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Abstract. The abstract should summarize the contents of the paper in short terms, i.e. 150-250 words. This article introduces the commonly used digital quantity calculation software Guanglianda in the civil construction market to calculate the sub item quantities of modern power plant civil engineering. Through research and practice, it has been proven that the Guanglian Da quantity calculation software is basically suitable for the calculation of modern power plant engineering quantities, which can greatly improve the efficiency of engineering quantity calculation and solve the constraints in traditional modern power plant measurement work. It is worth promoting. This article also proposes targeted solutions to the limitations of this digital quantity calculation software in modern power plant engineering quantity calculation, hoping to better use modern means to solve the problem of modern power plant engineering quantity calculation.

Keywords: Digitalization, Engineering Quantity, Guanglian Da, Modern Power Plant

1 Introduction

The determination of engineering cost is based on the number of sub projects to be completed and the measures taken to complete the sub projects. It is necessary to make correct calculations for the quantity of sub projects or measures. Due to the multi-stage and multi-level nature of engineering pricing, engineering measurement also has multi-stage and multi-level characteristics, including not only the engineering quantity in the preliminary design stage estimate document, the engineering quantity in the bidding stage engineering quantity list preparation, but also the engineering quantity in the bidding quotation stage and the contract performance stage change, payment, and settlement. The determination of engineering quantity is one of the most fundamental and important tasks in engineering valuation and investment control, but it is also the most labor-intensive, time-consuming, and error prone part. Due to the

large scale and complex design of modern power plant engineering, the amount of work used to be mainly calculated through manual spreadsheets. This working method not only has low efficiency, but also has insufficient accuracy for some complex sub items in certain situations.

This article introduces the most common digital quantity calculation software in the current civil market - Guanglian Da Quantity Calculation Software, to calculate the quantity of modern power plant civil engineering projects. Study the applicability of Guanglianda calculation software in modern power plants, and discuss methods to improve the quality and efficiency of engineering quantity calculation in modern power plants using Guanglianda calculation software.

2 Guanglian Da Computing Software

2.1 Introduction to Guanglian Da Computing Software

The software is based on the national standard and peace law standard atlas, adopts the overall modeling method according to the local calculation rules and the national unified list calculation rules, considers the relationship between various components as a whole, and supplements with direct input to solve the problem of calculating the quantity of components at each stage. The calculation software also has a change function, which can show in detail the engineering quantity changes due to design changes.
There are different list calculation rules and quota calculation rules embedded in the calculation software, and users can choose the required calculation rules according to the actual situation of the project. When the default calculation rules of the system cannot meet the requirements of users, the software provides personalized modification options, and users can modify the calculation rules of various calculation items according to their own requirements.

2.2 The significance of the calculation of engineering quantity by Glodon computation software

Improve computational efficiency and quality. Manual calculation is the traditional method of engineering quantity calculation, but the efficiency of manual calculation is very low. At the same time, the project scale of modern power plant is huge, the workload of manual calculation is very large, and often can not keep up with the required progress. And the manual algorithm is not accurate enough, due to the errors of the staff or the different interpretation of the drawings by different personnel, the quantity calculation error is always hard to control but often cannot be completely avoided in the quantity calculation. The computer software of Guanglianda is used to reduce the difficulty of engineering quantity calculation and improve the efficiency of engineering quantity calculation.

3D graphics improve the understanding of engineering. Using Guanglianda calculation software for modeling, it is easy to realize the transformation between plane graphics and stereo graphics in all directions, and it is convenient to recognize graphics.

To solve the problem that the current three-dimensional graphics can not be applied to the nuclear power plant engineering measurement. At present, the 3D center carries out the 3D modeling of the nuclear power plant project, and transforms the drawings from plane to three-dimensional graphics. However, because the three-dimensional model of the three-dimensional center can not distinguish between the wall, beam, plate, column and other components in civil engineering, and can only calculate the total amount of concrete, the total amount of concrete can only play a role in checking whether the manual calculation of concrete components is correct. This problem is solved by modeling with the components of Guanglianda and then summing up the calculation.

2.3 The foundation of the application of Guanglianda calculation software in modern power plants

Guanglianda calculation software is widely used in the civil building market, because the civil building design is simple, drawing specification, the CAD drawings are directly imported into the GuangLianda software, identification, and then calculation, the efficiency is greatly improved. However, the nuclear power plant project is huge, the design is complex, the standardization of the drawings is lack, and the recognition efficiency of Guanglianda is very low. In addition, the Guanglianda can not realize the calculation of some special components of modern power plants, which makes the GuangLianda has not been applied to the nuclear power plant project quantity calculation.

