Research on the BIM Application in Interior Design based on 3D Visualized Modeling

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Abstracts
Building Information Modeling has been deemed as the next significant revolution since the Computer Aided Design. Through this design, the two-dimension design has been transited to the three-dimension design. Furthermore, this modeling has been perceived as the most important revolution ever in the histories of architectural design, construction industry and project management. As BIM has been introduced and applied, the conventional working concept and the working mode have been broken through. The interior design is recognized as the vital part of the constructional engineering, and accordingly the designer shall keep pace with the development of BIM and proactively apply the BIM technology to the interior design engineering. Hereto, this paper delves into the research of BIM application in interior design.

Keywords: information; interior design; design tool; synchronous design

1. INTRODUCTION

IN accordance with the conventional computer aided interior design, the AutoCAD and other design software are adopted to carry out the two-dimension design of plane, space diagram and section and to make the design sketch through applying 3ds Max and other three-dimension software. Such working mode is similar to the traditional hand drawing in overall steps. The only difference lies in the drawing realization via computer. The conventional computer aided interior design, compared with the hand drawing mode, is more efficient and accurate. However, the designers remain trapped in the heavy sketching task. Based on the conventional design software, the interactions have not been well established between and among plane, space diagram and section and between these three aspects and the three-dimension model. If anyone of the drawings is modified, others shall be accordingly modified or even redrawn. Additionally, the inconsistency among contents in various drawings is commonly prominent.

The problems mentioned exist commonly in the course of computer aided interior design, posing a sever challenge for further elevating the design condition and the design efficiency. All these problems shall merely be resolved through applying the new technology. Accordingly, the reliable resolution is provided by the BIM, the abbreviated form of Building Information Modeling.

2. BRIEF INTRODUCTION OF BIM

BIM refers to the Building Information Molding. The basis of this theory is mainly originated from the CIMS theory (Computer Integrated Manufacturing System) of the manufacturing industry integrating the CAD and CAM and from the product information modeling based on the product data management and STEP. BIM is perceived as the digitized form of implemented entity and the functional characteristics of constructional project. A perfected information model shall be able to connect the data, course and resource in different stages of the construction project. Through the perfected information modeling, the project object can be completely described. For this reason, the perfected information modeling can be widely applied by all participants of the constructional project. BIM is characterized by the single project data source, capable of realizing the consistency and overall sharing among the distributed and heterogeneous project data, and of supporting the establishment, management and sharing of dynamic project information among the entire period of the project.

1. Characteristics of BIM

(1) Completeness of information modeling: Besides the description of 3d geometrical information and the topological relation of the project object, the information modeling is also capable of describing the complete project information, including the title of object, structure type, building materials engineering properties and other design information; construction process, schedule, cost, quality, manpower, machinery, material resource and other construction information; safety performance of engineering, endurance quality of materials and other maintenance information; engineering logical relationship between and among objects.

(2) Relevance of information modeling: The objects in the information modeling are correlatively identifiable. The system shall collect and analyze the information of the model and further generate the according diagrams and documents. If any object in the modeling is changed, all the correlated objects shall be accordingly upgraded as to keep the information model integrated and strong.
(3) Consistency of information modeling: The modeling information shall remain consistent among the entire period of the construction engineering. The same piece of information is not required to be repeatedly input. Moreover, the information modeling can be automatically evolved. The object of the modeling can be simply modified and extended without reestablishing the new modeling whenever the stage is among the period, successfully keeping away from the fault due to the information inconsistency.

2. Significance and effect of BIM

(1) Resolve the bottleneck problem faced by building field in information: The single engineering data resource shall be established; the modern CAD technique shall be boosted in application; the management of construction period shall be promoted, the engineering performance, quality, safety, schedule and cost among the entire period of construction shall be integrated and managed, and the total cost, energy consumption and environmental influence in the entire period of construction engineering shall be analyzed, predicted and controlled.

(2) Applied to engineering design: The 3d design shall be realized; the information shall be shared among different design professionals; the virtual design and the intelligent design shall be realized, and the collision detection, energy consumption analysis and the cost forecasting shall be realized for the design.

