

The dike information management and flood defence system of Anqing city  
Safety Assessment and Decision Support Software System of Dike  
(Version 1.0)



User Manual

Department of flood control and disaster reduction of China Institute of Water  
Resources and Hydropower Research

Research Center on flood and drought disaster reduction of Ministry of Water  
Resources

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## Preface

In China, the strategy of information driving **hydraulic** modernization is being **advancing**, which is aim to improve the decision-making **technique** on flood defence and disaster reduction by using **Hi-Tech means**. In order to intensity of flood prevention and rush to deal with an emergency during flood period, it is necessary to develop a software system of safety assessment on dike engineering, **which** will be a useful tool to carry out the safety management and risk assessment for engineers and mangers. In addition, the deterministic analysis **is** coupled with probabilistic theory in this system, which will be helpful for the safety assessment on dike engineering transferring the traditional method to predictional risk management. Safety Assessment and Decision Support Software System of Dike(SADSS) is also **an** important aspect of non-engineering measures.

This system has three functional modules: probabilistic and risk analysis; slope sliding analysis; seepage analysis. The Visual Basic is used as the developing language and SQL server or Microsoft Access is used as database management software. The system should allow proper user-friendly interface for the operator to input necessary data that will be used by the algorithms implemented in SADSS. Based on the data of typical cross sections, the risk degree can be real-time calculated at different flood water levels. Thus the dynamic risk diagram of the whole dike can be submitted. Moreover, the different safety grade can be classified according to specified standards and rules, the corresponding strengthening measures or forecasting schemes can be obtained by the existent counterplan database.

This handbook of the system includes the preliminary characteristic, operating condition ,hardware configuration **and** manipulation procedure, **which** is useful to be familiar with this software for users. Some other handbooks correlated with the system are as following:

Developing Handbook of the system includes some examples and results, input variables of the program and functions of the subroutine programs. **which** is useful to be familiar with some functions of the system, to verification and comparison by various input parameters.

Theory Handbook of the system **includes** the numerical model and corresponding algorithm. It can be useful to be familiar with the fundamental and functions of this software for senior users, **which** is helpful to solve some problems during the operating for users by themselves.

Code Developing:

Wu Xingzheng; Zhang Jinjie; Ding Liuqian

Technical Support:

Dou Kun; Sun Dongya; Zhao Jinyong

Mail Address:

e-mail:: [xingzhengwu@yahoo.com.cn](mailto:xingzhengwu@yahoo.com.cn)

The logo consists of the letters 'SADS' in a highly stylized, outlined font. The letters are interconnected and have a 3D, embossed appearance with shadows.

# 1. Basic Characteristic

Advancing Technology: Some advancing meaning, such as the visual programmed language **is** used in the developing of this software system. Some technology, such as the risk analysis approach and results display of the whole dike, is also employed firstly in professional application software.

User interface: The system has a user-friendly interface that facilitates easy interaction with operator in data inputting and updating and editing graphics. Which has an easier understanding for personnel with relatively low understanding of software, thus the efficiency of analysis can be improved. In addition, some basic materials, calculated results can easily input and inquire on the screen. The users can modify the scheme conveniently and comparison studying by various input parameters.

Stability, reliability, compatibility and expansibility: The core programs have been widely applied in some projects, and satisfactory results have been achieved.

Integrity: some computing results can be obtained by coupling the traditional deterministic analysis with probabilistic risk analysis; the system can be run based on the GIS. A relative macrosystem can meet the professional demand of processing the data, text, and graphics, and whole procedure can be completed form an initial designing, safety management to submitting prediction treating cases; expert knowledge, universal experience, some standards of criterions and regulations.

## 2 Main functions

Some correlated Engineering data can be achieved form a database server ( such as dike profiles, material constitute, soil parameters, technic standards)

Sliding and seepage analysis for specified dike section.

Probabilistic and risk analysis for specified dike section.

According to results of the different dike section, the safety assessment and some strengthening schemes can be presented.

Calculating of stability and risk display and submission of report forms for whole dike sections.

The results can be transferred to Web publishing sub-system by data interface.

Figure 1 and Figure 2 show that the main functional modules and the developing flow process of this system.

