The Application of Computer 3D Design in Green Building

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Abstract. In the current era, the conventional architectural design process has been difficult to adapt to the high performance and high quality requirements of green building standards. By analyzing the necessity of applying 3d design in green building design, this paper studies the feasibility of applying 3d design in green building design from the aspects of the characteristics of green building and the advantages of 3d design. The application of computer 3d technology in green building design can better highlight the economy, rationality and maneuverability of computer 3d in building design.

Keywords: Computer 3D, Green Building Design, Evaluation Method

1. Introduction

China's research on green building is relatively late, and there is no complete theoretical research system at present. Moreover, there are very few researches on the design of green public buildings. In this paper, by breaking down the information barriers between various stages, specialties and subjects in architectural design, a design method based on three-dimensional design that is suitable for green building requirements is constructed to provide theoretical basis for the in-depth development of construction engineering informatization.

Architectural design in China is mainly designed by a design team composed of professional designers in architecture, equipment, structure and electrical engineering[1]. However, the interactive application of design information among various professional designers is difficult. For complex buildings with high requirements for information processing, especially green buildings, conventional architectural design obviously cannot meet the requirements of green building design. This reminds us of the necessity of green building research.

2. Characteristics of computer three-dimensional theory

Computer 3 d is the abbreviation of building information model, based on the 3 d information
technology, through the digital model, the expression of construction project construction entity and the features of computer 3 d is not a software or a combination of several kinds of software, but as a concept, based on data management, the fusion of whole life cycle of construction projects in production and management process of information technology concepts.

2.1. The core advantages of 3d computer

The 3D model generated by the computer 3D software is directly designed by the software, which can realize accurate 3D view at any stage of the design. Parametric design refers to the change of model shape and other parameters in the design process by adjusting the relevant parameters of the model. The distribution of ambient lighting in the building is shown in Figure 1 below:

![Figure 1. Indoor environment of green building in the current era](image)

3D design can promote collaborative work between multiple design major, namely the members of the working party on the local computer to the same 3 d engineering design information model, everyone can design content synchronization in time into the center of the items on the file server files, or even between members can also borrow belong to each other certain architectural figure yuan for crossover design, so as to realize real-time data sharing between the members. It avoids the design adjustment when the design is nearly finished and improves the cost efficiency.

Computer 3d can integrate work information from various stages of a construction project as well as different professional categories into a single information model[3]. All kinds of information are completely preserved and related to each other, which eliminates the loss of information between different lines and stages in traditional design to a great extent, reduces the waste of resources caused by the separation of industries, and avoids the collision and mistakes caused by different majors.

2.2. The application status of computer 3d in different stages of construction projects

In the process of technology and concept maturity, three-dimensional design has been able to realize the full life cycle of the construction project information organization and management, the following will be the computer three-dimensional in the construction project in different stages of the application of a brief description.
In the feasibility study stage, in order to guarantee the project quality, function, technology and economic requirements, the owner needs to organize a large amount of manpower and financial resources for analysis. The three-dimensional design can produce a general architectural model for demonstration, simulation and analysis, which will greatly improve the reliability of the conclusion of the demonstration.

On the basis of 2d CAD drawing, the 3D design is used to realize efficient collaborative design of various specialties, and the 3D model scheme and construction drawing of the project can be drawn accurately and quickly[3].

2.3. Construction stage

Collision inspection of design problems before construction: 3d design realizes the design of 3d scheme model, so the conflicts between various systems in the design process are clear at a glance. Therefore, these problems can be discovered and solved in advance before the project starts, so as to improve the construction schedule and quality.

By adding a time dimension into the computer 3d model and using relevant schedule planning software, the whole construction process of the building and some conditions on the construction site can be dynamically simulated[9]. The simulation video can be used to find out some potential problems in the construction scheme in advance so as to optimize the construction scheme.

