

## Information Exchange in Traditional Architecture Database Construction Based on Open BIM Technique

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**ABSTRACT:** With rapid development of computer technology and destruction of traditional architecture, computer technology is applied in digital protection of traditional architecture, which brings big limitations. This paper introduces the ongoing construction of traditional architecture database based on open BIM technology in Korea. The author highlights the part in the project which utilizes IFC attribute set for information exchange, analyzes China's traditional architecture protection and demonstrates its superiority and necessity for design of modern architects. In this paper, the author describes the ongoing new Hanok database system construction in Korea based on open BIM technology. During construction of the system, utilization of IFC standard serves as the most critical part. Parameterized model based on object acts as the main object of the database system, while IFC currently does not support parameterized model exchange between different BIM systems. The author inputs parametric relationship in IFC attribute set, and then passes parametric relationship between different BIM systems through j exchange of attribute set. The new house database system involves three major BIM software systems. This study provides an important basis for compatibility study of BIM system in new Hanok database system.

**KEYWORDS:** Open BIM; Digital protection; IFC attribute set; Information interchangeability.

### INTRODUCTION

The rapid development of computer-aided technology has brought great convenience for architects in the field of modern architecture, as architects can structure different forms of architectures with computer-aided technology based on their own experiences and preferences, which constitutes modernized cities one after another. However, traditional architecture means special significance for China, South Korea and many countries. Although not as magnificent as modern architecture, they represent a culture, a history. Nevertheless, due to complex, fine and fixed structure of traditional architecture, the existing computer-aided technology is far from meeting requirement in this aspect [1].

Recent years see rapid development of BIM (Building Information Modeling) technology. Research on design and protection of traditional architecture based on BIM technology emerges endlessly. For instance, a Chongqing University student applies GDL technology of ArchiCAD parametric modeling tool in construction of a set of wooden model of Qing Dynasty official building [2]. But most of these studies are directed to certain BIM system, while one significant feature of BIM technology is that computer-aided systems cooperate to exploit the advantages of each system for the sake of maximum benefits. This paper describes the ongoing construction of traditional Hanok building database system and discusses protection of traditional architecture based on open BIM.

### OPEN BIM

Open BIM refers to data management and modeling approach that does not depend on the use of a software or format. The existing IFC data model developed by building SMART organization [3] is a neutral and open format that can be used in BIM system. The project is carried out based on the public IFC data model. Main current problems in design and protection of traditional architecture based on open BIM reveal in the following two aspects.

(1) Different software support for IFC standard is uneven, and there are a variety of problems in IFC standard-based data exchange. Data storage and exchange of BIM model mainly depends on IFC and its attribute set, but different software provides different support for IFC attributes and attribute set exchange among different BIM systems. This paper focuses on addition and exchange of IFC attribute set in traditional building elements.

(2) Current IFC version IFC2x3 doesn't support delivery of parametric relationship in BIM system. As different BIM systems' definition for objects differ, parametric model structured in BIM system is not interchangeable [4]. In

traditional Korean architecture database project, XML technology based on macro method is taken to solve this problem [5].

## INTRODUCTION TO KOREAN TRADITIONAL ARCHITECTURE DATABASE

Figure 1 shows architectural rendering of Korean traditional architecture database sample. In this overall concept map, Hanok integrated information browser is the key. After setting of the browser, user can download needed traditional building components and related information on the network through the browser.



**Figure 1.** Sample architectural rendering.

According to the energy consumption and carbon emissions characteristics of public buildings, low carbon design and analysis information model of public buildings should include geometric data, physical characteristics, construction requirements, price data and other relevant information of building components, construction machinery, pipeline and other basic elements, and architectural models, structural models and device models should be constructed based on this. According to design data and architectural features of sample construction, this study takes Autodesk Revit whole series software and constructs digital model of building, structure and equipment of sample building.

Based on energy conservation and functional design requirements of sample building and architectural model constructed with Revit software, energy-saving effect analysis of building body is conducted by combining Ecotect Analysis software, which includes thermal performance of buildings, building lighting environment and other analyses.