Although the design of modern power plants is complex, Guanglianda can not be directly recognized, but modern power plants, like general civil buildings, are also composed of basic components such as walls, beams, plates, columns, etc. The new version of Guanglianda software also opens some functions that limit the application of modern power plants (like the limit of the number of floors of a floor), users can modify the calculation rules of various calculation projects according to their own requirements. Guanglianda added the function of custom components, which laid the foundation for the application of Guanglianda calculation software in modern power plants. In this paper, the engineering quantity of modern power plant is calculated by the way of drawing and modeling.

3 The applicability of Guanglianda calculation software to modern power plants

3.1 Quantity calculation of the regular factory

Use Guanglianda graphic calculation software for modeling, and draw the plane design drawings into the GuangLianda software to form a 3D model, and take a

factory model of a certain project, as shown in Figure 1. As shown in the example, the engineering quantities of each component, each type of component and all components can be obtained separately by summary calculation. The calculation results not only include the most commonly used concrete volume, but also other required engineering quantities such as formwork and scaffolding, and each original parameter can be traced.

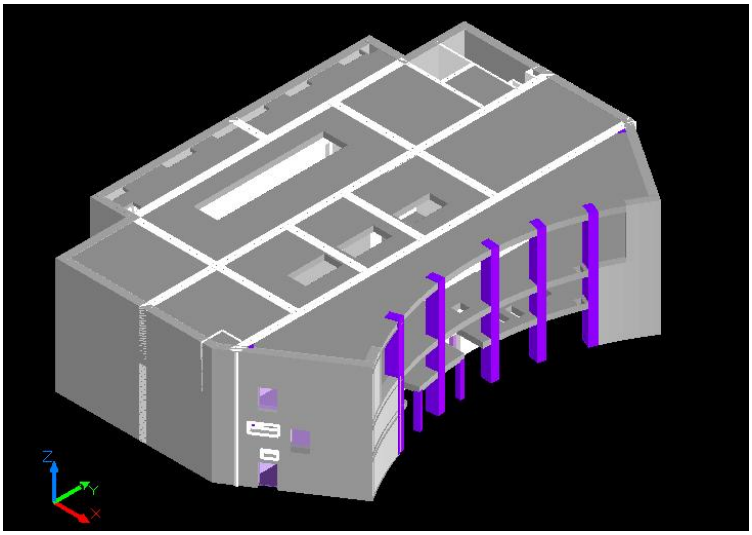

Fig 1 3D model of plant

In manual calculation, some components are easy to be ignored, missed or misclassified. With the Guanglianda calculation software to calculate, through the correct setting of calculation rules, GuangLianda will help designers to calculate and statistics. A common example is the short-limb shear wall: the shear wall whose section thickness is no more than 300mm and the maximum height to thickness ratio of each section is greater than 4 and less than 8 is defined as the short-limb shear wall. Because of the force, reinforcement and construction method of this kind of members are different from the general shear wall, the amount of work needs to be calculated separately. In the manual calculation, for each shear wall, it is necessary to judge whether it is a common shear wall or a short-limb shear wall, which is very error-prone. Using software calculation, the system automatically judges when calculating, to help designers distinguish different types of walls. This will greatly improve the quality of engineering quantity calculation.

Compared with civil buildings, modern power plants are more complex as a whole, but most of the plants still belong to relatively regular buildings such as safety plants. Modeling and engineering quantity calculation can be completed by defining and drawing the components of the system.

3.2 Quantity calculation of projects that cannot be accurately calculated

In some factories or projects, because of irregularity, according to the current manual calculation method, the calculation of the overlap of each sub-block is not very

accurate. When the error is accumulated, the total amount of engineering quantity may have a relatively large deviation. Guanglianda can improve the accuracy of the overall engineering quantity by improving the accuracy of the engineering quantity of each sub-block.

The calculation of negative excavation quantity of nuclear island in modern power plant belongs to this type. In the calculation of the quantity of negative excavation, the calculation method of the average value of the upper and lower bottom area multiplied by the depth is usually used in the hand calculation. However, the actual negative excavation engineering is very complex, and the section plan of the design drawings sometimes can not express the actual situation of each section and each section. More importantly, the slope should be considered according to the site conditions when calculating the amount of negative excavation, which often leads to the horizontal overlap of the negative excavation projects of adjacent subitems. When the horizontal projections of buildings and structures with different elevations overlap, the negative excavation project forms a cross overlap in the vertical direction, as shown in Figure 2.

