The integration and application of BIM and GIS in modeling

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Abstract. Refinement, intelligence, and standardization are the core requirements of today’s urban construction management. From the current situation, it is impossible to meet the needs of future urban construction and management by relying on a single technology. The integration of GIS and BIM provides new opportunities for urban construction management. GIS provides a basic framework for the construction and management of today’s cities, and BIM provides an accurate information model of a single building for urban construction management. The integration of GIS and BIM will bring new ideas and methods to city construction and management. A large number of high-precision BIM models provide detailed building information for city management and provide richer information for the construction of city 3D models. Although the fusion research of GIS and BIM has clear directions and urgent needs, the fusion research work of the two is still in the initial and exploratory stage.

1. Introduction

At present, in the existing literature on the integrated modeling of geographic information systems and building information models, more emphasis is placed on the theoretical possibility of the integration of BIM and GIS data and the prospects for the prospects of related industries after integration, but few modeling and integration of actual buildings often leads to the end of this topic being only a piece of paper, which is of little significance to practice, and the integration with related industries is not very close.[1]

This study takes the establishment of No. 1, No. 2, No. 3 and No. 4 student apartments on the Xinpingwang campus of Shanxi Datong University as an example. The use of GIS (Geographic Information System) can perform functions such as geographic information analysis and query and BIM (Building Information Model) construction[2]. The model after the model has the characteristics of architectural engineering attributes, using AutoCAD 2006, ArcGIS Pro 2.2 and Revit 2014 and other tools to build the model of the student dormitory apartment. At the same time, this research also conducts a preliminary discussion on the combination of 3D GIS model and BIM model, and puts forward prospects for the application of integrated modeling of geographic information system and building information model in the construction of digital cities and even smart cities in the future.
2. **Modeling based on BIM technology**

2.1. *data preparation*

In Revit software, the data in DWG format can be read directly. When the data in CAD is loaded into Revit, it will be displayed in the form of points, lines, surfaces, etc. In the process of importing DWG data into Revit software, if the graphics are more complex, there may be recognition errors. At this time, you can return to the CAD software to simplify the plan and delete some unnecessary points, lines and surfaces. Ensure the smooth progress of the research without affecting the accuracy.

2.2. **Specific process of Revit modeling**

Revit modeling is based on real buildings in reality, and can display the detailed structure of the building. In the research, the importance of building components can be used to decide whether to model them. The following is an overview of the Revit modeling process.

Open the Revit 2014 software, click New Project, and then select the "Import CAD" option in the Import tab to import the plan of the dormitory building in DWG format downloaded in advance. Then open the "mass and site" tab in Revit, click the "topographic surface" option, and define the topographic surface in the site plane by picking up points and specifying the elevation of the point. Then click the "Building Floor" option, and add a building floor based on the closure drawn on the terrain surface. The creation of elevation plays a very important role in the subsequent overall building modeling, and can position the corresponding components of the model. Open the Revit project browser, open the "Elevation" view, and click the "Common" tab to add elevation. The student dormitory apartment is divided into 3 floors, so four elevations can be established, namely "site", "2nd floor", "3rd floor" and "roof". Open the "Site" layer, click the "Wall: Building" option under the "Building" tab, draw the wall according to the DWG format student apartment plan imported in advance, and set the height of the wall on the site to "4000". Click "3D View" after finishing to browse the 3D model of the wall on the site layer. Open the "1st floor" layer, click the "Floor" option under the "Building" tab, and draw the floor slab according to the previously created 1st floor wall. The elevation of the floor is "2 floors", and click "3D view" when finished, Browse and complete the three-dimensional model of the first floor wall and floor. According to the operation of the first two
steps, draw walls and floors on each layer according to the floor plan in DWG format imported in advance. After completion, open the 3D view to browse the main building. Open the "Roof" layer, click the "Extrude Roof" option under the "Architecture" tab, select the roof range according to the imported DWG plan, and create an extruded roof based on the roof slope and other parameters. Because there is a dormer window on the roof of the student apartment, the dormer window also needs to be established. After completion, open the three-dimensional view for browsing. Finally, the building colors, doors, windows and other constructions are established and refined, and the results are as follows:

![Established BIM model](image)

Figure 2. Established BIM model

3. Analysis based on GIS technology

3.1. data preparation

After completing the BIM modeling, the model needs to be imported into the GIS software for analysis. The basic data used still includes a topographic map around the apartment in DWG format and an attribute table of each component of the student apartment, as well as from Revit The student dormitory model in .rvt format exported from.

After completing the data import, click on the "Zoom to Layer" in the project browser on the left to display the student apartment model built with Revit software in the GIS scene. The model generated in the GIS scene has a better browsing effect, and the indoor scene of the building can be clearly seen through the window. However, due to the large number of components in the building model established by Revit, it is often stuck due to performance issues when displaying in the GIS scene. Take No. 1 dormitory building as an example. When it is opened in the Revit software, there are nearly thousands of graphic elements. Each graphic element contains many attributes about the component, and the amount of data is extremely large. Very demanding. Therefore, the building model needs to be simplified to improve performance, and the results are as follows:
3.2. Connect to excel sheet

In ArcGIS, adding an excel file to a layer cannot be displayed directly in the attribute table, and needs to be converted to a file format acceptable to GIS. Open the "Conversion" option under "Toolbox", click "Excle Transfer Table", and select the pre-prepared building attribute table in xls format for conversion. Select the building component whose attributes need to be displayed, right-click the corresponding layer in the project browser, and select the "Connect" option to connect to the newly converted attribute table. After finishing, click the component to display the attribute table of the component.

The built model can realize the following functions in GIS: In GIS, you can query the attributes of buildings. Click on the relevant components of the building model to directly view the attribute information of the model. For example, click on the No. 1 dormitory apartment to display the attribute information of the building. In GIS, a series of spatial analysis operations, such as through-view analysis, sunlight analysis, and visual field analysis, can also be performed on the model. You can also measure the length, height, and distance of the model through the measurement tools on the toolbar. Construction simulation, planning analysis, material statistics, cost budget, etc.
4. Conclusion
In recent years, with the development of science and technology, researchers have continued to deepen their research on geographic information systems[4]. However, when conventional surveying and mapping methods are used to obtain building information, only the outline and surface information of the building can be obtained. Information acquisition is very difficult, especially when collecting information on furniture and other interior components, not only is the workload huge, but it is also very difficult.[5] This also makes it difficult to produce three-dimensional architectural models in the construction of digital cities, but in order to manage the city more intelligently, the model construction of urban buildings must be more refined and standardized. And BIM happens to be good at refined modeling, so the integrated modeling of GIS and BIM was put on the agenda.

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