

Application of BIM on Drawing Verification of Firefighting

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Abstract: In general, most of the function and using of building is for single purpose. However, current buildings combine several functions that causes a lot of problems not on firefighting only but also on environment engineering. Because of hard integration on different fields that causes a lot of conflict. That wastes cost and time. That also threaten the safety of firefighting.

This search focuses on the drawing verification and field inspection on firefighting. These two items both remain paper work. To complete the current work, it needs to bring a great amount of drawing papers in the field. By BIM, integrated data can be extracted. It makes the drawing verification and field inspection easier and increases the efficiency. That is the main point of this research.

Key Words : Building Information Modeling 、 BIM 、 Firefighting

1. Introduction

In recent years, it has achieved certain achievement of results to outsource the engineering practice management and construction review, conducted and assisted by BIM respectively [1]. For the construction management departments in Taipei and New Taipei City, there are researches of feasibility to incorporate BIM technology from non-profit organizations in automatic drawing verification. An initiative also exists to promote the establishment of paperless review platform. At the same time, allowing public projects to adopt BIM technology for construction during the process of construction permit application, Department of Rapid Transit Systems of Taipei City wishes to increase the usage of BIM technology in practice. In the last step of obtaining

construction permit – the inspection of firefighting unit, if BIM can be facilitated for drawing verification and field inspection before construction, the chance of pipelines collision during construction then can be greatly reduced.

With BIM, all the elements, including firewall, effective openings, fire detectors, fire hydrant pipes, and etc., have data of information. 3D model equipped with time becomes time-effective 4D model, which provides the timeline required for a particular project and in terms allows engineers to set up construction schedule. 4D model, coupled with the item data and relevant quantities, can be used efficiently for material selection and price valuation. Throughout the life cycle of the building, from planning, design, construction to the operation, information model of BIM is able to generate different benefits at different stages.

2. Research Topics

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2.1. The Drawbacks of Current Drawing Verification and Field Inspection

The procedures of drawing verification originate from Article Ten of "Fire Service Act", as written below:

"Drawings of fire safety equipment of any building for public use shall be completed with the examination and approval by the municipal, or county/city fire department before seeking the approval to commence the constructional work from the building regulating authorities.

Any item applying for preliminary examination under Article 34.1 of Building Act involving fire safety equipment of building, it shall be jointly examined by the building regulating authorities and the fire department.

In the event that a building not provided for public use is changing to one for public use, or a building provided for public use is changing to one for another type of public use, the building regulating authorities and the fire department shall jointly examine the drawings of fire safety equipment of the building in question [2]."

Authorities involved with the review covers from fire protection, construction and management, environmental protection, health, and etc. The application procedures are numerous and complicated. It takes lots of days to complete all the administrative procedures. Coupled with inharmonic coordination among each individual authority, documents are delivered and consolidated back and forth, causing inefficiency. This problem, therefore, are often being criticized.

Take the procedures in the Fire Department of Taichung City as an example. To obtain a construction permit, the company makes an online application reservation first without an internal inspection of work. Receiving the application, the Fire Department sends personnel for field inspection, and informs with first written report after defects are found. However, the company makes another application reservation without completion of improvement. As a result of duplicated applications, the field inspection is conducted twice repeatedly, which is time-consuming and labor-intensive. (After the application reservation, the field inspection needs to be completed in 7 to 10 days, or may be extended up to 20 days if necessary [3].)

After the case passes the drawing verification, it can proceed to field inspection. However, subsequent design changes on site due to self-decision cause differentiation from the drawings. The main reasons of differences between the drawing verification and field inspection are as follows:

1. The condition of actual construction site of the building is different from the drawings.
2. Different interpretation of rules, and the conflict of construction methods in practice and existing regulations.
3. Construction drawings are not produced or missing, causing part of the problem is not discovered in the drawing verification.
4. Negligence of the drawing verification.

For applications of building permits, the building plans have been converted to CAD files for administrative staffs to examine and verify the drawings easily with e-files. However, the fire equipment drawings, building plans, construction drawings, and other relevant information for the examination of Fire Department are still in paper format. For inspection personnel, it takes enormous time to examine and verify these documents. Especially for the buildings with complex purposes such as high-tech production plants, hazardous good factories, high-rise buildings, large-scale shopping malls, department stores, and opera houses, fire safety personnel need to spend even more time and effort on the drawing verification

2.2. The Development of Building Information Modeling (BIM)

With the development of construction at different stages of the life cycle, the gradual application of BIM elements, according to the project characteristics and the information obtained and required at different phases, is expected to have a certain degree of completion on the information of geometric and non-geometric properties. In other words, it is the level of enough and necessary information [4]; American Institute of Architects (AIA) and AIA BIMForum cooperated, developed, and published LOD Specification in 2013. Using LOD to define the BIM elements clearly explains the differences in the characteristics of the properties of the BIM elements. LOD is divided into five levels, from LOD100, 200, 300, 350, 400 to 500 [5].