Figure 2 is an architectural model sample. The system consists of three BIM design systems, Graphisoft's Ar-chiCAD, Gehry Technologies' digital project and Autodesk's Revit respectively. Information exchange between the three BIM systems is particularly important.



**Figure 2.** Architectural model sample.

In order to provide basic components of traditional building component database, first, parametric modeling of these traditional components in BIM system is needed. In this paper, the author chooses a traditional building component, conducts its parametric modeling, adds IFC user defined attributes of the component and tests information interchangeability among the three BIM systems

## DATA EXCHANGE OF ATTRIBUTE SET

### Attribute Set

IFC data model uses EXPRESS language to define its basic model standard organization, but information contained in the model is varied. To avoid too cumbersome of the data model, building SMART organization defines Property Set (hereinafter referred to as attribute set) to store and pass some individually needed information. If the model does not need this information, activation of these attribute sets is not needed so that these information will not appear in IFC data structure. Attribute set is divided into two types, one is basic IFC attribute set defined by building SMART organization. For example, for IFCwal, building SMART organization defines IFCwal common attribute set, the defined attributes include definition of whether the wall is interior or exterior. These attributes are globally generic or common attributes that often appear. If BIM system needs to pass such attribute information in the following other BIM systems, these attribute value can be defined, and these attributes can be stored and exchanged through IFC data model. However, as various countries and regions have their own specifications, features, these basic attribute sets cannot define all architecture information attribute, which requires the user to define some attribute set for storage and exchange of information attribute of some individuals.

To define attribute set, the following steps should be followed: a. Search originally defined attribute sets, if there is already defined corresponding attribute set, the corresponding attribute set should be taken; if there lacks defined attribute set, user-defined attribute is needed. b. User-defined attribute set can apply to building SMART organization to become a common standard attribute set in an area [6].

For traditional building components, such information belongs to endemic information data. In terms of traditional building components, this project needs user-defined attribute set and respective relevant attributes.

### Selection of Traditional Component and Attribute Set

In this paper, the author selects a pillar of traditional architecture as an object. After respective parametric modeling of the pillar, IFC attribute set is added to three BIM systems respectively. As passing parametric modeling in BIM system with IFC files is incapable currently, meta file with parametric relationship is entered in Description section[7] in the hope of passing parametric relationship with meta file in subsequent research. In addition, it includes name of the pillar and default value of each size.

### Exchange of Attribute Set

- (1) Add the above attribute set for the component in ArchiCAD. In ArchiCAD's IFC option, one can directly and easily add user-defined attribute set and various attributes.
- (2) After adding, an IFC file with the attribute set is generated. Confirm attribute in DDS of IFC browser.
- (3) Import the IFC file into ArchiCAD again to confirm its attribute.
- (4) Import the said IFC file to digital project and Revit respectively to confirm attribute information transfer.

### Digital Project Test

Addition of user-defined attribute set in Digital Project needs a XML file as "dictionary". For the component, part XML is encoded. After defined, add XML into digital project, which generates attribute set. In Revit test, add the above attribute set to the component [8].

### Test Results Analysis

According to the requirements of energy saving and the function design, and based on architecture model built with Revit software, architecture noumenon energy saving effect analysis is done by combining Ecotect analysis software, including analysis contents such as building thermal performance and building light environment [9].

### Building Thermal Performance Analysis

Simplify architecture model built by Revit, delete redundant information, derive gbxml file and create room information according to the principle of division of space, so that architecture building partition can be followed; import Ecotect analysis, retain geometric information and partial material object properties of geometry, divide sample architecture into 124 thermal partitions, add parameters required for energy consumption simulation such as meteorological data

(CSWD), building material, thermal parameter and schedule [10]. Ecotect Analysis import and dressing is shown in Figure 3.

