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Development of BIM-based evacuation regulation checking system for high-rise and complex buildings

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ABSTRACT

Recently owing to the increasing requirements for the improvement of qualitative factors of BIM-based design projects, it is necessary to develop an automated checking and evaluation process for the BIM data. Regulation information is an important factor for initial architectural design evaluations. The purpose of this study is to develop an automated system that designers and owners can check the evacuation regulation compliance of BIM data. In this study, the scope of applied regulation information is confined to evacuation regulation, as high-rise and complex building design has high priority and is critical on adequate disaster prevention systems and egress routes. To achieve this purpose, the authors have investigated case studies of BIM-based regulation checking process and illustrated the possible mechanism for the process through evacuation regulation analysis. Based on the presented methodology and scenario of the proposed automated evacuation regulation checking system, the authors developed a prototypical system, called InSightBIM-Evacuation.

1. Introduction

Communication between numerous participants is essential on collaborative projects, because the various design stages of the architectural process involve the collaboration of many disciplines. The management and utilization of the information that is used to communicate in these complex and diverse processes are very important. In particular, the design information that is generated in the early stages of a construction project is utilized and modified in the follow-up stages. Thus, systematic management is required in all the construction stages [1]. Recently, in the construction industry, the complexity and size of buildings have been increasing the uncertainty and decreasing the reliability. Furthermore, the specialization and departmentalization of the construction industry are increasing. In addition, the demands for collaboration with various disciplines are increasing. Open building information modeling (BIM)[1] could be one of the solutions to handle these situations [3]. Software can be communicated using a neutral format throughout the open BIM environment, such as the industry foundation classes (IFC),[2] which is an international standard [5]. BIM-based parametric and intelligent building objects can represent properties such as function, structure, usage, and regulation information. BIM is especially useful for checking the regulation using building object properties such as the characteristic and relation information for various disciplines [6,7].

The delivery of the BIM data is mandatory in advanced countries, and these countries are promoting the *automated checking for BIM quality, including compliance with the regulation* [8]. For example, Singapore has developed a BIM-based automated regulation checking process through the software *FORNAX* [9] and has built a construction administration system, *CORENET* [9]. The *SMARTcodes* [10] project in the USA has structuralized the regulations of the International Code Council (ICC) and developed automatic code compliance checking systems. In particular, regulation checks through an automated regulation checking system can reduce errors, time, and the inefficient use of human resources through objective verification [11].

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[1] Open BIM is a universal approach to the collaborative design, realization and operation of buildings based on open standards and workflows. Open BIM is an initiative of buildingSMART and several leading software vendors using the open buildingSMART data model [2].

[2] Industry foundation classes, IFC, are the main buildingSMART data model standard. The IFC format is registered by ISO as ISO/PAS 16739 and is in the process of becoming an official International Standard ISO/IS 16739. IFC can be used to exchange and share BIM data between applications developed by different software vendors without the software having to support numerous native formats. As an open format, IFC does not belong to a single software vendor; it is neutral and independent of a particular vendor's plans for software development [4].

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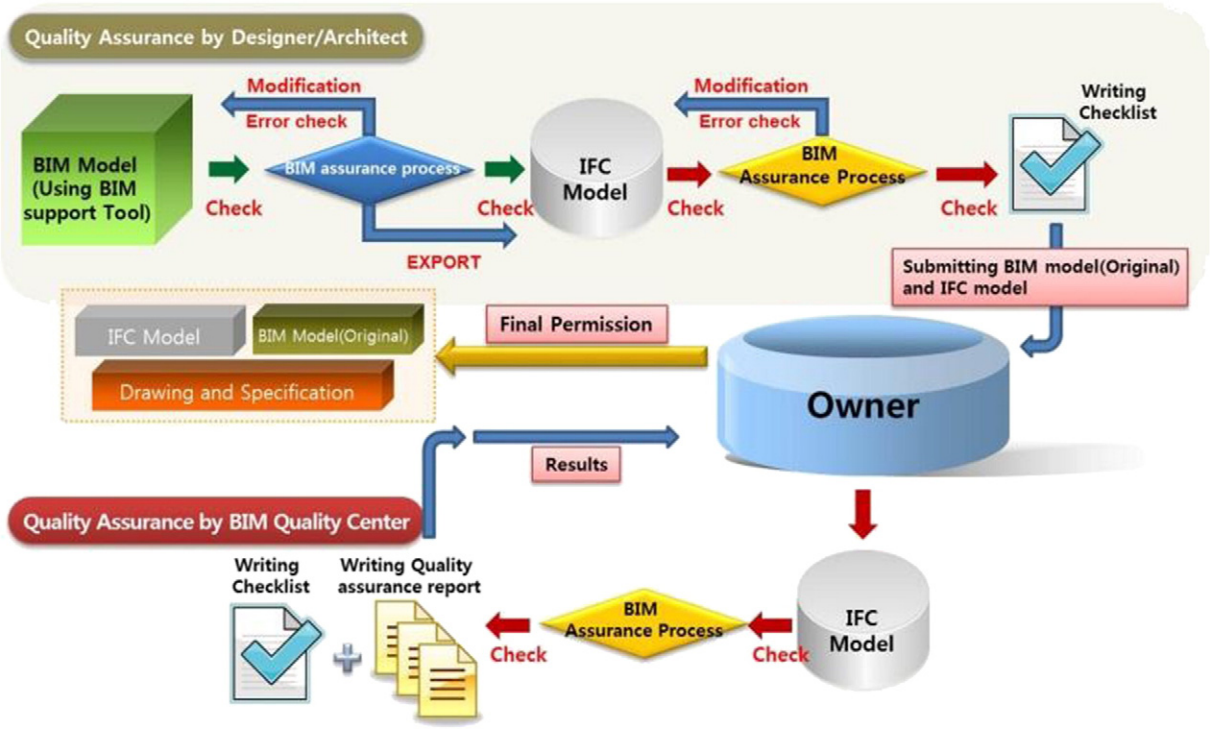

