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Research on Multi-Professional Collaborative Design Based on P-BIM Cloud Platform

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Abstract

With the improvement of technical requirements and increasing technical complexity of construction projects, the importance of multi-professional collaborative design is also highlighted, which has become a research hotspot in the industry. Collaborative design under BIM scenario is the development trend of the industry. At present, multi-professional collaborative design is confronted with such problems as the failure of collaborative design to achieve real landing, low efficiency of architectural design, lack of collaborative platform and integrated management technology, the failure of large-scale data transfer on demand, and the failure of localization of architectural design. Based on this, a multi-specialty collaborative design cloud platform based on P-BIM theory is built: The model data and software involved in each stage of construction project are integrated. Through P-BIM data exchange interface, the model data are unified and standardized, and then transferred to relevant specialties on demand. P-BIM cloud platform can effectively solve the problem of multi-specialty collaborative design, lighten the model, realize on-demand delivery, and improve the efficiency of multi-specialty collaborative design.

Keywords

P-BIM cloud platform; Collaborative design; Data interactio.

1. INTRODUCTION

Researchers at home and abroad have carried out relevant researches on collaborative design based on BIM technology, mainly from the two aspects of BIM data interactive sharing and BIM collaborative design. In the interactive sharing of BIM data. He qinghua et al. studied the typical application cases of BIM in recent years, combined with 32 kinds of software, and made a detailed analysis on the information interaction of data between software in the design stage [4]. Through literature review, structured questionnaire survey, action learning, focus group discussion and E-mail survey, f.h.banda et al. conducted a comprehensive analysis of 122 BIM software, obtained the data interactive format of each software, and provided research ideas for interactive sharing of BIM data [5]. Based on IFC standards, zhou hongbo et al. solved the problem of data interaction and sharing between software by establishing BIM component database, providing new ideas for BIM technology collaborative design [6]. Zhang jianxin et al. deeply analyzed the obstacles of BIM technology in China's architectural design industry at the present stage, and put forward suggestions on local application and development [7].

In BIM collaborative design. Liu Y et al. identified eight factors affecting BIM collaborative design through thematic group discussions and interviews, and conducted detailed analysis to provide empirical insights for BIM collaborative design [8]. In the design stage, Ohm and other

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collaborators use different BIM software, resulting in data loss, communication difficulties and inefficiency. It is proposed that the integrated design system be realized through the combination of BIM Modeler, BIM Checker and BIM Server modules to improve the quality and efficiency of the design [9].Through the analysis of BIM technology collaborative design, Wang qiaowen et al. put forward two ways based on Revit platform, namely file link and work set, to conduct collaborative design of construction projects[10].Lai huahui et al. analyzed that different BIM software and platforms are used by different architectural engineering design majors, resulting in low efficiency of data interaction, and proposed the technology route of data interaction and sharing based on IFC standard [9]. Zhang dehai et al. used Revit series and Navisworks software to carry out collaborative design research. Combined with the sino-german energy conservation project of shenyang university of civil engineering and architecture, the results showed that collaborative design in BIM scenario could effectively improve the efficiency and quality of architectural engineering design and reduce the cost [2].Aiming at the shortcomings of traditional visual collaborative design, Yang qilin proposed to realize the visual collaborative design of construction projects based on Revit, Fuzor, Civil3D and Infraworks software. Taking the east third ring road station of the second phase of chengdu metro line 4 as an example, the method process was elaborated [12].

Although BIM collaborative design based on the IFC standard has made certain progress, but shared collaborative design and data interaction is not a software or a simple platform can achieve. There is still lack of a local BIM collaborative design software and model database that can adapt to China's national conditions and conform to the habits of domestic architects.

2. MAIN PROBLEMS IN THE DESIGN STAGE OF BIM TECHNOLOGY

Generally speaking, collaborative design in BIM context is the development trend of the industry, and BIM technology mainly has the following problems in the stage of architectural design:

(1) BIM technology collaborative design has not been truly implemented

According to statistics, more than 90% of BIM projects in the industry are carried out after the completion of traditional 2D design drawings, and the intervention of 3D BIM design is often lagging behind [13].This is mainly because it usually takes a lot of time to directly use BIM software for design. Under the existing project development mode, the client leaves less time for the design institute. In order to quickly obtain the construction permit for construction, the 2D first and then 3D method can only be adopted. In the design stage, BIM technology only performs the inspection and visual display of "mistakes, leaks, collisions and defects" [14].

