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A Study on Utilization Plans for Already-constructed BIM data for Physical Protection Simulation

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Abstract : *Recently, diversified R&D concerning responses to not only natural disasters but also human accidents is being increased. In the case of terror response, quantitative analysis is possible by using a tool allowing physical protection simulation. At this time, construction of geometric modeling for simulation is essential. Therefore, performed was the conversion test to the form of data allowing physical protection simulation by utilization of the already constructed BIM model within the BIM/GIS platform. Through this, construction of more efficient geometric model became possible, and construction of more precise simulation model can be expected based on diversified case studies in the future.*

Keywords*-Physical Protection Simulation, Building Information Modeling, BIM/GIS Interoperable Platform, Model Conversion, AVERT™*

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I. INTRODUCTION

Recently, as interests in not only natural disasters such as earthquake, flooding, etc. but also human accidents such as fire, terror, etc. are increased, diversified studies and system development related to this are being increased. In the case of anti-terror simulation, visualization of threats of terror, or quantitative performance evaluation of physical protection system has become possible by utilizing the physical security evaluation tools certified by approved institutions. While the process of constructing shape information of the subject facility should precede for such simulation, this is also the part accounting for a relatively large relative weight among overall simulation procedures.

In the present study, a simulation tool called AVERT™ was selected to implement the protection simulation based on 3D model, and the preparatory process as shown in Fig.1 will be undergone prior to implementation of the present simulation.

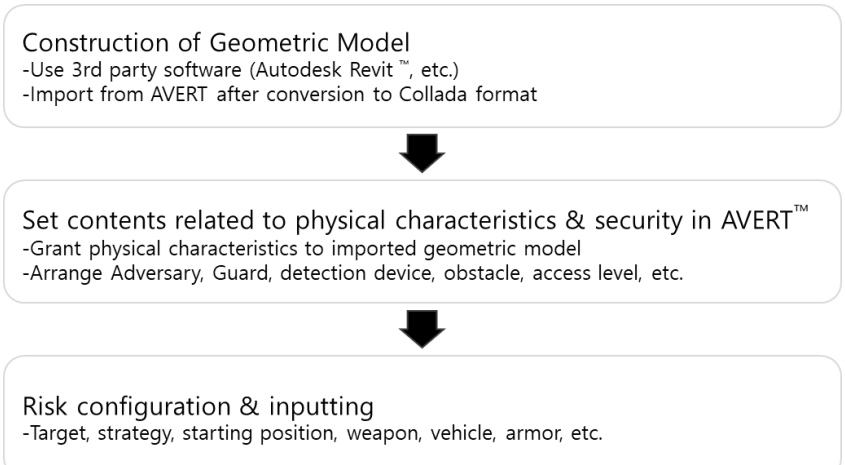

Fig. 1. Preparation process for AVERT™ simulation

At this time, if the already-constructed geometric model is utilized, the construction step for the 1st-stage model can be simplified, and the simulation procedure can be efficiently implemented. Thus, to minimize such efforts and to increase the productivity of data construction, conversions tests of the existing BIM model were conducted by various methods so as to be suitable for application to simulation, and the results are arranged herein.

II. TOOL FOR PHYSICAL PROTECTION SIMULATION

One of the simulation tools for physical protection simulation mentioned earlier is AVERT™, which is a physical security evaluation tool having completed the screening process of Verification, Validation, and Accreditation (VV&A) by US Department of Defense[1]. AVERT™ is used for quantitative identification of vulnerability of the protection system according to the simulation by generation of virtual models for physical protection system of important facilities by utilizing 3D modeling and simulation technique and for quantitative identification of vulnerabilities of the protection system by simulation with probabilistic algorithm and Monte Carlo Sampling techniques for the attack and defense situations among the physical protection system components of the relevant facility to resist diversified threats.

