

# Application of BIM Technology in the Design and Construction of Wooden Buildings

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## *Abstract:*

With the development of information technology, as an important pillar industry of national economy, traditional construction industry is facing opportunities and challenges. In this paper, BIM Technology Application in-depth analysis of the impact of the technology on architectural design and related applications. Aiming at the five characteristics of BIM modeling: visualization, coordination, simulation, optimization and graphing, this paper expounds the application of BIM Technology in architectural design major, which mainly involves architectural space, decision-making, dynamic system and the continuation of follow-up major. In this paper, based on BIM Technology of multi-disciplinary collaborative design and solve the problem of cross and collision in the system, the BIM model is constructed by using inter disciplinary collaborative design to check and modify the problem of cross and collision in the model. Experimental data show that this method can improve the efficiency of architectural design and construction.

*Keywords:* Wooden buildings, BIM, Project Management, Coordination and Simulation, Construction Cost.

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## I. INTRODUCTION

The traditional architectural system design is based on CAD as the operation platform, and the design results are displayed by the way of two-dimensional drawings such as plan, elevation and section. However, the building system design is composed of many specialties, each specialty will produce certain errors in the process of information transmission, which will lead to many problems in the later implementation of the design results, and affect the final realization of the design results. The design work of an engineering project is generally completed by the five specialties of architecture, structure, electrical, HVAC and water supply

and drainage. In the process of project design, due to the different organizational structure and management mode of different specialties, the information systems of different specialties are isolated from each other.

Different professional designers have different understanding of engineering construction, different expression forms of the same information content, and errors and omissions are easy to occur in the process of information transmission between specialties [1]. These factors lead to a large number of engineering data in the project is difficult to accurately communicate and share between the participants, resulting in various difficulties in the information interaction between the project participants, which hinders the improvement of the efficiency of the whole project design. Usually, the transmission process of building information in design, construction, operation and maintenance management is a series transmission process. The sequential linear transmission of building information will cause many problems in the transmission process of information among the project participants. This method of information transmission is likely to cause difficulties in later construction due to the lack of design depth and accuracy, and then the designer makes frequent design changes according to the problems of the construction party, which not only increases the design workload, but also cannot guarantee the design quality of the construction project.

The original intention of design work is to make a good plan before the project construction. Comprehensive plan can effectively reduce the loss of manpower, material resources, financial resources and time in the construction process, and improve the quality of project completion as a whole. A good architectural engineering design scheme can not only accurately express the designer's original design intention before the completion of the building entity, but also let the project participants understand the realization of its overall function, and can effectively shorten the construction period, reduce the construction cost and predict some problems that may appear in the construction and operation stages of the project. Different from the traditional two-dimensional graphic design, in recent years, the process of applying computer technology to three-dimensional graphic design parameters of construction projects and effectively synthesizing the relevant information of each participant is gradually developing, which is the so-called building information modeling (BIM) technology [2]. Building information model technology is based on computer technology and three-dimensional digital technology. Through the organic integration of the tool advantages of modern computer technology and project engineering parameters, an engineering data model or three-dimensional simulation model covering the overall information of the project is established [3].

The establishment process of the model is the process of editing and sorting out the overall design information of the project. The establishment of the three-dimensional simulation model has a positive effect on the project from the planning and scheme design to the construction process and the operation and maintenance after completion. Because the 3D simulation model constructed by BIM Technology contains the specific information and design parameters of the

construction project, a collaborative design platform for all participants of the construction project is built, BIM Technology runs through the whole life cycle of the project from design to operation management stage: designers can provide intuitive and effective virtual reality experience for all participants in the project planning stage through the model, so as to realize the visual design of the project and intuitively display the design results; Through the virtual reality function of the model, engineering and technical personnel can accurately understand and grasp the various parameter information of the building system in the design and construction stage of the project, and can make the most effective response to the possible situation in time; In addition, after the project is completed and put into use, the BIM model can accurately locate the specific location of the accident and the surrounding supporting environment, provide more convenient services for project operation management, and reduce the pressure of property management [4-5].

