Exploration of the Application Path of BIM Forward Design in EPC Projects

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Abstract. This paper firstly introduces the fit of BIM technology and EPC mode, and points out the impact of digital development on the construction industry, then analyzes the current situation of BIM forward design, including its development hindering factors and the current situation of mostly staying in the stage of design assistance and supplementation, and then discusses the advantages of BIM forward design compared with the traditional two-dimensional design, including the threedimensional visualization, the complete retention of data and information, and real-time The advantages of BIM forward design over traditional 2D design are discussed, including 3D visualization, complete retention of data information and real-time coordination. Based on the obstacles to the implementation of BIM forward design, it proposes the co-development of BIM forward design and EPC projects, and discusses a number of key issues such as selecting the BIM implementation of the same people, formulating the organizational structure of the design team, taking the standard family of components as the core, and advancing the transfer of design results to the downstream of the industrial chain, and finally initially forms the application path to realize BIM forward design.

Keywords. BIM, EPC, forward design, digitize

1. Introduction

In 2020, nine ministries and commissions, including the Ministry of Housing and Construction, jointly issued Several Opinions on Accelerating the Development of New Construction Industrialization, which pointed out that it is necessary to actively implement the general contracting mode and promote the deep integration of design, production and construction. In recent years, along with the EPC general contracting management mode application depth and breadth of the continuous improvement, the management of complex and diverse content, in the case of large-scale projects, project management coordination workload, design side of the control capacity is weak, the difficulty of cost control, the burden of risk, and so a series of problems have also come to the fore. Therefore, the EPC model also urgently need to seek strong technical means to help in the whole process of construction project management.

The idea of whole-life application advocated by BIM technology fits well with the characteristics of the whole-process project management mode of EPC general contracting projects, and is an effective tool and support for project management and improving risk resistance. BIM technology as the EPC model is a breakthrough to

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solve the existing problems of the two, and ultimately form a complementary, mutually beneficial, common development situation. 2021, the national "14th Five-Year Plan" outline will "accelerate the development of digitization, the construction of digital China" as a priority. In 2021, the national "Fourteenth Five-Year Plan" outline will "accelerate the development of digitalization and build a digital China" as the focus. In the construction industry, the transformation goal of "digital construction" is proposed, and BIM forward design is a key step in the construction industry's informationization and digital construction. How to promote BIM forward design in EPC projects, and its application path triggers people's thinking.

2. Current Status of BIM Forward Design

BIM forward design is not only through the BIM software to establish a BIM model for design, drawings, more critical lies in the multi-professional collaborative design, mutual information, proofreading, auditing, delivery, archiving, change, and even the design process of discussion, reporting, construction with the stage of the delivery, site inspection, and other full-process production mode of switching [1].

At present, there are many obstacles to the development of BIM forward design, for example, the main body of China's forward design is the design institute, and the direct beneficiaries are the construction side and the construction side, but the design institute needs to upgrade the computer hardware and talent, which increases the cost of production, but it is difficult to be the key beneficiaries of forward design [2]. Adopting a "post-BIM" interim solution for BIM technology to serve engineering design needs has become the status quo for most architectural design institutes in terms of BIM technology serving engineering design [3]. Therefore, the general practice of the industry is still stuck in the post-BIM state, the use of BIM modeling and visualization features, restore the completed construction drawings, through the three-dimensional characteristics of the model, check the design of the spatial and physical conflicts, and through the feedback of these conflicts or defects by the design team to make up for. So the current so-called BIM forward design is essentially a design aid and supplement [4].

3. BIM Forward Design Advantages

BIM construction drawing forward design is the reengineering of the traditional twodimensional design process, but also a change in the mode of thinking [5]. The implementation of BIM forward design is a necessary road from "Made in China" to "Created in China", BIM forward design lays the foundation for intelligent design and intelligent construction, and forward design is the purpose and ultimate goal of BIM [6].

Compared with the traditional two-dimensional design, BIM forward design has three major advantages: three-dimensional visualization, data information can be completely retained, and high real-time coordination [7], which can expose the traditional two-dimensional design problems in advance, and is conducive to the completion of the project design with high quality, while the BIM design results can be effectively transferred to the downstream of the industrial chain, which provides a key support for the implementation of the EPC model of the project. The EPC project is in accordance with the contract agreement on the engineering construction project design, procurement, construction, commissioning and other implementation of the whole process or a number of phases of contracting, usually the company in the lump-sum contract conditions, the contracted project quality, safety, cost and progress is responsible for, then this is for the distribution of benefits on this key issue, can effectively promote the BIM positive design landing.