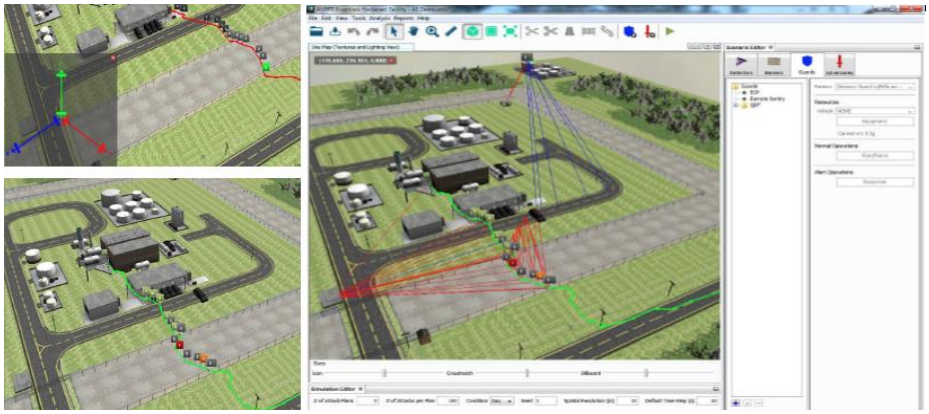

Fig. 2. Example for simulation of AVERT™ protection simulation

Design of traditional security system for protection of important facilities has been realized by qualitative analyses of experienced specialist in security analysis, and there have been limitations in quantitative analyses of cost effectiveness for the security defense system due to insufficient cases and specific data since the cases of experiencing loss through adversary's attacks occur infrequently, and there also was a difficulty in relying on the results. Since AVERT™ provides the basis for allowing investment decision making for the security system with optimized budget by visually showing the risks to asset owners and security analysis specialists as well as providing quantitative information for improvement of the protection system, it enables quantitative analyses.

III. BIM/GIS INTEROPERATION PLATFORM DATA

BIM containing unit member elements of buildings & indoor space information and GIS containing outdoor space information have been mutually integrated, and the platform forBIM/GIS interoperation for ceaseless information linkage between indoors and outdoors has been developed[2]. As a representative case utilizing this, there are integrated information platform of accidents & disasters & dashboard for combined accident response as shown in Fig. 3[3]. Information required for accident response for not only surrounding region information and detailed facility information (static data) on the member level but also sensing information collected in real time (dynamic data) has been organically integrated and ,effective & comprehensive accident response has become possible.

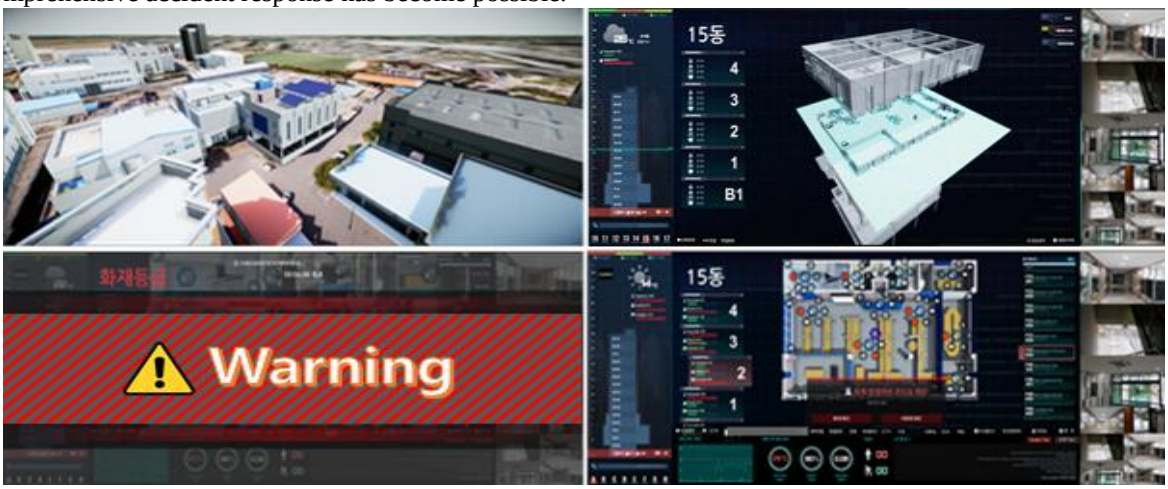

Fig. 3. Utilization case of BIM/GIS platform for accident response (natural disaster)

In this way, since the BIM data constructed within the BIM/GIS is basically composed of shape information and attribute information, it has advantages of not only being able to be utilized for overall life period stages such as design, construction, volume calculation, process management, maintenance management, etc. but also being easy to visualize 3D shapes. Consequently, facility model construction for the physical protection simulation by utilizing the already-constructed BIM data within the BIM/GIS platform is considered possible, through which effective simulation and expandability of the BIM/GIS platform can be expected.