On the basis of BIM model, designers can cooperate with time elements to simulate construction in advance on the computer. While finding out the problems existing in the design results, they can provide effective construction scheme for the construction party by simulating the construction process, so as to effectively control the construction time of the project and improve the construction quality. In addition, building information model is constructed by BIM Technology related software, which can realize the collaborative design among disciplines and automatically check the collision, timely find and correct the problems existing in the design before the implementation of construction operation, so as to effectively reduce design errors, improve construction efficiency, shorten project duration and save design and construction costs [6]. Building a collaborative design platform for different specialties and using BIM Technology to integrate the design results of different specialties into a whole will greatly enhance the value of design results compared with the traditional way [7-8].

## **II. MULTI PROFESSIONAL COLLABORATIVE DESIGN BASED ON BIM TECHNOLOGY**

At present, the industry practice of the construction industry is to deliver two-dimensional drawings as the final design results. Therefore, in the current domestic construction industry, the display of design results, the organization and management of relevant units to the project are carried out in the form of two-dimensional plane drawings, which has become an important obstacle to the wide application of BIM Technology in the domestic construction industry. In the process of architectural design, human beings should not only meet the increasingly complex requirements of architectural functions, but also put the pursuit of aesthetic feeling of design results in an important position. Complex curved surface is considered to be a "high-tech" and "post-modern" design technique that can stimulate designers' imagination. In ancient times, people began to explore the beauty of curved surface, and applied it to some famous

architectural designs.

However, the traditional two-dimensional design technology can not objectively and accurately express the geometric form of the building, such as the surface characteristics. Three dimensional design as an effective way to solve this problem arises at the historic moment. In the two-dimensional graphic design, designers must have high spatial imagination ability to truly feel the specific use of the internal space of the building, which has higher requirements for the spatial imagination of designers. And the space feeling of the designer to the building is a continuous process, simply relying on the two-dimensional space performance diagram can not explain the space sequence of the building in detail [9].

Three dimensional design based on BIM can fully realize virtual reality. Through the virtual display of real space, it can provide designers with realistic visual and auditory experience. The building model constructed by 3D simulation software is the entity mapping of real building. In the model, the material and material properties of each component can be displayed, and the information of all building components can be viewed at any time, so that designers can have a more complete understanding of the real building function. In addition, compared with two-dimensional plane drawing, BIM three-dimensional design can accurately express the geometric characteristics of the building, there is no obstacle to geometric expression, and can accurately express any complex architectural modeling through the parameter setting of the software. Among the selected "top ten contemporary buildings in Beijing", terminal 3 of capital airport, as shown in Figure 1, National Grand Theater, National Swimming Center and other famous buildings show the unique style and charm of contemporary buildings with their unique appearance and structure [10]. However, the common feature of these buildings is that the modeling design of buildings is quite complex, which can not fully express the designer's intention and intuitively show the design results through two-dimensional design software.



Fig. 1: Terminal 3 of capital airport

Although 3D attributes are the basis of BIM design, they are not all. BIM model not only contains the spatial geometric data of building components given by 3D design process, but also

integrates non geometric information such as material characteristics, physical characteristics, mechanical parameters and design attributes into BIM model based on 3D model. BIM model can automatically obtain the plan, section, elevation and other two-dimensional drawings of the design project in accordance with the drawing rules of relevant design disciplines through the graphic operation function of 3D simulation software. The basic structure of BIM is shown in Figure 2.

