A STUDY ON PRESERVATION METHOD OF HISTORIC BUILDINGS IN ITABASHI, TOKYO, USING BIM AND GIS

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1. Introduction

The article deals with the topic of Historic Building Information Modeling (H-BIM) applied to the historical architecture of an urban park within the Itabashi district of Tokyo.

The document will address a methodological discussion concerning the construction of parametric models of historic buildings in the park starting from laser scanner detection and Geographic Information System Technology .

The research is prompted by the modern need to have databases full of exhaustive information, through which we can preserve the historical heritage present in the Japanese reality, monitoring the conditions and planning the future.

This work is carried out in collaboration with the Nihon University of Tokyo, the Alma Mater Studiorum University of Bologna, the Itabashi municipality and the Topcon industry.

This work is preparatory for the development of the redevelopment project of the park, through the reuse of its buildings, the arrangement of the green and urban furniture pursuing the objectives of maintaining the historical memory of the place and its harmonization in the urban context, creating a further pole of attraction for citizens and visitors.

2. Target area and sight

2.1 HISTORY OF KAGA PARK

The terrain consists of floodplains along the Arakawa River in the northwest and the Muroto Tadashi district, a volcanic plateau in the central and southwestern part. A small river flows in this plateau.

It is the Shakujii river with the Kodaira water source flowing in the southern part of the district from east to west, the basin has a relatively wide and delicate valley.

In this valley was built in the year 1876 the laboratory and production center of gunpowder of Itabashi where stood the largest villa daimyō of Edo, in the same year the palace was built for the production of artillery cannons of the Army. Characteristic of the geographical environment of the Hirao villa is that the Shakujii river that runs through the Nakasendo Shimo Itabashi cottage adjacent to the palace to the east and west, flows into the house forming a vast pond.

One of the reasons why the military ministry requested the site for the construction of the Itabashi gunpowder production site on the site of the Hirao residence in Meiji 4 is the topography of this valley floor. It is believed that the Ministry of Hyōbu has issued a judgment that the damage to the Itabashi Town district can be minimized in the event of an explosion by installing a pyrotechnic manufacturing facility in this relatively large place.

The second reason for the creation of the industry at this site is the proximity of the Shakujii river from the qule you can draw water and use its energy through the waterwheel used since 1853.

At the adjacent Noguchi Research Institute (Kaga 1 - chome 8), there is a part of the equipment to verify the performance of the ammunition called a trajectory tube. From the aerial photographs of 1964 it can be seen that the pipe extended directly on Mt. Hirao, in the Kaga park, to the center of the mountain.

In 1896, the completed explosives factory began to operate as the main artillery factory of the Itabashi factory.

Subsequently, this factory was renamed "Platekiti gunpowder manufacturing place" and the final name is Tokyo Army / Itabashi factory. Subsequently, other industries arose in the area and not only for the production of weapons or gunpowder but also for example of paper mills.

This establishment of state-owned factories and large companies mainly in Itabashi, the Takino River and the Oji area became the basis of industrial development in Japan.

It can be said that the area is only one of the starting points for modernization in Japan (Figure 1).

Figure 1. Plan of the Kaga park area.

Figure 2. Plan of the Kaga park area with highlight the buildings cases study.

2.2 TARGET OF THIS STUDY

The topic of the renewal of the historical and architectural heritage is deeply felt in countries with a great historical tradition such as Japan, where the case study is inserted.

In the present case, this is a current topic of Tokyo, such as the renewal of the urban park now called Kaga Park, located in the Itabashi district.

For the enhancement and modernization of this park, the first committee was created in the year 2008 which aims to complete the redevelopment in the year 2025 following the inspiring principles that are to ensure the identity of the places, enhance the green areas and existing buildings in the optic of the inclusion of these spaces within the city and as an extension of of the cultural offer of the city. The Kaga park, which will probably change its name in Itabashi Historical Park, covers an area of about 260m x 130m crossed by the Shakujii river.

The area was chosen for the construction of gunpowder and ballistic tests, so there are still industrial archeology buildings related to this type of activity and in particular there are a ballistic tube launch site, a laboratory of combustion, a deposit of gunpowder, explosives laboratory and test rooms.

The site was chosen in a strategic position as it is relatively close to the city center but at a safe distance for possible explosions and near the watercourse for moving the mills and for drawing water.

