Research on Design and Optimization of Geotechnical Engineering Based on BIM(Building Information Model) Technology

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Abstract. The BIM is short for "building information model", first originated in America in the 1970s. After the completion of the three-dimensional geological modelling of the project site, the section interception tool provided by the modelling software can be used to obtain the engineering geological map of any section. Different from the two-dimensional section results provided by the geotechnical engineering survey, the section obtained by the software is projected vertically with the information of all geotechnical layers in a rectangular box on the surface.

Keywords: BIM Technology, Building Information, Geotechnical Engineering, Digital Simulation

1. Introduction

The application of BIM, can help to realize the integration of the information architecture, from the architectural design, construction, operation, until the end of the building life cycle, all kinds of information integration in a 3d model always information database, the design team, the construction unit, construction operations and the owner and all staff can be based on BIM work together, to avoid the existence of information island, improve efficiency, save resources, reduce cost, achieve the goal of green science and technology and building integration.

2. Practical application of BIM technology

At present, BIM is mainly limited to architecture and structure, and many powerful functions have not been realized. In addition, BIM software localization group lacks resources; It is only limited to the design stage and has not realized the integrated management of the whole life cycle of the building. In the field of geotechnical engineering investigation, the engineering geological data of the underground space of the construction site can be provided by means of drilling, and the results of the investigation
are mostly shown in two-dimensional drawings\textsuperscript{[1]}.

How to integrate the engineering geological information of the underground space of the building site with its superstructure by means of modeling to realize the collaborative cooperation of multi-specialty BIM is a subject worthy of research. Therefore, based on an in-depth understanding of the BIM concept, this paper USES the related ideas of three-dimensional geological modeling, BIM technology and BIM software to conduct preliminary application research on the three-dimensional visualization of geotechnical engineering survey results.

2.1. Applications of BIM and three-dimensional geological modeling in the field of architecture

The building information model of BIM is mainly the modeling of buildings, while the application of BIM technology in geotechnical engineering survey is mainly reflected in the three-dimensional visualization of geotechnical engineering survey results, and works in collaboration with the construction, structure and other majors. In a broad sense, the three-dimensional visualization of geotechnical engineering survey results belongs to the category of three-dimensional geological modeling\textsuperscript{[2-4]}.

![Figure 1. Application of BIM in geotechnical engineering -- profile](image)

So-called 3 d geological modeling, as shown in figure 1, in all kinds of raw data, including drilling, section, seismic data, such as depth map, geological map, topographic map, geophysical data and geochemical data, engineering survey data, hydrological monitoring data, etc.) as the foundation, established can reflect geological structure form, the internal structure relations and geological properties change law of the digital model. Through appropriate visualization, the digital model can present the virtual real geological environment. More importantly, the model-based numerical simulation and spatial analysis can assist users to make scientific decisions and avoid risks.

2.2. Application of BIM technology in geotechnical engineering

In geotechnical engineering is an important application field of 3 d geological modeling, geotechnical engineering survey, design, and construction in the city, in the whole process of 3 d geological model can intuitively to geological and tectonic form show before planning designers and geotechnical engineers, convenient communication between engineering design and construction personnel, make its can accurately analyze the actual geological problems, to carry out the engineering design and construction, reduce project risks. Therefore, three-dimensional geological modeling has been paid
more and more attention by urban management, planning, construction departments and engineering construction units\(^5\). At present, a variety of 3d geological modeling software developed in combination with different majors have emerged at home and abroad, among which GOCAD, GeoMo3D, positive geological GIS and so on are relatively influential. Case of 3d geological model with CAD is shown as figure 2.

![Figure 2. Case of 3d geological model with CAD](image)

There is not much geological 3d simulation software for geotechnical engineering investigation, and the geological modeling and visualization analysis are not specific enough to meet the professional functional needs of engineering geology production and research. How to develop or utilize the existing BIM software technology, realize the coupling between three-dimensional engineering objects (structures) and three-dimensional strata, strengthen the expression ability of geotechnical engineering survey results, and add geotechnical engineering survey to the whole life cycle process of BIM is a topic worthy of research.

3. BIM software available in geotechnical engineering investigation

Generally, BIM software can be divided into the following two types : (1) BIM core modeling software, including architectural and structural design software, electromechanical and other system design software (such as Autodesk Revit series, Design Master, etc.); (2) BIM model-based analysis software, including structural analysis software (such as PKPM, SAP2000, etc.), construction progress management software (such as MS Project, Navisworks, etc.), in-depth design software for making and processing map Shop Drawing, budgeting software, equipment management software, visualization software, etc. At present, domestic units have independently developed independent three-dimensional geotechnical engineering survey information system, but lack of professional data exchange interface with the building, structure and other professionals, unable to work together. Using existing BIM software (such as Autodesk Revit, Civil3D, etc.) to visualize the 3d results of geotechnical engineering survey and work cooperatively with other specialties is a way to apply BIM technology in geotechnical engineering survey field. This paper tries to use Revit software to explore the possibility of this approach. 3d effect diagram of the pile foundation layout of the load bearing layer is shown as figure 3.
Figure 3. 3d effect diagram of the pile foundation layout of the load bearing layer

Software in Revit architecture of 3d modeling technology already quite mature, it get rid of the traditional three-dimensional modeling based on CAD platform of some complex operation, the main reason is that it has the function of strong API (Application Programming Interface, namely the application programming interface), Revit API provides access to Revit function, can realize the analysis and visualization application and building information model in Revit software integration, thus the user can according to their own needs to extend the functionality of Revit, Implement user customization of the model[6]. Revit API can be used for secondary development programming according to the requirements of three-dimensional visualization of geotechnical engineering survey results to improve the efficiency of three-dimensional geological modeling of geotechnical layer.

4. Conclusion

In summary, BIM is mainly limited to architecture and structure, and many powerful functions have not been realized. In addition, BIM software localization group lacks resources. How to integrate the engineering geological information of the underground space of the building site with its superstructure by means of modeling to realize the collaborative cooperation of multi-specialty BIM is a subject worthy of research. Therefore, based on an in-depth understanding of the BIM concept, this paper USES the related ideas of three-dimensional geological modeling, BIM technology and BIM software to conduct preliminary application research on the three-dimensional visualization of geotechnical engineering survey results.

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