Application Digitalization Technology in Architectural Design

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Abstract: As people’s understanding of digitalization technology gradually deepens, digitalization technology has been widely used in the field of architectural design. The application of digitalization technology in architectural design is mainly reflected in its ability to visualize creative ideas, so as to provide designers with more effective references and thoughts, and significantly improve the level of architectural design. This paper focuses on the exploration of related problems about the application of digitalization technology in architectural design, which is of great significance to the development of China’s modern architecture industry.

1. Review on Application of Digitalization Technology
In the current development of the architecture industry, the digitalization technology is becoming increasingly complex, and the scale of buildings involved is getting larger and larger, which puts higher requirements on architectural design. In the process of architectural design, it is not only necessary to ensure that the design should be accurate and reasonable, but relatively obvious problems and hidden dangers should also be avoided. Based on the implementation of such architectural design work, the most basic task is to analyze and process various information data, to carry out detailed analysis and calculation for all information, to ensure that it can be reflected in the final architectural design, and to jointly maintain the orderly implementation of the construction project[1].

It is one of the important development trends to use digitalization technology in architectural design. The effective combination of digitalization technology and architectural design makes the construction structure of construction projects smoother and clearer. It can better solve some of the problems that might be encountered in the design of construction projects, and ultimately ensure that the architectural design work can be more smoothly carried out, which helps to improve the overall level of architectural design and construction, having a stronger guiding effect on the construction of subsequent construction projects[2]. Like the coexistence of the real environment and the virtual environment in the digitalization age, traditional architecture will not only continue to exist, but also will gain deeper development. People in the digitalization age will put forward higher requirements for architectural design. Architectural design is required to be more meticulous in function, more adaptable to changes and different needs, more advanced in technology, and richer and more complex in aesthetics.

2. Classification of Digitalization Architectural Design Techniques
Software of architectural design with digitalization technology applied belongs to industrial software
in China. Due to the many problems involved in the design process, there are multiple kinds of software. Besides, lots of software shares the same functions, so it is difficult to classify them. Based on domestic and foreign software in the current stage, such software can be roughly divided into two categories, i.e. conventional software and emerging software. Among them, conventional software is mainly divided into software for computer aided drawing, computer aided analysis and computer aided management [3]. Emerging software can be divided into software about virtual reality, generative design and 3G. (Table 1)

Table 1. Application classification of Digital Architectural Design Technology

| Application classification | Representative software          | Effect                                      |
|---------------------------|---------------------------------|---------------------------------------------|
| Computer Aided Drafting   | Autocad, photoshop              | Design platform conversion, improve work efficiency and quality |
| Conventional application  | Auxiliary analysis              | Structure, environment, sound, photothermal, ventilation, energy consumption and other analyses. |
| Auxilary management       | PKPM Engineering valuation, Virtual , Construction etc. | Team work, engineering management, property management, etc. |

The development speed and application level of digitalization technology have shown the strong vitality of the technology, and its superiority is more and more obviously reflected in architectural design. However, we should clearly understand that digitalization technology in architectural design should be oriented to the architectural design process because architectural design is the process rather than the result. As a design and technology, digitalization of architectural design is also supposed to have such positioning. Only in this way can digitalization technology truly play its role in architectural design. Computer Aided Architecture Design (CAAD) is the main application of digitalization technology for architectural design. The process of architectural design is a process of continuously solving problems. Only when it is oriented to the design process can digitalization technology be included in the process of solving problems and participate in the design. The positioning of digitalization design technology for the architectural design process must be conducive to the transmission and restructuring of design information, for the nature of the architectural design process is “transmission and restructuring of information”, a process to understand and solve problems through transmission and restructuring of information [4]. Neither of them is dispensable. Only when these two requirements are met simultaneously is the digitalization technology truly oriented to the design process, so that the architect can better navigate between science and art to conduct architectural design, thus shortening the design cycle and improving the design quality and enhancing the creativity of architects.

