Title: The Analysis of Architectural Constructability Using BIM and Basic Study of Improvement

Authors: JungMin Lim, Masters Degree Candidate, Hanyang University  
SunYoung Choi, Masters Degree Candidate, Hanyang University  
JuHyung Kim, Professor, Hanyang University  
JaeJun Kim, Professor, Hanyang University

Subjects: Architectural/Design  
IT/Computer Science/Software

Keywords: BIM  
Construction

Publication Date: 2011

Original Publication: CTBUH 2011 Seoul Conference

Paper Type: 1. Book chapter/Part chapter  
2. Journal paper  
3. Conference proceeding  
4. Unpublished conference paper  
5. Magazine article  
6. Unpublished

© Council on Tall Buildings and Urban Habitat / JungMin Lim; SunYoung Choi; JuHyung Kim; JaeJun Kim
The Analysis of Architectural Constructability Using BIM and Basic Study of Improvement

JungMin Lim1, Sun-Young Choi2, JuHyung Kim3, JaeJun Kim4

1 Master course, Department of Sustainable Architectural Engineering, Hanyang University, Seoul, Korea, eg1999@hanyang.ac.kr
2 Master course, Department of Sustainable Architectural Engineering, Hanyang University, Seoul, Korea, vroombear@hanmail.net
3 Professor, Department of Architectural Engineering, Hanyang University, Seoul, Korea kcr97jhk@hanyang.ac.kr
4 Professor, Department of Architectural Engineering, Hanyang University, Seoul, Korea jjkim@hanyang.ac.kr

Biography

While Lim, Jeong-Min worked for Gyungdong E&C Inc. for one and half years as a site engineer, he entered CM/CIC laboratory of Architectural & Environmental Engineering, Hanyang University in 2011 to study the construction process management and construction jobs and started the research on the field of construction. Currently, he takes a training course for fostering experts for foreign construction and CCM (Certified Construction Manager) course, and he has a will to spread Korean Architecture all over the world with the progress of the research related with the construction process management and foreign construction.
Abstract

Recently, methods to accurately select an inflection point for the curve of topography that fits well with the actual topography are developed, which reduces errors. However, the existing inconvenient and inaccurate methods are still used for the estimation of the amount of earthworks in the construction field. The BIM-based process is applied to improve the existing inconvenient and inaccurate methods in the construction fields. However, most studies were conducted focusing on architectural constructions and even in earthworks, only research on overall project management or the estimation of quantities has been conducted.

Therefore, this study is intended to suggest the process of estimating the amount of earthworks based on BIM that is more efficient and accurate than the existing estimation methods of the amount of earthworks in the field of earthworks. It is necessary to study on the guideline to suggest the accurate criteria that a hands-on worker can refer at the phase of early introduction.

Keywords: BIM (Building Information Modeling), Constructability

Introduction

Background and Purpose

Recently, as construction projects are gradually getting more large-scaled, complicated and high-rise, the process of construction is getting complicated, which causes the reduction of construction period and cost etc. through efficient management when constructing to be an important factor.

For the purpose of this efficient project management, it can be said that BIM (Building Information Modeling) is one of convergence technologies that draw public attention to achieve the target of process innovation and efficient project management. The term of BIM has been used as a concept to integrate information (3D Object Information and Related Data) that is created during the life cycle of the whole construction project ranging from the planning of construction projects to maintenance and their process and their compatibility (Choi, Cheol-Ho, 2008).

By applying this BIM, it is possible to minimize various interception and errors that caused by inaccuracy of information at the early stage of construction projects and makes it possible for smooth communication of participants of those projects.

Review of Existing Literature and Research Trend

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Main Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kwon, Dong-Hyuk (2003)</td>
<td>The Study of Constructability Analysis of High-rise Office Projects</td>
<td>By extracting and suggesting items that could be problems that occur at the phase of construction and deducing them as priorities for importance and frequency etc., the results of survey and analysis of the level of influence on each item are represented.</td>
</tr>
<tr>
<td>Kim, Ho-Jung (1999)</td>
<td>The Study on a Plan of Utilization of Constructability Analysis Concept at Public Office</td>
<td>To overcome the inefficiency of domestic construction production process, the checklist that is possible to be applied at each design phase is developed for the review of design by introducing the constructability analysis concept.</td>
</tr>
<tr>
<td>Nam, Yong-Ho (2007)</td>
<td>Application of Partnering and Constructability in the Design Development Phase of Public Design-Build Projects</td>
<td>It suggested a plan for efficient application of partnering and constructability analysis concept at the phase of execution design of design-build bidding type.</td>
</tr>
</tbody>
</table>
As shown in Table 1, the studies related to constructability have been conducted on the basis of some cases and constructability concept but the reality is that the analysis work of constructability utilizing various technological aspects to improve this is insufficient.

