

VISUAL BASIC-TECHNICAL DESIGN OF SALT PAN SOFTWARE

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Abstract: Based on the complexity of the technology calculation of salt pan and the application tendency of computer software, and taking the modularization designing idea as the direction, utilizing Visual Basic 6.0 which is a visual program language facing the objects as the platform, the second-generation "VB-Technical Design of Salt Pan" software with friendly user interface and more powerful functions has been developed successfully in this study. The general structure of software and the key point of function realization are described in this paper, and at last a concrete application example was also given in this paper.

Key words: Visual Basic (VB); technical design of salt pan; brine production; crystallization; production management

PREFACE

The technical design of salt pan is instructional in the construction and technological transformation of solar salt field. But due to the complexity of the working process, it needs to select the suitable design parameters and make calculations repeatedly to get the actual results. Therefore, since the 1980s, the technicians of salt industry have tried to introduce the computer technology into the technical design of salt pan, in which Li Liangxian [1], Liang Shengyu [2] and others have done a lot of useful work. Especially the first-generation computer software described by the article "Technical Calculation of Salt Pan Design" software [3], has achieved the ingenious integration between the programming language and the technical and calculating method of salt pan,

facilitating the application and improving the reliability and accuracy of the calculating process greatly, shortening the working hours and getting the universal application. However, with the increasing development of computer technology, the first-generation computer software compiled by the Basic language and based on the DOS operating system has revealed the increasing shortcomings and deficiency such as the single interface, simple functions, poor flexibility and the weaker ability of controlling by designers. Accordingly, a new kind of software with more powerful functions and higher flexibility needs to be developed.

The paper attempts to develop the above-mentioned computer software named VB-Technical Design of Salt Pan Software which is based on the Windows operating system, with the

object-oriented design methods and programming language is used, i.e. Visual Basic. As we known, Visual Basic which has the excellent advantages over other languages is the most powerful programming language among all the software development tools. It is not only easy to learn and inherited the basic characteristics of interactive programming from the Basic language, but also has the user-friendly development interface, perfect functions, higher flexibility and lower desire to the running environment. In addition, because of its full support for the visual programming and the controlling function of data access, as well as the powerful ability to develop the database applications, it is very easy to be accepted [4].

The second-generation "VB-Technical Design of Salt Pan" software not only retains and enhances the functions of the original software, but also adds some new ones. For example, users can make necessary changes and complementarities to the calculation source procedures according to the actual production requirement, and they can also transfer and storage the existent data or add new data at any moment during the calculation process, with carrying out the verification of the existing salt as well as doing the new design. Moreover, the automatically generated tendency chart provides great convenience for the technicians to analysis, compare and

choose the best information. In addition, the calculation results can be stated in the form of the report forms or graphics which can make the expression more intuitional, concrete and vivid. The realization of these functions not only supplies the reliable basis to the technical design and production management of salt plant, with saving time and energy for the technical staffs, but also provides the effective protection for the storage management of production materials. Consequently, it is suitable to apply to the production and management departments of salt field due to its strong value of popularize and application.

INSTRUCTION OF SOFTWARE

"VB-Technical Design of Salt Pan" software was compiled by adopting Visual Basic 6.0 of Microsoft Co., Ltd as the development tools, using Windows as the operating platform and Excel to generate the report forms, transferring AutoCAD to display the graphics, providing the database support by Access2003, linking to the datasheet through ADO under the environment of VB, and calling the data in the table by the statements of SQL. The flow diagram of "VB-Technical Design of Solar Salt Plant" software is shown in Fig.1.