Fig. 1. BIM-based quality assurance process plan in Korea [12].

Fig. 1 shows the BIM-based quality assurance process plan in Korea [12]. This process can be classified as quality assurance by designers/architects and as quality assurance by a BIM quality center. The designers and architects create BIM data using BIM support tools. They submit the BIM model and IFC model after error checking and modification through a BIM assurance process. The owners receive the results of the quality assurance through the BIM quality center and approve the final permission [13]. In this study, the authors have

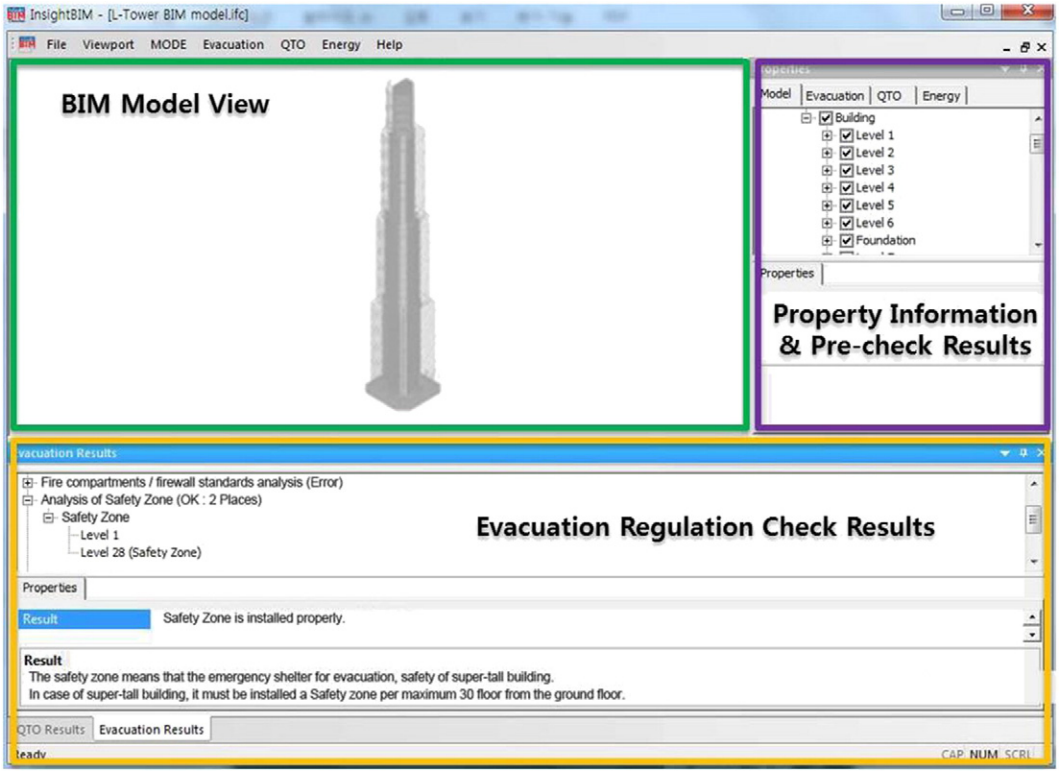

Fig. 2. *InsightBIM–Evacuation* interface.