ISSN: 2414-1895 DOI: 10.6919/ICJE.202208_8(8).0121

Research on the Application of BIM Technology in Complex Curved Bridge Engineering

Yi Zhou

Southwest Jiaotong University Hope College, Chengdu 610000, China

Abstract

Building Information Modeling (BIM) is a tool for establishing a building model in a computer based on the corresponding information data of construction projects and construction projects. It can simulate the actual environment through digital information, and finally display it in the form of three-dimensional animation through the screen. Curve bridge engineering is different from architectural engineering. Bridge designers take into account both structure and aesthetics. They are both rigorous engineers and romantic artists. So there is a huge amount of work in the design phase. The adjustment and optimization of the finite element calculation model during the design needs to be actually displayed in the drawing design. This process of fine-tuning requires repeated deliberation, often takes a lot of time, and is actually inefficient. If the design can be unified on a collaboratively designed BIM model, after modification and adjustment, the model can be used to automatically generate drawings, which will greatly improve design efficiency, reduce costs, and improve quality. The article introduces the advantages and application methods of this new technology in complicate curved bridge construction, and then explains in detail from the design stage and the construction stage, and discusses the key points of BIM technology application.

Keywords

BIM Technology; Curved Bridge Engineering; Application Research.

1. Introduction

With the progress of society and the development of cities, the rapid economic development is accompanied by a large number of population gathering in cities, which has caused huge pressure on urban traffic. Traditional ground roads, railways and other transportation facilities have gradually been unable to meet people's increasing demand for transportation facilities. Complex curve bridges came into being and became an effective way to solve the problem of traffic pressure in modern cities. In order to give full play to the advantages of complex curved bridges in solving traffic problems, urban viaducts have gradually formed a viaduct network system, and its traffic organization efficiency and traffic capacity directly affect the traffic conditions of the entire city. This requires that the production activities of construction enterprises should use engineering projects as the carrier to improve the technical quality management system of the enterprise, do a good job in the training of management technology and operational skills, handle the relationship between the enterprise and the project, and incorporate all employees of the enterprise into the quality management system. middle. Enterprise leaders should lead all employees to do quality and benefit activities, deeply study the main content of project quality management, apply scientific quality management methods, and improve project quality.

In recent years, informatization and digitalization have gradually penetrated into our lives. In order to conform to the development of the times, bridge construction has also ushered in the information age. BIM technology has made great contributions to the development of bridge construction. The

ISSN: 2414-1895 DOI: 10.6919/ICJE.202208_8(8).0121

application of BIM technology in bridge construction not only promotes the development of bridge construction, but also greatly improves the construction quality and construction efficiency of complex curved bridges.

2. Basic Theory of BIM Technology

2.1 The Connotation of BIM Technology

BIM technology is an important technical means to promote the development of the construction industry in the direction of information management. Based on the data information of construction projects, the digital information data is transmitted through the expression of the three-dimensional building information model. These information data have two characteristics: the three-dimensional model of the building information can store the geometric information of the building, the physical and chemical information, and the information of the building components. Functional information, etc., through this data information, information sharing and data transmission are carried out at various stages of the engineering project; the data and parameters of building information can be calculated and operated in different stages of the project, and can be adjusted in real time.

BIM technology has the following three core application values in construction engineering: First, it provides a database covering all construction information of construction projects, and uses BIM technology to build a three-dimensional database, narrowing the gap between the construction industry and the manufacturing industry, providing design units and The construction unit provides the basis for collaborative work, which can achieve the consistency and continuity of construction project information and promote the orderly progress of construction projects; the second is to provide a comprehensive collaborative management platform to integrate and integrate all complex data information involved in the project. management, and process complex and irregular data into intuitive, visualized, and organized information. During the implementation of specific projects, all participating units can easily and quickly obtain project engineering information, and can comprehensively and accurately Grasp the project situation and cooperate with the actual engineering problems to improve the construction efficiency; the third is the construction simulation. According to the data information of the building information model combined with the construction schedule plan, the construction process of the building can be simulated, and the full life cycle management of the building can be effectively realized.