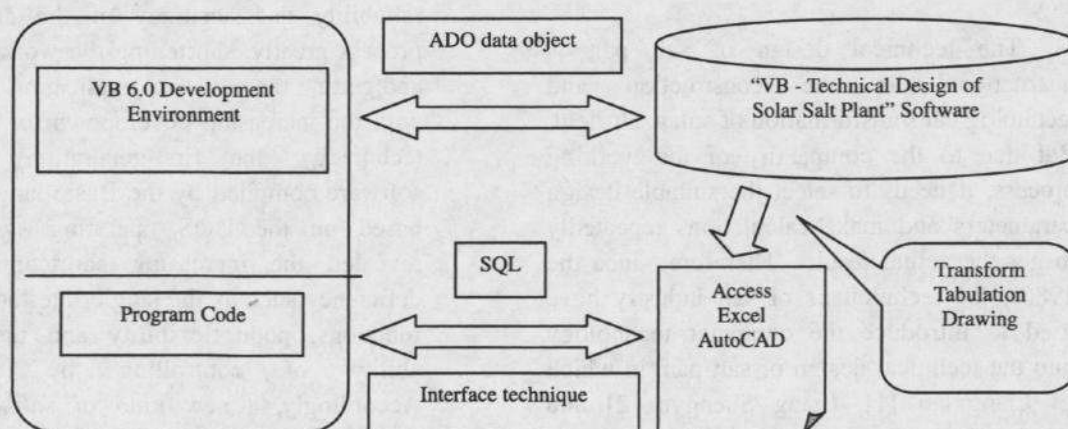


Fig.1 Flow diagram of software

The software is made up of four parts including one main interface and three sub-interfaces, which has utilized the Resource

View (Engineering Resources View) provided by Visual Basic to design the menu of the program's interfaces, with adding six main

menus such as "Function Selection", "Area Proportion of Evaporation to Crystallization", "Integrative Results Table of Technical

select a certain menu by clicking the mouse to execute the corresponding function conveniently. The whole structure of software