Inspectors must clearly define in detail the usage requirement of LOD on BIM. The inspection side should give a clear standard of examination when the design side is producing BIM model for the drawings. Consequently, both sides can be consistent and the conflict on interface can be reduced.

- LOD 100 – Conceptual Design
- LOD 200 – Schematic Design/Design Development
- LOD 300 – Construction Documents and Shop Drawings
- LOD 400 – Fabrication
- LOD 500 - Lifecycle Management[6]

2.3. The Prototype of System Structure

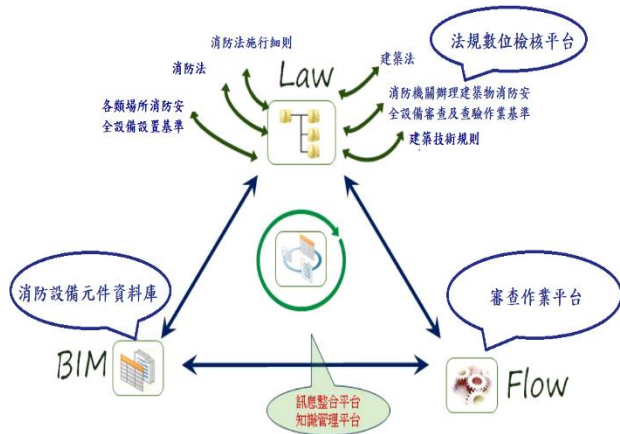


Fig 1 System Flowchart.

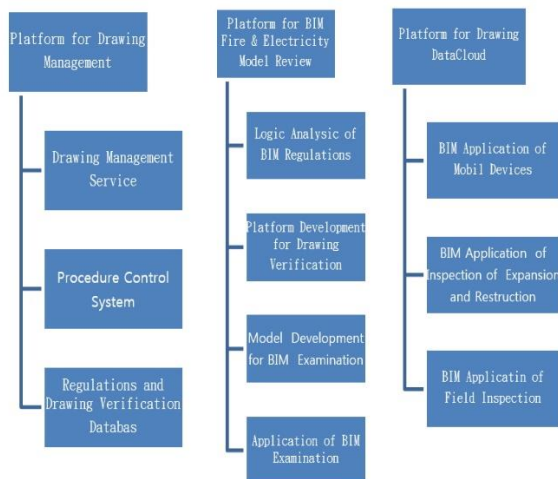


Fig 2 System Structure.

The system structure consists of three components: Platform for Drawing Management, Platform for BIM Fire & Electricity Model Review, and Platform for Drawing Cloud Database.

The Platform for Drawing Management replaces the existing platform of drawing verification at the back-end. The user-friendly, easy operating interface provides fire technical personnel or qualified professional organization to upload the design of BIM drawings to this platform for inspectors to conduct case review.

Platform for BIM Fire & Electricity Model Review mainly quantify (quantification and non-quantitative analysis) the information of regulations (the standards of safety equipment for various places). After the standards of BIM drawing verification is set up, BIM can be imported for verification. The establishment of Platform for Drawing Cloud Database provides on-site inspectors to facilitate portable electronic devices (laptop, tablet, mobile phone), to extract the BIM model data from Cloud Database and to verify the location and quantity of fire safety equipment on construction site. Then, the traditional inconvenience of looking through numerous 2D drawings for inspectors can be eliminated.

4. Conclusions

In this study, by incorporating BIM technology at the stage of drawing verification offers the following benefits:

1. The establishment of review platform for paperless submission can save lots of 2D drawing paper produced traditionally.
2. The establishment of review platform on line helps speed up the review process, allowing the industry to have more accurate measurement of cost and schedule.
3. During the drawing verification, through the review process and discussion with fire technical personnel, doubts can resolved immediately, and interface conflict between on-site condition and design specification after completion can be effectively reduced.
4. With visualization, the position of all fire pipelines at different heights can be completely rendered in the model. During the drawing verification, adjustment can be done directly in the model, which can reduce the generation of errors.
5. For special cases, when there is enquiry between normal practice and regulations, by taking advantages of BIM, the problem can be detected early, and the alternative plan can be selected or the selective regulations can be adopted.

With the results mentioned above, importing BIM into drawing verification can achieve substantial benefits. By applying BIM at all stages, relevant information can be obtained and updated quickly, reducing paperwork exchange and manpower consumption. It effectively achieves transparent review process. Overall, it not only creates convenient for stakeholders but also enhances administrative efficiency

Acknowledgement

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