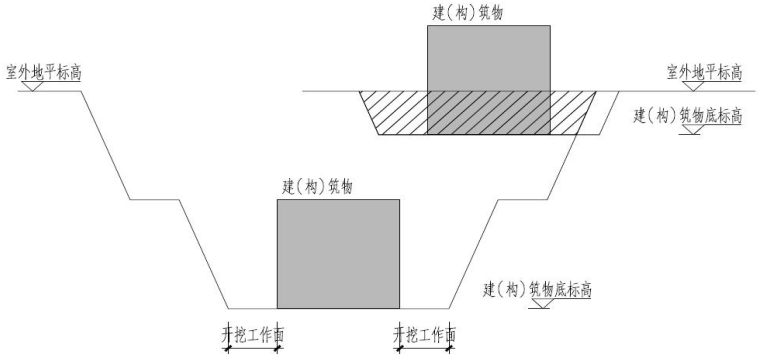

Fig. 2 Schematic diagram of the cross overlap situation of negative mining

The design department can not consider the above cross overlap when drawing according to the subitem. The negative excavation amount is calculated according to the molecular item of the design drawing. The amount of cross overlap part is repeatedly measured, which greatly affects the calculation accuracy of negative excavation amount and is very unfavorable to the investment control of negative excavation project. In this case, Guanglianda modeling is used to summarize and calculate the negative excavation models of each plant and channel according to the position of each plant and channel in the general drawing. After the model of each sub-item is established, it is packaged and saved as a "block" unit. When the overall model of negative mining is established, each "block" is extracted and inserted into the appropriate position in the total diagram. In the GuangLianda calculation rule, the volume of the intersecting part is set to be deducted according to the actual, and the overall model of negative excavation is obtained. The accuracy of the engineering quantity obtained is greatly improved compared with the hand calculation.

3.3 Engineering quantity calculation of irregular components

For some irregular, variable section or curved surface components, it is also possible to use the Guanglianda calculation software to rotate, move custom lines, custom surfaces and other ways to carry out modeling and calculation, but the calculation efficiency of this component is not much different from that of hand calculation.

3.4 Calculation of decoration quantity

Different from general civil construction, the decoration of modern power plants is much simpler than general civil buildings. The decoration function of civil construction calculation software can basically meet all types of decoration of modern power plants, and it is convenient and quick to calculate with software.

3.5 Application of rebar calculation software in modern power plants

Compared with the calculation amount of civil construction graphics, the calculation amount of reinforcement is much more limited in the use of modern power plants. 1) In modern power plants, the thickness of wall and board is relatively large, so there is at least one layer of reinforcement in the middle of the wall board. The reinforcement in the middle layer cannot be arranged in the system of Guanglianda, so the length and number of roots must be calculated manually and input into the software. 2) For circular or curved surface components, the rebar calculation cannot be arranged. The length and quantity of rebar should also be calculated manually. Considering that the modern power plant part of the design of steel reinforcement reinforcement map has been out of the steel table, in this case, the Guanglianda steel calculation software can calculate steel reinforcement is not so important.

4 The convenience of Guanglianda calculation software to modern power plants

4.1 Convenience of Guanglianda calculation software in different measurement stages

In the preliminary budget stage, construction drawing budget stage and bidding stage, the quantity of works shall be calculated according to different rules. In the preliminary budget stage, the quantity of works shall be calculated according to the calculation rules stipulated by the budget quota; in the budget stage, the quantity of works shall be calculated according to the calculation rules stipulated by the budget quota; in the bidding stage, the quantity of works shall be calculated according to the calculation rules stipulated by the bidding bill. These calculation rules are different, and the calculated quantities are also different. Under the traditional calculation method, the engineering quantity needs to be recalculated at different stages. The new engineering quantity can be obtained automatically by modifying the corresponding calculation rules or some parameters by using the Guanglianda calculation software.

For example, the calculation of earthwork quantities. According to the "Code for the Calculation of Quantities of Building Construction and Decoration Engineering" (GB 50854-2013), earthwork quantity is calculated according to the size of the design drawings [1], and according to the "Nuclear Power Plant Construction Project Budget Quota" (2014 edition), the calculation of earthwork quantity needs to consider soil types and construction methods. It is necessary to put slope and reserve working surface [2]. For the same building or the same set of drawings, the bidding bill of quantities and the general (pre) calculation should be respectively calculated, because of the different calculation rules, the quantities need to be calculated respectively. When the building scale is large or the component type is complex, it is more troublesome and time-consuming to calculate separately. Using Guanglianda calculation software, it is convenient to get different engineering quantities by modifying the working width and slope coefficient.