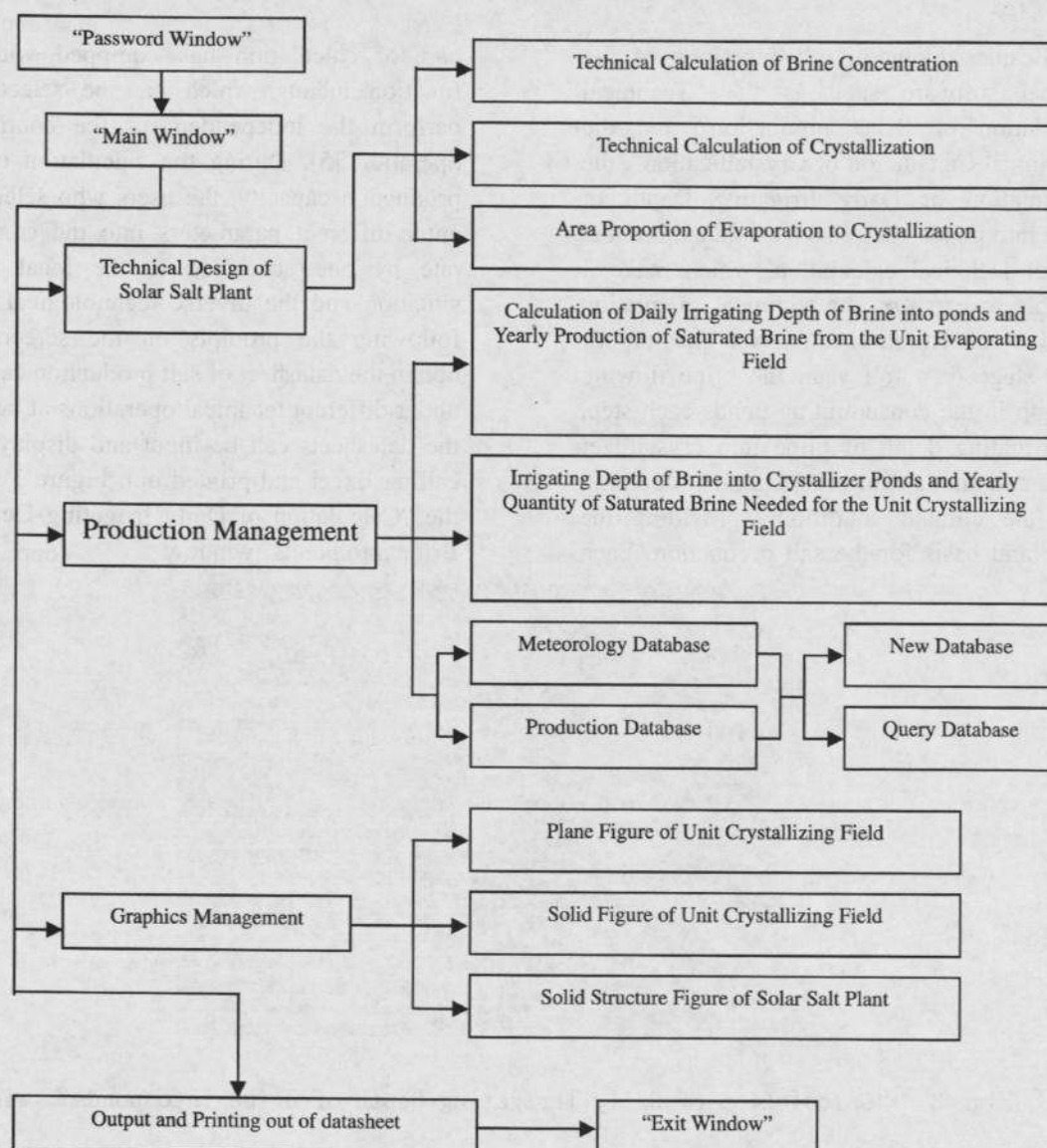


Fig.2 The whole structure of software

Calculations", "Graphics Management", "Production Management" and "Exit". Synchronously, some appropriate sub-menus are added under the main menus. For instance, three sub-menus such as "Technical Calculation of Brine Production", "Technical Calculation of Crystallization" and "Calculation of Daily Irrigating Depth of Brine into ponds" are appended into the menu of "Function Selection", and "New Database", "Open Database" and "Query Database" sub-menus are added into the menu of "Production Management", so the users can

is listed clearly as shown in Fig.2.

Before the technical design process, it needs to analysis and settle the information on the aspects of meteorology, hydrology and soil, and the addition of the function module named "Production Management" makes it simple and standard to enter, query and manage the materials. The technical staffs can not only transfer the existing documents directly, but also establish the new database through the menu options. After storing the database into the software, the data-processing can be done to the required part of information,

such as inquiring about the weather condition by inputting the accurate date or selecting a certain period of time to generate the corresponding data column automatically, and

Besides including all functions of the original software such as the "Technical Calculation of Brine production" and the "Technical Calculation of Crystallization", the "Calculation of Daily Irrigating Depth of Brine into ponds" has also been added into the part of technical calculation, which make it possible to carry on the technical calculation of brine-concentration and crystallization for some stage or a full year, the brine flowing strength in the concentrating ponds each step, the irrigating depth of brine into crystallizer ponds and annual salt production in according with the climate conditions, providing the guide and basis for the salt production. Each

the calculation results of average and extreme value with the changing tendency can also be printed in the form of graphics or report forms.

part of calculation has equipped with the function menus, which can be selected to perform the independent or the continuous operation [5]. During the calculation of salt production capacity, the users who select and enter different parameters into the computer one by one according to the local actual situation and the diverse technological chain following the prompts on the screen, can obtain the datasheet of salt production capacity under different technical operations at last. All the datasheets can be input and displayed by calling Excel and printed out. Figure 3 shows the "Calculation of Daily Irrigating Depth of Brine into ponds" window.

Fig. 3 "Calculation of Daily Irrigating Depth of Brine into ponds" window

The styles of salt plants' configurations are not same because of different conditions in the meteorology, topography and crystallization technical mode. For the site-plan, the styles of salt plants' configurations can be divided generally into three types including the concentrated, semi-concentrated and scattered styles, and the crystallizing field unit includes three types of "Separated Channels for Feeding and Discharging of Brine", "The Channel applicable to both Feeding and Discharging of Brine" and "Vertical Channel Setup". It usually costs a lot of time for designers to find out the relevant graphics as the typical template when they design the site-plan of salt

field or the structure of crystallizing field, so it makes against the unified classification and management of engineering gallery. In order to facilitate the manipulations of archiving, query, calling and modifying the drawing documents, it is necessary to establish the gallery and then manage the documents by using the library management. Besides reserving the typical configuration graphics for calling, the "VB-Technical Design of Salt Pan" software also can make users to establish their own graphics library as the complement based on their needs, which can be realized by clicking the menu of "Graphics Management". The compiling of this module is completed by calling the commands of AutoCAD in the

environment of VB. Users can make use of this function at any time to obtain the structure chart of unit crystallizing field, the three-dimensional configuration graphics and so on. They also can carry out many operations to the graphics such as adding, deleting and modifying ground on the local actual situation, as well as editing or querying the subsidiary information and printing them out. In addition, users even can look over the volume change of brine concentration, the "Relation Curve of Brine Evaporation Coefficient and Concentration", the "Relation Curve of Brine Penetration Coefficient and Concentration", the table of "Salt Yield from Saturated Brine Evaporation", "Volume Change of Water Evaporation" and other related information.

