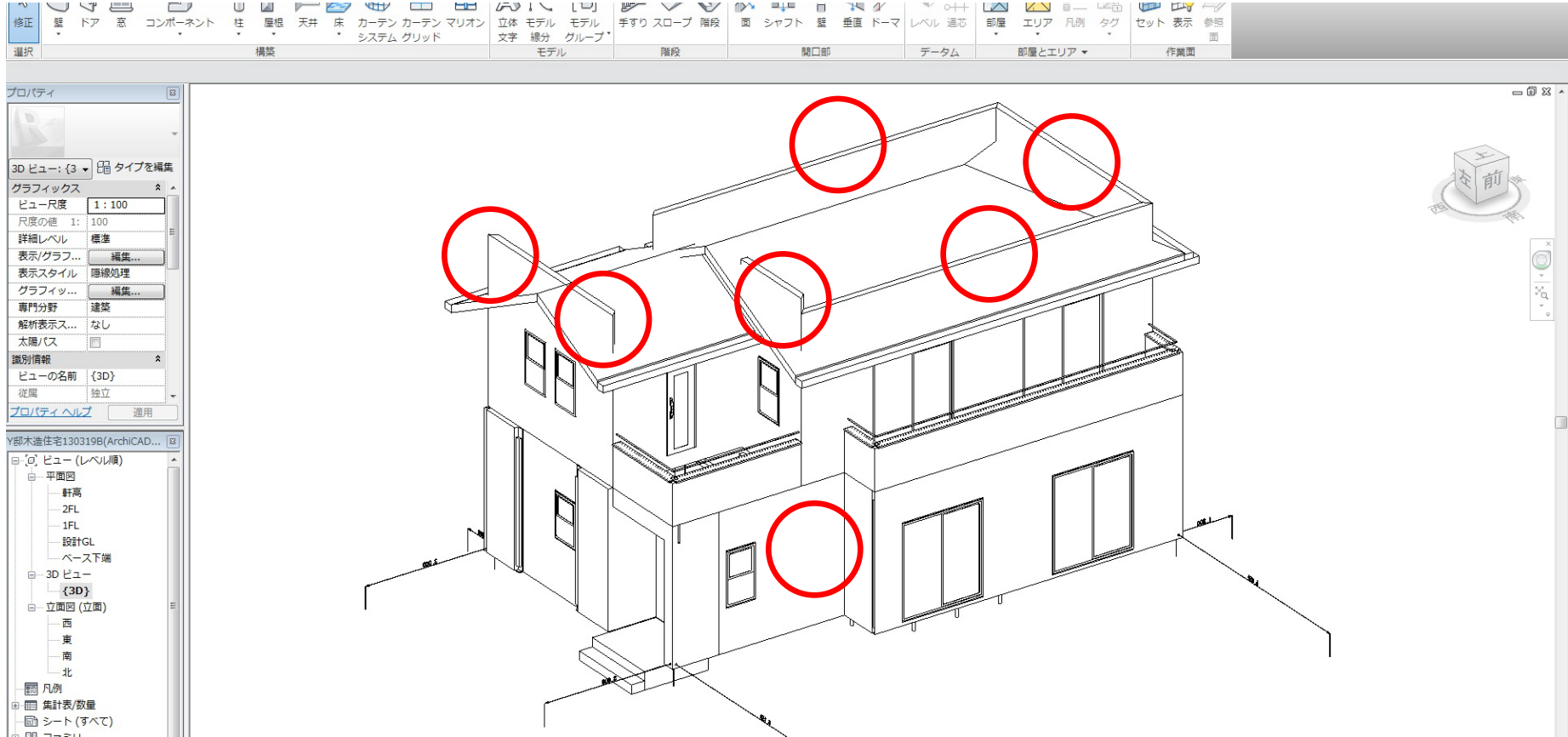
▪ ArchiCAD



▪ Revit

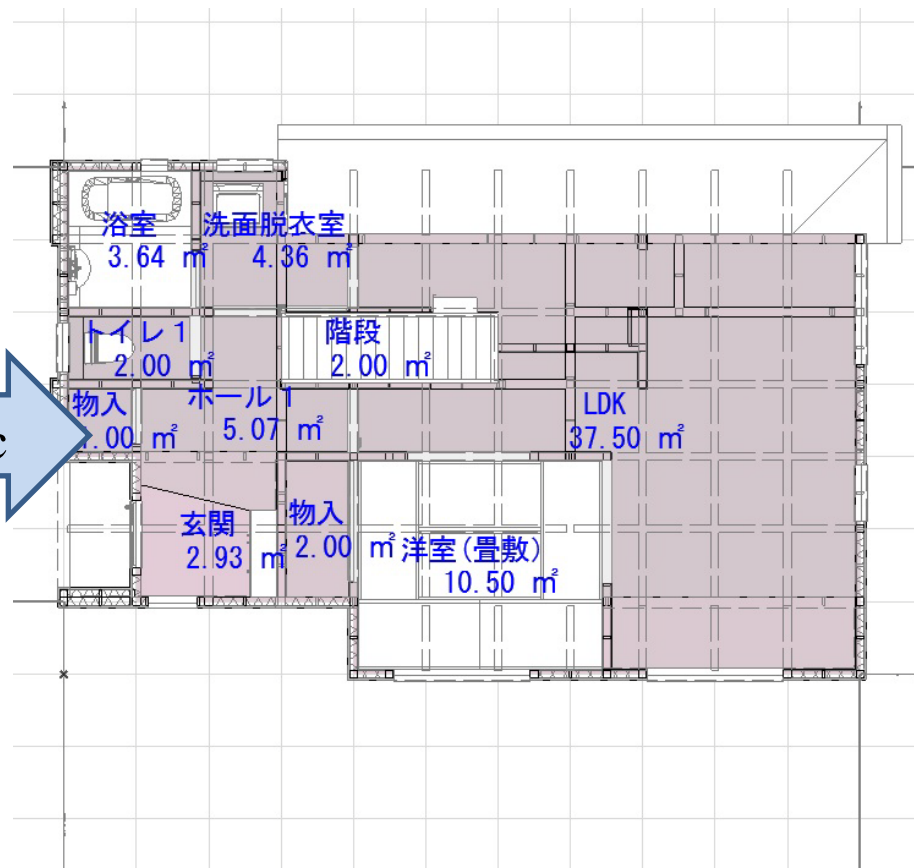
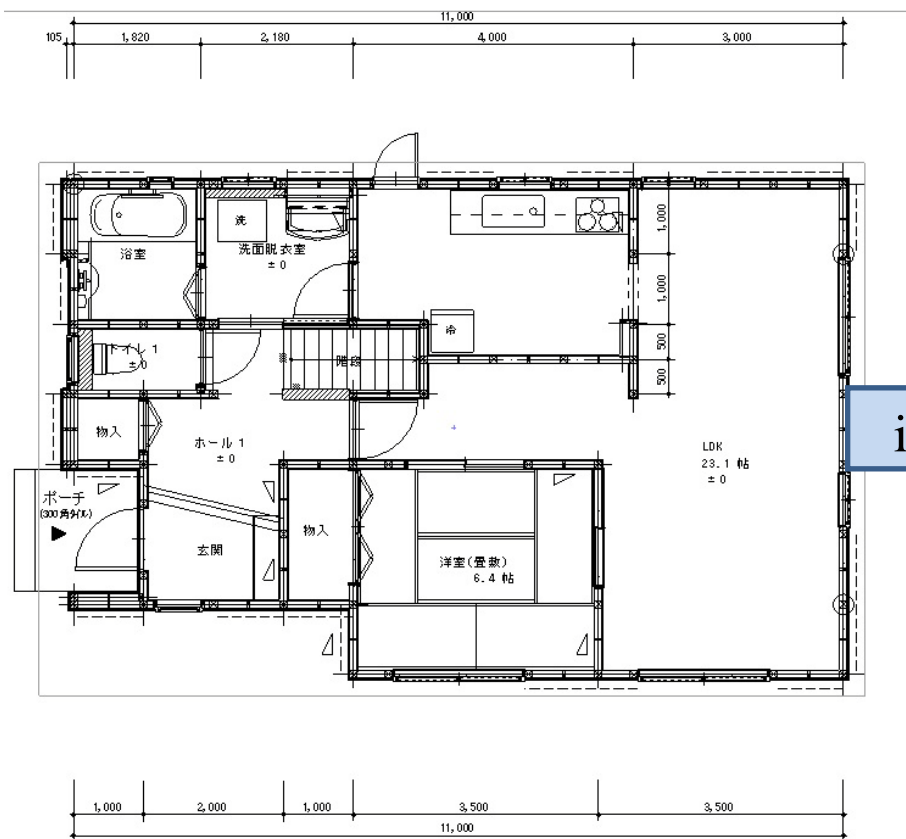
Exploring about the compatibility

(ArchiCAD→Revit)



Exploring about the compatibility

(ArchiCAD→ifc→ArchiCAD)

