The application of BIM technology in the construction of three dimensional digital city

Yan Xiao*

Department of Management, Chongqing Technology and Business University, Chongqing 400067, China

*Corresponding Author email: xiaoyan@ctbu.edu.cn

Abstract. This paper focuses on the application of BIM technology in the construction of 3D digital city. Digital architecture, as the basic unit of digital city, is an important part of the process of urban informatization. With the development of science and technology, people have put forward higher requirements for the three-dimensional model of digital city. This paper first introduces the current digital urban engineering, and the hot spot in the construction of digital city (3DCM). Then it lists the traditional modeling method of 3D city model, and points out that the traditional modeling method has a large amount of modeling engineering, and the quality of the model is not enough.BIM, as the beginning of digital city, brings vitality to digital cities. Based on the deficiencies in the current digital city construction, this paper expounds the two ways of combining BIM with digital city, and probes into the BIM in architectural planning. Then it introduces the revolutionary technology of the engineering field information - BIM, and demonstrates the feasibility of applying the BIM technology to the 3D city model with the technical features of the BIM.

1. Introduction

First of all, we introduce the background of this study. At present, digital city is the focus of urban informatization construction. Many cities have invested great enthusiasm and efforts pool and achieved good results[1]. At present, digital city is the focus of urban informatization construction. Many cities have invested great enthusiasm and efforts pool and achieved good results. Using modern digitalization to manage cities, we first need to establish realistic and accurate 3D urban landscapes[2]. BIM is the foundation of the related information data of the construction project, and the building model is built, and the real information of the building is simulated by the digital information[3]. As an important part of the city, digital architecture has become an important part of the construction of three-dimensional digital city[4]. At the same time, the construction of digital cities in China is also in full swing. The construction of digital urban geospatial framework promoted by the National Geographic Information Bureau has been carried out in 220 cities of 29 provinces, autonomous regions and municipalities directly under the central government.

PIn the construction of three-dimensional digital city, the application of BIM technology needs to establish a special building information model system, analyze all kinds of data information, and make clear the structure of the building model. However, in the current digital city, the 3D building model is only the surface model of the building, which is divided into the interior space of the building and does not contain the various attributes of the building, which is used in the appearance of the three-dimensional architecture[5]. Since the construction of digital city is a huge and heavy systematic project, there is still a long way to go to digitally digitize the entities in the city. With the development of science and technology, people have put forward more and more demands on the 3D building model, so that more information can be added to the building to make the digital earth and digital city have the "soul".

Building information model (BIM, Building Information Model) is an engineering data model that contains all kinds of information of construction projects based on 3D technology[6]. Making it an independent building body, according to the local environmental characteristics and other factors, formulate a sound planning plan and improve work level. However, the emergence of BIM

technology can shorten the process of digitalization of urban entities, and improve the accuracy and quality of urban models.

2. Establish an advanced building information model system

This kind of model system is the basic content of the practical application of 3D technology, including the construction information, data model and so on, which can express the relevant work content in detail. The building information model is the engineering data model which contains various information of the construction project based on the 3D technology, which expresses the relevant information of the project in detail. Therefore, the data that needs to be processed is no longer limited to a limited number of buildings or a city district, but all the three-dimensional information that needs to be expressed throughout the city. It contains the geometric information pool of buildings, which contains physical properties and functional characteristics of building components and related project life cycle information.

BIM can provide a great advantage for designers. For the BIM technology, in practical application, the main functions include: breaking the limitation of the traditional building data model, no longer the simple element drawing of the point and line, but in the three-dimensional space, adjusting the structure model of the door and window and so on, and improving the reliability of the design work. Compared with existing 2DGIS, the amount of data will be increased by more than 100 times, but GIS itself is far from CAD and 3DMax in 3D data modeling and visualization.

Table 1 Text format at all levels under AlSC arsenic A

Name	Upper level sign	Node sign	Subnode name	Icon sign
Primary subnode	root	keyAISC	AlSC	BOOK
Two level sub node	keyAISC	keyAISC	AIS_ British system	BOOK
Three level sub node	AISC_US	Keyl_GONG	I_Profiles	BOOK
Four level sub node	Keyl_GONG	keyW	W	BOOK

According to the standard format shown in Table 1, all the nodes are entered in the Excel document, then the text document is imported, and then the text is read in turn by the Treeviewl.Nodes.Add function.