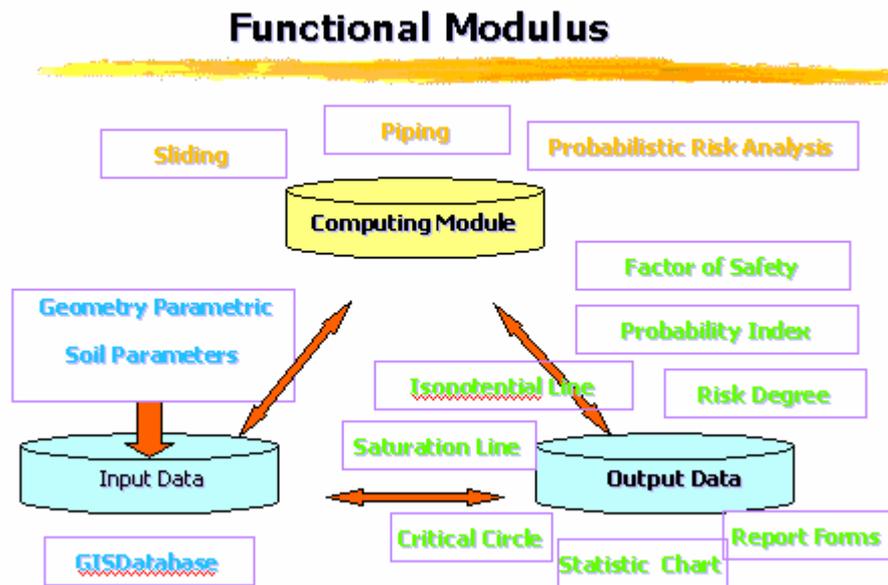


Figure 1 the main functional modules of this system

### Diagram of risk analysis process

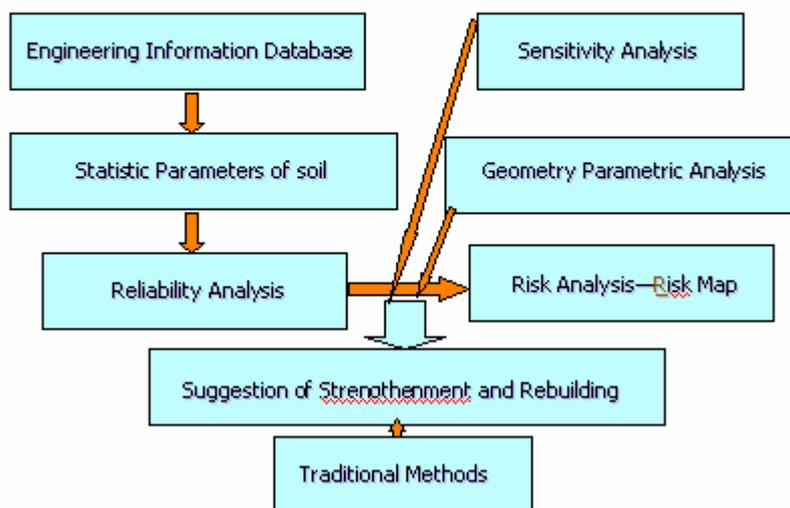


Fig. 2 Developing flow process of this system

### 3 System Environment

According to the requirements of the system design guideline, the client/server structure is used in this system. The system can be operated in a local area network. The hardware device includes: server, personal computer, printer.

The operating system is Windows 9X or NT. Visual Basic is used for developing the core program and graphic user interface.

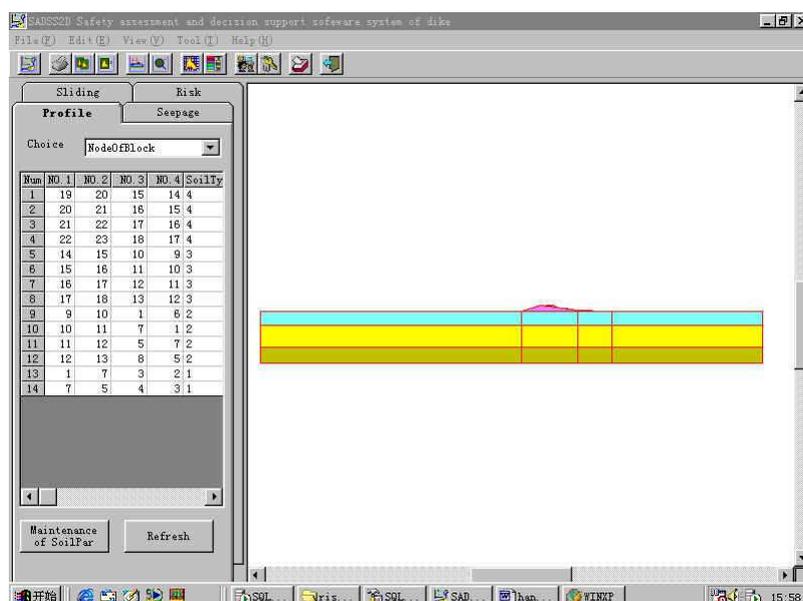
In the system design, modular structures are accepted. Every executing module is controlled by the main control program. You can press the option control to switch over the different functional module. Besides, the system also has the connecting interface with the design database and the Web publishing system.