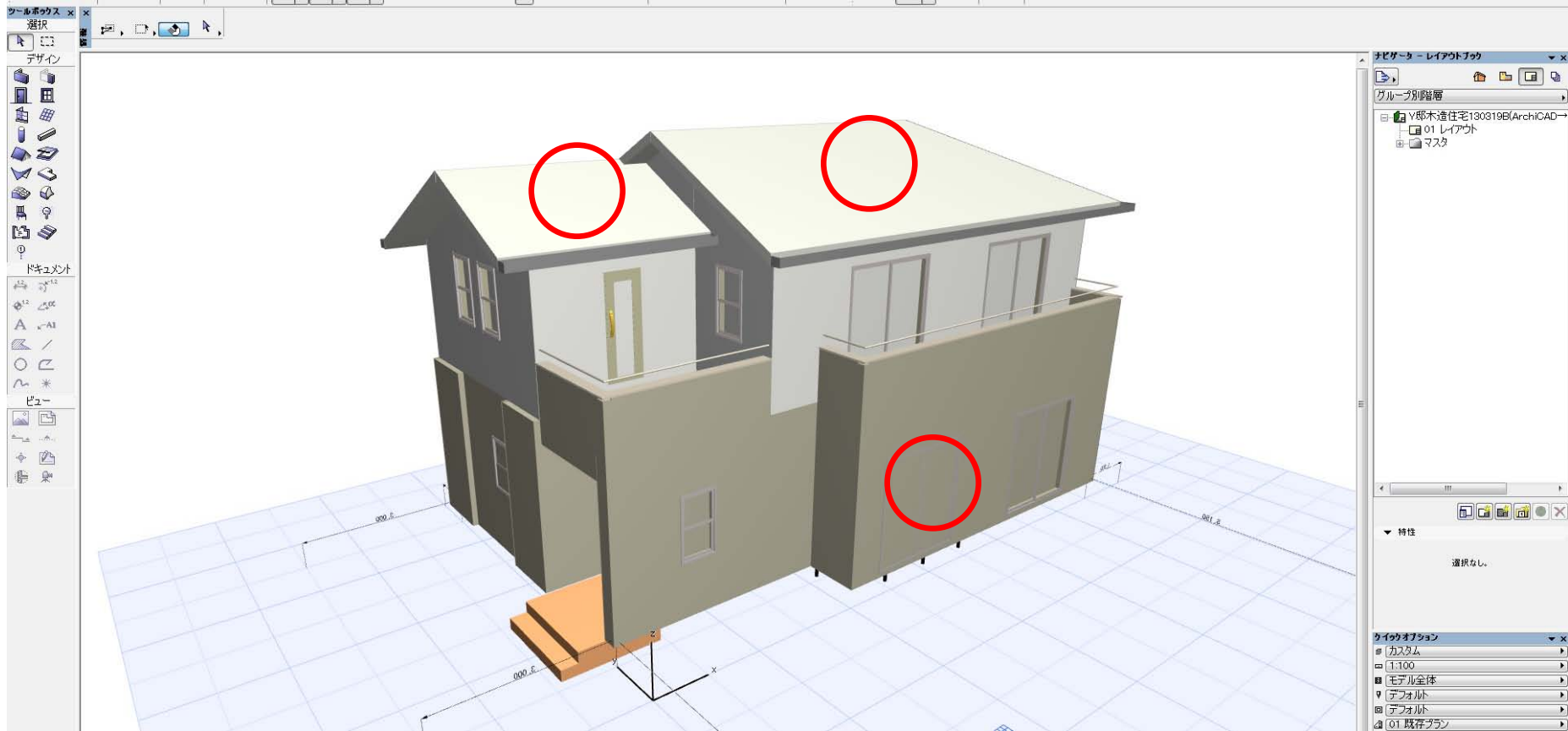


▪ ArchiCAD

▪ ArchiCAD

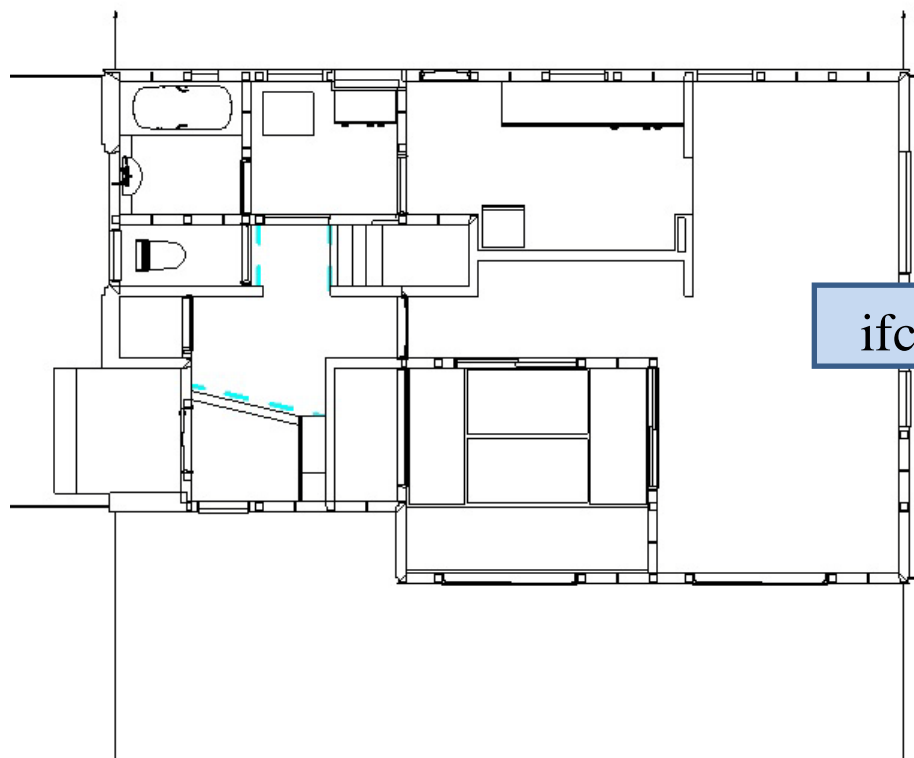