KEY TECHNOLOGY OF SOFTWARE DEVELOPMENT

Output of the complex Excel report forms controlled by VB

The dynamic output of the complex Excel report forms is often faced when we apply VB to the software development. Generally the "Data Report" included in VB 6.0 has been adopted to realize the form printing. However, because of its more simple function, inadequate flexibility and need to combine with the data environment designer provided by VB at the same time [6], it is too inconvenient to control and with unsatisfactory print function. To solve above issues, we try to take Excel spreadsheet as the template and output the data to Excel through the data control in VB, so as to utilize the convenient functions of typesetting and printing of Excel. Especially for the tables with more characters in the database, it is impossible to print out all data characters if only using "Data Report", as the size of paper can not be changed and it is inconvenient to design the interface of report forms by the "Data Report". However, these shortcomings can be able to overcome in Excel, and it will become so easy to design the requisite interface of report forms, with printing all data characters out [7].

The key technology to make the report

forms by using Excel is how to output the dynamic data into Excel quickly and accurately based on the required format. The methods are listed as follow: First of all, it should be done to establish the OLE object instance and define the initialized Excel object. After pitching on the "Citation" menu item under the menu of "Project" in VB, and then selecting and quoting Microsoft Excel 11.0 Object Library to call the incident and method of Excel, we can also visit the database of Access 2003 by ADO (Active X Data Object) and use the SQL statements to obtain the data. This is followed by setting the format of report forms and using "Range" or "Cells" property of "worksheet" to set the value of each cell in the worksheet. Due to the requirement to generate new dynamic formats of report forms according to the user-specified "Design Steps", it is necessary to carry through the dynamic change to the original design template before reading-in the data. This process can determine the "Design Steps" entered by the users through the "Case" statement, according to which they can adjust the format of original template. Passing through the last step, a new template file has been generated and the next step is to fill the data stored in the database into the template accordingly. In the end, it should be the preview and print of report forms. After generating the required report forms, the users can send out the instructions such as "Save", "Preview" or "Print" to Excel.

Realization of AutoCAD graphics information management by VB

The development and application of engineering gallery can not only realize the uniform and classified management, but also improve the utilization rate, simplify the configuration design procedure of salt plant and enhance the work efficiency. This software makes it true to establish the graphics database by using the database function of VB and achieve the functions such as the storage, compilation, modification of the graphics information and the computer management through ActiveX Automation, with using AutoCAD as the Server, VB as the Client, and linking VB to AutoCAD by OLE technology [8]. When using the "VB-Technical Design of Salt Pan" software, besides of calling the

existent configuration graphics stored in the software, users can also modify, print or add some new galleries for standby real time based on the local actual situation [9]. The crystallizing field of "Separated Channels for Feeding and Discharging of Brine" structure type is as shown in Fig.4.

APPLICATION EXAMPLES

The application process of this software on calculating the yearly brine-concentrating capacity in a certain salt field is introduced as follow. First of all, double-clicking the icon can get into the running environment. When the program starts to run, the "Password Window" shows itself. This window has some text boxes for users to input the correct user name and password to enter the "Main Window".

After landing successfully it shows the typefaces of "Welcome to use 'VB-Technical Design of Solar Salt Plant' software" in the

"Main Window", as shown in Fig.5. By clicking the sub-menu of "Technical Calculation of Brine Production" under the "Function Selection" menu the users have the right to enter the corresponding function window. The users can follow the onscreen prompts to input the hydro-meteorological data and technical parameters of salt field into each text box one by one, and then click "OK" button to throw out the module window of calculation results, as shown in Fig.6, Fig.7 and Fig.8, respectively. It is also easy to return to the last window for users to modify or remove expediently if the initial data input have some errors. After completing the technical calculation of brine production, the relation curve between the evaporation area percent and the concentration on each step can be drawn automatically by clicking the "Drawing the Relation Curve" option, as shown in Fig.9.