### 4 Fixing

Since the sub-system is an important constituent of the whole system on flood defence and decision-making support, it can be fixed by running the executed file for the whole system fixing. In addition, it also can be fixed by itself executed file.

### 5 Start-up

SADSS can be started by two modes: one is by pressing the main menu of risk analysis in whole system host interface. The other one is by pressing the program icon. The start-up interface is shown in Figure 3.



**Fig. 3 Start-up interface**

( some information can be displayed by press the right key of the mouse, such as element mesh and node number and block number and soil layer, dike cross section displaying)

## **6 System graphical user interface**

The graphical user interface of the system is composed of menu bar, tools bar, shortcut button, status bar, working and displaying area, etc. ( as shown in Fig. 3). The working area is divided into two parts, the left area is the user's input area. The right area is the graphics display area. The user's input area will be used for input display control parameters, computing mode; the graphics display area will be used for displaying the graphics related to the dike section, computational mesh, calculated results. Corresponding to the pressing choice button in user's input area, the graphics can be displayed in the graphics display area simultaneously. Due to the input data and output results are excessive in the probabilistic and risk analysis, the data input and graphic display were accomplished by pressing command button.

The graphics clicked in the graphics display area can be zoomed and output to the clipboard. The cursor position corresponding to coordinate value can be shown on the status bar.

### **6.1 Generating Mesh**

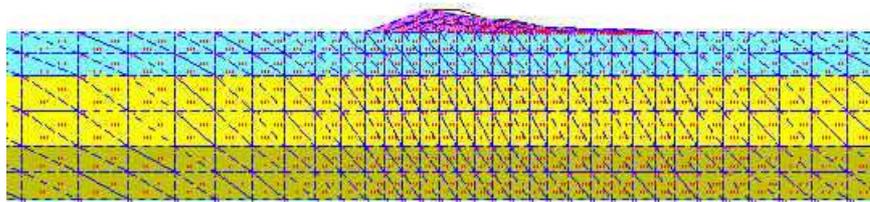


Fig. 4 Element and node of the dike section

## 6.2 seepage analysis

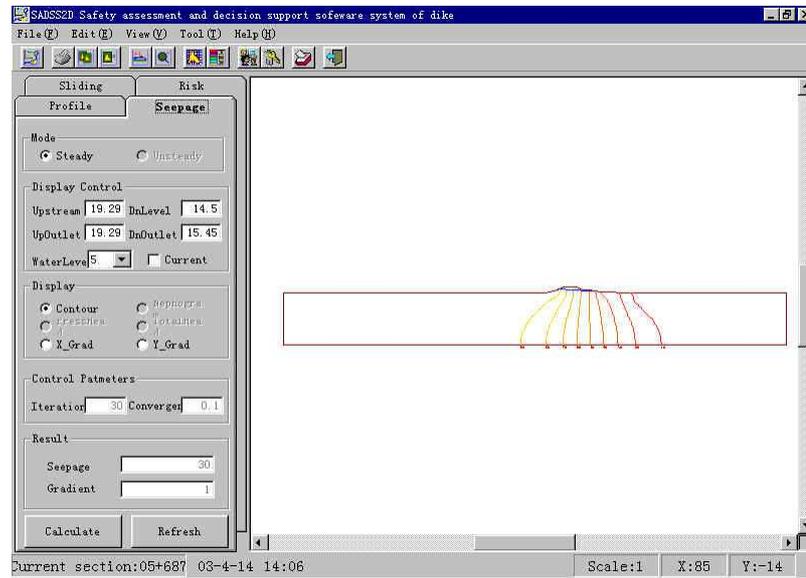
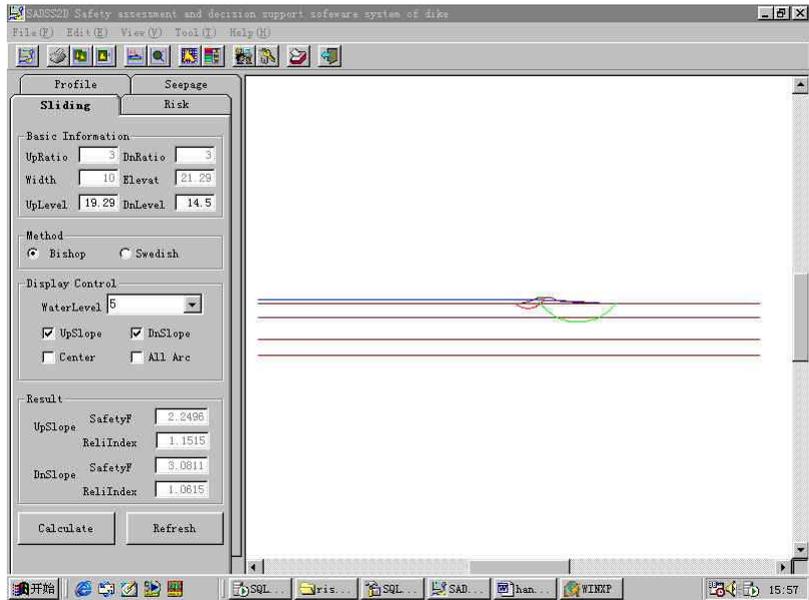