3. Application of Digitalization Technology in Architectural Design

3.1. Principle and Scope of Application of Digitalization Technology in Architectural Design

3.1.1. Digitalization of Conceptual Design. Although the digitalization technology is currently a
powerful tool for designers, for it can help to conceive the 3D shape, space, color and effect of the building, and can consider the design proposal based on the base environment, yet the most important means is still that the architect conceives the design idea first and then expresses it using the CAD design software. There is lots of software in this domain, e.g. Auto CAD, Revit and Sketch, which really provide great convenience for designers to turn ideas into digital models. Nevertheless, so far, there has not been any interactive design system in a real sense that not only reflects the design concept in time, but also can easily change according to the designer's design intent and can calculate the design indexes, e.g. sunshine spacing, building energy consumption and building density, in real time[5]. (Figure 1) According to the characteristics of the computer, these indexes are fairly suitable for the computer to calculate and timely respond to. The current method, in a strict sense, is a one-way design process rather than an interactive design process, which means that the designers use the computer to model based on their design ideas, process the model, obtain expressions such as design sketches and animation effects, conduct discussions on the design, modify the design conceptions based on the feedbacks collected, and then modify the model, so to gain the final design results after repeating the procedures for several times. The problem here is that the process of design communication is carried out offline, and online interaction cannot be performed on the computer. Therefore, how to achieve online interaction on the computer is an important direction that the CAAD technology should study, which also requires architects and computer engineers to work tirelessly to provide design platform tools that are more convenient.

3.1.2. Digitalization of Plan Optimization and Special Analysis. In the process of designing the floor layout plan, after the preliminary plan is determined, CAAD can analyze and evaluate the various functional activity relationships such as design indicators and attributes that can be quantified and collected. In the design stage of the architectural design plan, CAAD technology can also qualitatively and quantitatively analyze various physical, environmental and functional design technical indicators (e.g. building sunshine, building energy consumption, thermal insulation, fire and disaster prevention, and budget estimate) to make the architectural design more rational and scientific. Most of the above are technical and computable[6]. At present, the aided analysis and feedback optimization of special design indicators in the design process of floor layout plan have been accepted by most architects, and have been applied in foreign countries.

3.1.3. Digitalization of Base Environment Analysis. To effectively implement architectural design, it is also necessary to strengthen the detailed analysis of the surrounding environment to ensure that the surrounding environment of the construction project can be relatively coordinated with the building, so as to exert the maximum application value of the building. Digitalization technology is also of strong practical value in analyzing the surrounding environment analysis. For example, for the analysis of building energy consumption, digital processing can be realized to visualize the level and variation pattern of energy consumption, so as to provide reference for the optimization of subsequent design schemes[7]. (Figure 2)
3.1.4. Digitalization of Study on Absolute Architectural Space. It is relatively easy to restructure information in absolute space using architectural design digitalization technology. Because the vast majority of information restructuring in absolute architectural space can be achieved by means of collage restructuring which is exactly the strength of digital arithmetic logic[8]. For instance, if we use Archicad, we can operate on the electronic board only by selecting “proportional division” and inputting the golden section ratio (1:1.618). With Photoshop, it is very simple to realize the conversion between the picture and the background as well as the overlapping, analysis and restructuring of the layers. Moreover, with digitalization technology applied in architectural design, architects can reorganize the absolute more freely and flexibly. Due to the adoption of digitization technology, information restructuring in absolute architectural space has been transited from the 2D plane to 3D virtual space, and there appear many information restructuring methods that can only be found in 3D space, e.g. Boolean operation, lofting, deformation, rotation and scaling.

4. Conclusion
In conclusion, in the development of the current architecture industry, all kinds of relevant technical means have achieved relatively ideal innovation and optimization, the traditional architectural design industry and design methods and architecture teaching are facing opportunities and challenges. Designers or computer engineering technicians working in the digital architecture industry are supposed to seriously think about the architecture in the digital era. Such thinking is not only limited to the application of digitalization technology, but also should be extended to how digitalization technology is influencing people's material and spiritual life in various aspects. Therefore, it is of great significance to strengthen the application of digitalization technology in architectural design.

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