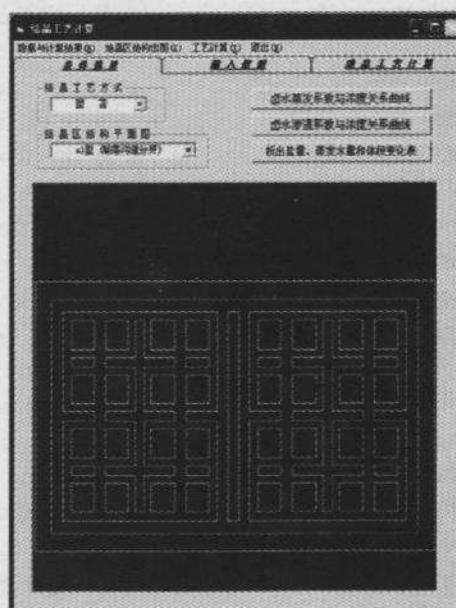


Fig. 4 Crystallizing field of "Separated Channels for Feeding and Discharging of Brine" type

Finally, the technical calculation results can be printed out in the form of report forms by clicking the "Print" button, as shown in Fig.10. After completing the technical calculation of brine production and crystallization separately, users can obtain the

terminal values of "Yearly Production of Saturated Brine from the Unit Evaporating Field" and the "Yearly Quantity of Saturated Brine Needed for the Unit Crystallizing Field" by clicking the menu of "Area Proportion of Evaporation to Crystallization". Moreover, the

“Integrative Datasheet of Brine Production Capability” and the “Integrative Datasheet of Crystallization Capability” can be displayed by clicking the menu of “Integrative Results Table of Technical Calculations”, so that the

users can decide to print them out or return to re-calculation by themselves. Finally the software system can be exited by clicking the “Exit” menu.



Fig. 5 Main window

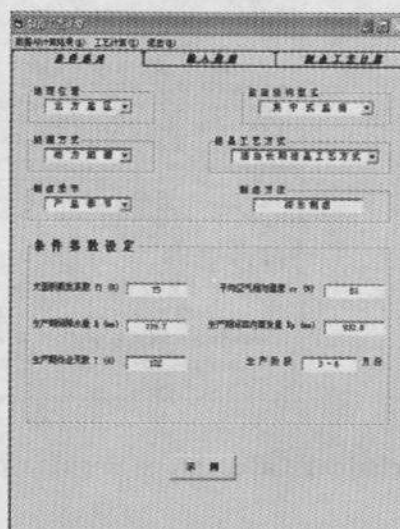


Fig. 6 “Condition Selecting” window of “Technical Calculation of Brine Production”

数据输入窗口

参数设置

初始参数设置

初始温度 t_0 (°C): 25

初始浓度 C_0 (kg/m³): 10

第一级蒸发面积 A_1 (m²): 1000

蒸发率 α (%): 2

计算步数: 20

各步计算设置

步数	1	2	3	4	5	6
初始温度 t_0 (°C)	2.0	3.0	4.0	5.0	6.0	7.0
初始浓度 C_0 (kg/m³)	3.0	4.0	5.0	6.0	7.0	8.0
初始温度 t_0 (°C)	7	8	9	10	11	12
初始浓度 C_0 (kg/m³)	8.0	9.0	10.0	11.0	12.0	13.0
初始温度 t_0 (°C)	9.0	10.0	11.0	12.0	13.0	14.0
初始温度 t_0 (°C)	11.0	12.0	13.0	14.0	15.0	16.0
初始浓度 C_0 (kg/m³)	12.0	13.0	14.0	15.0	16.0	17.0
初始温度 t_0 (°C)	13.0	14.0	15.0	16.0	17.0	18.0
初始浓度 C_0 (kg/m³)	14.0	15.0	16.0	17.0	18.0	19.0
初始温度 t_0 (°C)	15.0	16.0	17.0	18.0	19.0	20.0
初始浓度 C_0 (kg/m³)	16.0	17.0	18.0	19.0	20.0	21.0
初始温度 t_0 (°C)	17.0	18.0	19.0	20.0	21.0	22.0
初始浓度 C_0 (kg/m³)	18.0	19.0	20.0	21.0	22.0	23.0
初始温度 t_0 (°C)	19.0	20.0	21.0	22.0	23.0	24.0
初始浓度 C_0 (kg/m³)	20.0	21.0	22.0	23.0	24.0	25.0