At present, some achievements have been achieved in the development of architecture design software in China. We can use BIM technology to introduce special software systems, such as ARCHICAD software system, SYSENS software system, PROJECT software system and so on. Therefore, many scholars combine the advantages of these systems to build the three-dimensional landscape model of the whole city, and use the model to manage the whole city's three-dimensional information, which is the beginning of the study of the three dimensional city model (3DCM). It is conducive to comprehensively improving the construction level of 3D digital city and optimizing the application mechanism of advanced technology, shown as figure 1.
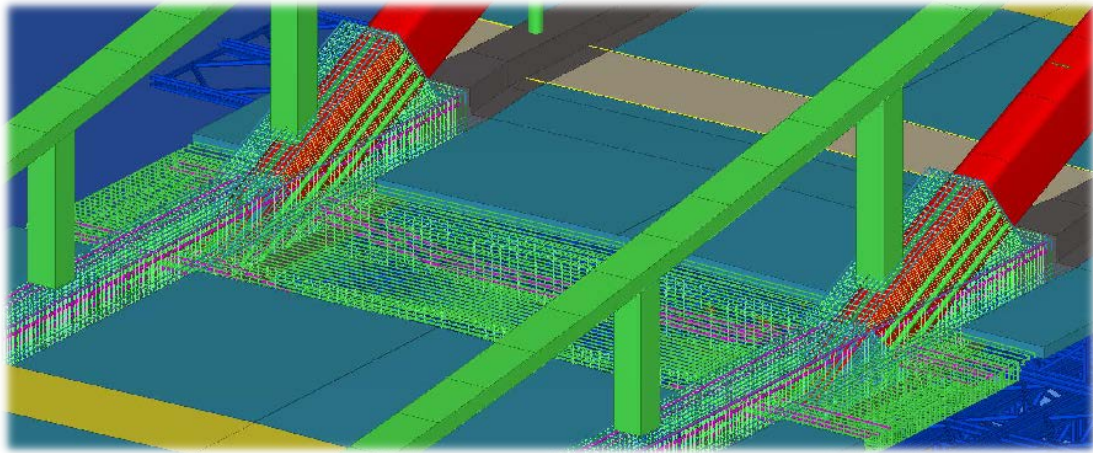
Figure 1 collision detection example: collision between prestress and steel arch

The object of IFC building is cfIis city site), cfIBiulidng (Architecture), cfIBuidlin Lang tJ to the floor), IcfCdum sigh column), cfIBae hehe beam), cfIsla sighting floor board), lcfwall (wall) well C standard, the space structure is divided into four levels, that is, site, building, floor and space. For the BIM system, in the process of applying this technology, the urban construction project team should follow the IAI technical standard, establish an advanced control system, clear the requirements for the data exchange of the building structure, and improve the various work systems. Their relationships are shown in Figure 2.
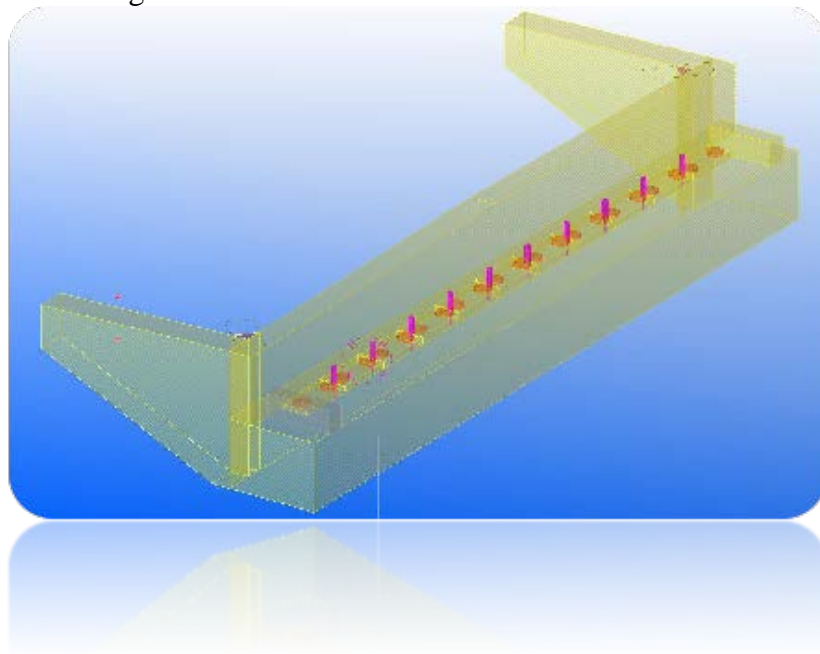

Figure 2 IFC relationships among the main objects in the architecture field

In theory, a virtual building engineering model includes more site models, and each site model includes different architectural models, such as floor structure, component structure, and so on. In practical applications, factory projects usually contain several building structures, or they contain no floor structural components directly contained in buildings. Therefore, in the process of applying the related technology, we should analyze the various models of the virtual structure, understand the requirements and characteristics of the actual work, establish a special management mechanism, and gradually improve the efficiency of the work.