Exploring about the compatibility

(ArchiCAD→Revit)

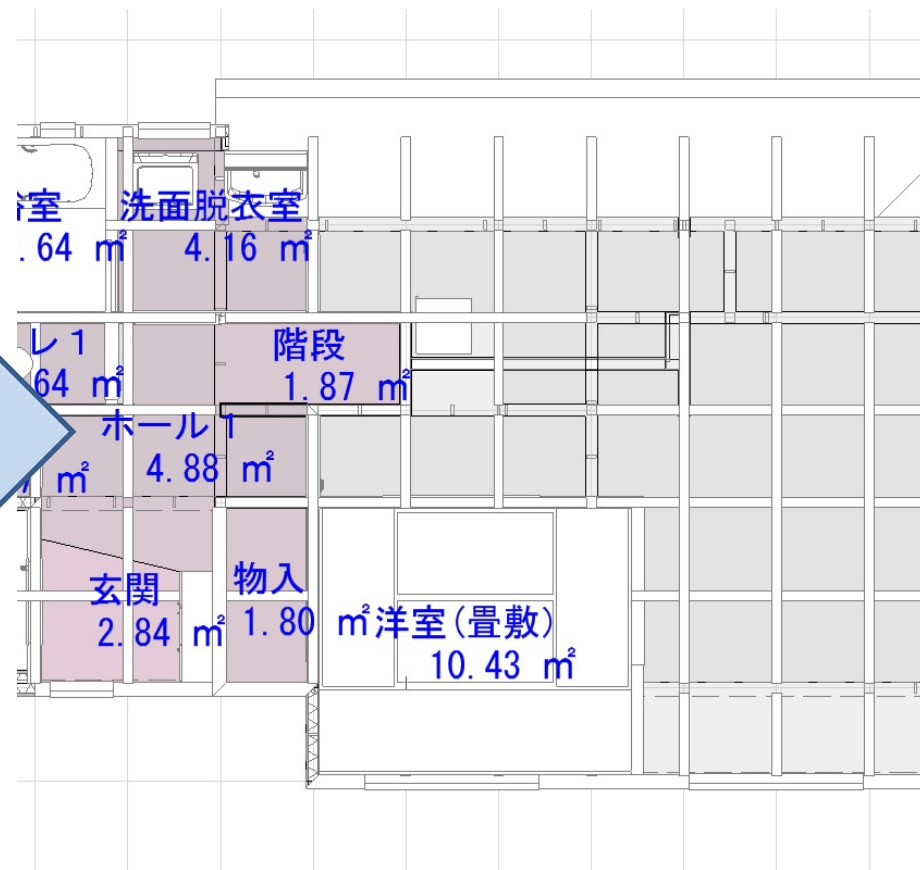
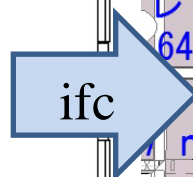