Fig. 5 Isopotential line obtained by the seepage analysis

(Some information of seepage coefficient, water head, seepage gradient, boundary condition and water level curve can be displayed by press the right key of the mouse)

## 6.3 Sliding stability analysis



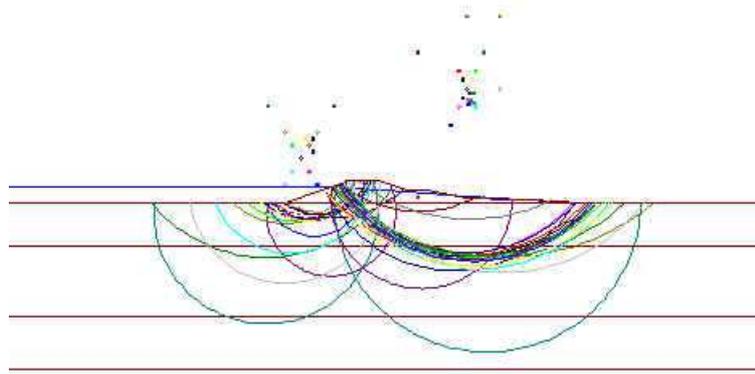
**Fig. 6 The interface of stability analysis**

For the specifying dike section, the slope stability analysis can be accomplished with simply Bishop method or Swedish circle method. The safety of factor and probability index of upstream slope and downstream slope can be obtained of this dike section at various water level.

( the computing results of stability analysis and soil parameters can be displayed)

ParName	No. 1 Layer	No. 2 Layer	No. 3 Layer	No. 4 Layer
SoilName	人工填土	重壤土	细砂	中砂
EffectCohc	10.0000	10.0000	10.0000	10.0000
EffectFric	16.5000	16.5000	7.5000	7.5000
WaterGravity	16.2200	16.2200	18.0700	18.0700

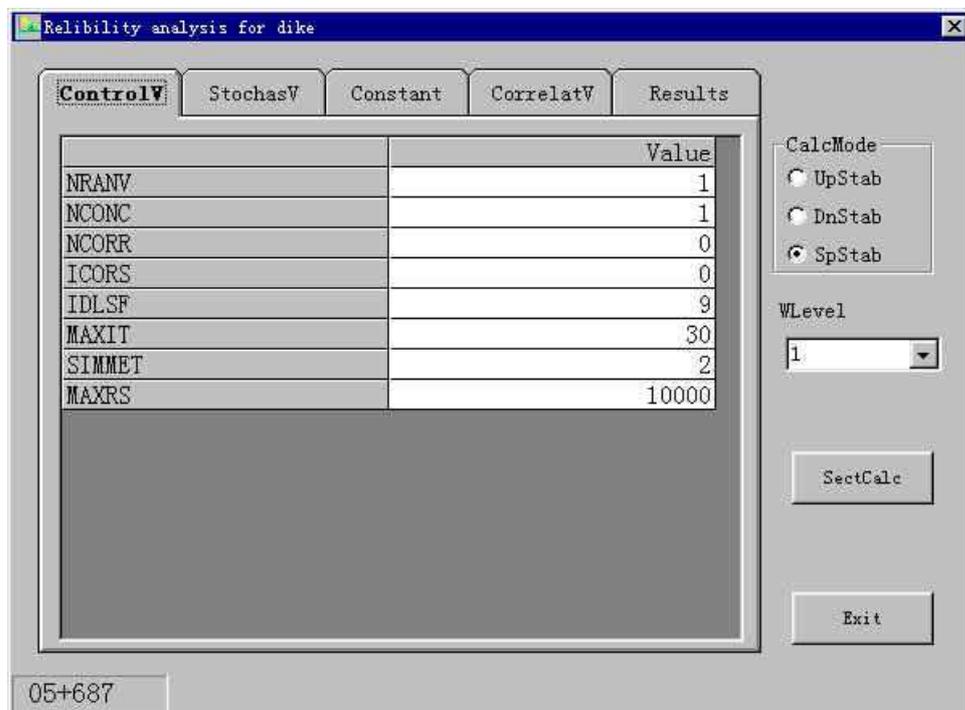
**Fig. 7 Updating of soil parameters**



**Fig. 8 Circle searched in this analysis**

In addition, the upstream and downstream water design level can be updated, and then the stability analysis can be calculated again. The binary search was used in finding the critical circle. All the circles searched in this analysis were shown in Fig. 8)

