Application of 3D Digital Technology in the substation design

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Abstract. During the operation of a substation, the requirements for the engineering design are very strict, requiring the cooperation of multiple professions, and the demand for engineering digitalization is also increasing. The three-dimensional digital technology is to effectively solve the problems encountered in the substation operation in the form of data representation and data storage, and provides reliable technical support and efficient concepts of technology for substation operation. This time, the main analysis of the specific application of 3D digital technology in the substation design, and combined with the actual situation of China's current substation, the development prospects of 3D digital design are analyzed and prospected.

1. Introduction
Design as an important link in engineering construction is not only to provide technical drawings that meet construction requirements, but also to establish basic data for the entire life cycle of the project, providing information support for subsequent procurement, construction, operation and maintenance, etc. With the improvement of design requirements and the improvement of computer technology, the design concept of the power industry has greatly developed, from the traditional 2D CAD design to the 3D digital design. With the continuous advancement of 3D digital design technology, the collaborative work of professional design will become closer, the degree of design automation will become higher and higher, and many specifications, standards and calculation processes will be highly integrated into the software platform, design efficiency and quality will be significantly improved.

2. Introduction to 3D digital technology
3D digital technology is a digital technology for information integration. Among them, 3D refers to the representational form of data, which is in sharp contrast with two-dimensional technology, which will make the graphical representation more intuitive and more beautifying. Digital technology is the way to save data, which is more precise, and can be modified, edited, and copy. Three-dimensional digital technology is also more widely used. Digital technology is based on the information model. Under the unified structure of the project, a platform is built around the project's work flow and capital flow to achieve resource sharing. Therefore, the rapid development of technology is driving the rapid development of design, and 3D digital technology is also an important tool for professional learning.
3. Characteristics of 3D digital design

Three-dimensional digital technology has strong visibility and operability. Its practical application is more extensive. It pays more attention to design quality and efficiency than traditional two-dimensional design. It can be better applied to transformer operation. It is the most effective helper for substation operation. It is an accurate and feasible design concept. After comparing 3D digital design with traditional 2D CAD design, we find that 3D digital design has the following characteristics.

3.1. High degree of visualization

The visualization of 3D digital technology is significantly higher than that of 2D CAD design, and its accuracy and intuitiveness are much higher than those of 2D CAD design. This also allows our owners to understand the designer’s design intentions more clearly. This has reduced misunderstandings and differences in the prerequisite communication process of engineering projects in China, and greatly improved the efficiency of engineering operations.

3.2. Transformation from drawing to data

Three-dimensional digital technology can transform traditional information of paper into computer data information for computer operation. Such a transformation saves a lot of manpower and material resources and is easier to save, and also improves the accuracy of the data. In addition, 3D digital technology can also convert relatively discrete electronic information into information of statistic data. Designers will not spend a lot of time looking for electronic information when designing drawings. Thirdly, 3D digital technology can also directly transform personal experience and lessons into knowledge accumulation of enterprises. This is very important for subsequent designers.

4. Application of 3D digital design of substation

The following uses the Bentley platform solution as an example to introduce the application of 3D digital design of substations.

4.1. Integrated Design Platform

The integrated design platform provides us with an advanced collaborative environment and enables our work to run more safely and efficiently.

Make management easier and more effective, what is, leaders or project managers can understand the status of the project in a timely manner; Designers can share information securely and quickly, allowing out-of-town personnel to participate in projects through remote access.
Establish a directory structure that meets various types of design documents for the project. Secondly, it is necessary to clearly define the majors to facilitate the inquiry and reference of models between different majors. A multi-level index directory with a hierarchical structure allows designers to quickly query and browse project files, providing a clear hierarchical structure for document management for collaborative design.

The integrated platform also has flexible functions of rights management. The read and write permissions of design documents are divided according to different functions of design of project members to ensure the accuracy of design files. The project owner always has reading access to all engineering documents, and the professional and responsible person only has reading and writing access to the models and drawings designed by him, forming a system of responsibility for the designer to his own volume, which effectively avoids misuse and error of the design documents.

