Application of 3D modeling in power engineering survey and design

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Abstract. In the rapid development of social economy and science and technology, digital three-dimensional modeling technology has been widely used in machinery, architecture, planning and other fields. Especially in the era of big data, computer aided design software in power design began to innovate in the direction of 3D and digitalization. In order to keep up with the design requirements of the international market, Chinese scholars begin to focus on how to apply 3D modeling technology in the survey and design of electric power engineering, master the basic structure and operation characteristics of the digital 3D design software, and provide effective technical support for the survey and design of electric power engineering in the new era. Therefore, after understanding the unique advantages of digital 3D modeling technology, this paper takes 110kV overhead line in a certain area as an example to focus on the application of 3D modeling in power engineering survey and design, and then defines the development direction of 3D modeling software technology in the new era, so as to gradually replace the traditional power engineering design means.

Keywords: three-dimensional modeling; Electric power engineering; Survey and design; Electrical appliance design; Information model.

1. Introducion

In the wide application of computer 3D modeling technology, relevant technical theories have great contributions to social construction and development. From the perspective of practical application, three-dimensional technology can let people know in advance the final form of the object that has not been implemented, such as architectural renderings, automobile models, industrial product molds, etc., which belongs to an emerging industry in the construction and development of modern society and plays an important role in various fields. In essence, 3D modeling technology is proposed based on computer 3D drawing software. It can draw things in real life or design according to a certain scale, so that people can perceive their final shape, texture, color, etc., and effectively deal with various problems of traditional design calculation. Nowadays, the common 3D drawing software in the market includes 3D Max, CAD, etc. Each technical software has its own unique characteristics, which should be randomly selected according to the technical functions and application characteristics. One of the most representative is 3D Max, which has powerful functions and is mainly suitable for automobile model design, industrial product modeling and other aspects.[1-3]

With the rapid development of computer hardware and software technology, the application scope of computer-aided design in the electric power industry is more and more wide. Compared with the traditional three-dimensional design platform, the information storage and transmission quality of the new three-dimensional modeling design has been comprehensively improved, and it has been widely used in electric power engineering projects, with the characteristics of data integration, intuitiveness, cooperation and so on. From the perspective of power engineering survey and design, the use of two-dimensional maps to show the convenience of engineering survey, although the results meet the requirements of traditional engineering construction management, but in order to better meet the requirements of engineering construction management in the new era, some scholars proposed to use three-dimensional modeling technology to design operations. The reason is that two-dimensional picture information shows a relatively simple content, can not help

the staff quickly understand the complex geological conditions of the construction area. The 3D stratum structure model can show the stratum distribution of power engineering area directly, which is very important for site construction management and project design. At present, 3D geological models mainly stay in the model display stage, and have not been widely used in engineering investigation reports. This is because relevant enterprises have not really realized the application value of 3D modeling technology and have not mastered the relevant technical and theoretical knowledge, so it is difficult to give full play to the important role of such technical means during the investigation and design of electric power engineering. For example, a 3D terrain model of a block based on borehole information can show the following: first, the underlying distribution of the entire block; Secondly, the stripping of all strata is fully displayed; Thirdly, any path profile cutting state, intuitively select the stratum distribution and pile foundation bearing layer; Finally, the distribution shows the uniformity of the subsoil layer, defining the thickness of the soil layer and the phenomenon of missing or interlayer. Therefore, after understanding the basic requirements and development status of power engineering investigation and design, this paper studies the application effect of 3D geological modeling technology in power engineering investigation and design according to the main content and application direction of 3D modeling technology, taking the substation of a certain area as an example.[4-6]

2. Methods

2.1 Application Development

No matter in which field the 3D modeling software technology is applied, the practical working principle is consistent. For the investigation and design of electric power engineering, technology and pipe distribution are the main contents, among which the pipeline computer-aided design process is shown in Figure 1 below:

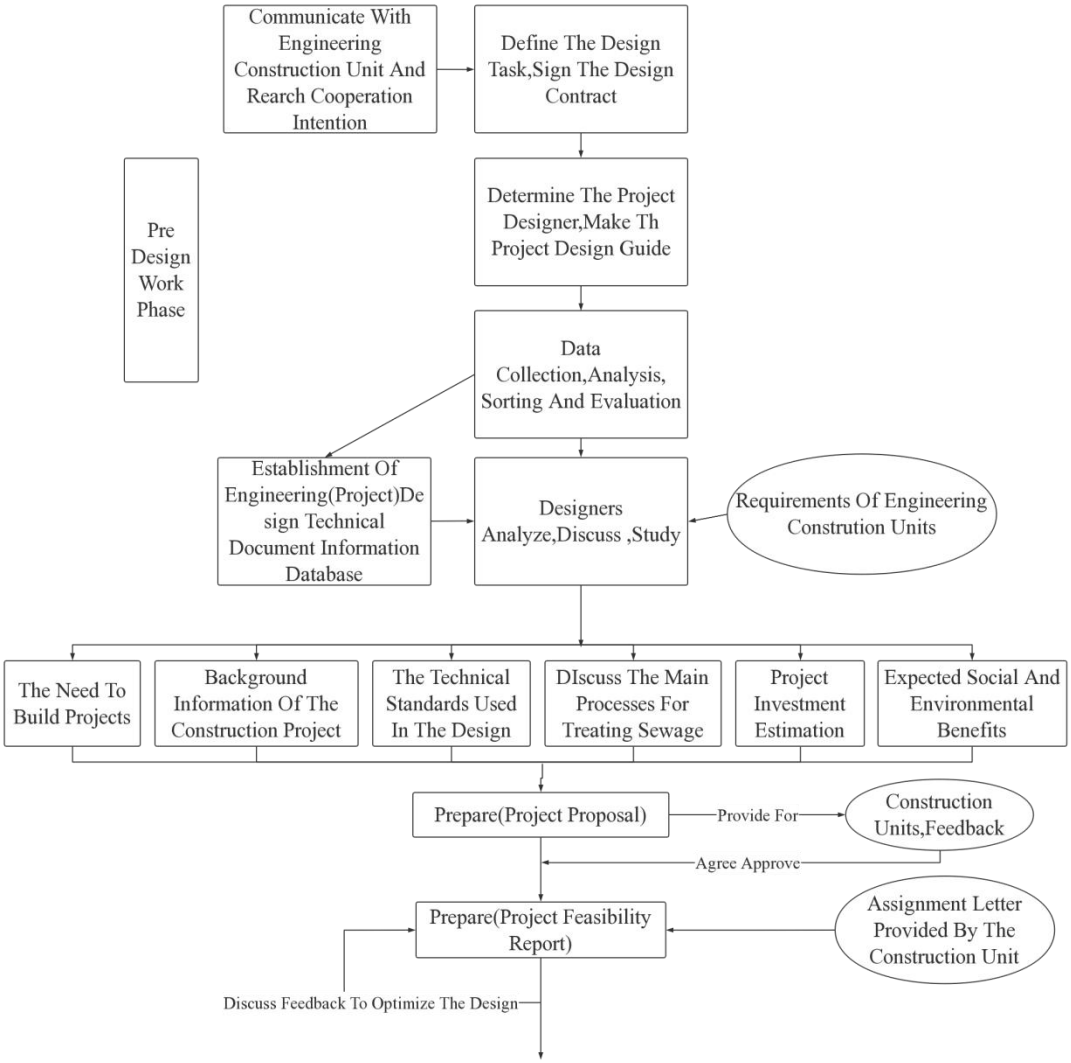

Figure 1. Flow chart of computer aided design

Based on the above figure, you can see that specific operations involve the following steps: First, prepare the conditions. The pipe material control staff shall use the computer platform to establish the pipe material grade table required by the pipe distribution database, which includes the manufacturer's product data, pipe and component standards, pipe design specialty, etc., which are derived from pipe control, pipe equipment, supply system, etc. Secondly, the distribution database. Pipe material control professionals will enter pipe grade tables and related dimensional parameters into the database to adjust the accuracy and feasibility of the test database. It should be noted that since most engineering projects are ongoing, the database should be continuously improved; Thirdly, the piping model is established and the piping program is run. Designers should use the tools provided by the system to build a framework model and then implement human-computer interaction design under the guidance of hierarchical specifications. By mastering the overall pipeline trend and using the stress analysis program, checking calculation analysis is carried out according to the traditional work experience, to determine the specific stress situation and readjust the pipeline trend, and finally to form a standardized and perfect three-dimensional model diagram. After the modeling, the staff should use the collision test function to calibrate the collision between the pipeline, the building and the equipment, and then adjust the wrong area according to the verification results to orderly complete the 3D piping modeling. Finally, the engineering drawing is generated from the 3D pipe model. After the construction of the three-dimensional model, it is necessary to use the design system to provide a plan generation subsystem, pay attention to the effective association with the system database, so as to obtain the plan and stereogram of the construction pipeline. At the same time, axonometric and piping material tables are automatically or

semi-automatically generated using program or axonometric generation software to facilitate product production and site installation. Because the investigation and design of electric power engineering mainly focus on the process and pipe distribution, the database conforming to the standards of electric power industry should be built first when applying the 3D modeling technology, so as to provide effective basis for the practical exploration and application.[7-9]

2.2 Modeling Analysis