3. Application of computer 3d in green building design

Firstly, the method of direct call, information extraction and other forms of information call is applied in the three-dimensional computer technology to evaluate and analyze the green building, which is mainly based on the relevant provisions of the green building evaluation standards for public buildings in China. This requires a digital model containing all the building information and a building performance analysis tool that can identify this information, as shown in Figure 2 below:

![Figure 2. The three-dimensional lighting analysis aimed at improving resource utilization](image-url)
Both the general term and the preferred term have their evaluation points in the evaluation process, and relevant supporting materials should be submitted. The key points of evaluation and the requirements of certification materials are clearly specified in the relevant provisions of the green building evaluation standard\textsuperscript{[3]}. Based on the advantages of 3d design, this paper analyzes the key points of evaluation and the supporting materials, and studies the feasibility of 3d design application in green building evaluation terms. The following formula can be used for evaluation:

\[
\text{BIM}(P_{A,B}) = \frac{s(B + A) - s(A)s(B)}{\sqrt{(1 - s(A))(1 - s(B))}} \tag{1}
\]

As shown in the above formula, its water saving and water resource utilization, material saving and material resource utilization and indoor environment quality are evaluated and analyzed by computer 3d technology in the same way\textsuperscript{[6]}.

3.1. Ground and outdoor environment

\begin{itemize}
  \item Evaluation points: a. Whether curtain wall or high reflector façade; B. Whether the building affects the standard lighting time of adjacent buildings; C. Whether outdoor landscape lighting directly illuminates the air.
  
  \item Evaluation of proof materials: general layout, architectural renderings, architectural design, building facade design drawings, glass curtain wall or mirror type aluminum alloy decorative wall drawings and design documents, outdoor landscape lighting design, glass curtain wall related special report, design unit or a third party to provide the sunlight analysis report, etc.
  
  \item 3D design research sunshine analysis report: the 3d design software is used to export the architectural design model into a model in a certain format. The exported model can be used for the simulation analysis of the sunshine analysis software, and then the simulation analysis results are compiled into the sunshine analysis report.
\end{itemize}

3.2. The surrounding environment of the building

\begin{itemize}
  \item Evaluation points: a. whether the wind speeds of 1.5m in the pedestrian zone around the building is less than 5m/s in the simulated outdoor wind environment.
  
  \item Evaluation documents: a. Architectural master plan; B. Outdoor wind environment simulation analysis report.
  
  \item 3 d design research of the wind outdoor environment analysis: using the method of analysis of sunshine similar points, using the computer 3 d design software architecture design model a certain format of the model was derived, the export model for wind environment analysis software simulation analysis, according to the simulation results to determine whether a pedestrian zone around building wind speed satisfies the requirement of less than 5 m/s, etc.
\end{itemize}

3.3. The energy conservation and energy utilization

\begin{itemize}
  \item Evaluation points: the design value of the thermal performance index of building envelope is compared with the standard value to judge whether the thermal performance of the maintenance structure conforms to the energy-saving standards;
\end{itemize}
◆ Evaluation documents: a. Architectural design description with thermal performance parameters of envelope, detailed drawings of envelope practices, and energy saving calculation report;

◆ Use computer three-dimensional statistics of thermal performance parameters of the enveloped structure: extract the parameters of the enveloped structure through the software list and other functions, compare the extracted results with the energy-saving design standards, and judge whether the thermal performance of the project enveloped structure meets the requirements of energy-saving standards.

4. Conclusion

From the above analysis, it can be seen that the application methods of three-dimensional design in green building mainly include the following: by exporting the computer three-dimensional design model into the relevant format required by different software analysis, directly applying it to the related building performance analysis and design scheme optimization, and the analysis results are used to write evaluation reports, etc.. Relevant architectural information was extracted from the computer three-dimensional design model, and modeling was carried out again in the analysis software. The simulation results of the analysis software were used to optimize the design scheme and write relevant evaluation reports. The information of equipment, materials and building thermal performance parameters in the model scheme is directly counted by three-dimensional computer software, which can be used for the statistics of recyclable material consumption in the material saving evaluation and the judgment of whether the thermal performance of envelope meets the energy saving standard in the energy saving evaluation.

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