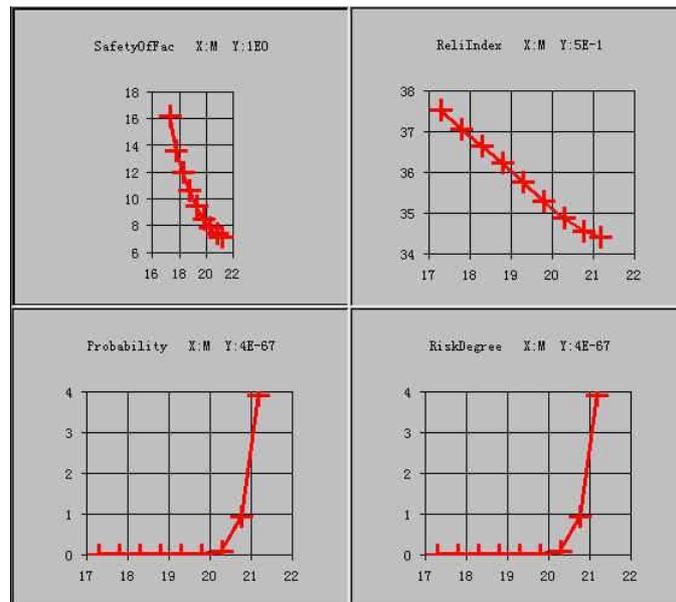
## 6.4 Risk analysis



**Fig. 9 Interface of probability analysis**

(the input data, such as control parameters, stochastic variables, constants, correlated coefficients, and results, can be real-time modified)

The Monte Carlo numerical simulation method has been employed to calculate the probability index of the dike section at various flood water level. The sampling method can use the important sampling or direct sampling method. There are more than ten distribution types of a random variables in the system.



**Fig. 10 Calculating results display of the specified dike section at various water level**

( Four safety evaluation index at the different working situations, such as upstream stability, downstream stability, seepage stability, the values and the percent obtain by comparison with the value obtained at design water level.

## 6.5 Risk display for the whole dike

The safety evaluation and risk display only for a certain dike as mentioned above; the risk analysis results also can be displayed along the whole dike on the GIS map. Besides, according to the user requirement analysis, the computing results and input data also can be display along to the longitude direction.

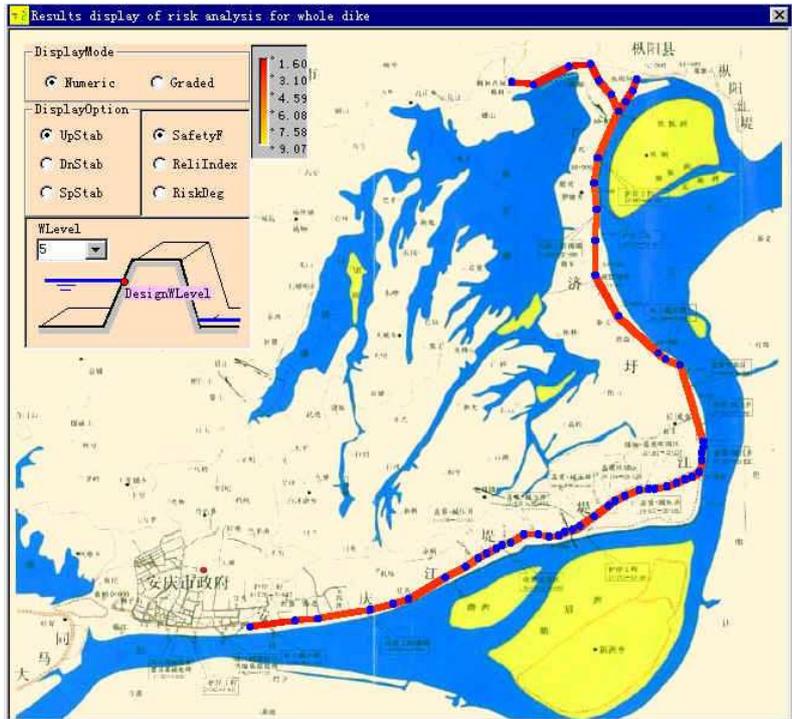


Fig. 11 Risk map of the whole dike (according to values)