(2) Inefficient architectural design

Currently, the transfer of BIM data basically depends on IFC format. In theory, IFC basically meets the data requirements of architectural engineering design, but the IFC standard system is large and the integration of application relationships are complex, so it cannot automatically call the model information to determine the accuracy. In practical applications, software vendors used their own databases to connect with the platform. The databases were not built in accordance with IFC standard format, which resulted in information loss and errors in IFC file transfer of different software [15].Moreover, there is no good data transmission channel between different majors, forming an "Information Island", which leads to a lot of repetitive work between majors or departments, such as model reconstruction and data re-entry.

(3)Lack of appropriate collaboration platform and integrated management technology

Currently, collaborative design of BIM technology is mainly based on Revit series software, which is implemented by Architecture, MEP and Structure through file link and working set.

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With the increase of model data, the data interaction efficiency of Revit also decreases, component information is lost, and there is a lack of an appropriate collaboration platform and integrated management technology [16].

(4) The model data is too large to be delivered on demand

The realization of lightweight model is an important condition for BIM data interaction and sharing [17]. The data transfer of BIM software is usually based on IFC standard. The complete sub-model of IFC, which pays attention to one-off delivery, is complex, computational and spatial complexity, and inefficient in transmission. It is difficult to support the collaborative work of high-density data interaction modes of multi-participants. In fact, in the process of collaborative design based on BIM technology, according to the differences of architecture, structure, electromechanical and other specialties and design stages, the demand for relevant data is different. Therefore, it is necessary to transfer data on demand for each design stage.

(5) At the design stage, BIM collaborative design fails to achieve localization

At present, although collaborative design based on BIM technology has made some progress, it is basically based on foreign Revit, Architecture, ArchiCAD, Tekla, Caitia, Rhino and other software using IFC data format, which does not meet the domestic standard specifications and design habits. However, Tianzheng, PKPM, Yingjianke, Guangxia, Lizheng, Haochen, Hongye and other software are used in the domestic architectural design, but few studies are based on the domestic collaborative design of software architecture.

3. METHODOLOGY

Above all, although BIM has made some progress in building collaborative design, there are still some serious problems that need to be solved urgently, such as collaborative design not landing, inefficient building design, huge model data, and localization not being realized. A series of standard specifications, software and platforms are needed to make BIM collaborative design develop better. And application. Based on this, this paper proposes a P-BIM cloud platform for multi-specialty collaborative design based on P-BIM theory, which conforms to domestic standards and design habits, and provides a new solution for BIM collaborative design.

The P-BIM mode mainly includes three parts: P-BIM database, P-BIM software and information exchange mode. With P-BIM content as the shared database, P-BIM software can share information among P-BIM software through P-BIM software information exchange standard, breaking the information island among different professions. Based on the theory of P-BIM, this paper builds a P-BIM cloud platform to study the applicability of BIM collaborative design.

3.1. Working Process Framework of P-BIM Cloud Platform

The establishment of P-BIM cloud platform runs through the whole life cycle of the construction project and consists of six parts, as shown in figure 1. By analyzing the application of BIM in every stage of a project, the BIM data generated and the BIM software involved, the purpose is to integrate the required software and data information. Finally, through the P-BIM data exchange interface, the information and model are standardized and unified, and transmitted to the project participants on demand. In order to better serve the engineering project, the second processing of engineering information is carried out. This paper is mainly based on the P-BIM cloud platform to carry out collaborative design research of architecture, structure and electromechanical specialty, as shown in figure 2. Before establishing the model, three professional stakeholders communicate fully in advance, put forward the data needs of all parties, and set up information filtering in the data exchange interface. The designer first invokes the P-BIM standard database required by the corresponding specialty from the P-BIM cloud platform, and carries out the modeling work for each specialty. Secondly, the collision

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model is checked, and the collision results are fed back to the professional modifications. Finally, the data is output through the P-BIM data exchange interface, and the professions are downloaded on demand through the P-BIM client.