IV. CONVERSION OF BIM SHAPE INFORMATION

In the case of AVERT™, Collada is mainly used for construction of detailed 3D model such as facilities, terrain, etc. where Collada 3D geometric standard model has high interchangeability with 2D/3D authoring tool such as Google Sketchup™ or AutoCAD™. Therefore, Collada has been selected as an interlinking forma for the conversion test of the already-constructed BIM model, and the model conversion tests have been conducted according to the following methods.

In the first method, a review was made in AVERT™ for conversion of the BIM/GIS model with actual image mapping after conversion of the BIM model modelled in Revit™ to Collada by utilizing the Plug-in called Lumion™ Exporter, followed by implementation of actual mapping in Sketchup™ and subsequent conversion to Collada.

In the second method, a review was conducted by calling from AVERT™ after direct conversion to Collada by using the Plug-in called Lumion™ Exporter within Revit™

In the third method, confirmation of omission status for shape information, member information & material information was implemented by conversion to Collada in Infraworks™ after direct calling of Revit™ model from the Infraworks™, by use of which method, the final conversion data could be constructed [4].

During such conversion processes, some problems as follows occurred, which has been solved via trial & error since these occurred mostly in the process of conversion of source data to Collada format required by AVERT™.

a. Problem of object merging

As the problem having occurred first, the phenomenon of objects not being completely separated in the process of granting physical characteristics to each terrain object occurred after importing into AVERT™ when Lumion™ Export Extension of Revit™ as the existing conversion method for Collada as shown in Fig. 4. This problem has been solved by setting so that objects having the same texture were not merged into one object while Infraworks™ was utilized as a Collada conversion tool.

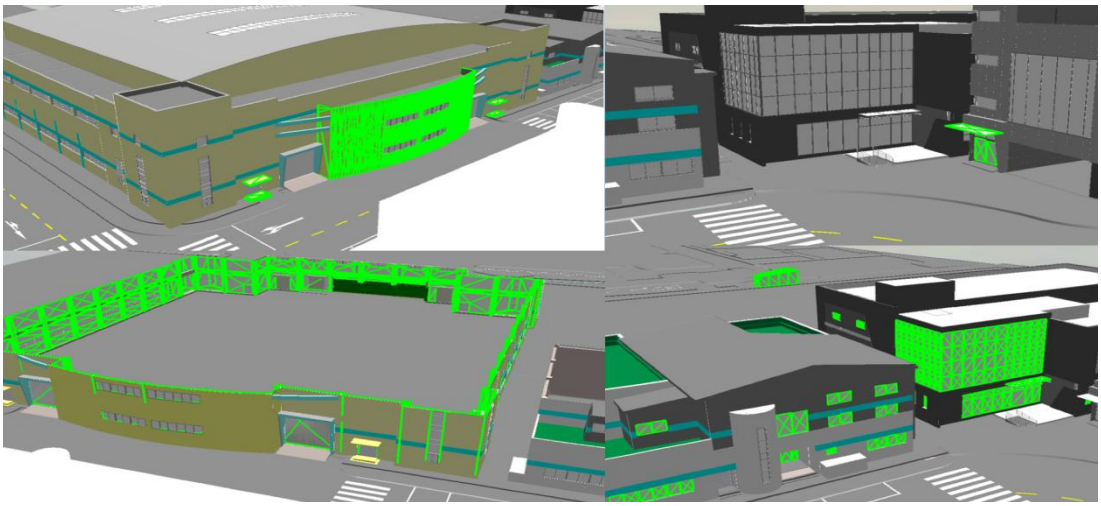

Fig. 4. Problem of mutually different objects being merged to be recognized as one

b. Distortion problem of finishing Texture

AVERT™ is software utilizing 3D model with an aspect where visual beauty is also deemed important. As this problem mostly depends on the texture of source data for a well-constructed 3D model, these Textures are saved in such format as png, jpg, etc. within the Textures folder separately from Collada data of dae format in the process of producing Collada data with Infraworks™. Therefore, it should be set so that the relevant texture can be used together in the process of bringing Collada data in AVERT™. However, problems of the original texture being distorted also occurs since the method of expressing the Texture varies from program to program.

c. Differentiation problem for security zones

In the data aimed at usual construction, the concept related to physical security is not reflected. However, in the case of AVERT™ dealing with physical protection system, setting of limited security zones is always required for determination of adversary's infiltration status. Although differentiation can be made for setting of security zones by utilizing the functions of AVERT™ after bringing 3D model for general buildings from AVERT™,, the easier method involves terrain division, etc. by considering the zones as the security subject & the zones otherwise for terrain division, etc. from the design (BIM modeling) stage. In the present study, terrain division operation was additionally implemented for setting of security zones within the BIM model as shown in Fig. 5 to perform the conversion test.