Exploring about the compatibility

(Revit→ArchiCAD)



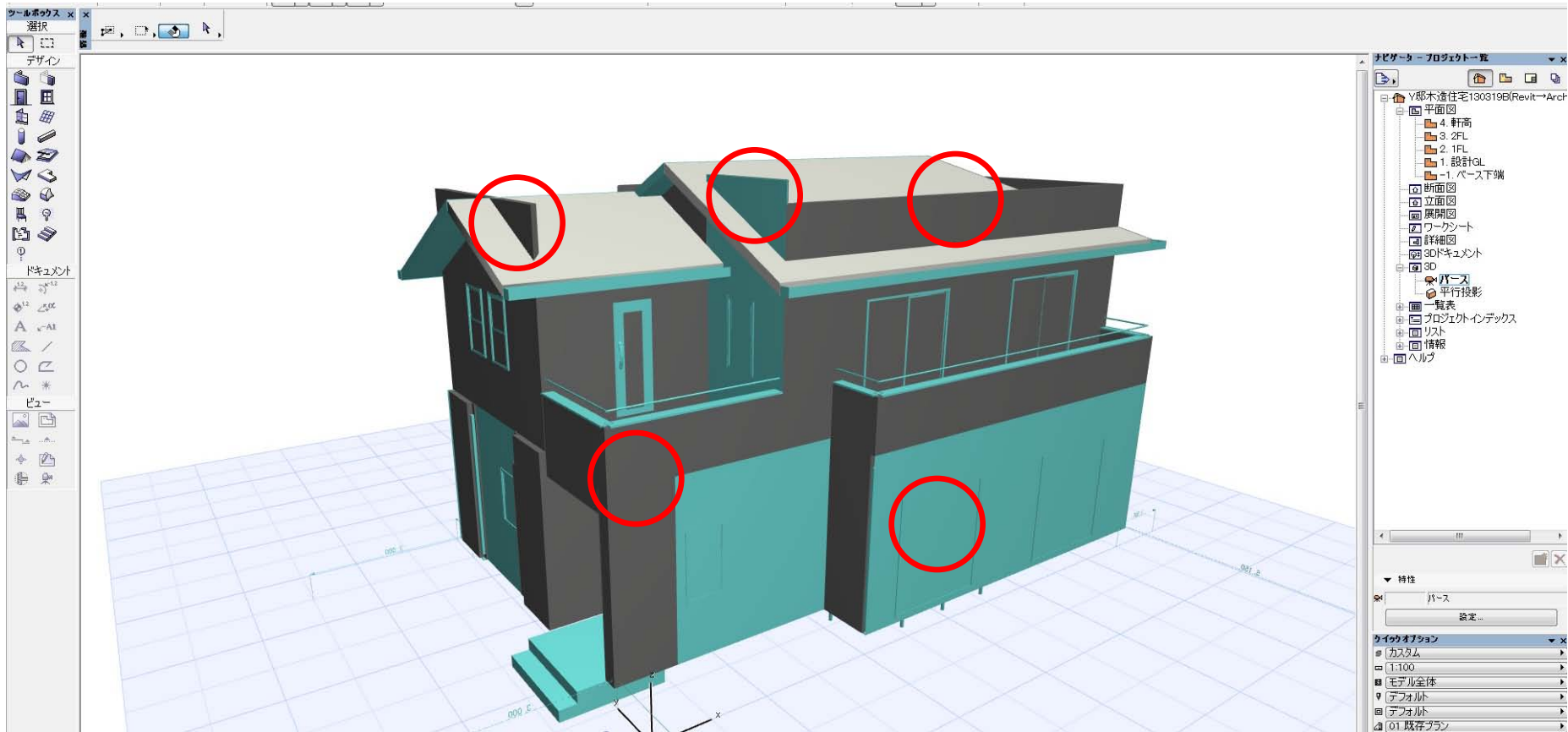
・Revit



・ArchiCAD

Exploring about the compatibility

(Revit→ArchiCAD)



Conclusion of this study

- By BIM authoring software, the information describe in confirming application documents is stored as project information, is managed by 2D drawing function, or is linked with 3D building model object.
- However, there is no guarantee by which these pieces of information is standardized such as IFC, because these information stored by software native format.

Conclusion of this study

- Since this has the insufficient function in which software outputs and inputs the information on a building model in an IFC format, the present stage of the compatibility of the model through IFC is insufficient.
- In order to deal with a BIM model by building confirmation, it is important to define IFC required for confirming application independent of the function of BIM authoring software, and to appeal for software vendors to output the information satisfactorily from the software.

Study on the process model

- The processing method of the electronic signature or BIM model data in building confirmation are researched using reference from domestic and foreign advanced cases.
- The research consortium which involved in an academic sector, architect office, the house maker, the general contractor, the software vendor, and the confirmation body is under organization.