(3) Applied to construction and management: The management of IPD (Integrated Project Delivery) shall be realized. The 4d construction management being dynamic, integrated and visualized shall be realized: The construction and the 3d model of construction site shall be well geared into the construction schedule and be integrated with the construction resource and site layout information as to establish the 4d construction information modeling. The dynamic integrated management towards the engineering schedule, manpower, material, equipment, cost and layout in the construction phrase of the construction engineering shall be realized, as well as the visualized modeling for the construction process.

All participants of the engineering shall be cooperated and coordinated in work: the information shall be shared among all participants of the engineering, the documents, diagrams and video shall be submitted, examined and approved via the internet. Based on the collaboration, all participants of the engineering shall jointly carry out the negotiation and coordination, and the management and control of the construction quality, safety, cost and schedule shall be realized.

The virtual construction shall be realized: the construction shall be carried out on computer, the function of the construction engineering and the potential problems from construction perspective shall be forecasted prior to the practical implementation of construction via the virtual construction modelling.

3. ADVANTAGE RAISED BY BIM IN INTERIOR DESIGN

The application of BIM in domestic interior design has shifted it highlight from the construction, structure and water, heat and electricity systems in the conventional construction project progressively to the interior design, including the furniture, area requirement and fixed device. Furthermore, the interior design can be detailed as office space design, hotel design and store design. The BIM shall provide the advantageous foundation for all of these mentioned aspects.

1. BIM software is able to rapidly establish the 3d visualized modeling, getting rid of the redundant tasks through adopting the conventional 2d design tool. The designers shall directly view the 2d plane drawing and rapidly establish the correspondingly relevant modeling. Additionally, in the course of boosting the interior design engineering, the parametric concept of the BIM can be adopted to adjust the interior design at one’s will. The consistency of the design can be maintained on the basis of the correlative characteristic between and among the objects of the modeling. In the meantime, the parametric concept shall bring abundant data information to each component of the interior design, including the thickness of the ceiling, material of the floor, design and color of the wallpaper extra. As a result, the working efficiency of designers shall be greatly elevated, and the engineering shall be more expressive (as shown in Figure 1).
2. Visualized modeling shall elevate the efficiency of communication. As the conventional 2d drawing manifest, the error is inevitably generated by all participants of the engineering whether through viewing or understanding. This is because the information shall be missed or mistaken while being transferred due to the limited individual specialty, spatial imagination ability and work experience. Through the 3d visualized modeling established on the basis of the BIM technology, the information transfer shall get rid of the mentioned individual limitations. The concepts and ideas of the designers shall be presented in front of all participants of the engineering through the relations between and among all components of the design, including the spatial layout, facing and material, as well as the placement of furniture. Additionally all participants of the engineering shall not consider their professional backgrounds, cultural conditions and spatial imagination abilities. The design is easy to understand through the visualized 3d modeling. The communication and coordination of all participants shall be more efficiency through clicking any component of the engineering for detailed property and information (as shown in Figure 2).

3. The construction simulation shall resolve the problems in advance. In the conventional interior design, the arrangement and installment of the pipelines shall generally be fulfilled relying on the experience of the designers, causing huge waste of material, manpower and cost. Through the construction simulation of BIM, all these works can be simulated as to eliminate the drawbacks existing in the design and change the parts of places deserving to be changed. Meanwhile, the construction simulation accompanied with the collision check shall detect the conflict points existing in the construction as to reduce the possibility of rework and reduce the increase of the extra cost.

4. The details are concerned. In the conventional 2d design, if the details of the interior design shall be highlighted, including the lighting, shadow and material, these require the manual operation and the large-scale
adjustment with complicated procedures and high costs. Such information shall be included into components by the BIM technology, and the details can be highlighted via the BIM. The detailed information of any place in the engineering can be manifested through designers’ clicking and modified at designers’ wills. Accordingly the design shall be more expressive and realistic.

5. Abundant additional functions

As abundant information of the represented construction is contained in the data base of BIM, the foundation for further application of BIM is laid, creating more additional functions for the design.