The main steps of the interest rate process are to create, manage, use, distribute and share, and the main process of maintenance and storage of the product life cycle information is constructed, distributed and shared. PLM is a group of collaborative solutions that include complete technology,

organization and process, and these elements are based on the same elements in the construction engineering management, and the corresponding basis for both PLM and BLM is analyzed in Table 2.

Table 2 PLM and the corresponding basis of BLM

	The main content of PLM	The corresponding basis of BLM
technology	The main functions of the PLM system	A subsystem or application that has been applied
	Electronic warehouse management	Document management
	Document management	CAD
	Product structure and configuration management	Progress control software
	Spare parts management	Communication and collaboration platform
	Process change management	Other project management software, such as contracts, materials
	Engineering flow management	Engineering flow management
	Project planning management	Set up (property) management system
	PLM integrates with CAD/CAM, ERP, SCM (Supply Chain Management, supply chain management).	Some integration has been carried out, such as document management and communication and collaboration platform integration, project management integrated system.
organization	The core group of the project organization is responsible for the entire life cycle of the product.	Owner team
	Integrated product development organization (IPT, Intergrated Product Team)	Design team
	Establishment and management of organization for processing and assembling collaborative work	Construction team and design and Construction Group
	Customer service and support team	Facility (property) management team
		But there is a lack of core team responsible for the whole life cycle.
process	Process definition and process reengineering (integration)	Process analysis and optimization
	Optimal practices, such as PACE and CMII	Process management and workflow management
	Process management and workflow management concurrent engineering	The parallelism of the design process

3. The application of BIM technology in the construction of three-dimensional digital city.

BIM data is applied to the construction of 3D digital city. During the construction of 3D digital city, direct construction and indirect construction should be used rationally. (1) directly using the IFC parser to directly apply the building model data to the construction of digital cities; secondly, the indirect way is to convert the IFC building information model into CityGML data and then use the ictyGML data in the digital city, shown as figure 3.
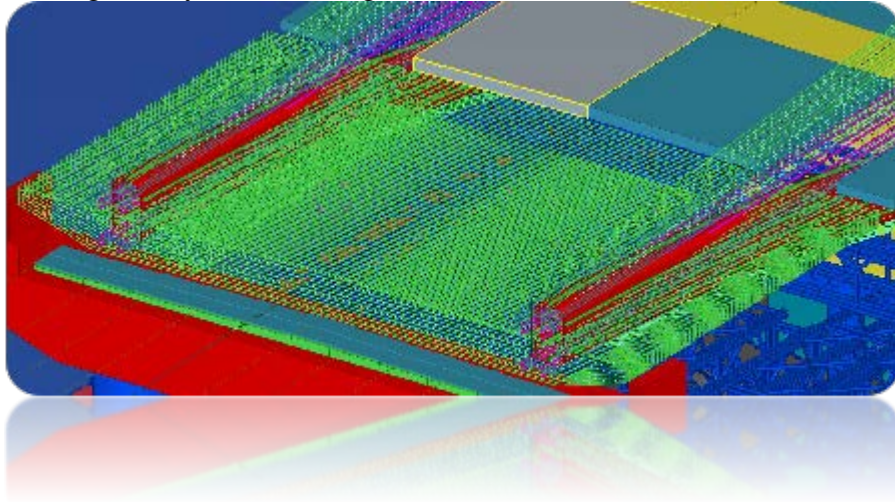

Figure 3 collision detection example: collision between steel bar and steel arch

3.1 Direct method analysis

They think that if we want to roam inside the building in WorldWind, we need to use the 3D building roaming system platform. On the basis of building a three-dimensional geographic information browsing platform, combined with the modern GIS technology and BIM technology, the actual work situation is analyzed, and a special data platform for building roaming system is set up. Under the condition that all kinds of systems connect with each other, all kinds of platforms are switched to exchange macro and micro data.

The two platforms communicate by sharing the location of the geospatial space, that is, for any location in the 3D building roaming system in the WorldWind platform, it can find a geographical location corresponding to it. During the operation of the data platform, it is beneficial to obtain the data of altitude, climate, geography and so on, and discover the hidden danger of earthquake construction in time, so as to take effective measures to eliminate hidden dangers and improve its work efficiency.

3.2 The application of indirect method

CityGML (City Geography Markup Language city geographic markup language) is a general information model used to express and transmit three dimensional objects in the city. It is the latest open standard for urban modeling. It is mainly to use the management form of urban geographical markers to establish a special model of data transmission, and to open management of the modeling work according to the relevant requirements, and gradually improve the work efficiency. The standard is derived from the field of Geographic Information Science, which is used to store and exchange 3D models of virtual cities.