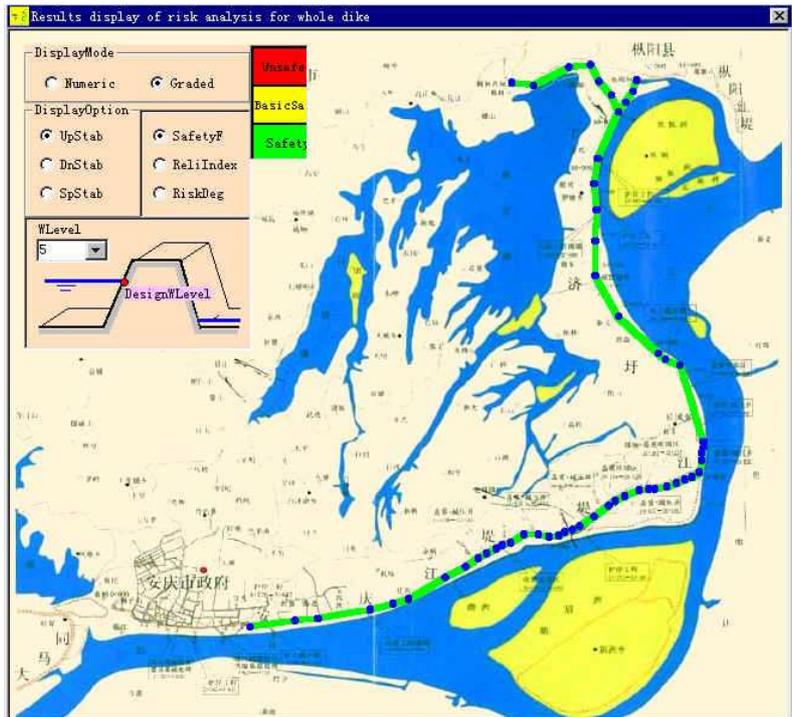


Fig. 12 Risk map of the whole dike (according to safety grades)

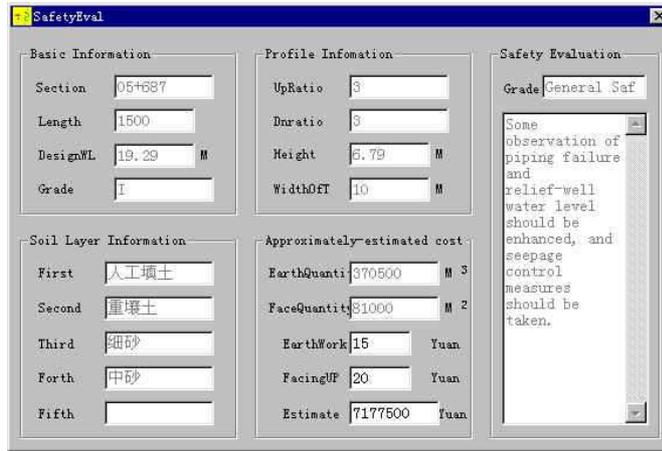


Fig. 13 Assessment standard can be modified by users

6.6 output of the safety assessment results with statistic graphs and report form for whole dike

