

Case study analysis on the application of BIM in Korea's civil engineering industry and securing of interoperability of BIM models

Jaehyun Park¹, Hyundong Lee^{1,2}, Pilljae Kwak¹

¹ Korea Institute of Civil Engineering and Building Technology, Environmental and Plant Engineering Research Institute. 283 Goyangdae-ro, Ilsanseo-gu, Goyang-si, Gyeonggi-do, Republic of Korea

² University of Science and Technology, Construction and Environment Engineering. 217, Gajeong-ro, Yuseong-gu, Daejeon, Republic of Korea
{jhpark1224, hdlee, pjkwak}@kict.re.kr

Abstract. This research studied the examples of civil engineering-BIM applications to grasp how much BIM is being applied throughout Korea's civil engineering industry, and then analyzed the research related to the enhancement of interoperability to secure universal availability of BIM models.

Keywords: BIM (Building Information Modeling), Civil engineering, BIM data, Interoperability

1 Introduction

A recent trend in both domestic and international construction industries reveals a certain paradigm shift in construction through establishment and utilization of facility data management system throughout its entire lifecycle, from planning and design of a facility to building, operation and maintenance. This has eventually resulted in a great amount of effort to introduce 3D-based BIM technology. [1]

BIM (Building Information Modeling) can define all property information related to a full lifecycle of a target structure, from planning and design to construction, operation and maintenance, in terms of technology of construction, production, management and utilization. A BIM model, which is generated by such technology, is a virtual structure built with 3D graphic data and also a data model, which contains non-graphic data such as property information. [3], [8], [11]

In both domestic and overseas construction industries, there has been a lot of movement to actively utilize BIM technology – introducing BIM even in the early construction planning and design stages, for example. On the other hand, the civil engineering SOC industry is still at the beginning stage of BIM application and introduction. Many difficulties exist with the introduction or standardization of BIM due to civil engineering's unique characteristics and conditions [10], and the reality is

that the industry lacks a sufficient number of research and case studies in the application of BIM. [11]

This research focuses on the civil engineering SOC industry in Korea, studying and analyzing various research and case studies that have applied or utilized BIM in the civil engineering SOC field. Moreover, it aims to grasp the current level of BIM-related technology to apply it to the Korean civil engineering world by examining the current status of research and analyses on interoperability (information interchangeability), conducted to secure universal availability of BIM data models.

2 Contents of research

2.1 Trends in research on BIM application in Korea's civil engineering SOC industry

Research and case studies, which have utilized the results of BIM applications in civil engineering SOC facilities in Korea until now, have been investigated and the summary of which is as follows in Table 1.

BIM in the Korean civil engineering industry is still in its introductory phase. While there have been a number of instances of vertical structures such as plants, terminals and stations in which the application of BIM is convenient, the past 5-year period has seen a series of active research on facilities with horizontal structure (linear structure) including rails, roads and bridges, all of which have been known to be extremely difficult and technically limiting for BIM to be applied. Although BIM is not yet employed in an entire lifecycle throughout civil engineering, more cases have started to partially apply BIM technology in specific civil engineering projects and related studies, from design and construction review to process management (4D BIM) and cost calculation (5D BIM). [1], [12]

In addition, the total range of areas in which BIM is applied has been steadily expanding within the civil engineering industry, an area of which involves research studies that have developed a BIM library model on water circulation facilities containing water supply, sewage and LID installations in which the application of BIM has been lacking.

Table 1. Past research on BIM application in Korea's civil engineering industry.

Research (Author & Title)	Target Facility	Description
Lee (2011) [8] BIM application in Civil Engineering - Seohaean Expressway expansion project by Korea Expressway Corporation (2008-2009)	Highway	Through BIM modeling of a 2D design drawing of a highway, 2D design and 3D design can be compared, from which the possibility of BIM application can be determined.

Cho et al. (2011) [1] Application of Construction Management Integrated System based on BIM in Civil Engineering Project, – For Honam KTX Zone 4-2 site	High-speed railroad	Prior to the construction, establish and utilize a 3D virtual site by BIM modeling of information such as topography, tunnels, bridges and other structures contained in all lines.
Jeong et al. (2014) [4] A Study on Slope Modeling using BIM	Roadside cut slope	Design a cut slope in a linear section on top of ground modeling constructed by applying BIM (considering ways to utilize BIM in facet ground)
Kim et al.(2014) [7] BIM application case study of civil infrastructure industry	Railway construction site(Lines, tunnels, stations, etc)	Through BIM modeling of a target structure, check for design errors and execute a process simulation
Yang et al.(2012) [13] IFC-BIM based CO2 Emission Accounting in Design Phase of Cable-stayed Bridge	Bridges (Cable-stayed bridges)	Determine the means to calculate CO2 emissions during the BIM-utilized design phase, and verify suitability of the method by applying it to cable-stayed bridges
Min et al.(2012) [9] A Study on Standardization for Civil-BIM Construction of Harbor Structure based on Geo-Spatial Information Technique	Port structures (International Passenger Terminal)	Propose GIS technology-based BIM layers on port structures and civil engineering-BIM standardization via a comparison analysis with an existing BIM
Moon et al.(2014) [10] Development of BIM Library for Civil Structures based on Standardized Drawings-Focused on 2D Standard Drawings of The MOLIT	Road culvert and revetment structure	Construct either a BIM library model on road culverts and revetments or a design model based on BIM library
KICT (2013) [5] Report: Development of Integrated Operation Technology on Construction Information & Spatial Information based on BIM/GIS Interoperation Platform (Environment).	Water circulation facilities (water supply, sewage and LID facilities)	Develop a BIM library model for efficient operation and maintenance of water circulation facilities

2.2 Research trends on improving interoperability of domestic BIM data

Kim et al. (2009) analyzed the IFC compatibility of the BIM data model of structures that had been constructed by using commercialized BIM modeling tools. Also, through comparisons among similar advanced researches conducted domestically and internationally, problems with BIM data compatibility via IFC as well as the means to fix them have been proposed. [6]

Choi et al. (2011) conducted not only compatibility tests using the shape and property information of major construction materials but also those based on additional property expansion by defining new property sets. Also, the problems that have resulted from these compatibility tests were analyzed and possible solutions were proposed. [2]

Lastly, Park et al. (2014) performed an interoperability analysis of BIM-IFC conversion model in order to systematize transmission and exchange of facility data for water supply maintenance and to evaluate the quality of a BIM model in a water supply facility to be utilized. From this, the information interchangeability and

universal availability of the BIM model were verified, and efforts were made to not only understand technical limitations and obstacles present within current IFC models but also provide the means to fix the issues. [11]

3 Conclusion

This research studied the examples of civil engineering-BIM applications to grasp how much BIM is being applied throughout Korea's civil engineering industry, and then analyzed the research related to the enhancement of interoperability to, for example, secure universal availability of BIM models.

In order for BIM to be more vitalized and widespread in the civil engineering world, more and more cases of BIM applications such as construction of BIM library model on civil structures must be obtained and, concurrently, standardized research and construction of a BIM-applied system based on a defined purpose of civil engineering BIM's utilization, scope and universal availability must be also carried out.

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