确定 取消

Fig. 7 "Data Input" window of "Technical Calculation of Brine Production"

数据输入窗口

参数设置

初始参数设置

初始温度 t_0 (°C): 25

初始浓度 C_0 (kg/m³): 10

第一级蒸发面积 A_1 (m²): 1000

蒸发率 α (%): 2

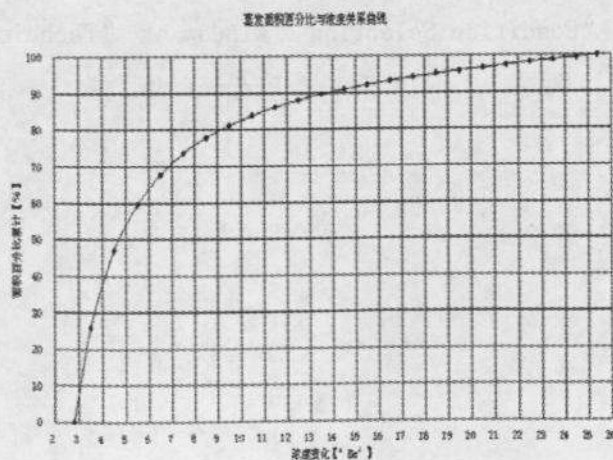
计算步数: 20

各步计算设置

步数	1	2	3	4	5
初始温度 t_0 (°C)	2.0	3.0	4.0	5.0	6.0
初始浓度 C_0 (kg/m³)	3.0	4.0	5.0	6.0	7.0
初始温度 t_0 (°C)	7	8	9	10	11
初始浓度 C_0 (kg/m³)	8.0	9.0	10.0	11.0	12.0
初始温度 t_0 (°C)	9.0	10.0	11.0	12.0	13.0
初始浓度 C_0 (kg/m³)	12.0	13.0	14.0	15.0	16.0
初始温度 t_0 (°C)	11.0	12.0	13.0	14.0	15.0
初始浓度 C_0 (kg/m³)	14.0	15.0	16.0	17.0	18.0
初始温度 t_0 (°C)	13.0	14.0	15.0	16.0	17.0
初始浓度 C_0 (kg/m³)	16.0	17.0	18.0	19.0	20.0
初始温度 t_0 (°C)	15.0	16.0	17.0	18.0	19.0
初始浓度 C_0 (kg/m³)	18.0	19.0	20.0	21.0	22.0
初始温度 t_0 (°C)	17.0	18.0	19.0	20.0	21.0
初始浓度 C_0 (kg/m³)	20.0	21.0	22.0	23.0	24.0
初始温度 t_0 (°C)	19.0	20.0	21.0	22.0	23.0
初始浓度 C_0 (kg/m³)	22.0	23.0	24.0	25.0	26.0

确定 取消

Fig. 8 "Technical Calculation Results of Brine Production" window



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“VB-Technical Design of Salt Pan” software has many prominent characteristics as follow:

Three basic calculations such as "Technical Calculation of Brine Production", "Technical Calculation of Crystallization" and "Calculation of Daily Irrigating Depth of Brine into ponds" are combined with some functions of "Production Management" and "Graphics Management" in this software. The whole idea of design is clear, comprehensive and correct, and the function modular, graphics program and the standardization of calculation value are integrated strictly.

When compiling the source codes, each calculation step and the required values of technical parameters have been embedded in the program. Therefore, it has no use for considering the calculation process and can calculate quickly and accurately only by simply inputting the interrelated data. After having a good grip of this software, it only takes about ten minutes to complete an annual calculation process.

Considering that the users need to make some necessary changes and supplement for the calculating source codes according to the actual production requirement, this software is suitable for the technical design and production management. It is convenient and intuitional to input or modify the design data, and the calculation results can be obtained and output quickly and accurately by both displaying and printing. In addition, it also facilitates the technicians to master the method of storing and querying the related data at any time. To sum up, it has strong value for popularizing.

This software is compiled by the high-level Visual Basic language, which is linked and transferred with AutoCAD and Excel, and can be displayed in the form of report forms or graphics easily and intuitively. It also can be compiled into the executable file or generated to be the erection sequence installed in any computer. In conclusion, this software has beautiful interface, easy operation, objects and tasks visualization, interactive dialogue and achieves the unification between the accurate calculation of computer and the design experience of designers.

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