The construction of BIM application value system for residential buildings’ design stage in China based on traditional DBB mode

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Abstract

Through statistical data issued by Ministry of Housing and Urban-Rural Development of China, in 2015, China’s real estate companies completed construction area of 7,356,930,000 square meters, of which the residential construction area occupied 69.53%. In China, building information modeling (BIM) technology has developed gradually these years. Despite the successful applications of BIM in commercial buildings, tourism buildings, culture and educational buildings and other public buildings, the application of BIM for residential buildings has not gained wide acceptance, which was only limited to residential buildings’ underground garages. This project aims to cover this gap by studying the application of BIM on residential buildings’ design stage under the commonly used DBB (Design-Bid-Build) mode. Through the investigation and participation of several projects, this paper constructs BIM application value system including specific implementing scheme and delivery forms based on the DBB mode. The system covers the phases of scheme design, preliminary design, construction drawing design and detailed design and involves the professional fields from general layout, municipal facility, landscape, architecture, structure, MEP(Mechanical, Electrical & Plumbing) and refined decoration.

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Keywords: BIM; residential building design; application value system; DBB mode

1. Instruction

Through statistical data, in 2015 in China, real estate enterprises completed construction area of 7,356,930,000 square meters, of which the residential construction area occupied 69.53%. With the continuous development of society
and economy, the living standard improves as well. Residential buildings are developed to be more comfort, compact, intelligence, environmental friendly and attractive. This requires the design of the residential buildings to be more sophisticated and designers to deal with more complicated information. The analysis of BIM implementation in China in recent years showed that the application of BIM still mainly focused on commercial buildings, tourism buildings, culture and education buildings and other public buildings. The Implementation points mainly were the 3D presentation, the clash detection, complex joint construction direction. The Intervention was usually after construction drawing design. When BIM was used in the residential buildings, the practical effect was mainly limited to the clash detection and optimization of the facilities of residential buildings’ underground garages. BIM hasn’t played real effective role in the buildings’ design. And the transmission of the information between stages was not effective. In China, most of the residential building projects are based on traditional DBB mode. In this mode, owners sign a professional service contract with design companies. After the completion of the construction drawing design, the owners choose appropriate construction company by bidding. Under DBB mode, the design companies and construction companies work completely independently, which makes poor constructability of the design and ineffective transfer of the information between project stages. Although in recent years, the trend of the project management mode based on BIM technology towards to integrated modes, such as EPC(Engineering Procurement Construction) mode or IPD(integrated project delivery) mode, the construction projects in China still mostly operate under DBB mode which can easily fit the policies and regulations of China.

Therefore, it is of practical significance to research how BIM can be effectively used during the design of the residential buildings under traditional DBB mode. Through the investigation and the participation of several residential building projects, this paper presents the implementation points for residential buildings’ design phase and proposes the delivery system so as to construct the application value system. The residential projects we chose occupy large area and have higher height differences or complicated terrain. The building form includes villas, multi-storey and high-rise residential buildings. BIM can exert more advantage in complicated residential projects, the implementation points can also be of some significance to other residential projects. The application value system covers the phases of scheme design, preliminary design, construction drawing design and detailed design and involves the professional fields from general layout, municipal facility, landscape to architecture, structure, MEP(Mechanical, Electrical & Plumbing), and refined decoration, which will be the guidance to the implementation of BIM technology for residential building projects.

2. Application value of BIM in the scheme design stage of residential building projects

The design process generally includes the fields of general layout, landscape, architecture, structure, MEP (Mechanical, Electrical & Plumbing), refined decoration and investment estimation. In the stage of scheme design, the professions of general planning and architecture design in advance, and other professions provide design descriptions to illustrate their design requirements. The general layout and the elevation information has been preliminary determined before the design of the single building, which contains the function partition, traffic flow control, the buildings’ location and layer and other basic information. Then make unit design of the single building and confirm the design scheme with the owner.

The design of general layout of the residential projects should take advantages of terrain characteristics to reasonably plan the elevation of the road, site and buildings and also take economic considerations. The software Autodesk Civil3D can be used early in the scheme design stage to simulate original terrain. Civil3D can turn the original geological data into generating surface through calculation and has the advantages in earthwork plan, which makes the design economic and reasonable. For the projects which occupy large area, have higher height differences or complicated terrain, the construction of the site model in civil3D or other effective BIM software can accurately control the slope gradient to avoid the catchment area and ensure the effective drainage. The site model should contain the municipal pipe network, roads and the location of the buildings and structures. The model can be released to the Google Earth map service website, which can make designer and owner better understand the project in a real environment. In addition, the model can be exported to the software of Autodesk Ecotect to simulate the sunlight shadow, thermal environment, wind environment and occlusion problems as a scientific basis for the selection of the site plan.

The major work of architecture design in China’s scheme design phase is to do the unit design, in which the
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