On the one hand, string modeling of gold tools. By using the database of 3D modeling technology, it enables the graphic 3D assembly of the string of hardware, and supports the functions of hardware connection inspection, matching size inspection, collision inspection, load matching, etc. After assembly, the length, weight and other values will be calculated automatically. On the other hand, tower modeling. This three-dimensional model can accurately show the form and dimensions of the tower, including basic information such as weight, material and condition.

2.3 Three-dimensional geographic information model

In the establishment of 3D geographic information model by oblique photography, the scheme selection process includes the following points: first, determine the starting point of the line and the surrounding grid planning scheme; Second, download image data from the network; Thirdly, according to the distribution of villages, a multi-path scheme is selected. Fourthly, collect the distribution planning information of road network, basic farmland and inflammable and explosive materials in municipal departments; Fifth, the scientific adjustment of the path scheme; Sixth, clear the range of aerial photography; Seventh, after comparing multiple path schemes, choose the best technical scheme. After sorting out the geographic information data obtained by 3D design in recent years, the comparison results of various image data are shown in Table 1 below:

Table 1 Comparison results of image data

Contrast project	timeliness	precision	use-cost	major advantage	Main disadvantages
Network satellite film	common	low	ignore	Download from the network, without outdoor work.	The elevation accuracy is low, and it can only be used as an auxiliary for early line selection.
Orthophoto image	tall	The plane accuracy is high, and the elevation is difficult to implement in 3D software.	low	Low cost and clear image.	The dem elevation recognition degree is poor, and the ground objects have to be modeled one by one, so the accuracy of ground object

					elevation is low.
oblique photograph	tall	High plane and elevation accuracy	tall	The features have clear appearance, high elevation accuracy and intuitive display.	Can't automatically identify the type of ground objects, and all of them are electrically verified by ground objects.
Point cloud	tall	Plane and precision tell height	highest	The features are clear in appearance and highly accurate, and can penetrate vegetation to the ground.	The data is embodied in the form of points, which is difficult to be processed in the later stage. It is mainly used for display and can measure the conductor and ground wire of the line.
electronic map	minimum	low	There is no capital cost, but the application is cumbersome	The elevation accuracy is acceptable and meets the requirements of initial design.	Can not reflect the recent changes in features, drawings can not be intuitive.