The engineering amount can be automatically collected through applying BIM. Various comprehensive charts related to windows, doors and materials can be easily generated through this model. Additionally it is convenient to collect the area and volume of a certain partition wall, or the quantity, price and manufacture information of the decoration components. The designers shall be prone to apply BIM to the construction project budget, providing the accurate data foundation for the controlling the decoration offer and tender offer and guaranteeing the controllable difference ratio of the actual cost. The accurate purchased amount can be guaranteed through adopting BIM to generate the purchasing list.

Besides the spatial function design and visual art design, the sound, light and heat systems of the interior space are also involved in the interior design. The quality of sound, light and heat systems of the interior space are highly required by the large-scale public buildings. Various physical data of the structural material are contained in the database of the BIM, (thermal resistance and sound insulation coefficient), laying the foundation for directly exporting the information modeling to the analysis software, as Ecotect and IES, for the physical analysis of sound, light and heat systems of the construction.

6. Realizing information sharing and cooperative work

In the BIM, all the basic component data related to the constructional engineering are stored in the unified data base, realizing the integrated information. On that basis, the cooperative work platform, centered by the BIM, can be established, allowing all the designers special in interior design, electricity, water supply and drainage to carry out the cooperative design via the same building modeling. Additionally, through the cooperative work platform, all the designers are able to promptly communication with and transfer information to the owner, contractor and material supplier. Various information can be effectively managed and applied, guaranteeing the coordinated, high-efficient and smooth design.

4. APPLICATION OF BIM IN INTERIOR DESIGN

The core modeling software of BIM is shown in Figure 3. Generally several types of software shall be integrated for specifically practical case making.

![Figure 3. Core Software of BIM](image)

1. Design flow of BIM technology in interior decoration

Currently in the interior design process, the design of construction drawing, design sketch and preliminary budget shall be carried out be specialized people through using different types of software. There are many prominent problems in the current decoration market, including the design sketch distortion, deviation between
budget and eventual contract price, inevitable mistakes and omissions on design drawing, conflict between and among decoration component, original construction structure, water, electricity and machinery. Accordingly the customers are less satisfying with, trusting the decoration companies. Under the traditional work flow, the entire decoration industry shall be promptly more standardized and high in efficiency. As the BIM technology has been widely applied and popularized, the interior decoration design flow based on the BIM is researched by the author. If the BIM is available, the decoration architectural elements can be directly drawn in this modeling. Through the collision detection among components, the conflict and collision between and among decoration component, original construction structure, water, electricity and machinery can be eliminated, and accordingly the rework can be significantly eliminated, greatly elevating the efficiency of construction site and reducing the increase of cost and the project delay due to the construction coordination. The application of BIM in drawing the decoration architectural element has been deemed as one of the most widely applied orientations of BIM in the construction design field.

2. Non-BIM

The BIM technology has merely emerged for several years, and it is not as perfected as other technologies. Currently this technology has not been completely popularized in the entire construction industry. For this reason, the majority of the present construction designs are basically made or drawn on the basis of the 2d information conventionally. The BIM is neglected. Under such circumstance, the interior designers are required to apply the BIM technology to draw spatial modeling for construction in accordance with the specific conditions of the engineering, and to include the available information related to the water, electricity, structure and machinery of the construction into the BIM. On such basis, the designers shall make the decoration component modeling and carry out the collision detection.

In BIM, the “Zu” order can be adopted to load the furniture and other soft decoration modeling as to arrange and design the furniture. Furthermore, through the interior lighting setting, the “rendering” order can be drawn on for rendering the design sketch. Accordingly the 3d simulated design sketch from any perspectives can be made, greatly elevating the efficiency of design.

BIM technology shall directly generate the professional 2d construction drawing, detailed chart and the specific chart in accordance with the 3d interior design modeling containing the constructional information made by the designers. Hence, the design efficiency and the accuracy of design can be fully elevated. As for the hetero-type and other parts failing to be identified through adopting the 2d diagram, the visualized function of BIM can be adopted to resolve such problems, creating the convenience for the acquiring the direct understanding of the design by constructors. In addition, any section information can be acquired, providing the reliable data for the model design and construction, as to realize the constructability.