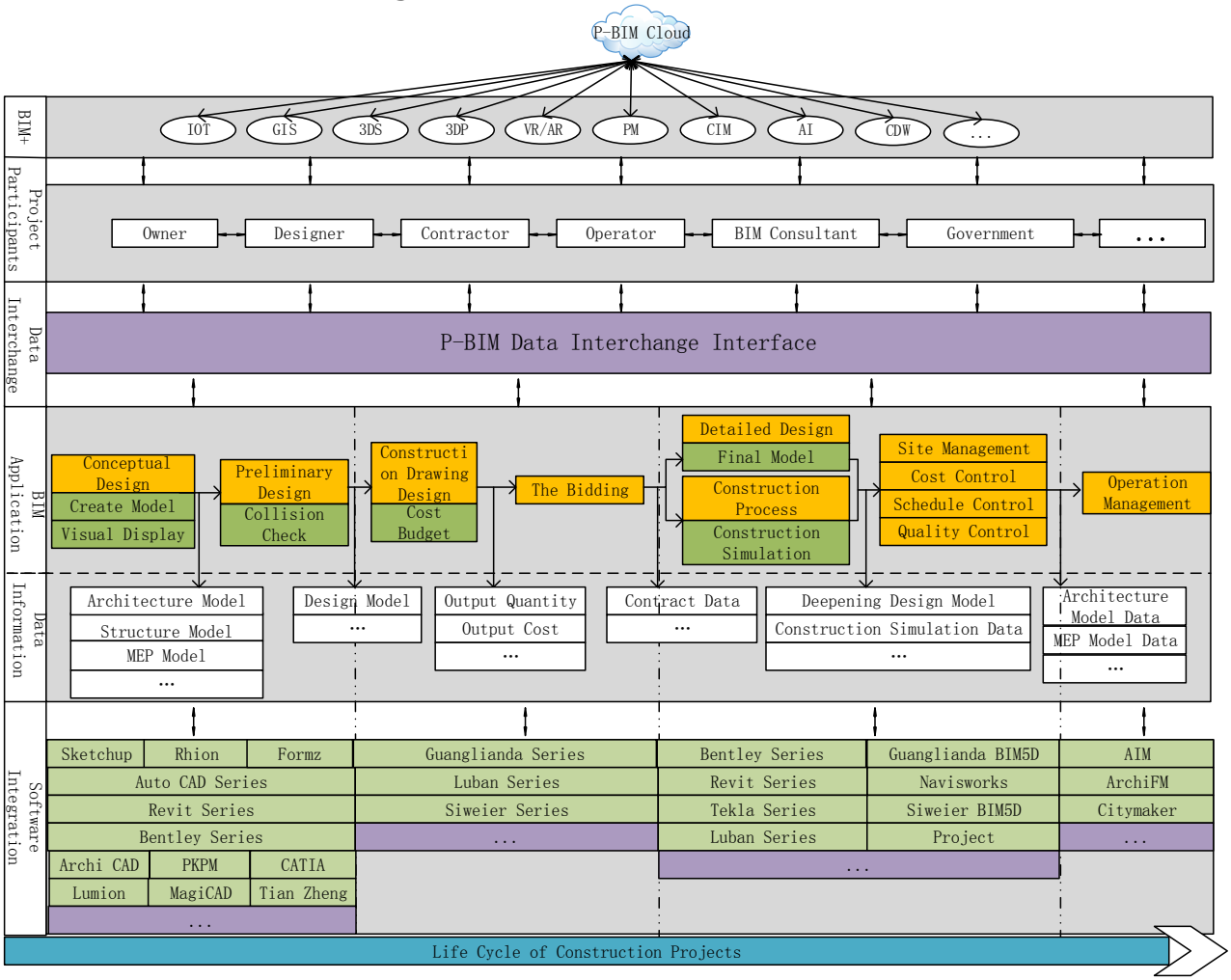

Figure 1. P-BIM Lifecycle Cloud Platform

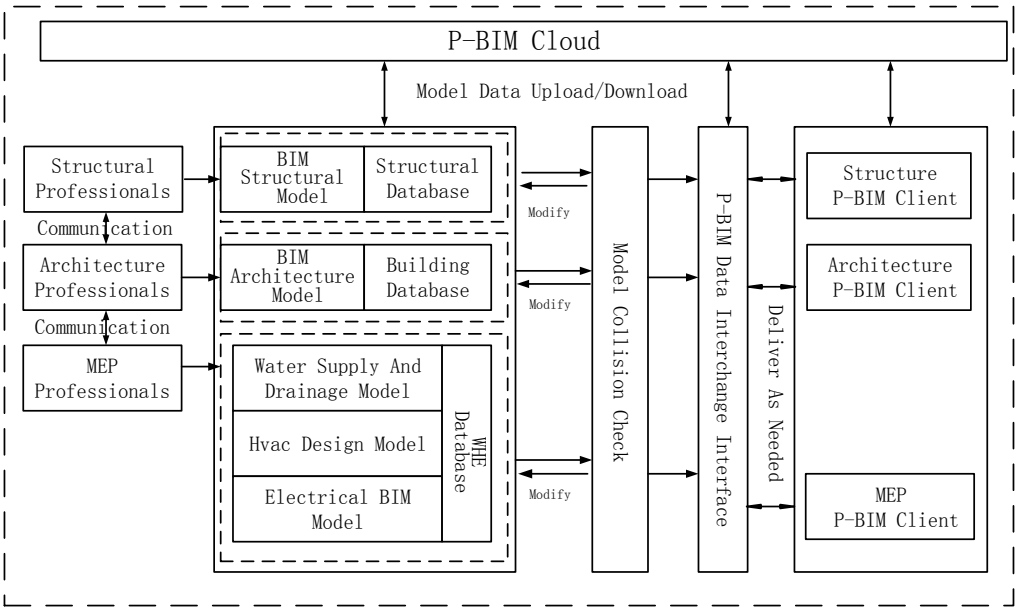

Figure 2. Data Interaction Flow Chart

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3.2 Establishment of P-BIM Cloud Platform

(1) Standards for building P-BIM cloud platform

The P-BIM standard is based on the concept of "P-BIM" of China BIM Development Alliance. It forms a BIM application standard system in line with China's engineering practice, together with national standards such as "Classification and Coding Standard for Information Model of Construction Engineering Design", "Unified Standard for Application of Information Model of Construction Engineering", "Construction Application Standard for Construction Information Model".

(2) Software for building P-BIM Cloud Platform

P-BIM cloud platform includes P-BIM cloud, a series of P-BIM architectural design software and P-BIM client. P-BIM cloud, which is used to upload or receive model data, is a virtual storage platform for P-BIM database. P-BIM Architectural Design Software refers to the integration of the original architectural design software through P-BIM cloud platform, providing P-BIM data interface for exporting or reading standard model data. P-BIM Cloud Platform aims at realizing the collaborative design of exploration, foundation pit, foundation, building, structure, water supply and drainage, hvac, electrical and other specialties.

(3) Establishment and interactive principle of P-BIM database

P-BIM database is based on the theory of Model Breakdown Structure (MBS). It decomposes the project building information model with independent deliverable information as the guidance, and obtains the distributed database structure corresponding to the project decomposition structure. Its database structure satisfies BIM data total model, BIM data sub-model and BIM data sub-model three-tier model structure [18].

4. CONCLUSION