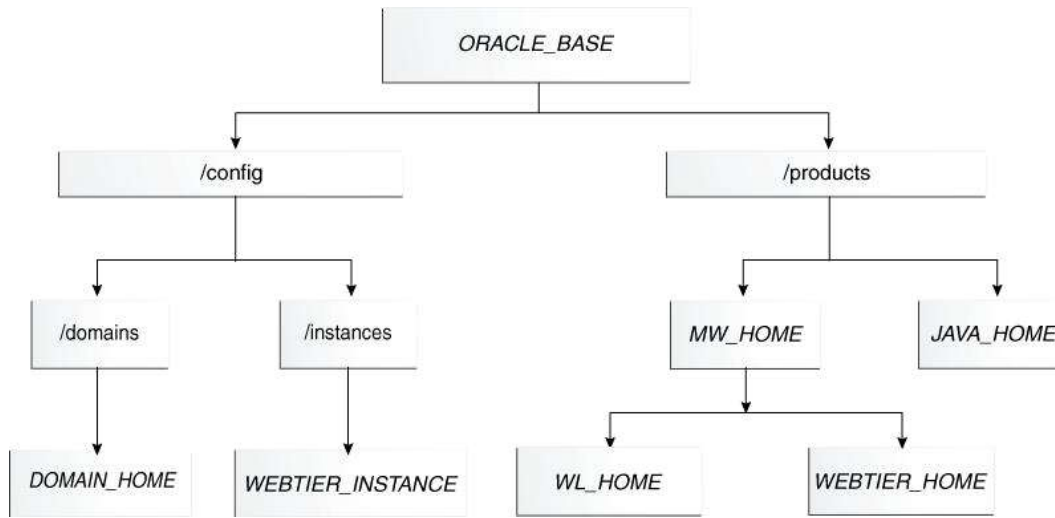


Fig. 2: The basic structure of BIM

The management organization structure in project construction is shown in Figure 3:

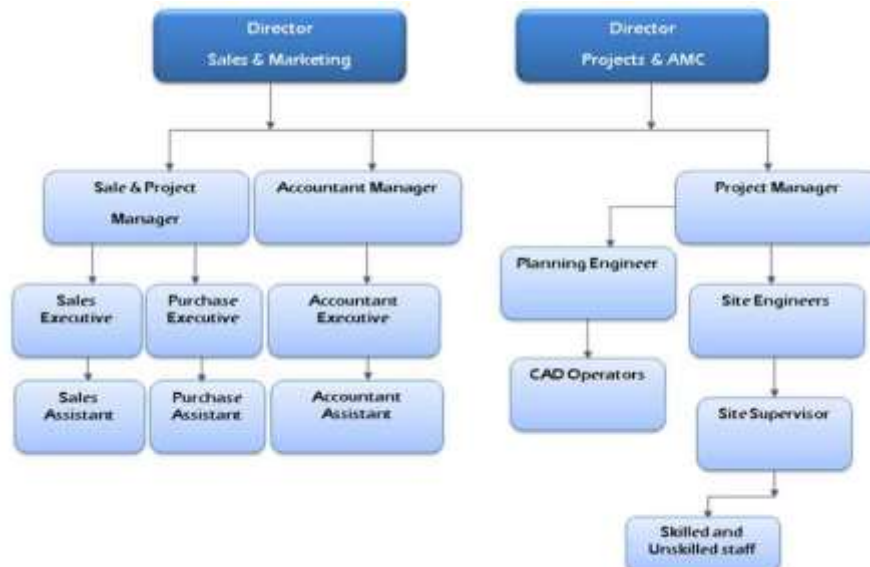


Fig 3: Management organization chart

### III. LIFE CYCLE MANAGEMENT OF BUILDING BASED ON BIM

Life cycle management process is shown in Figure 4. Four aspects are included in this stage:

(1) Application of project planning stage

The analysis and selection of analysis site and site selection directly affect the positioning of the project. In the traditional life cycle management, the analysis and selection of site are influenced by subjective factors, which can not deal with information in a scientific and effective way, resulting in insufficient quantitative analysis of site, and then affect the project positioning. After applying BIM Technology to the site analysis and selection of prefabricated construction engineering, it can take the geographic information technology as the basis to simulate the process of site construction, especially when dealing with the earth rock balance and site boundary problems, which can more accurately analyze the rationality of the site and ensure the accurate positioning of Construction Engineering.

(2) Drawing and modeling

In the completed BIM model, each image source represents a specific meaning, including space size, metal materials, etc. If the parameters of a component are changed in the management work, the related components will usually change, and then the model modification can be fully controlled. Using BIM Technology model can accurately simulate the difficulties in construction, such as new structures, new forms and nodes. Once problems are found in the engineering design, the scheme can be optimized at the first time to fundamentally guarantee the quality of prefabricated buildings. In addition, based on BIM, designers of construction engineering can use its visualization function to discuss design scheme with owners, construction units and construction suppliers, so as to comprehensively improve management efficiency.