2.2 Features of BIM Technology

BIM technology has many distinctive features, which can effectively combine the data information of construction projects, give full play to the characteristics of construction, make the construction process intuitive and clear, establish a standard technical application system, scientifically optimize the construction process, and then improve construction projects. quality. BIM technology has the following characteristics:

(1) BIM technology has the characteristics of visualization

In the traditional building construction process, the construction unit obtains building information by analyzing the construction drawings, and then uses professional space imagination to construct a three-dimensional model of the building, which requires high professional quality of construction personnel. BIM technology can directly display the information and data of the building in a three-dimensional form, visually and clearly display the spatial characteristics and data information of the construction project, and visualize the information of the construction project in the construction stage, effectively improving the quality and efficiency of the construction project. .

(2) BIM technology has the characteristics of coordination

Using the characteristics of the coordination of BIM technology, the data information of each stage of the construction project has a certain correlation, and the adjustment of some data information will also change the data information of other stages, effectively realizing the coordination between the various stages of the construction project. In actual engineering construction, using BIM technology,

ISSN: 2414-1895 DOI: 10.6919/ICJE.202208_8(8).0121

designers can edit the data information in the database to ensure that various data information can be linked and updated, and to achieve information coordination between participating units.

(3) BIM technology has the characteristics of simulation

BIM technology can simulate various technological processes of the construction process in the time dimension. In the planning stage of the building and the bidding process, the construction project is simulated, and the BIM technology can be used in the design process to scientifically simulate and analyze various technical indicators of the building. At the same time, the actual construction process is simulated based on the BIM building information model, thereby realizing scientific and rational construction.

(4) BIM technology has the characteristics of optimization

In construction projects, BIM technology can provide building-related information and optimized data information. The use of BIM technology can scientifically analyze factors such as time, data information, and complexity of construction projects at each stage, optimize the process flow of each stage to form a scientific construction plan, and then improve the construction quality of the building.

3. The Basic Theory of Curved Girder Bridge

The basic theory of the overall curve bridge can be divided into the following three categories:

(1) Longitudinal analysis theory: The curved bridge is analyzed as an elastic member concentrated at the axial centerline of the beam (assumed that the shear center and the centroid coincide), and can be divided into simple torsion theory and warpage according to whether the section warping is considered or not. The twist-torsion theory is applicable to the case where the span-to-width ratio is greater than 4.

(2) Lateral analysis theory: The spatial analysis of curved beams is approximately decomposed into longitudinal and transverse bridge directions by various methods. According to the lateral analysis theory, after the loads distributed on each longitudinal beam are obtained, the solution problem is transformed into the above. longitudinal analysis theory.

(3) Three-dimensional space analysis theory: The curved beam is not decomposed vertically and horizontally, but is directly analyzed as a three-dimensional space structure.

4. Research on the Application of BIM Technology in Complex Curved Bridge Engineering

There are many parametric design software in the field of BIM, such as Revit of series A, OpenRoads of series B and Catia of series C. The characteristics and advantages of each software are obvious. Revit benefits from the wide application of AutoCAD, which has a large user base and is easy to learn and easy to learn. The operating performance of OpenRoads software is high, and there are few people who master the software application. Catia software is difficult to operate, and is usually used for complex structures such as steel structures. In general, Revit has a relatively wide application in the field of transportation, but faced with road and bridge projects with large volumes and complex structures, it is also difficult to model efficiently and with high precision. provides an effective solution.