Table 2 Research Related with BIM

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Main Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gang, Hyun-Cheol (2003)</td>
<td>A Study on the Development of Construction Business Integrated Model through Case Studies of BIM</td>
<td>The application cases of domestic and foreign projects were analyzed, and it suggested problems and possibility of BIM application.</td>
</tr>
<tr>
<td>Lee, Jin-Hee (2007)</td>
<td>A Study on Possibility of Domestic Application of BIM-Based Integrated Design Process</td>
<td>It suggested a plan for integrated management of information during the whole life cycle of a building utilizing BIM and for construction of a cooperative system, and figured out the possibility of application of design process based on BIM by comparatively analyzing the existing design process.</td>
</tr>
<tr>
<td>Park, Su-Hun (2007)</td>
<td>Current Situation on Initial BIM Introduction in Korea and Desirable BIM Application on Environment Analysis</td>
<td>It suggested a method to reflect a BIM design tool efficiently that was differentiated from the existing 2.3D program.</td>
</tr>
</tbody>
</table>

As shown in Table 2, recent construction has tendency to utilize the technological aspect of 3D-based BIM for improvement of constructability works. When delivering information, there is a problem that the intention of an architect is hard to be understood due to discordance on the drawings. Many uncertain items are not solved through pre-cooperation in construction projects. From the past up to recently, constructability is not considered at the phase of design in most structures, and due to this, many problems occur when performing the actual construction. Therefore, a plan must be prepared to improve the efficiency of construction by reviewing and checking various problems in terms of construction that occurred at the phase of design in advance. Like this, to minimize time and cost that are unnecessarily consumed at the construction field, the introduction of BIM technology is being actively reviewed. This introduction of BIM technology will improve the productivity when performing a construction project through an elaborate prearranged plan and review before performing a project, and it is intended to visualize interception that occurs 2D drawings and to suggest the expected effectiveness of constructability analysis and items to be improved using BIM technology.

Definition of BIM and Necessity of Constructability Analysis and Expected Effectiveness

Definition of BIM

The information in the existing field of architecture was expressed through symbolic language and 2D-based drawings information system, but it has been changed to store all information contained in a project as shown in Fig. 1 in the database of a computer along with changes into 3D-based information system that has the actual shape and information of a building and to express information as necessary with various forms through BIM technology.

BIM stands for Building Information Modeling and refers to a technology to produce and manage all information that is applied to various fields during the entire life cycle of a building (a project) from the concept design at the early stage to the phase of maintenance. Therefore, in the case of application of BIM technology, various information could be more efficiently utilized in...
the field of architecture, and the actual state is that since various advantages are materialized, people are striving for BIM application through diverse approach in the country as well as internationally (Kim, In-Han, 2008).

Necessity of Constructability Analysis

When constructing a building in the past, changes of design and reconstruction frequently occurred since it depended on experiences of a manager. If BIM is applied, it would be possible to check interception in advance and could expect that dispute and risk between a client, an architect and a constructor would be minimized.

Plan for Constructability Improvement

When previously constructing a building, works were performed based on 2D and after modifying and supplementing the performance of constructability analysis and reviewing and checking the constructability analysis, design and construction were conducted and if the interface is not sufficient due to impediment of communication between members and separation of design/construction, there is a tendency to depend on only experiences and knowledge but when progressing works through BIM and if the scheduling is efficiently managed with minimization of errors according to changes of design/construction and improvement of communication between each company by performing design and construction after works of constructability analysis utilizing 3D BIM, it’s possible to check whether there is interception or not before construction as shown in Fig. 2 below so it’s possible to minimize time and cost.

Figure 14 Check of Interception by Using BIM

Since the constructability analysis and review at the phase of preconstruction through 3D virtual BIM and efficient cooperation support are possible, enhancement reliability with a client and quality improvement can be expected.

Conclusion

This paper is a basic study for constructability analysis and items for improvement using BIM, and BIM is currently at the early stage of introduction so concrete and systematic process is not sufficient and even though the number of cases that it was applied for working-level has yet only two digits, if it’s further developed so its process is improved and systematized in the future, the introduction of BIM into domestic construction market would also settle down as a sustainable and reasonable tool, not for the short period of time, so it would be possible to have the effect of reduction of construction period and cost in the overall construction such as the system of awarding a contract as well as constructability analysis and improvement. Various and continuous research that could quantitatively figure out by conducting constructability analysis whether substantive reduction of construction period and cost occurs by applying it to a few real fields will be continued in the future.
Reference

Park, Su-Hun (2008). Building performance analysis based on BIM under the consideration of design process, Report of Joint Research Supported by the Program to Discover Rising Researchers, Korea Architecture Society
Kim, In-Ho (2008) Definition and Overview of BIM, CAD&Graphics, pp100