With the continuous improvement of BIM standards and the maturity and stability of application environment, the recognition of BIM collaborative design in design enterprises has also been improved. Through literature review, this paper summarizes the difficulties BIM technology faces in collaborative design, including collaborative design has not landed, low efficiency of architectural design, huge model data, localization has not been achieved, and so on. Based on this, through the establishment of P-BIM cloud platform, the data information generated in the whole life cycle of construction project is sorted out, and the information is standardized and standardized through P-BIM data interface. The information is transmitted to the project participants on demand, so as to realize decentralization and point-to-point transmission, and the information is carried out by the project participants. Secondary processing. On the basis of P-BIM cloud platform, the data interaction principle of P-BIM multi-specialty collaborative design cloud platform is elaborated in detail: building specialty, structure specialty, Electromechanical Specialty communicate fully before design, and improve the tasks and needs of all parties. Firstly, architects, structural designers and electromechanical designers call the required P-BIM standard database from the P-BIM cloud platform for modeling. Secondly, the professional models are aggregated, collision checks are carried out, and the collision results are fed back to the professional modifications. Finally, the model data is output through the P-BIM client. P-BIM cloud platform adopts MDB data format to ensure the stability and integrity of data in the transmission process. P-BIM cloud platform is an important embodiment of BIM landing, which provides a feasible path for the interaction and sharing of BIM data in the design stage. Of course, there are also some problems in the application of P-BIM cloud platform, and the related standards, specifications and theoretical basis need to

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