Application and Prospect of BIM Based Metal Structure in Water Conservancy and Hydropower Engineering

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Abstract. BIM technology is an effective method to realize the standardization and universal management of metal structure design, manufacturing, construction and installation, operation and maintenance. This paper expounds the related application and research of metal structure BIM technology in water conservancy and hydropower engineering, combined with the characteristics of metal structure equipment, analyzes the resource library construction of gate and hoequipment, CAD/CAE integrated application, digital handover and so on. Taking the requirements of hardware and software of BIM application as the starting point, this paper analyzes the problems in the process of BIM application, and expounds the application advantages of BIM cloud platform. Summarize and prospect from the whole process of design, manufacturing, installation, operation and maintenance, and explore the new mode of metal structure equipment management. The results show that this method can effectively improve the quality and efficiency and reduce the cost and risk.

Keywords: Metal structure; BIM technology; Digital handover; Cloud platform

1 Introduction

Metal structure in water conservancy and hydropower engineering of all kinds of equipment as the main operation of the late project maintenance subject, with diversity, activity, complexity and dispersion [1], engineering construction, design, manufacturing, construction, installation of each link of the whole process of equipment information resources, cause the equipment management is difficult, low management efficiency [2-4]. Building information model BIM (Building Information Modeling), was initially applied to a single industrial and construction industry and gradually extended to water conservancy and hydropower engineering, rail transit, aviation, machinery, electronics and other fields. It mainly provides three-dimensional digital information and model of the whole life cycle for engineering planning, design, construction, operation and maintenance stages, supports data cross-professional sharing and collaborative operation, and has the advantages of visualization, digitalization and intensification, and improves the production efficiency of design management. The

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technical characteristics of BIM play a huge role in solving the above problems [5-7]. BIM technology provides new design concepts, new design ideas and new design methods for hydraulic metal structures; Construction and management units can access data and information at any time, facilitate the construction, equipment installation and operation and maintenance, and realize the real value of the whole life cycle. This paper discusses the whole process of BIM in engineering design, manufacturing, installation, operation and maintenance, and explores a new model of water conservancy and hydropower metal structure equipment management and design. The results show that this method can effectively improve the quality and efficiency, while reducing the cost and risk.

2 BIM Technology Application

2.1 3D Digitization

With BIM technology as the data management and system design platform, the node authority and different design roles are assigned to each professional after the project approval [8]. The professional achievements are carried out at the same time in the same space, and the project progress can be grasped in real time. Through collision inspection, we can intuitively display the different positions and conflicting positions. It can timely check the leakage and fill the design scheme, reduce the professional repeated coordination work, greatly reduce the probability of errors in the early stage of the project, and provide a strong guarantee for the quality of the project.

And traditional design method is different professional designers in two-dimensional drawings between professional work, two-dimensional design can only use the plane and section expression design information, water conservancy and hydropower engineering size is generally more complex, it is difficult to show design results, it is easy to design personnel express their design intention and understand the deviation, each professional is easy to appear wrong, leakage, touch.

2.2 3D Digitization Drawing

3D model is the basic carrier of BIM model, and also the main content of the design stage [9]. In general, there are many water conservancy and hydropower engineering majors, so whether the project data organization level is clear directly affects the smooth completion of three-dimensional design tasks. First, the composition structure of the project should be analyzed, and the assembly document tree management should be carried out combined with the professional characteristics, the model level should be clarified, and the model organization planning should be carried out. According to the relationship between project category, design stage, professional level and partial project, establish the model organization structure of metal structure professional equipment. The BIM model construction diagram of generator layer of hydropower station is shown in Figure 1.

Fig. 1. BIM modeling diagram of generator layer

Gate and Sewage Barrier Database.

According to the structure of the gate, it can be divided into plane gate, arc gate, human type gate, etc.; according to the hole position of the gate, it can be divided into exposed top gate and submersible hole gate; according to the gate function of the gate, it can be divided into working gate, accident gate, access gate and so on.

Due to the gate form, summarizes the characteristics of all kinds of steel gate structure, the gate components classified, analysis of door blade and embedded parts structure and construction rules, the gate structure hierarchical, modular, construction, summarizes the universal framework and components at all levels, using 3d design platform, the gate individual components and frame parametric modeling, establish the underlying template library, and use database for data management application. Call single portal frame and base component template to quickly complete single portal modeling from bottom up. And customize the corresponding two-dimensional drawings, through the series of parameter template rapid assembly and complete the whole set of the construction design of the plane steel gate. After continuous application, the top-level template library of various types of steel gates is gradually enriched, and finally the serialization and parameterization of all steel gate types are realized.