3. Application examples of BIM technology in interior decoration

The parameterization design is the biggest characteristic of BIM technology. When BIM is adopted in the interior decoration design, all the interior construction and materials are specifically recorded, including the partition, wall space, design of ceiling and others. While the interior 3d modeling is being drawn, the specific chart, construction drawing and detail drawing are also accordingly generated. When the project is designed, the construction drawing is also fulfilled. Hence, this technology is high in the applicable significance.

(1) Draw 3d modeling for interior decoration architectural element based on BIM

The BIM application shall realize the 3d modeling for interior wall space, floor, ceiling and partition. The drawn modeling is shown as Figure 4. The 3d modeling presenting the direct view shall reduce the experience requirement of the constructors.

Figure 4. 3d modeling for interior decoration
(2) Collision detection

In the site of decoration construction, the conflict and collision between and among decoration components and various pipelines and devices are commonly existing and difficult to be resolved. Under the application of 2d design, the design and construction of building, structure, device and decoration shall be carried out respectively, and each step shall be attached a set of drawings. Under such scattered working mode, the collision and conflict between each component are inevitable. However, under the application of BIM, the 3d entity modeling shall be established for all components. What you have to do is just to select the modeling type to be detected and apply the collision detection order in the menu of collaboration. Hence, in accordance with your selection, the 3d modeling shall be detected and scanned as to identify the overlapped or mutually conflicted pels. The conflict report is generated, and the conflicted amount due to the overlapping pels is notified. The overlap of pels shall lead to the mistake or error in the construction. After receiving these alarms, the mistakes and error can be promptly corrected.

(3) Introducing 3d modeling for decoration

Under the BIM, the “zu” order can be adopted to directly introduce the preset 3d interior model for furniture and device as to assist the fulfillment of the final design sketch. (as shown in Figure 5) The designers are able to draw on the 3d modeling to design freely from any perspectives and to confirm the material property, facing color, lighting layout and fixed devices as to specifically and exquisitely analyze the design. Hence, the design quality is guaranteed.

(4) Rendering virtually and actually

The details are highlighted in the interior design. The final effect of the design is closely bound by the lighting, material, facing and furniture. Whether in the design step or in the deepened design step, the BIM technology anyhow lays the foundation for designers to vividly and conveniently manifest these details. Each component, size and texture and other information are presented in the 3d modeling, whereas the effect of the modeling is rigid. To reach the effect of simulation, the rendering order in the BIM software is adopted as to render the 3d space and enliven the image as shown in Figure 6.
(5) Construction drawing and specific drawing generated automatically
All the drawn interior decoration 3d entity models are composed by the surface layer, basic layer, keel and various fittings being well geared into the decoration construction. All these interior components are recorded in the BIM software. For this reason, the BIM technology shall directly fulfill the construction drawing and specific drawing as shown in Figure 7 required for the construction based on the 3d modeling. As various generated drawings are originated from the same modeling, all the drawings and charts are correlated with each other, avoiding the inconsistency of different drawings. If the design shall be modified, no matter which drawing shall be modified, the other correlated drawings shall be accordingly modified promptly.

(6) Generate the detailed chart and control the cost
The engineering amount can be automatically collected through applying BIM. Various comprehensive charts related to windows, doors and materials can be easily generated through this model. Additionally it is convenient to collect the area and volume of a certain partition wall, or the quantity, price and manufacture information of the decoration components. The designers shall be prone to apply BIM to the construction project budget, providing the accurate data foundation for the controlling the decoration offer and tender offer and guaranteeing the controllabledifference ratio of the actual cost. The accurate purchased amount can be guaranteed through adopting BIM to generate the purchasing list.

5. CONCLUSION

The application of BIM shall change and deepen designers’understanding of the space and of the interior construction. The significance and method establishing this modeling have been gradually recognized and simultaneously introduced the new subject for the interior design education. Such technology is perceived as the new impact and revolution of design concept raised by the developing information technology.

Reference