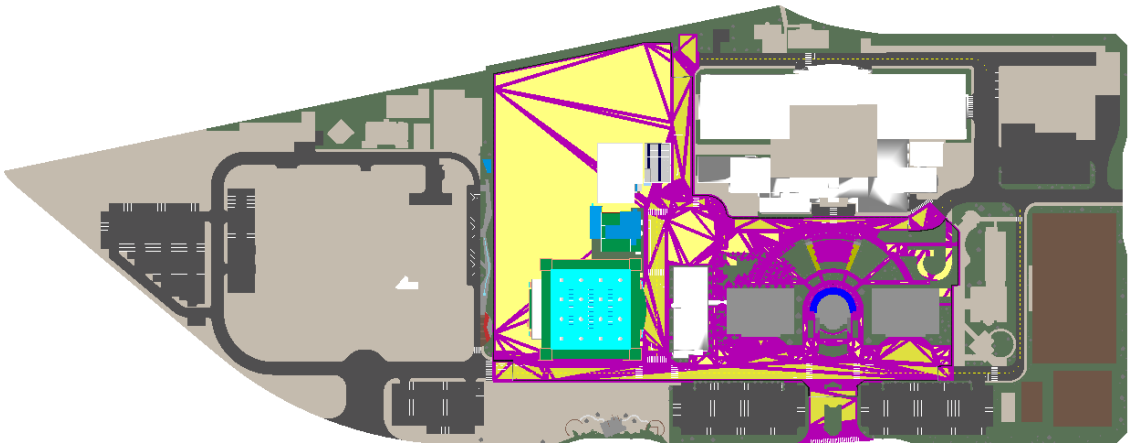

Fig. 5. Setting for security zone within BIM model

V. CONCLUSION

While limitations such as deformation of shape, omission of already-constructed construction information failure of information to be linked were discovered during the Collada conversion process of BIM data, Collada data was finally produced by utilizing Autodesk Infraworks™ after undergoing correction processes for a few times, and the following results have been utilized for physical protection simulation.

(1) Results of conversion of the integrated platform data for the model subject facility to Collada format (Standard format used when AVERT™ brings the Geometry)

(2) Texture data saved together with Collada format (What is produced together when saved as Collada in Autodesk Infraworks™)

Physical protection simulation has been performed by using data converted in this way, and visualization of the results was possible as shown in Fig. 6.

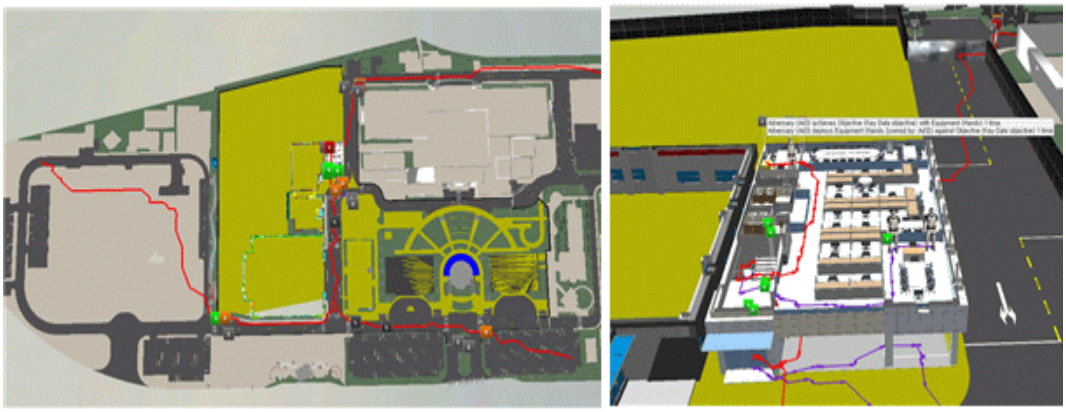

Fig. 6. Simulation development situation inside & outside the building when the adversary succeeded in infiltration

Through BIM model conversion process for linking with AVERT™ for this time, construction of geometric model of AVERT™ has been considered possible by using the data in the BIM/GIS interoperation platform. However, more elaborate establishment of the process for conversion of source data to the Collada format required by AVERT™ is considered necessary through diversified case studies in the future. Also

considering physical protection upon model construction, differentiation for protection zones at the design stage needs to be kept in mind for reflection.

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