4. Application Path of BIM Forward Design in EPC Projects

Design in the whole EPC project system in a key position, design management is also the most important management of the project, "design is the leader", the design stage determines the whole project life cycle of 80% of the cost and investment [8]. Therefore, based on the management advantages of EPC projects, it is especially important to establish the application system of BIM forward design in EPC projects.

4.1. Fellow Travelers for BIM Implementation

First of all, EPC projects need to select subcontracts with BIM practice capabilities, mainly including design and construction units. BIM forward design itself is in addition to the traditional design requirements, there is a part of the content of the construction needs of the front. The design unit should have the ability of BIM forward design, and the construction unit should have the ability to build based on BIM design results on the ground. Through the BIM forward design can indeed bring great value, but this is standing in the EPC whole process perspective, rather than just design or construction of a stage, if the construction unit does not cooperate, then the design of the positive design results will be difficult in the subsequent stage of the landing and continuation of the cost of the initial investment can not be converted to the cost of the latter part of the cost savings, and even more can not be practiced in the construction of high-quality.

The value of BIM positive design is directly realized mainly in the construction phase, but the workload is in the design phase. Compared with projects under the traditional model, projects under the EPC model have the natural advantage of reallocating time and cost, which will be conducive to the landing of BIM positive design.

4.2. Design Team Organization

Secondly, after determining the BIM implementation of the same people, focusing on the design team, compared with the traditional and reverse design of the organizational structure, the organizational structure of the forward design in the EPC mode as shown in figure 1, to be divided into professional designers, BIM coordination manager, drawing personnel and research and development personnel. Based on this organizational structure, the designer can complete the design itself efficiently, the BIM coordination manager is responsible for the collaboration among various professions, the technical problem solving of BIM 3D software and the coordination of docking the downstream units' requirements, etc., the drawing staff is responsible for the rapid drawing to cope with the current design drawing review system, and the R&D staff is responsible for solving the problem that the current BIM software cannot match the forward design requirements through secondary development, etc. The R&D staff is responsible for solving the problem that the current BIM software cannot match the forward design demand through secondary development.



Figure 1. Design team organization

The personnel organization structure, different from the traditional 2D design and BIM reverse design, introduces the drawing and R&D personnel, which is to ensure that the designers concentrate on BIM forward design and are not constrained by the current drawing review system. The introduction of drawing and R & D personnel is because the industry technology chain and industry chain is not mature, this is only a transitional means, the author believes that BIM forward design will eventually be realized, but also to ensure that the project life cycle of information technology and digital precision management.

4.3. Standard Family Components

BIM forward design and later application landing, family components is the core, it is the basic component unit of the BIM model, but also the basic carrier of data, for the same type and different types of construction projects, family components can be reused, as shown in figure 2. Practice has proved that many standardized sample documents in the past are unable to achieve full coverage of various types of projects, but the standardization of BIM model, most of which can be achieved by using the standardization of family components. Therefore, for EPC projects and enterprises, it is an effective way to realize project standardization to establish and continuously update and maintain their own standardized family library, and then call from it.



Figure 2. Example of a family component

4.4. Downstream Delivery of Design Results

In EPC projects, BIM forward design is not the end of the design stage, through the drawing review, but also need to better apply the design results in the procurement, construction stage, and some also need to the operation and maintenance stage, that is, the need to realize the "one model in the end". Compared with traditional design, BIM forward design will invest more cost, only by utilizing the high-quality design results in the early stage to guide the efficient construction in the later stage, and saving time, manpower, material and financial resources in the later stage, can we generate a virtuous cycle and further promote the application and development of BIM forward design in EPC projects.

After the BIM forward design, the data information has been structured, so the unique code of the family components in the project is the key to transfer the BIM forward design results to the downstream stage, and it is the "hook" linking the design BIM and construction BIM. Combined with the software used in BIM forward design, the unique code of project components is compiled, and the design results are stored independently using database technology. In the later stage of application, the general increase of non-geometric attribute information (such as location attributes, construction attributes, business attributes), this type of information can only be added in the database, that is, "number and model separation". Adopting the "digital model separation" technology not only provides the basis for prefabrication and processing of components and on-site installation in the later construction phase, but also enables managers to manage the implementation and landing of the project in a more orderly, refined and clear manner.

5. Conclusion

This paper discusses a number of key problem nodes, such as fellow travelers of BIM implementation, design team organization structure, standard family components, and transmission of design results to the downstream of the industrial chain, and forms an application path to realize BIM positive design.

Nowadays, it is the era of "digitalization", solving problems from the front-end of design and realizing efficient management based on BIM technology are the powerful hand of EPC projects to improve management efficiency, control project cost and enhance risk-resistant ability. We believe that in the future, BIM forward design will be realized, and at the same time, it can guarantee the accurate management of informationization and digitization of the whole life cycle of the project.

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