Now status of our research

- As an overseas advanced case, a research on the electronic application (e-submission) of the Singapore government was conducted.
- Gathering and analyzing of information about the function and composition of the prototype system to develop was started.

Research on the SG e-submission

- Date : 2013/9/13
- Venue : Building and Construction Authority (BCA)
MND building

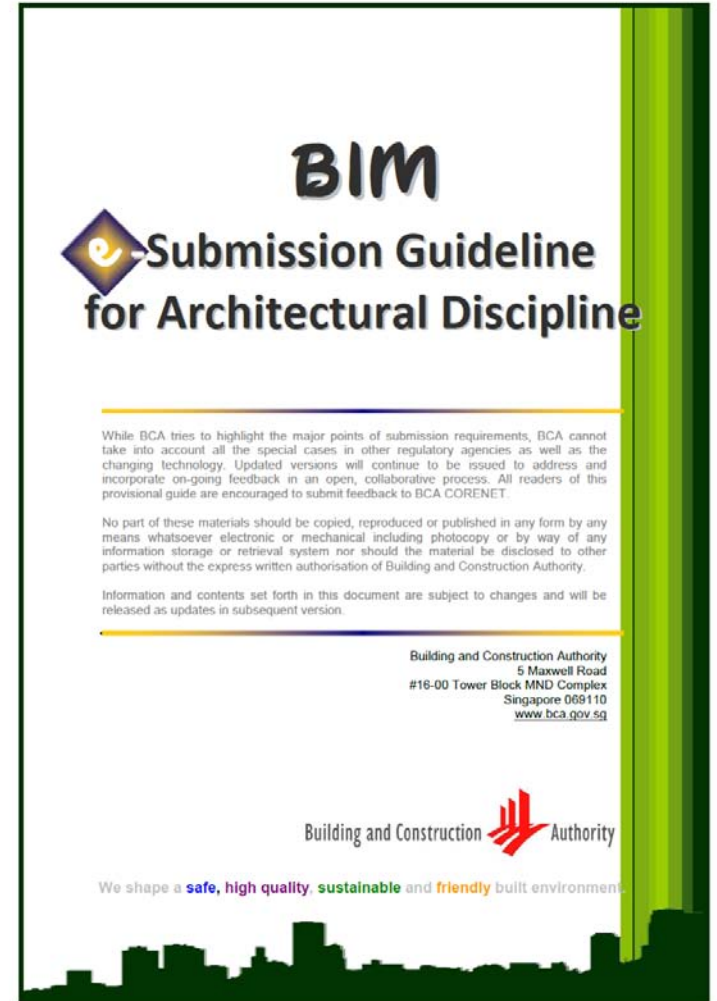


Research on the SG e-submission

- Unlike our country, the supervisory authority of urban or building regulation is divided in Singapore.

- URA: Urban regulation
- BCA: Building regulation

- E-Submission guideline for architectural discipline is published from BCA.



Research on the SG e-submission

- In SG e-submission, the data formats which each government office required are different.

URA

→ Native Format of BIM authoring Software (e.g. Revit, ArchiCAD)

BCA, and the others

→ 2D drawing format includes 3D model which was outputted from BIM authoring software (DWG, PDF)

※ building confirmation is based on 2D view.

Research on the SG e-submission

- After confirmation, the image of 2D drawing is exported to a microfilm, and archived eternally.



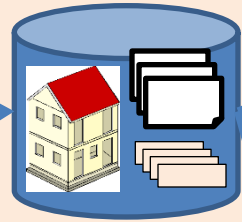
The point of SG e-submission

- Even if the application documents are received as data, they are not archived as data.
 - The 3D model submitted is only used as reference.
- SG e-submission is positioned in the middle of Steps 2 and 3 with our perspective of development.

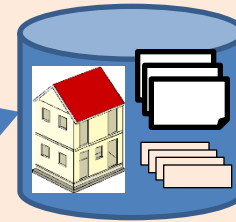
Research on the SG e-submission

Concerns of compatibility

Applicant (QP)



BIM Native



BIM Native

URA



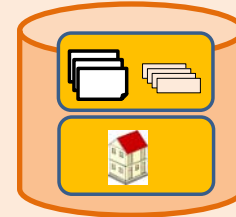
2D output



3D output

Compatibility is OK?

Compatibility is OK?



BCA

Combined
DWG/PDF

Moreover, step-by-step building confirmation is accepted in SG.
How does compatibility secure between each confirmation stage?

Viewpoint for Prototype system development

- At present, it is difficult to perform building confirmation by perusing a BIM model directly.
- How to treat 3D model based on 2D view of SG e-submission is realistic solution.
- At Prototype system of BRI, some technologies insufficient in SG case is implemented aiming at improvement compatibility and electronic archive.
- The definition of the BIM model for building confirmation is considered supposing development of the viewer which can make checking view from BIM model directly.

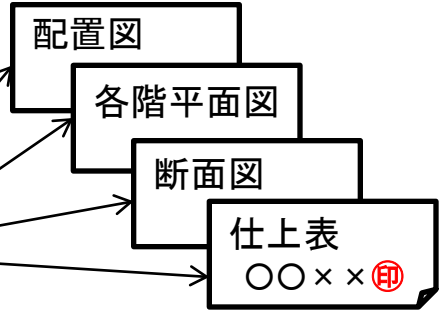
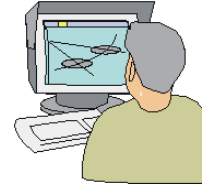
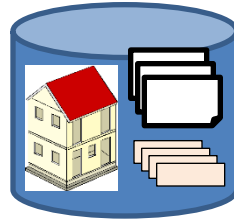
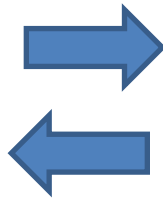
Image of Prototype System

Definition of BIM Model for building confirmation

IFC, XVL, 3D-PDF+XML...