4.1 The Modeling Design of Complex Curved Bridges

This paper uses Excel, Dynamo and Revit software to realize the rapid creation of BIM models of curved bridges through the steps of bridge splitting - model classification - model creation - attribute addition - model integration. Among them, bridge splitting can be divided into bridge span structure, superstructure such as bearing, substructure such as bridge pier, abutment, foundation, and bridge deck pavement auxiliary facilities. The model classification is determined according to the characteristics of the bridge structure, and the method of creating conventional components with Revit as the main body and the method of creating special-shaped components that cooperate with

Excel, Dynamo and Revit are defined; the model creation is based on the creation of the bridge centerline, and an appropriate component family is selected. , through parameter addition and relative 3D coordinate position determination, the placement of different types of component families; attribute addition is based on the bridge component coding standard to achieve batch addition; model integration is to gather all elements of the model to ensure its comprehensive 3D view. exhibit.

4.2 The Creation of Bridge Centerline

Based on the secondary development plug-in of Civil 3D, obtain model data suitable for BIM, export highway engineering pile-by-pile coordinate table and curve report, divide each beam section of Huanghua Bridge in combination with road plane and longitudinal section, and extract relevant information of road centerline control points Stored in an Excel table, use Dynamo programming software to generate the 3D centerline of the bridge, and import it into Revit software.

4.3 The Creation of Bridge Component Family

Combined with the location and structural characteristics of some domestic bridges, main beam families can be created by means of contour families. The specific modeling ideas are as follows: select parameters such as beam height, top and bottom plate thickness, web thickness, flange width and thickness, create a contour family based on Revit, use Excel to obtain the contour size parameters of each section of the main beam, and combine the bridge centerline created by Dynamo , supplemented by slope superposition, head and tail angle calculation, expansion joint width setting, and automatic arrangement of T beams and box beams through lofting fusion to obtain the bridge superstructure.

Some bridge substructures are mainly composed of column piers, vase piers and pile foundations. In view of the same/similar characteristics of components, the rapid construction and preservation of similar components can be realized by selecting family template files - 3D model creation - parameter adding, in order to provide a convenient means for the subsequent creation of similar structural models.

For the auxiliary facilities of the bridge deck pavement, Revit is used to build the structural model to complete the fitting process of the information model, and Excel is used to set the step size, spacing, type and other information in advance, and then batch placement is realized through Dynamo.

5. Conclusion

BIM technology has made great contributions to the development of bridge construction. The application of BIM technology in bridge construction not only promotes the development of bridge construction, but also greatly improves the construction quality and construction efficiency of complex curved bridges. Applying BIM technology to the whole process of construction, from before construction, during construction to after construction, using BIM technology to control the quality of different construction stages can greatly reduce project quality problems and reduce accidents due to quality problems. The introduction of BIM technology in the construction process can not only expand the ideas of construction quality management, improve the information transmission method in construction quality control, but also improve the efficiency of construction management and construction quality control.

Acknowledgments

Thank you for the support of 2020 School-level Quality Engineering and Youth Research Project of Hope College of Southwest Jiaotong University(Project number: 2020033;Project Title: Research on the Application of BIM Technology in Complex Curved Bridge Engineering).

References

[1] Meina Zhang, Xuchang Jin. Research progress on performance-based seismic design of bridge structures.[J]. Journal of Liaoning Provincial Transportation College, 2012(03): 9-12.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202208_8(8).0121

[2] Fangyu Guo,Yelda Turkan, and Charles T.Jahren. Case Studies of BIM Practices within Mechanical Contractors.Construction Research Congress.2014:229-238.

[3] Lingtong He.The application status of BIM in the world[J]. Engineering Quality, 2013, 31(3).

[4] Guohui Yu.Stability Analysis of Urban Single-Column Pier Viaduct [D]. Guangzhou: Guangdong University of Technology, 2014, 19-44.

[5] Yongjie Pan, Xinxin Zhao, Xiaoguang Liu. Analysis and thinking on the application status of bridge BIM technology [J]. China Railway, 2017(12): 72-77.

[6] Hao Dai, Wen He. Research on parametric modeling method of water transportation engineering projects based on Revit [J]. Hong Kong Engineering Technology, 2018 (1): 52-55.

[7] Yinqiao Zhu. Research on BIM information management of steel bridges oriented to structural behavior [D]. Chengdu: Southwest Jiaotong University, 2018.