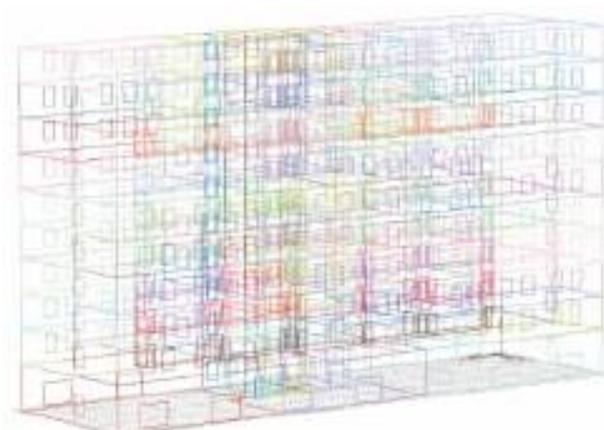


Figure 3. Ecotect Analysis model import and dressing.

#### Building Light Environment Analysis

Light constitutes an important part of building environment. Excellent lighting design can improve building comfort, reduce lighting energy consumption. This study conducts analysis and evaluation of natural lighting and artificial lighting environment with Ecotect, provides a series of control parameters such as lighting coefficient, illuminance and luminance, output the model to Radiance with BIM technology platform for further analysis of various elements of light environment. Sunshine and shadow analysis of sample building is shown in Figure 4.

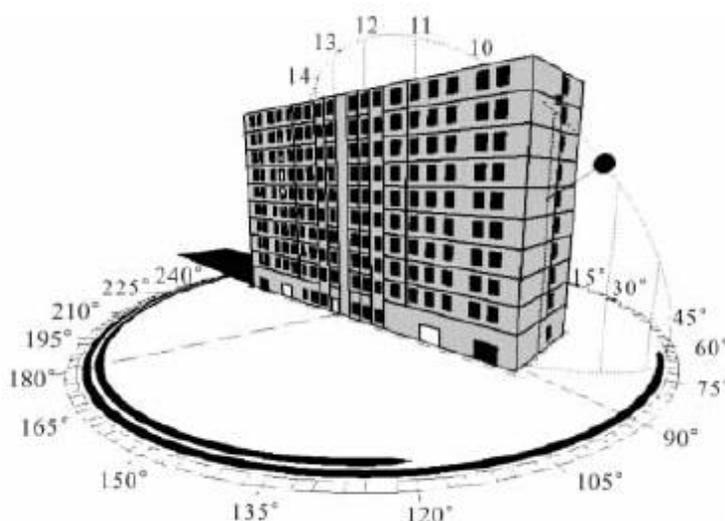


Figure 4. Sunshine and shadow analysis of architecture.

Analyze natural lighting of office area in architecture with Ecotect, set external conditions as overcast model which is the most unfavorable for indoor lighting. Take a northern office on the second floor as example, due to relatively large room width and depth, natural lighting condition is only better near the window. To control indoor illumination to 300 lux, more than 40% of natural lighting time still needs artificial lighting according to the above lighting energy-saving analysis. Hence, optimization strategy is to improve artificial lighting energy saving design, improve energy saving efficiency while meeting the requirements of office lighting[11].

#### CONCLUSIONS

Information constitutes the core part of BIM technology, information storage and exchange in each BIM system is the problem BIM Technology has been striving to resolve. If the problem can be solved very well, each BIM system can be made full use and thus production efficiency of the whole construction industry can be improved. IFC, as currently the

only recognized international standard in construction industry, although has a variety of different problems at current stage, its huge potential for data storage and exchange has become increasingly recognized. With the development of IFC technology, it is believed that relevant research and support will be more and more perfect.

In this paper, the author makes an overall introduction of ongoing Hanok database system construction based on open BIM Technology in South Korea. During construction of the system, use of IFC standard represents the most critical part. As parametric model based on object constitutes the main object of the database system, IFC so far doesn't support exchange of parametric model between different BIM systems. The author inputs parametric relationship in attribute set of IFC, then transmits parametric relationship between different BIM systems through j exchange of attribute set. The new house database system involves three main BIM software systems, which provides an important basis for research on compatibility of BIM system in new Hanok database system.

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