Based on the analysis of the above table, it is found that during the survey and design of electric power engineering, selecting UAV, collecting relevant data information by means of tilt photography, and completing 3D modeling based on pictures with POS data can not only solve various problems faced by traditional manual model design, but also effectively control the cost of survey and design, ensuring that the staff can, after modeling, Master the exterior and three-dimensional dimensions of all buildings.[10-15]

2.4 Electrical Design

First, three-dimensional line selection. According to the analysis of the previous path scheme, the position of the corner pole tower should be determined according to the service conditions of the tower, and then the terrain curve of the center line and side wire of the path should be generated after the elevation is extracted. It should be noted that, in the process of line selection, the corner tower should be determined from the 3D interface first. There will be deviations in the optimal tower position judged by the naked eye. Therefore, the staff can modify the tower position by combining 2D section; Second, the tower line. This kind of wire erection can be divided into three forms. Usually, the pile position upright tower is used to determine the tower type of the corner tower, and then a single upright tower is used to adjust the height of the corner tower. Finally, electrical check. Electrical check includes guide ground match, wire distance to ground, cross crossing distance, parallel line spacing check and so on. Since the 3D modeling software contains a complete database, the data changes of different regions during the experiment can be comprehensively considered during the verification period, so as to realize the 3D visual verification analysis and comprehensively improve the design accuracy and work efficiency.

2.5 Structure Design

According to the analysis of the design flow chart shown in FIG. 2 below, during the investigation and design of electric power engineering, it is necessary to scientifically check the hydrometeorological and other basic conditions according to the path scheme, and preferentially select the foundation forms suitable for different regions of electric power engineering according to the stress conditions of various tower foundations.

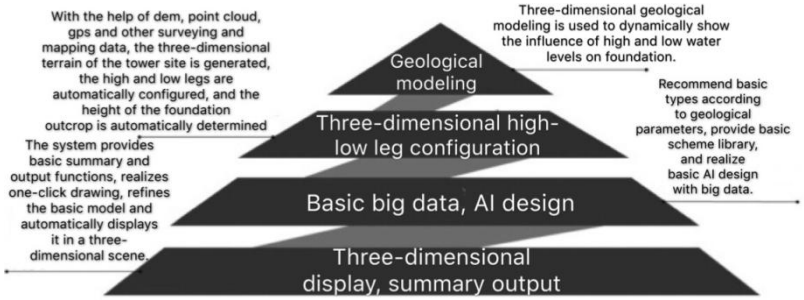

Figure 2. Flow chart of basic design

3. Result analysis

Combined with the survey and design requirements of electric power engineering mastered in the above studies and the analysis of the application content of three-dimensional modeling, it can be seen that in the development of modern economic construction, digital three-dimensional modeling design software plays a positive role in electric power engineering. Taking Istation software as an example, it can directly put forward the overall process and working characteristics based on the design of smart substation, with certain compatibility and intelligence. The staff only need to provide the basic ideas and relevant parameters of engineering design, and the software can automatically generate the interval section map and plan, and orderly complete the short-circuit calculation, equipment selection, tension calculation, grounding design and other work. Compared with the primary design plane of electrical appliances, Istation software can present 3D model renderings and animation forms through 3D modeling, which is convenient for staff to understand from multiple angles and finally form the design scheme. The application characteristics of Istation software are shown in Table 2 below:

Table 2 Application characteristics of Istation software

Project module	IStation
Three-dimensio	Using autocad to draw 3D graphics is simple and convenient.