4.2. Collaborative Design

4.2.1. Collaborative Design of 3D Reality Model. In order to design the project more accurately, UAV tilt photography technology was used for aerial photography of the substation site area in the early stage of the project. After obtaining the image, it went through the steps of geometric correction and joint adjustment of uniform and uniform multi-view images. After performing space-three calculations by software, an image-based ultra-high-density point cloud can be generated, and a high-resolution real-world 3D model based on the image texture is generated with a model resolution of 0.2 m. The real-world model establishes a precise environment space for the design of the substation and line outlets in the preliminary design stage. The subsequent digital design refers to the real-world model for reference planning and design. Relying on the accurate model, the preliminary design is carried out based on the feasibility design. The modification of each major will be reflected in the collaborative platform, and other majors can update the reference model in a timely manner and adjust the layout design of the major accordingly.

4.2.2. Inter-professional collaborative design. Each major works in a unified space, and cross-references and locates. Any major model modification will prompt other majors to update. The layout design of each specialty is coordinated. After the design is completed, it is checked and modified within the group. The revised model is released and the model is locked for release as a final reference for other disciplines. After all models are completed, a collision check is performed and a comprehensive review is performed to check the model's layout rationality and attribute integrity.

4.3. Professional design

(1) The symbols of the equipment components in the main wiring of electricity shall be associated with the equipment in the distribution device layout model.

(2) Three-dimensional electrical safety clearance and three-dimensional lightning protection verification should be completed to optimize the electrical layout of the entire station.

(3) Using three-dimensional digital design means for lightning protection design, providing three-dimensional visual lightning protection range, and making lightning protection verification more intuitive.

(4) Illumination calculation should be completed based on the lighting layout model. In DIALux, solid objects such as substation GIS equipment built in BBES can be directly imported, thereby simulating a more realistic scene environment and making the calculation results of illumination more accurate.

DIALux is used for indoor lighting calculation analysis, which simulates space scenes to make the calculation results more accurate. At the same time, the display of multiple effects makes the design results more intuitive, which improves the efficiency and accuracy of lighting design.
(5) The control cable laying design can realize automatic laying, and complete cable flow optimization, also use cable paths and cable channel cross sections in the best possible way, as well as knowing about automatic statistics of cable length, path nodes, and layering of cables.

(6) The list of materials is automatically counted from the model.

(7) High voltage cable design
Position and model the spatial trend of high-voltage cables, and perform cable collision detection based on the digital model of the entire station of the substation, effectively avoiding collisions between cables, cables and structures such as supports, walls, beams and columns, and the setting of the turning radius of the central axis of the cable ensures compliance of the cable design.

(8) Collision check
In the stage of construction drawing, in order to ensure the quality of the design, all majors conducted collision inspections, found collisions between majors, adjusted and modified in a timely manner, avoided design changes, and saved the cost and time of project construction.

5. Application of 3D Design Results

5.1. Sectioning 2D drawings
After the modeling of each specialty is completed, it is released after verification within the group, and the model is locked. After all models are completed, a collision check is performed and a comprehensive review is performed to check the model's layout rationality and attribute integrity. After the model is completed, each specialty generates a two-dimensional plan drawing, material statistics and other finished products by cutting the three-dimensional information model.

5.2. PDF Model
The model can be converted into a 3Dpdf file, even without a professional 3D platform, the information model can be smoothly viewed.

5.3. Mobile Application
In addition, install ProjectWise Explorer Mobile on the iPad mobile terminal to access the hospital server, and then view the model through Navigator Mobile. The constructional personnel can view the model information on the mobile terminal on site.

5.4. Picture rendering and roaming animation
The 3D model can be used to easily render pictures from various angles, and provide exquisite visual walking-through animation.

6. Conclusion
China's economy is developing at a rapid pace, electronic products are constantly increasing, and people's demand for electricity is increasing. Therefore, the speed of network construction of the power grid is also developing towards high efficiency and high indicators. This requires us to change the traditional concept and three-dimensional digital technology is applied to substation operation. Two-dimensional digital technology can no longer meet the needs of people and the power grid. It lacks control over the economics and optimization of detailed layouts, and it is not efficient, and it cannot meet the needs of power well. Therefore, in the power industry, the design of substations should be changed from two-dimensional design to three-dimensional digital technology as soon as possible. The traditional concept of design has fallen behind and must be reinvented to provide timely and accurate information for substation construction.

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