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Application of BIM technology used in the urban bridge design

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Abstract. BIM technology is a new technology that is at the forefront of research in the field of civil engineering, and has been preliminarily applied in the design stage of infrastructure. However, BIM software design professionals are not widely used in China, and projects that use BIM to design urban bridges are still relatively rare. This paper is the analysis of existing cases of urban Bridges designed based on BIM related software. The methods and steps of using BIM related software for design are summarized. It is concluded that BIM technology can play a role in improving and enhancing the 2D design results in the design of urban Bridges, improve the efficiency of bridge design, and pave the way for the subsequent construction stage and operation and maintenance stage. Through the analysis of the application of BIM in urban Bridges, this paper provides basis and reference for the design projects of urban Bridges in the future.

Keywords: BIM technology, urban bridge, bridge design.

1. Introduction

BIM technology is a new technology that is in the forefront of engineering research, and has been preliminarily applied in the design stage of housing construction, bridges and tunnels. BIM technology provides a platform for all project participants to communicate with each other and exchange information. It is not only an information transmission tool, but also a technology that combines engineering projects with information technology [1-2]. In the 21st century, China gradually began to use BIM in the construction industry, establishing its own BIM research center and acquiring related BIM software. Since then, the application of BIM technology in China has gradually developed and gradually matured. In recent years, with the rapid development of urban bridge construction, BIM technology has gradually been successfully applied in bridge engineering projects. Zhou [3] analyzed the design stage of municipal interchange project based on BIM. Li et al. [4] explained the three-dimensional visual display of the bridge disease model. Lian [5] studied the application of BIM technology in bridge design based on Bentley platform. In this paper, the steps and methods of using BIM technology in urban bridge design are described in detail. Combined with practical application cases, the application of BIM technology in urban bridge design is analyzed, and the advantages and disadvantages of using relevant BIM software for bridge BIM design are summarized.

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2. BIM based urban bridge design process

2.1. Appearance modelling scheme

Through the fine modelling of the project, the established model can convert the 2D drawings into 3D models, so that the owner can intuitively understand the appearance of the project, and through the simulation of the construction project, the bidding unit can more intuitively observe the construction site and building layout, which facilitates the bidding and bidding of the project and puts forward opinions on the project more conveniently. At the same time, the designer can also find out the more difficult problems in cad design and solve it in time. Based on the model of bridge contour modeling, the construction of bridge construction of the construction of the construction of the bridge construction of the BIM form is provided, and the height of the connecting piece and the beam of the beam is not able to be embodied in the drawing, and the modelling of the BIM form can be fully embodied, which is good for the construction of the factory. The BIM software Revit is used as an example. Revit can be used to build urban bridge models, and the conversion between 2D models and 3D models can be easily formed. Using Revit to build a bridge model, the family needs to be drawn first. A family in Revit is a set of primitives containing the parameters set of the corresponding components of a bridge and the related graphical representation. For example, the main bridge is a concrete-filled steel tube arch bridge with tie bars, and the approach bridge is a prestressed concrete simply supported box girder bridge. Tied arch bridge is a kind of bridge that combines the advantages of arch and beam. It combines the two basic structural forms of arch and beam to bear loads together and give full play to the structural performance and combined function of beam bending and arch compression. Tied arch structure can be applied to various terrain, which is of great significance for the exploration of BIM landing technology [6]. The superstructure system of tied arch bridge generally includes arch rib, tie bar, cross beam and bridge panel, which can be divided according to the structure system in modelling. The building of this project component family cannot be achieved simply by using lofting commands, that is, different methods are used to model each part of the bridge.

2.1.1. Structural modelling. In the process of constructing the formation model, the parameters should be parameterized in synchronization, such as the length, height, width and the material and material used by the component. After the establishment of the family members, the parameters that need to be parameterized are annotated. The number of components can make the family members more adaptable in loading the project, provide the design personnel with a more simple way of operation, and make the use of BIM technical statistics more convenient when entering the construction stage, and provide a powerful foundation for the cost of the project.

The lower structure includes the abutment and the pile foundation and the bridge pier, because the shape is simpler, and the order of the sample command and the establishment of the hollow shape are used. First, a sample section is established on different facades, and then the superfluitied parts. This way is used to create the abutment and the pile foundation and the bridge pier, which are achieved to convert the 2d drawing into the real model.

