Research on the secondary design of prefabricated buildings based on Three-Dimensional

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Abstract: With the improvement of design requirements and computer technology, the three-dimensional design with multi-professional collaborative design, refined design and engineering digitization as the core, is being popularized and used in the substation engineering design of State Grid Corporation. This paper will use the three-dimensional software to deepen the design of prefabricated buildings, and refine assembly building design, embed pipeline and set openings reasonably, which would reduce the site labor input, shorten the construction period, and reduce the site construction risk, and improve the quality and technological level of engineering construction at the same time.

1. Introduction
In 2018, State Grid Corporation of China will fully implement three-dimensional (3D) design in power transmission and transformation projects of 35kV and above. First, through the establishment of an integrated design platform, multi-specialty design collaboration and real-time information exchange can be realized to effectively improve the quality and efficiency of engineering design. Second, 3D design with digital, visual features, can achieve full information simulation and improve the level of engineering construction.

As the main building structure of the substation, the secondary deepening design of the prefabricated steel structure seriously restricts the construction and installation in the later stage. The secondary deepening design of the prefabricated steel structure based on 3D design is actively carried out, which provides a reference for promoting the application and research of 3D digitization in the whole process of the substation.

2. Application status of three dimensional design in substation
At present, the application degree of substation three-dimensional design can be simply divided into four kinds.

2.1. 3D collision detection and roaming demonstration
The 3D collision detection and roaming demonstration mainly carries out the collision inspection of the 3D model of the substation and the owner's demonstration application through the establishment of the 3D model in the later stage, so as to provide the owner with intuitive and perceptual design demonstration, and provide help in optimizing the design to reduce the occupation area and on-site collision[1].
2.2. 3D drawing
Based on the establishment of the 3D model, the 2D construction drawing needed by the project is extracted from the 3D model by drawing customization of 3D software.

2.3. Collaborative design
On the same three-dimensional design platform, engineers of all specialties integrate computing analysis software and engineering management software, carry out multi-specialty cooperation and collaborative design, and realize three-dimensional design in the true sense according to the requirements of design specifications.

2.4. Digital handover
On At present, power grid engineering information is scattered among construction management and operation units, and there is no standardized and unified standard. Most of the information is in the form of paper medium drawings and documents, which is time-consuming and labor-consuming and easy to make mistakes. Digital handover While submitting drawing files of traditional design finished products, 3D models, electronic drawings and documents, databases, which include all stages of engineering design, are packaged and handed over in the form of substation digital engineering design information management platform[2].

With engineering equipment object as the core, coding as the main line, intelligent correlation and mutual verification, it provides basic data for owners' subsequent management and application of digital power plant.

3. Application of 3D design in the secondary design of prefabricated buildings
The current power transmission and transformation engineering of 3d design work has been through the pilot project promotion, but for the 3d design in prefabricated buildings secondary deepen design study is less, this section from the prefabricated building cladding, steel structure nodes and integrated pipeline three dimensional two aspects to discuss the three dimensional design application in the secondary prefabricated buildings design.

3.1. 3D design in the aluminum magnesium manganese alloy composite curtain wall integrated panel secondary deepening design
Magnesium aluminum manganese alloy composite wall integrated wallboard is a common wall plate, the integrated panel by 2 thick plate, waterproof breathable membrane, 150 thick steel exterior frame (wear $\Phi$ 50 cable tube in the keel, 150 thick fire rock wool clip), steam trap, 1 thick plate.

Building plates are processed in the factory and splice at the site. For electrical, grounding, fire protection and other facilities in the building, follow-up construction should be carried out at the substation site. In this way, there will be obvious exposed buried pipes, which will affect the appearance and increase the on-site workload. In order to realize factory processing and assembly construction in the real sense, a kind of embedded pipe structure based on assembly building is proposed[3].
Figure 1. Decomposition of a single wall panel based on 3D

Aluminum magnesium manganese alloy composite curtain wall integrated wall panels, if the daily maintenance is reasonable, the service life can reach more than 50 years, can meet the requirements of the building's 50-year service life, during which time there is no need to replace. The integrated wallboard and keel are all completed in the factory, which saves about 50% of the construction time of on-site wallboard installation.

3.2. 3D design in the secondary deepening design of assembled building steel structure joints

The node model of assembled building steel structure is established by using 3D design software, including beam-column connection model, liang-liang connecting nodes of node model and column connected to the node model, node structure model is obtained by using the finite element software, according to the calculation results to optimize the node, steel structure nodes and establish the 3d model library, convenient for engineering application in the future[4].

3.3. 3D design in the secondary deepening design of integrated pipeline

The secondary deepening design of integrated pipelines mainly focuses on electrical equipment and pipelines, considering various factors to meet the requirements of relevant specifications, operation and maintenance. In the comprehensive design, the transportation channels of electrical equipment should be fully considered. In short, the general rules for the layout of professional pipelines are to stagger, side by side, upward and compact installation as far as possible, and there must be enough space for maintenance and transportation of equipment[5].

Openings, buried pipes and doors and Windows required by large boxes such as switches, power boxes, lighting boxes and grounding terminal boxes are reserved during prefabrication according to the operation and maintenance requirements of the substation. 3D software is used to realize the rapid
establishment of 3D models and carry out collision inspection of pipelines.

Figure 3. Schematic diagram of the integrated wall panel pre-penetration pipe and opening

4. Conclusions
The secondary deepening design and application of the prefabricated steel structure buildings based on 3D can effectively optimize the pipeline and hole layout, reasonable embedded pipeline and set up the hole, realize the reasonable layout of the pipeline. At the same time, the refined 3D models and drawings provided by 3D design can reduce the design and construction of the hole and buried pipe error risk, save the construction period for on-site installation of wall panels, which can also improve the quality of the project.

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