nal modeling	
Gallery structure	The combination of three-dimensional gallery and two-dimensional gallery can not only meet the requirements of three-dimensional design, but also meet the requirements of two-dimensional construction drawing design
database	Access data structure is adopted, without additional database software, and the gallery and database are completely combined. All performance parameters and the gallery can be directly retrieved through fields such as equipment model, and the graphics and database are completely open and can be expanded and modified at will.
Safety distance check	According to the specification requirements, the safety distance between electrical equipment can be checked, and several projects in a certain area can be checked in various ways.
Interval model	Using model to define common interval plane sections, splicing can be directly called in the software.
Electrical calculation	Electrical design modules such as short-circuit current, conductor tension sag, grounding current, grounding resistance, step voltage, contact potential, etc. are embedded, and calculation parameters can be directly extracted from drawings to run calculations.
lightning protection	Can carry out three-dimensional lightning protection design and protection range verification, including the three-dimensional effect of lightning rod, lightning wire and joint protection range.
other	Automatically fill in the stamp, automatically generate the drawing catalogue, and automatically generate the volume material list and the engineering equipment material summary table. Be able to map in batch print. Including multi-line text, dimension marking, professional marking, table processing and other complete sets of auxiliary tools.

However, from the perspective of overall development, there are still many problems in the application of 3D modeling software technology in the investigation and design of electric power engineering. Taking modifying the setting of the arcs of the old line of cross-crossing line as an example, the arcs of the working condition are calculated repeatedly according to the process in Figure 3 below. Since the arcs of the old line may be different from the theoretical data, the safety factor input by the software is not consistent with the actual line, and it is difficult to accurately simulate the actual arcs in the end. Nowadays, during the investigation and design of power engineering, the staff will input the observed temperature, line, meteorological conditions and other parameters, and calculate the arc of the actual working condition several times in strict accordance with the regulations, so as to avoid unnecessary safety risks in the construction and management of the project.

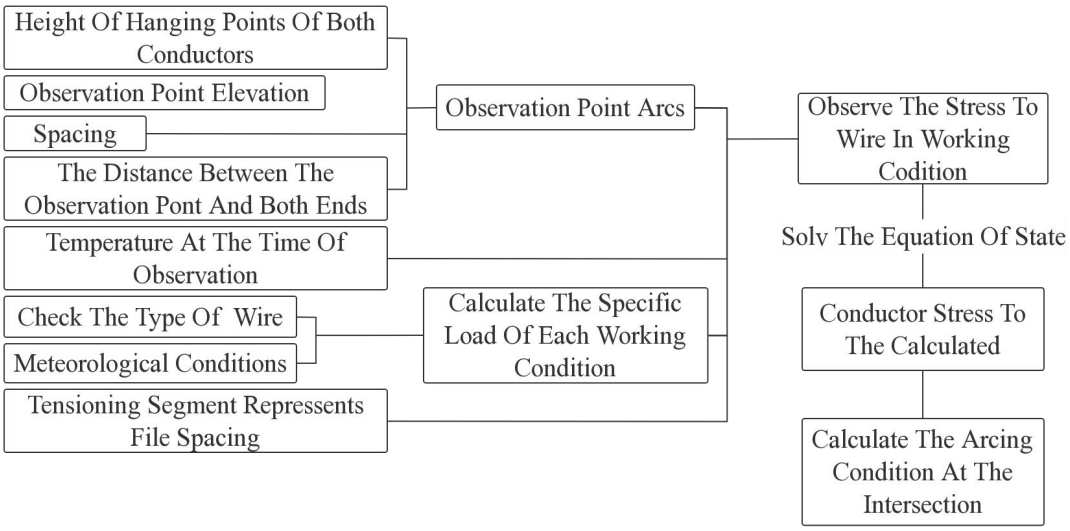

Figure . 3 Flow chart of old line sag treatment

4. Conclusion

To sum up, 3D modeling software technology has gradually replaced the traditional working mode with drawing design as the core, and the survey and design work of electric power engineering has been transformed from two-dimensional graphic design to three-dimensional design. In this way, the project design scheme can be visually presented, and the appropriate operation path can be conveniently selected by the staff to avoid unnecessary safety risks in the field measurement. Therefore, while strengthening the application research of 3D modeling software technology in the field of electric power engineering, it begins to combine with the needs of field investigation and design to optimize and innovate, so as to build an intelligent and digital management platform, which provides strong support for the site construction operations management.

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