2.1.2. Upper structure modelling. The upper structure usually includes the main beam, the beam and the arch rib, which contains the main arch tube, the plate, the abdominal bar. In the establishment of the main beam and the model of the beam, the model is modelled because the main beam and the structure of the beam are more complex. The first method is to model the use of Revit software directly, and in the process of the arch, the cad drawing is imported into the Revit software, which is parameterized, and this method creates the arch, the model of the abdominal bar and the tie bar is rougher, and it is generally not adopted in the case of the situation. The second method is to model the arch with dynamo. Parameterized by dynamo. The pilot is the axis of the arch axis, and then the curve is connected to the control point, the arch axis is built, and then the pipe section is created, and the arch line is created by the path of the arching axis, the arch rib is created, and the last import is imported into Revit. In addition, the corresponding coordinate points are connected after the dynamo guide to the index data, which can

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be used to create the abdominal bar, the flat and the tie model, and can avoid the problem of the position and the shear restriction of the pin bar in the Revit, and the efficiency is higher.

When modelling, two problems should be paid attention to. When building a table of people, the position relationship of the coordinate axis of the construction piece and the sample is noted. Because the cartographic instructions of the Revit software are not as accurate as the cad drawings, and if there is no construction of the coordinates of the group sample, it is easy to cause the various graphs in the components to match the drawings, but the disconnect between the graphical figure in the 3d view and the shape of the family component is caused. Second, a series of commands should be paid attention to, such as rotation, mirror image and array, simplify the modelling process and improve the efficiency of the work.

2.1.3. Attachment modelling. The attached structure is usually railings and road lines. The railings in the Revit menu bar are used to draw the bar path lines in the Revit menu bar, and the system follows the path. Rail effects are generated in the project. In the drawing of road lines, the first step is to create the road path by using the spline curve. Secondly, the outline of the joint and cross-sectional diagram is used to draw the outline of the fusion of the sample. Finally, Revit select the path and contour and create the entity shape. In the process of drawing. It is important to note that the failure of the shape failure may be the vertical metric profile of the reference point of the sample. Finally, the path and contour are selected and the entity shape can be created. In the process of drawing, it is important to note that the failure of the shape failure may be the vertical metric profile of the reference point of the sample.

2.2. Based on the engineering quantity of BIM

First, in the view table, the material from the detailed table is selected. Secondly, Revit selects the class of artifacts that need to be measured in the interface, and select the conventional model and the structure base category. Then Revit selects the selected fields in the interface, and the elements such as the family, name, volume, area, and total. Next, the selection of the interface is chosen, and then Revit selects the group for the first order, and then rank the name. Finally, the selection format is selected in the interface, and the total number of selected calculations is selected in the condition format of volume and surface product.

The accurate and effective engineering data obtained through the work of the bridge project can be used for the cost estimation of the proposed phase, thus the comparison and selection of the project, and the quantity of the engineering quantity can be used directly for the engineering quantity of the project before the construction and the quantity of the project after the construction. Through the detailed watch of the Revit software, it is very convenient to interact with the model, which can correspond to the model and the model.

3. Urban bridge design example analysis based on BIM

3.1. Project of Shanghai Xujiahui corridor

The main structure and ancillary facilities of the bridge were modelled by Autodesk Revit. The main steel beam adopts Tekla to create 3D model and issue 2D drawings. Lumion and Infraworks software was used to create effect display and roaming animation. Fuzor, Navisworks and other software were used for construction simulation [6].

The main steel structure of the corridor bridge is relatively complex, and the BIM design software TEKLA is used to carry out the forward design of the main structure. After the modeling is completed, as shown in Figure 1, this software can be used to carry out collision check and space size check, and use the 3D model to export construction drawings that can guide the construction, so as to realize the forward design of BIM.

The auxiliary design of the bridge is the pipeline of the corridor, and the auxiliary facilities are generated by family modeling, as shown in Figure 2. Modeling by Autodesk Revit can reasonably plan

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the pipeline layout, optimize the construction plan, and provide a basis for later operation and maintenance.