4.2 The convenience of GuangLianda calculation software when upgrading design drawings

In the process of nuclear power plant project design, it is very common to upgrade the drawing. When the first edition (A) of the design drawings is completed, the cost consulting department starts to prepare the bidding bill of quantities. At the same time, the design drawings are constantly upgrading, the real construction drawings are the C version or D version of the possibility is very high, which adds a lot of extra work to the cost consulting department, and the bidding bill of quantities can not keep up with the rhythm of the design version upgrading, which leads to the bidding bill of quantities is likely to have a relatively large difference with the quantity of the drawings used for construction. To the late amount and completion settlement difficulties.

Use Guanglianda quantity calculation software for quantity calculation, modeling after the first version of the design drawings is completed, if the drawings are upgraded, only the changes in the drawings are corrected, instead of repeatedly making the bidding list. The cost consulting department therefore reduces unnecessary duplication of labor and saves manpower and material resources.

4.3 Convenience of quantity with construction units

When the construction of all or part of the project of the modern power plant is completed, the cost consulting unit and the construction unit will check the quantity of the project, which is an important basis for the completion settlement. Because of the large scale and complex technology of nuclear power plant project, the work of engineering quantity check is complicated and tedious. Guanglianda calculation software provides the function of quantity, if the cost consulting unit and the construction unit agree to use the same version of the software for quantity calculation, through the quantity software, you can compare the cost consulting unit and the construction unit of the quantity difference and quantity difference, and then the two sides of the difference part of the processing, can complete the quantity work, which not only improves the work efficiency, It also brings convenience to both sides.

5 Application prospect of Guanglianda calculation software in modern power plants

To sum up, Guanglianda quantity calculation software can be used for engineering quantity calculation of modern power plants. By introducing Guanglianda quantity calculation software to calculate the engineering quantity of plants with regular structure forms, the quality and efficiency of engineering quantity calculation can be greatly improved, and the limitation of insufficient calculation accuracy of partial items such as negative excavation can be solved in the past modern power plant measurement work. It can be extended to calculate the quantity of civil engineering with the software of Guanglianda. However, Guanglianda is inefficient in dealing with some special components, complex components and reinforcement problems, which limits the application of Guanglianda software in all projects of modern power plants. If the following problems are solved, it is believed that GuangLianda will have a good application prospect in the application of modern power plants.

The checklist calculation rules and quota calculation rules commonly used in modern power plants are introduced into the system. Guanglianda calculation distinguish between single library and quota library, the latest GuangLianda calculation software list rules have included the latest version of the national standard construction and decoration engineering quantity calculation specification, which can meet the requirements at present, but the list specification of the nuclear power industry has been compiled, after the list is released, It is unknown whether the current national standard list can meet the requirements of modern power plant bidding project quantity list. The most commonly used quota in modern power plants is the industry quota, and the special industry quota is not in the current quota database of the Guanglianda calculation software.

Supplement the components commonly used in modern power plants and general industrial buildings. Containment, cow leg and so on are common components of modern power plants. Although the current Guanglianda calculation software can be realized, the process is still complicated. If the software includes these components, it will greatly increase the applicability of Guanglianda in modern power plants.

Increase the processing of variable cross section components. Guanglianda can only build fixed width walls and fixed thickness of the plate, raft, etc., modern power plants, which is not applicable to the variable section of modern power plants.

Perfect reinforcement function. As mentioned above, Guanglianda can not deal with the layout of the middle layers of the component, nor can it arrange the arc rebar, which are the two most critical problems that limit the application of the rebar calculation software in modern power plants. If these two problems can be solved, the calculation of rebar engineering quantity will be greatly simplified.

6 Conclusion

Quantity calculation is an important basis of all stages of engineering valuation. It is of great significance to calculate quantity correctly and efficiently. The quality and

efficiency of engineering quantity calculation can be greatly improved by using Guanglianda quantity calculation software to calculate the engineering quantity of the plants with regular structure in modern power plants, and it can also solve the constraints in the measurement work of modern power plants in the past, which is worth promoting. This paper explores the scope of the application of Guanglianda in modern power plant engineering quantity calculation. For the limitations of the digital quantity calculation software in modern power plant engineering quantity calculation, this paper also puts forward targeted solutions, and also puts forward the urgent problems to be solved in the application of Guanglianda calculation software in modern power plant engineering quantity calculation. Hope to better use modern means to solve the problem of modern power plant engineering calculation.

References

1. GB 50584-2013.Standard method of measurement for building construction and fitting-out works [S].
2. The detailed estimate norm for construction work of nuclear electrical power plant(2013).[S]