According to the layout, the arc gate can be divided into roof type and submersible hole type, according to the arm form, and according to the arm form, straight arm and inclined arm, which is mainly composed of the blade, arm and hinge structure. Part of the bottom formwork is the same as the plane gate, and the frame template is more complex than the plane gate, which needs to introduce more Angle parameters. The sewage barrier is simpler than the gate form, and the template is similar.

Hoist and Closing Machine Equipment Database.

Hoist mainly has fixed hoist, trolley type hoist, bridge type hoist, one-way or two-way gate hoist, rotary crane, hydraulic hoist, etc. Hoist mainly includes lifting, walking, turning, hydraulic and other institutions, as well as frame and door frame struc-

ture, all belong to non-standard design, and many of the series standard products are mainly purchased from outsourcing manufacturers, such as motor, reducer, brake, etc.. Due to the differences in sample parameters of different brands, product parametric templates are established according to the main installation and appearance parameters of different brand series, and parameterized design table series and product database are formed, which are managed through a unified database. When updating the product parameters, just update the design table data. The structure template is consistently designed with the gate template.

3 The BIM Application Platform

BIM technology uses information data as the basis of the model to realize the information collaboration between various participants and different professions of water conservancy and hydropower projects, so as to guide the whole life cycle management of the project. The specific performance is: in the design stage, the realization of three-dimensional visualization, information technology, multi-specialty collaborative design, reduce the collision of different specialties, design changes, and combined with finite element calculation, to achieve design verification and optimization; In the construction stage, the implementation of construction simulation, construction schedule management, quality management, contract management and investment cost management; In the operation and maintenance stage, the whole life cycle management such as comprehensive model display, digital monitoring and management of dam safety, equipment asset management, and inspection management is realized.

3.1 Hardware and Software Environment

BIM platform software is the foundation of BIM application, and hardware and network are the basic architecture and architecture link of BIM application and operation. In order to realize BIM, we need to integrate hardware and software to consider decisions, and rationally use public resources such as network technology and cloud technology.

BIM technology has many available software, such as 3D design software AutodeskInventor, Catia, Solidworks, digital engineering collaborative design software Bentley, Microstation, etc.

BIM series software has high requirements for the performance of computer hardware. The decentralized software layout increases the burden of software management during the project coordination period. It mainly relies heavily on the inconvenient graphics workstations to participate in the collaborative operation, and cannot realize the remote collaboration, and cannot realize the digital display and delivery of remote terminals and mobile terminals.

The cloud platform uses centralized or distributed layout to structure the server on the network, relying on high-performance hardware equipment, underlying management software and centralized deployed application software, and provides an efficient shared hardware and software environment. The BIM series software is integrat-

ed in the cloud. The project participants enter the project collaboration environment through the authorization of the project manager in the cloud, use the BIM software with preset standardized project template, participate in the real-time collaborative work of the project, and get rid of the dependence on the software and hardware of the PC end. The BIM model construction diagram of the ball valve of hydropower station is shown in Figure 2. The cloud platform provides a standardized usage environment. All users who log in to the cloud will work together with the same version of BIM series software in the same environment, which can standardize the production activities.

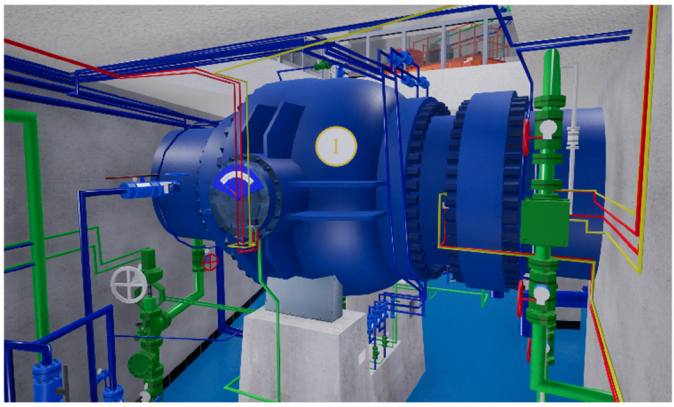

Fig. 2. Ball valve BIM modeling diagram

BIM data as one of the core technology data, compared with the traditional user data are stored in the local PC, the graphics workstation port is difficult to control, there are many ways to leak, its data security has great hidden dangers. Dedicated cloud platform terminal and data separation, the information storage to the cloud, in the cloud for the data processing including calculation, rendering, 3 d model, local terminal just display equipment, no local storage, all desktop data are centralized storage in the enterprise data center and set the storage strategy and access, so the cloud platform data more secure and stable.