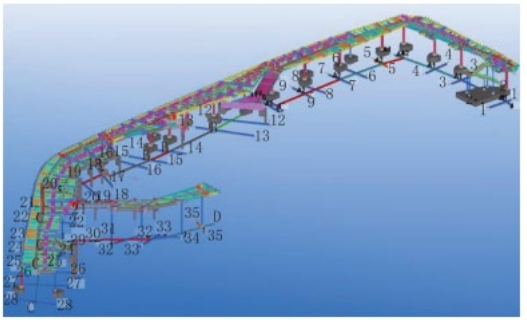


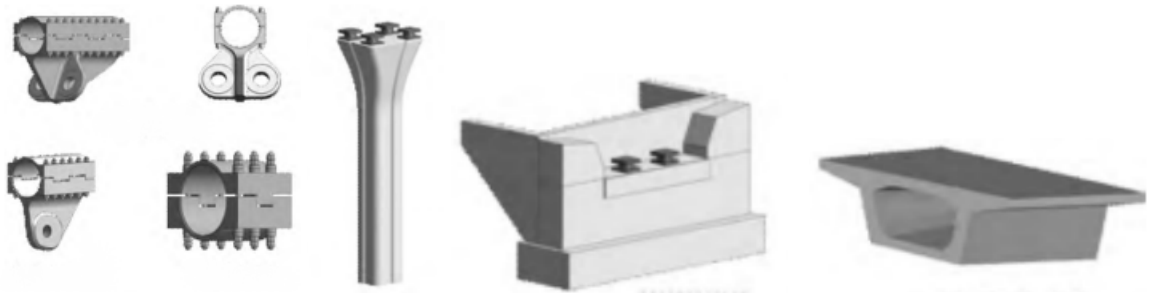
Figure 1. Bridge steel keel model [6].

Figure 2. Bridge pipeline and keel integration [6].

In the process of BIM forward design of Shanghai XuJiahui Air Corridor project, a variety of different BIM software is used to carry out the forward design of the project, which improves the design efficiency of the project, avoids many problems in two-dimensional drawing design, and explores the new possibilities of BIM in municipal Bridges.

3.2. Chongqing Hechuan Qujiang River Landscape Bridge project

BIM technology is introduced into the design of Qujiang River Landscape Bridge project in Chongqing Hechuan, that is, BIM positive design. This method completes the design of the bridge in a three-dimensional way, so that the bridge can be displayed in 3D mode during the design process, as shown in Figure 3, which enables the communication and decision-making in the construction process of the project to be carried out in a visual situation, avoiding many understanding errors caused by not understanding the project or reading the detailed drawings [7].



(a) (b) (c) (d)

Figure 3. Parameterization warehouse component. (a) Rope clip; (b) Pier; (c) Abutment; (d) Standard section of main beam [7].

For the components of surface modeling, the project uses GH software to construct the components, and then uses parametric interactive tools to exchange information to Autodesk Revit for modeling, while setting reinforcement, material, material and other information for the components.

The new technology of BIM+VR is adopted in the design process of the bridge, as shown in Figure 4, which can increase the implemensibility of the project and give early warning to the safety hazards that have not occurred in the project implementation process, so as to effectively avoid risks.

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(a) (b)

Figure 4. BIM and VR technology. (a) Cloud computing technology; (b) VR technology [7].

4. Analysis of advantages and disadvantages of BIM application

4.1. The advantages of BIM technology

BIM 3D modeling is simple and intuitive, clearly expressing the overall shape and local details of the bridge, and solving the complicated details design of the designer in the design process of 2D drawings, such as the placement of connectors and beams, the height of K-supports, etc. The errors in 2D drawings can be located accurately to reduce later design changes. BIM technology cannot only save costs in the design stage of a project, but also improve management efficiency for the downstream operation and maintenance personnel of project products with complete 3D models [8].

The application of BIM technology in the structural design of building construction can fine-control the time and space required by each step, make full use of virtual technology, effectively predict the specific direction of subsequent structural design adjustment, and ensure the implementation effect [9].Through the definition of different attributes and materials for different components in the BIM modeling process, Revit can calculate the amount of each component and various materials after the completion of the model, which provides an important basis for cost control in the later construction.

4.2. Shortcomings of BIM technology

(1) Revit is a BIM software mainly serving the construction industry. For Bridges, the application flexibility is poor, the content of the family library is insufficient, and a lot of manpower and time are needed to conduct the family component modeling.

(2) BIM technology has higher professional requirements for BIM practitioners. BIM application in the design period needs to transmit model information to other stages, so practitioners are required to understand and master the corresponding knowledge at each stage of the project and the application of BIM-related software [10].

5. Conclusion

The application of BIM technology is increasingly widespread, and it is recognized and supported by more and more designers and owners. This project combines BIM technology to carry out bridge design and project quantity statistics. In this paper, the steps and methods of using BIM technology in urban bridge design are described in detail. Combined with practical application cases, the application of BIM technology in urban bridge design is analyzed, and the advantages and disadvantages of using relevant BIM software for bridge BIM design are summarized, which are by using a series of BIM software of Autodesk to carry out bridge shape modeling, road modeling and preliminary preparation of construction cost, some design errors and misses are found and properly solved after communication with designers, reducing the possibility of later design changes. At present, the application of BIM technology in municipal affairs is not mature enough, and it is rare for designers to skillfully use BIM software. Although it takes a lot of time and effort to improve and promote this technology, it is still worth adhering to and implementing in the long run, especially when the design unit and the construction unit can actively apply BIM technology, its value is very considerable.

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