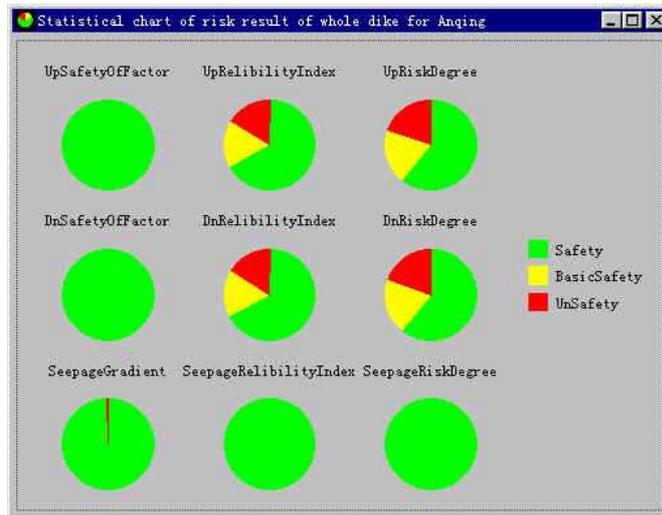


Fig. 14 The statistic pie chart for different modes

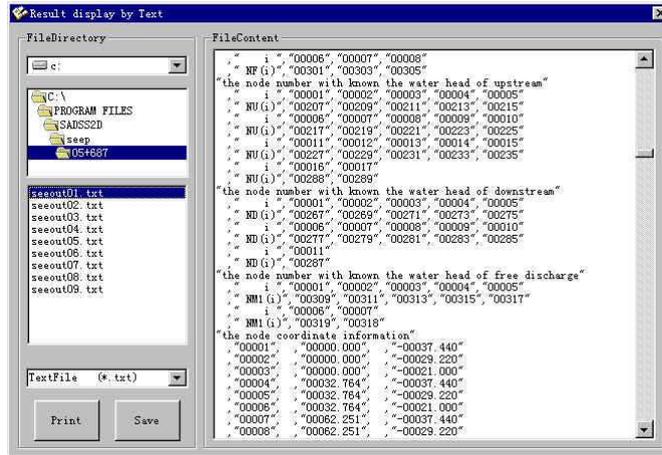


Fig. 15 The computing results can also be displayed by text file

Users can also be referred to the results with text files by press “text display button”. Once users come across some wrong with this program system, they can find the reason by looking over the file of check.txt.

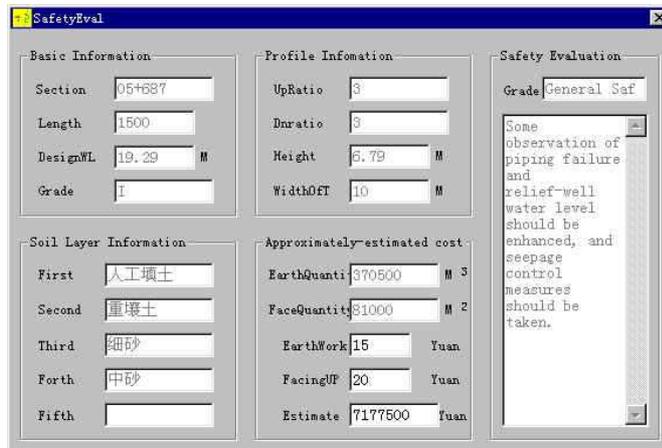


Fig. 16 Safety assessment results

Some suggestion of dike safety assessment can be given by press the “safety assessment button”.

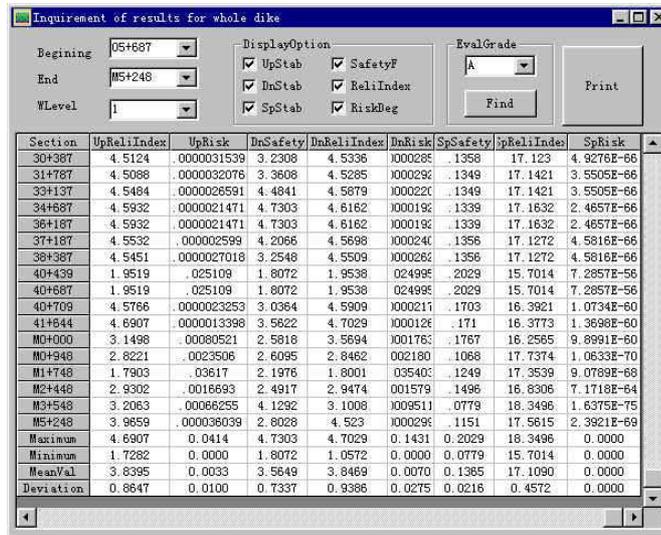
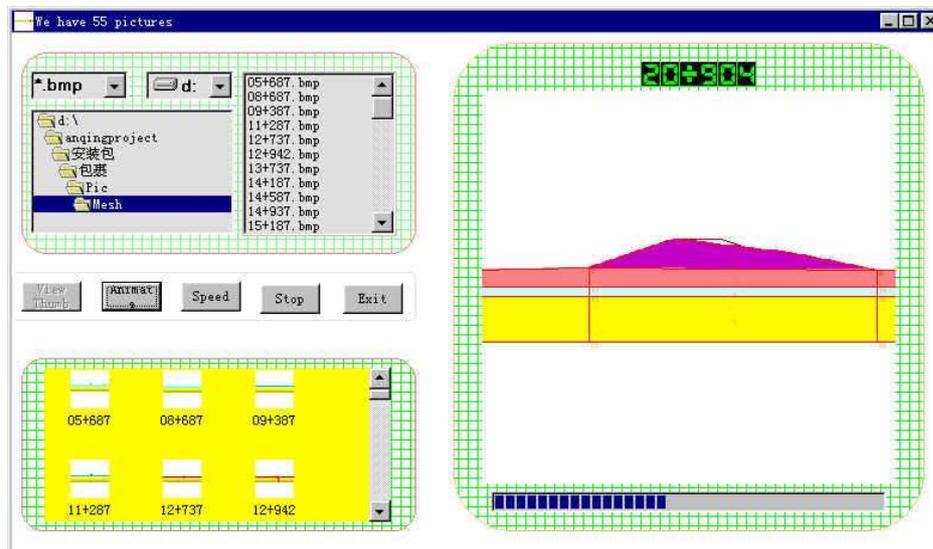