CAD

BIM



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 +XML +PDF
- Workflow design
- Communications support
- History Archive

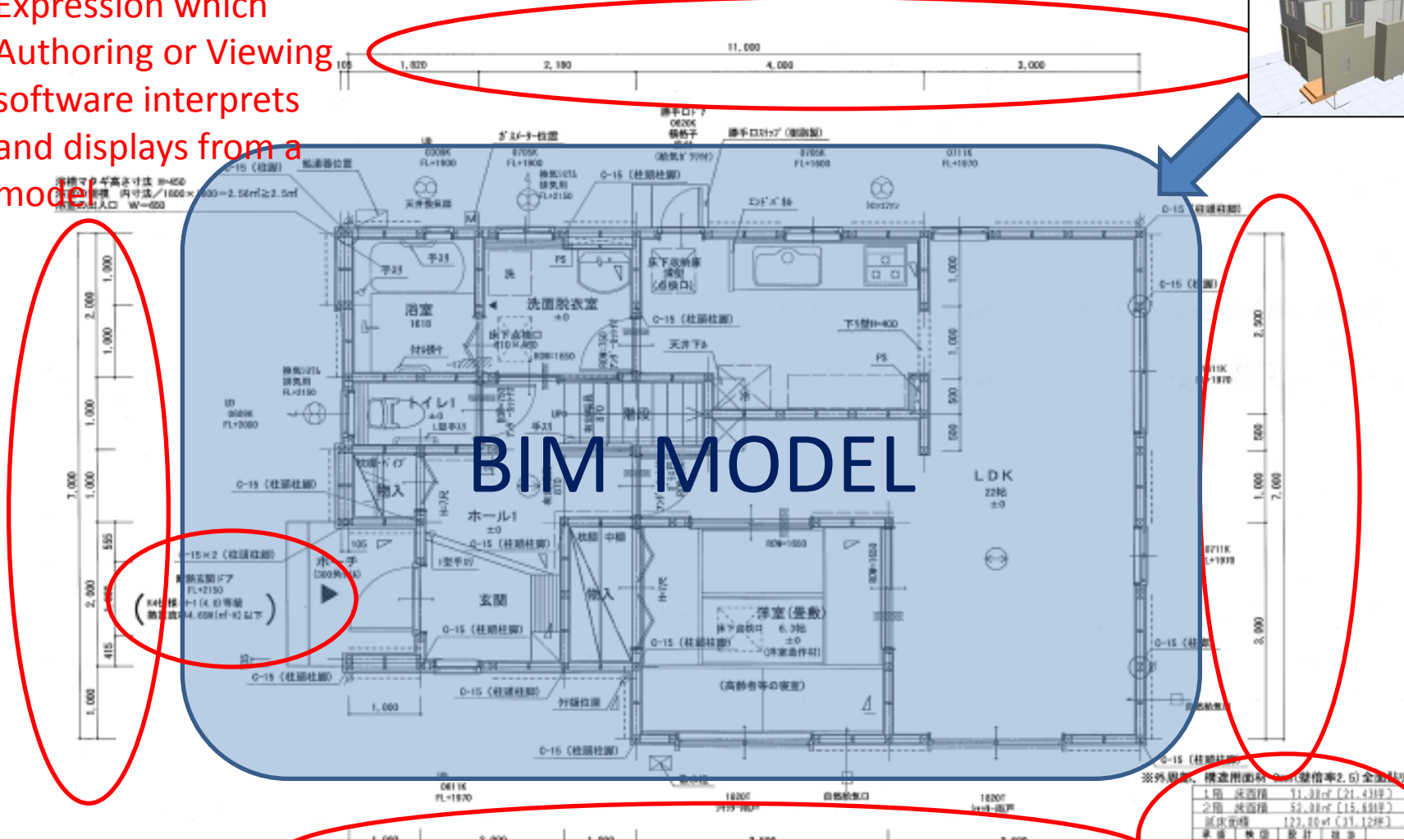


Confirmation tools

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

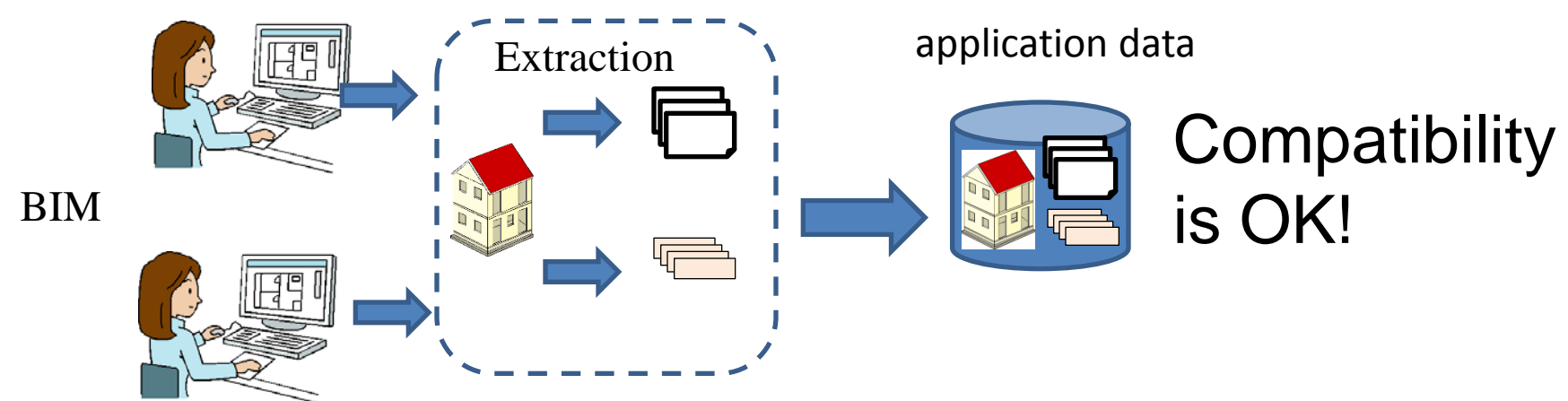
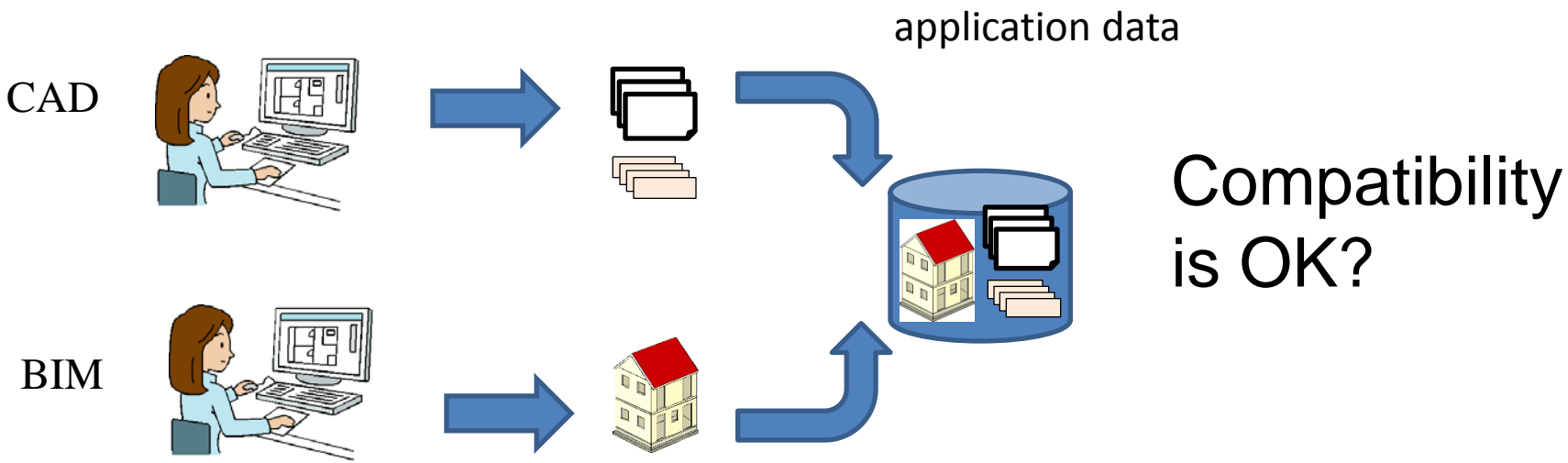
Difficulty of Confirmation Checking by Model View

Expression which
 Authoring or Viewing
 software interprets
 and displays from a
 model



As development of the 1st phase, the unifying-to model-view of 2D drawing regally required is developed instead of development of an advanced viewer.

Difficulty of Confirmation Checking by Model View



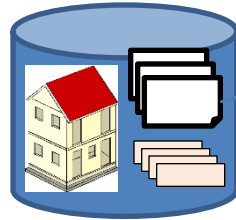
BIM Authoring Workflow using one BIM Model