Starting from a historical-critical research already carried out by the work, the aim was to recreate the entire urban environment and its buildings through the acquisition of point clouds with laser scanners and then return three-dimensionally all the parts of the complex.

The buildings being studied are two buildings located in the position indicated on the map (Figures 2, 3,4,5).

Figure 3. Building case study.

Figure 4. Building case study.

The main objective of the redevelopment of the park and of the architectural and cultural history contained in it offers the opportunity to develop a case study applying the modern laser scanner and GIS survey techniques and to return the survey using H-BIM.

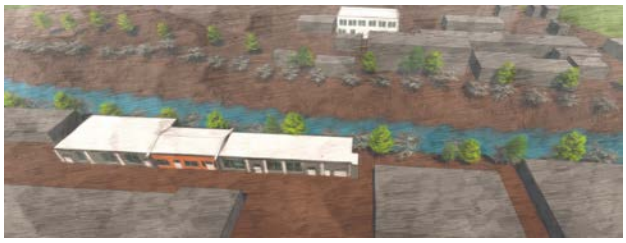

Figure 5. Previsional Revit Model.

3. Data organization

3.1 EXISTING DRAWING DOCUMENTS

Board of Education, Municipality of Itabashi surveyed the site and some buildings for existing drawings in 2016. 3D BIM model data are based by the documents.

3.2 EXISTING 3D DATA OF GIS

The grounds data in 3D BIM model are made with DEM (digital elevation model) by Geo spatial information authority, Ministry of Land, Infrastructure and Transport. Buildings outline data and road edge data are very important information for combination of BIM data and GIS data in terms of positioning.

3.3 3D MODELING OF BIM

For organization of laser scanning, provisional 3D BIM model with GIS data is very important and useful to make work (survey and make point crowd data) efficiency. And this model will be base to whole model including VR data.

3.4 3D SCANNING IN THE SIGHT

The first operation, after historical research, was to identify the necessary tools and methods. To do this, a meeting was held with Topcon technicians, identifying the most suitable instrument for the purpose called Topcon GLS-2000 series Laser Scanner (Figure 6, Figure 7). Based on the potential of this tool, the survey campaign to be carried out in the field has been planned.

4. Data modeling

The 3D BIM model of this study consist of buildings data, fitting and ground data (Figure 8). So the Existing BIM model may be modified to 1940 model or prospective model like conversion designed model with every matching information. Once the laser scanner operation has been performed, the data obtained is processed through the ReCap program to pass from the point cloud to the mesh (Figure 9, Figure 10).

This mesh will be imported into the Revit program for the purpose of creating Loadable Revit Families and adapted to different instances.

Figure 6. Laser scanner Topcon GLS-2000 series.

Figure 7. Data acquisition with laser scanner.

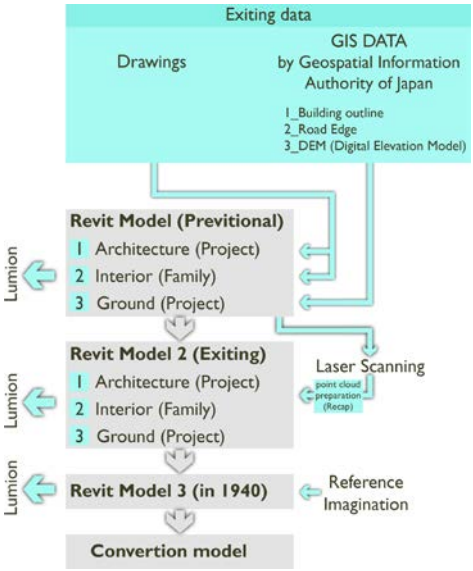

Figure 8. Workflow.

Figure 9. Data processed in ReCap.

Figure 10. Data processed in ReCap.

5. Conclusion

The survey, the data processing and the restitution of the model of the first building examined gave the possibility to understand the potentialities and the critical aspects of the method. This first survey can therefore be defined as a test for planning and optimization of the same for the study of subsequent buildings and related open spaces. In addition to testing the potential of the laser scanner instrument, we tried to optimize its use by identifying the minimum number of stations necessary to achieve the desired precision. In addition, all the time necessary to carry out the various operational phases, such as: data processing to obtain the point cloud, and then the 3D geometric model, and subsequently the BIM model and the VR model, were evaluated. In this way it is possible to estimate the number of people, the tools to be used, the times for carrying out all operations up to the completion of the entire complex in order to identify times, costs and results.

Acknowledgemets

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