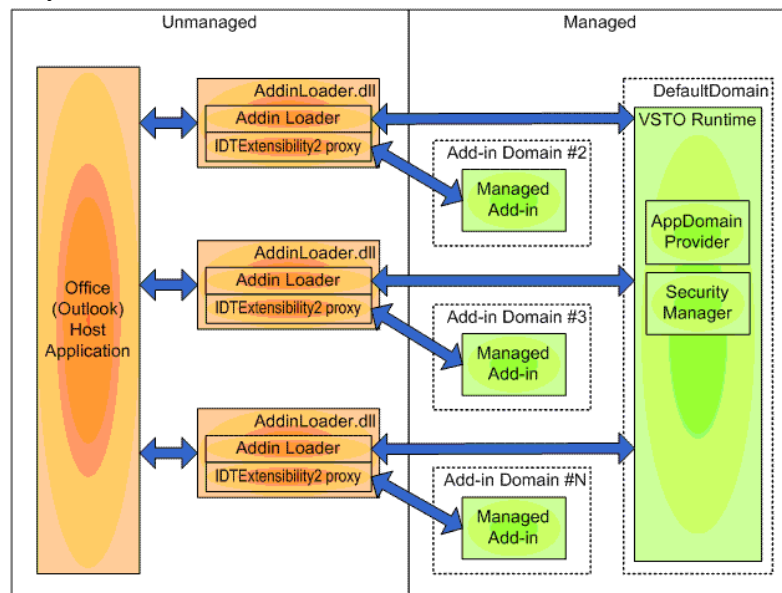


Fig. 4: Life Cycle Management Process

(3) Check for design conflicts

In the traditional life cycle management work, the three-dimensional space model is often constructed according to the subjective consciousness of the management personnel, so it is difficult to avoid the human error between construction and design, especially in the pipeline construction link, it is easy to cause the collision between different pipelines due to the lack of in-depth understanding of various pipeline space relations by different professional designers, which affects the construction progress of construction engineering. At the same time, it will increase the construction unit cost. In view of such problems, in order to ensure the quality of construction engineering, it is necessary to deepen the design of various professional pipelines. Therefore, the BIM management system can be applied in the project. When designing the project model, the staff can simulate the state of various pipeline construction through the BIM system, so as to analyze the relationship between pipelines. Once the problems are detected, the system will show the specific content and location, so that the staff can modify them in time, and then find out the problems before construction, so as to avoid the delay of completion time. And so on.

(4) The construction of the tradition of engineering quantity statistics

Due to the use of CAD software to calculate and construct the relevant building information, it is difficult to automatically complete the quantity statistics, so it usually consumes a lot of labor time to improve. If BIM is applied to construction engineering, the system can automatically integrate the information of component quantities and material types, and managers can consult it at any time. Thus greatly shorten the working time, and can ensure the accuracy of the calculation results, for the prefabricated building cost management, progress management and other work to provide the basis.

#### **IV. CONCLUSION**

By comparing the characteristics of traditional two-dimensional design, three-dimensional design and collaborative design based on BIM, this paper takes the construction of BIM model through collaborative design among specialties as the main research direction. At the same time, in view of the fact that it is not easy for designers to find the collision and intersection problems between water supply and drainage pipeline system and buildings and structures through the conventional two-dimensional graphic design, a new solution to the collision and intersection problems existing in the BIM model of the project is proposed by using simulation software and NavisWorks software.

In view of the fact that the traditional two-dimensional and three-dimensional design can not meet the increasingly complex situation of building system design, this paper puts forward a new way of building BIM model based on multi professional collaborative design method of BIM Technology. The BIM model of building main body is established through the selected software, and the BIM model of building main body is linked to the building process of BIM

model of pipeline system, so as to realize the collaborative design among specialties. The BIM model of architectural design information is constructed by using 3D simulation software.

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