The method of the compatibility maintenance during a file of views

CAD



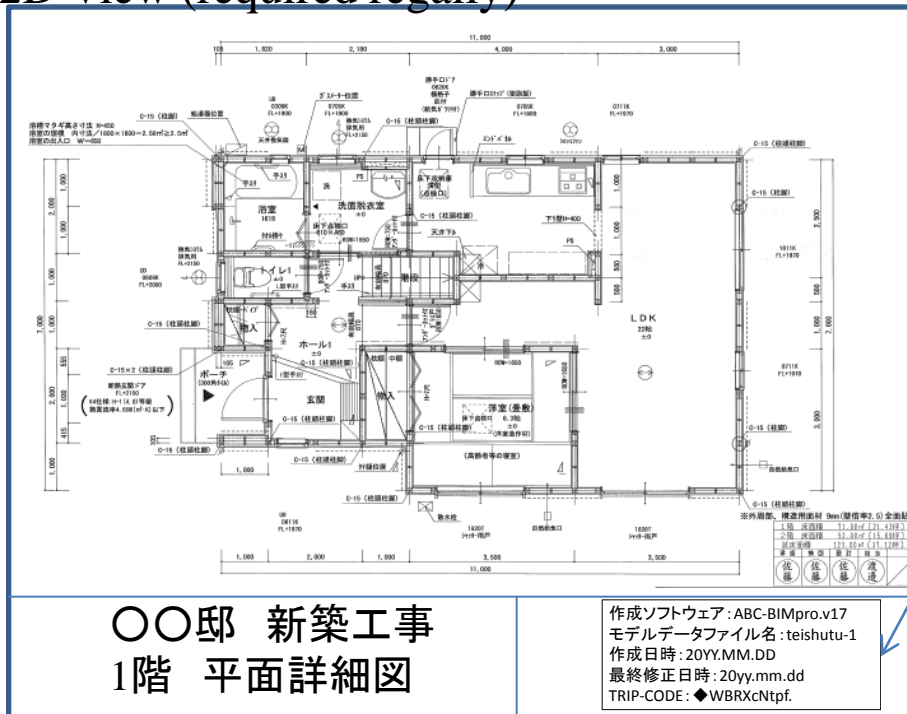
BIM



Example of indication

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

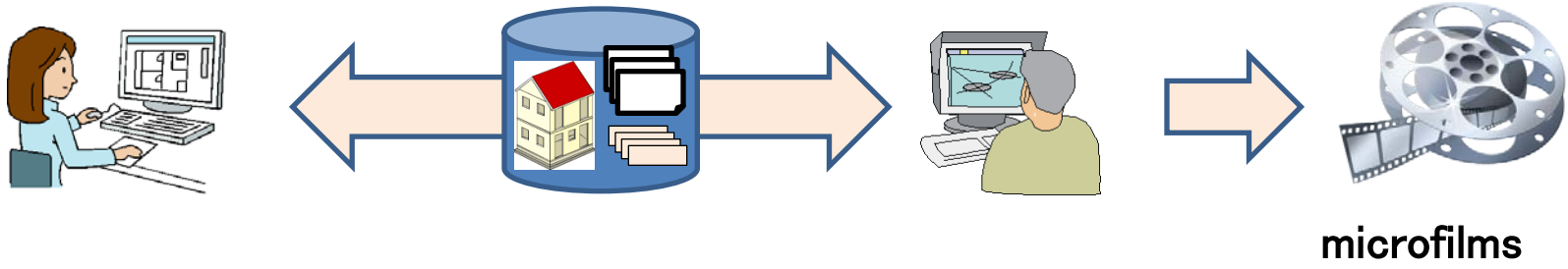
2D View (required regally)



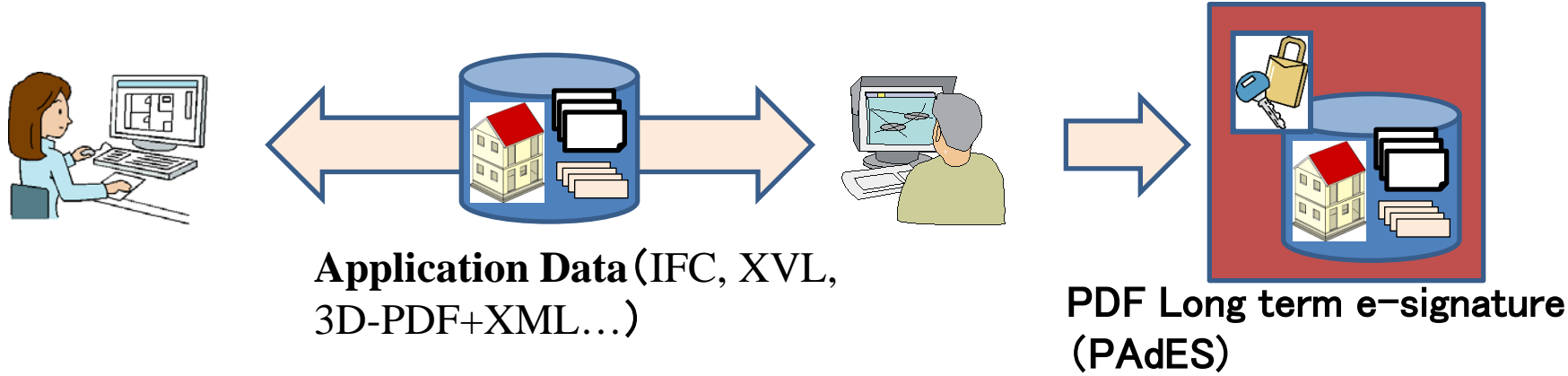
The display which shows generated
 “AT ONCE” from the “ONE”, “Unified”
 BIM file

Digital Achievement with Long-term e-signature

SG e-submission

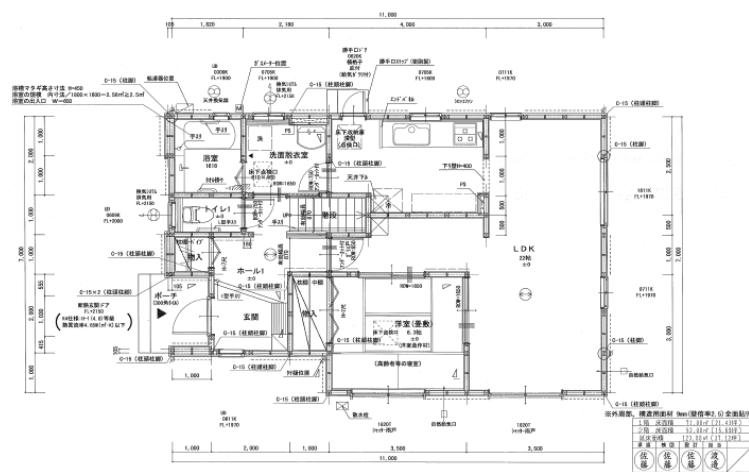
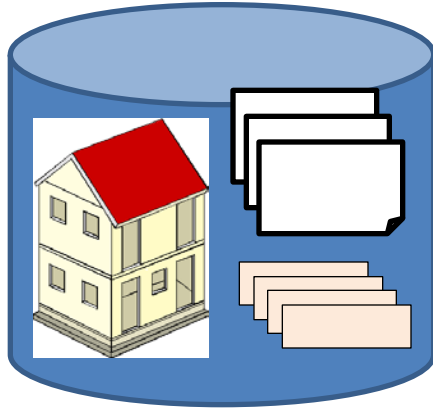


Digital Achievement



The validity of the signature for at least 15 years is secured by integrating application books data as an attached file (Trailer) of PDF (ISO-32000s), and attaching a long-term signature to the file.

An Idea of definition of BIM Model for building confirmation (under discussing on WG)



Contents of Data	Data Format
3D Model	IFC (2x4 or 2x3)
2D Drawing	Unified to 3D Model by IFC 2D objects
Scanned Documents	PDF (unified IFC if possible)
Traceability Data	XML

Thank you for your attention!

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