GML defines roads, buildings, water bodies, vegetation and greenbelts. GML data can fully define the actual situation of urban plants and green space, describe them in detail, on the basis of detailed analysis of various data, to improve the reliability of work, and to analyze and control all kinds of detail data, and gradually enhance the accuracy of work. Therefore, it is necessary to be compatible with accurate and detailed data provided by IFC in GML. This requires the use of open source BIM software, shown as figure 4.
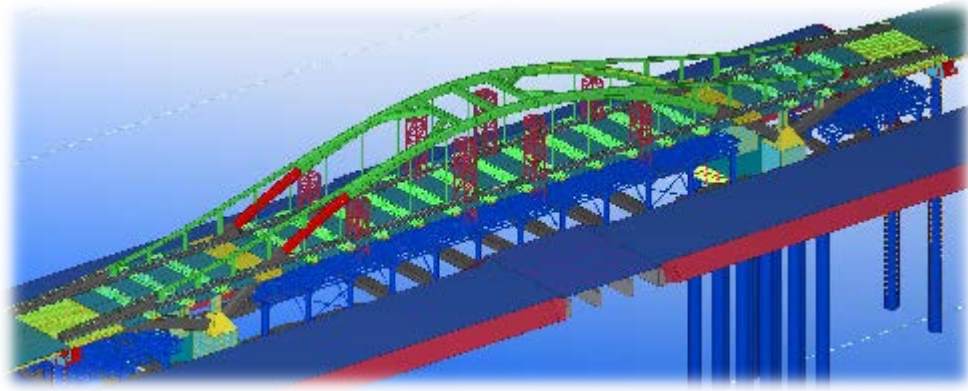
Figure. 4 example of accurate engineering volume statistics: sub contract settlement of steel structure specialty

4. The application of BIM in Digital City

4.1 3D City Modeling

The establishment of three dimensional city can provide people with all kinds of realistic scene information about the city in all directions and intuitively, and can enter the city in the virtual environment, feel the similar experience with the field observation, and can express the three-dimensional space information vividly and vividly. The types of urban buildings are different in size, shape, color and texture. Every city has its own characteristics in its development, such as its shape characteristics. Therefore, in the process of designing the three-dimensional model of the city, the management of the shape and size should be done well, the color and texture of the city are clearly defined, and the "aeronautical measurement technology + ground photography" should be used reasonably to improve the effectiveness of the modeling work. And through the BIM River, you can get the precise height, appearance size and indoor space information of the building easily. So by integrating BIM and GIS, building information model software is used to model the building, and then the building space information is shared with the surrounding environment to greatly reduce the cost of space information.

4.2 Municipal modeling measures

Through the fusion of BIM and GIS, three-dimensional modeling of internal and external pipelines can be effectively carried out and the heat conduction route of heating in winter can be simulated to detect the influence of heat energy on the pipeline nearby. After establishing the relevant model, we should analyze the requirements of the installation of the municipal pipeline, clear the actual situation of the heat conduction route, analyze the actual situation of the pipeline by using the advanced testing technology, find the problem of pipeline rupture in time, and take effective measures to solve the problem.

4. Conclusion

Through the integration of BIM data and 3DCM data, the construction of 3D city model is realized. At present, BIM is a new technology, and the data source is less. With the popularization and application of BIM, the integration of BIM and GIS technology will inject new vitality and vitality into the construction and development of 3D digital city.

References

[1] Nsabimana A, Lai J, Li S, et al. Surfactant-free synthesis of three-dimensional nitrogen-doped hierarchically porous carbon and its application as an electrode modification material for simultaneous sensing of ascorbic acid, dopamine and uric acid[J]. Analyst, 2017, 142(3):478.

[2] Amirebrahimi S, Rajabifard A, Mendis P, et al. A framework for a microscale flood damage assessment and visualization for a building using BIMâ "GIS integration[J]. International Journal of Digital Earth, 2016, 9(4):363-386.

[3] Chi H L, Wang X, Jiao Y. BIM-Enabled Structural Design: Impacts and Future Developments in Structural Modelling, Analysis and Optimisation Processes[J]. Archives of Computational Methods in Engineering, 2015, 22(1):135-151.

[4] Usluogullari O F, Temugan A, Duman E S. Comparison of slope stabilization methods by three-dimensional finite element analysis[J]. Natural Hazards, 2016, 81(2):1027-1050.

[5] Atazadeh B, Kalantari M, Rajabifard A, et al. Extending a BIM-based data model to support 3D digital management of complex ownership spaces[J]. International Journal of Geographical Information Science, 2017, 31(3):499-522.

[6] Zhao Y, Long Q. Multiple imputation in the presence of high-dimensional data[J]. Statistical Methods in Medical Research, 2016, 25(5):2021.