Fig. 17 Statistic report forms of the risk evaluation



Fig. 18 Detailed report forms of the risk evaluation



**Fig. 19 Display of the computing results for whole dike sections**



## 7 Menus and their functions

As shown in Fig. 2, the main menus of this system include the following contents:

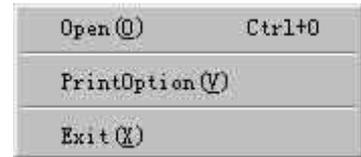
- File
- Edit
- View
- Tool
- Help

Tool Bar is under the main menu. When user move the mouse to shortcut of tool bar icon, a note of the shortcut will be displayed after a whistle stop.

## 7.1 File Menu

This Menu main includes the following contents:

open  
Print option  
Exit

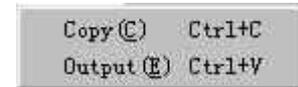


For each mode, the stability and seepage analysis for a specified dike section will be carried out by selecting the open menu. After the risk analysis for the whole dike has been completed, Print Option menu is used to output control on the report forms.

## 7.2 Edit Menu

This menu includes:

Copy  
Output

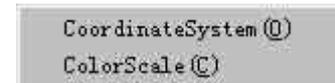


Some graphs obtained by sliding stability analysis and seepage calculating can be copied and output. A range can be selected by dragging in rectangle, and the graph clicked can output to clipboard or file.

## 7.3 View

Main includes:

Coordinate  
Color scale

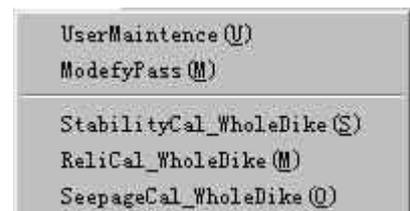


Coordinate View is used to display the coordinate scale of the dike shape and mesh. Color scale is a touch-tone button to show or hide the scale.

## 7.4 tool menu

It includes:

User management  
Password  
Sliding stability analysis for whole dike  
Probability analysis for whole dike  
Seepage analysis for whole dike



User management and password are used to update and maintenance the user

name and password.

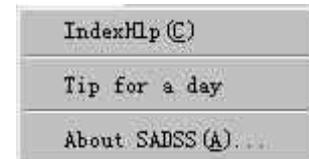
## 7.5 Help Menu

It includes:

Index

Tips for everyday

About SADSS



User Handbook, theory, developing Handbook, design standard, safety management code and some basic knowledge of flood defence and emergency measures are involved. In this case, user can lookup some information and operation note. The hyper-linked text mode has been used to organize these help information, so you can browser them easily. Version and address information can be shown by clicking the about SADSS button.

## 8 Explanation on risk analysis and strengthening scheme

Referring to the guide of safety assessment for dam, the classifying of grade of safety for existing levee follow these rules: when the safety index of all kinds of evaluation are Grade A, then the evaluation Grade is A; when some safety index are Grade B, then the evaluation Grade is B; when more than one safety index is Grade C, then the evaluation Grade is C. If there are one or two index in Grade B and the others in Grade A, it can be assumed as Grade A with better construction quality.

The strengthening scheme of construction after the hazard depends on the engineers' subjective decision for long time. Thus, there are three kinds of results after strengthening and repairing: one is that the measures is appropriate and the target is accomplished; two is that some excessive measures have been taken, and it results in increasing of cost; three is that insufficient measures have been taken, which can not meet the demand of bearing capacity of the failure structures and then a potential incipient fault of safety still exist. Safety degree or bearing capacity of some structures can be diagnosed by systematical computing and scientific analyzing.

When the safety grade of a specified dike section is Grade B and Grade C, the

responding strengthening prediction scheme can be given by this system. Presently, there are the following schemes (under updating):

Case 1: Some observation of pool level and settlement and river-bed scouring should be enhanced, and upstream revetment should be reinforced.

Case 2: Berm and gland should be built.

Case 3: Some observation of piping failure and relief-well water level should be enhanced, and seepage control measures should be taken.

## **9 References**

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