3.2 Construction of BIM Dedicated Platform

Many IT vendors on the market for design enterprises give BIM cloud computing network application solutions mainly storage layer, management, application service layer, application interface layer and access layer as the infrastructure, relying on software and hardware suppliers support configuration in the cloud BIM application requires high performance graphics processing, data processing, storage equipment and related BIM software, through the network will IT infrastructure and cloud desktop application, realize the IT infrastructure, especially server resources sharing, all BIM data model and application, analysis of the results of the data focus on the server unified management. Cloud services are located on a personal PC, but do not rely on

the local main hardware resources, build a secure and stable working environment and provide efficient mobile BIM collaborative design support.

The current mainstream cloud platforms in the market are Alibaba, Huawei and Tencent. The basic functions of the mainstream BIM platform products are listed as table 1:

Table 1. Software and hardware of the systems

Hardware	network interface	GE interface, support for NCSI function, support for WOL and PXE
	Management module	Provide SOL, remote KVM, remote switch machine and other rich management functions
Software	cloud platform	Multiple BIM with concurrent user licenses
	Family library	Provide a thousand BIM family library files
	Think tank	Provide thousands of BIM smart data
	Independent management platform	Support the multi-user self-service application for the right to use the hardware resources
	Operation and maintenance mode	Provide unified hardware and software management through the Web
	Mobile access	Support for IOS, Android and other mobile terminal access

BIM dedicated cloud deployment type systematic engineering, including software, hardware, network and operation and maintenance management four elements. Administrators can flexibly adjust and allocate cloud server resources through the underlying software, deploy personalized software environments, and avoid bottlenecks in hardware and network aspects, otherwise it will waste resources.

3.3 Practical Application in Construction Phase

Water conservancy and hydropower projects have the advantages of large investment scale, strong professionalism, diversified structural forms, and multi-professional participation. The advanced simulation, calculation and 3D visualization digital model technology of BIM is used to establish a virtual simulation environment for the main body of engineering construction and construction structure. Use the simulated environment for intuitive "pre-construction" drill, and timely understand the operation sequence arrangement, construction difficulties and construction safety hazards in the construction process. In the formal construction process, according to the on-site feedback, timely detection and capture of dynamic changes in each stage can effectively avoid missing items, missing items, miscalculation and repeated measurement in engineering measurement, and improve the accuracy of investment cost. At the same time, the BIM model after design deepening and optimization can adopt the best

construction technology scheme, improve constructability and reduce unnecessary rework and material waste.

3.4 The Application of Operation Stage

BIM technology effectively integrates the information of different stages of manufacturing, design and construction, and is an effective support for digital operation and maintenance. Through the BIM 3D operation management platform, the real data in the real operation can be mapped to the virtual scene using the corresponding monitoring and sensing equipment, so as to achieve the functions of real-time data information broadcasting, dynamic picture visualization, remote and convenient operation and maintenance. At the same time, the use of BIM technology can carry out full-service and all-round intensive management, risk prediction and intelligent decision-making, and improve the level of digital health diagnosis of equipment.

As an emerging technology, BIM is not protected by any laws and regulations in the water conservancy and hydropower industry, and it also encounters many problems in its development. Therefore, in view of the above problems, the state should issue corresponding and perfect laws and regulations on the application of BIM technology in water conservancy and hydropower projects, so as to protect the use of the technology within the legal scope and provide a fair competition and healthy development environment for the construction of water conservancy and hydropower projects.

4 Conclusions

BIM technology is an effective method to realize the whole life cycle management of hydraulic metal structural engineering projects, which is mainly characterized by complex structure and customized demand. This paper studies the application of BIM technology in the whole life cycle management of metal structures of water conservancy and hydropower. Taking a pumped storage power station project as an example, the whole process management scheme of BIM technology in the stages of design, construction, operation and maintenance is introduced. The application results show that the method can effectively improve the quality and efficiency of the project, reduce the cost and risk of the project, and realize the digital operation and maintenance, which has an important reference value for the digital transformation and development of the industry.

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