

SLOPE/W Tutorial

This is the script for the SLOPE/W tutorial movie. Please follow along with the movie, SLOPE/W Getting Started.

Introduction

Here are the results obtained using SLOPE/W to determine the minimum factor of safety and the critical slip surface for the profile shown.

Define

For this analysis we start by creating a new SLOPE/W project from the Start Page of GeoStudio. In the KEYIN Analysis dialogue box, you need to identify what method of analysis you are going to use. Select Morgenstern-Price and ensure that a half-sine interslice force function is being applied. Under the pore-water pressure option, select piezometric line. Under the slip surface tab, select the entry and exit method to search for the critical slip surface. Give the analysis a name and description.

The first time you start working with SLOPE/W, it is helpful to learn what different toolbars exist. Many of the dropdown commands are also available as individual icons on the many different toolbars. You can familiarize yourself with the toolbars by toggling them on and off.

When developing a numerical model, the first step is usually to set the working area, which defines the size of the space available for defining the problem. The working area may be smaller, equal to or greater than the printer page.

The next step is to set the scale. The scale should be set such that the minimum and maximum extents in SLOPE/W match those required for the analysis. Define the x and y extents to find an approximate scale and then fine tune it so you have a 1:1 aspect ratio.

A background grid of points will help you draw the problem. It's always a good idea to save your file frequently.

It is often helpful to sketch an axis. The axis is drawn by moving the cursor from the bottom left corner and stretching it outward. The number of increments can be adjusted using the Set: Axis dropdown menu.

Before defining the geometry in SLOPE/W, it is convenient to first sketch the problem. Select Polylines from the Sketch menu or use the sketch polyline icon. Use the cursor like a pencil; clicking the left mouse button to create a series of lines. The lines are considered objects, which can be adjusted or deleted using the Modify: Objects command.

When creating the numerical model, first draw the geometry; create and assign materials, draw pore-water pressure conditions and draw the slip surface geometry, which will control the mode of failure you are going to analyze.

Let's start by drawing the geometry. Individual soil regions are created using the DRAW: Regions command. Click the left mouse button to create region points. Once the polygon region has been closed, you can either continue to draw additional regions, or you can exit the draw regions mode.

Materials are first created and then assigned to geometry objects. Choose materials from the DRAW: dropdown menu. Click on KEYIN: to create a material. Add a new material, name it and select a strength model from the drop down list. You can use the tab key to move between the edit boxes.

To create a second material, you have choices; you can either add one, or you can clone the existing material. The materials can now be assigned to the individual geometry regions.

The pore-water pressure conditions for both soils will be defined by a single piezometric line. Choose pore-water pressure from the DRAW menu. Add the piezometric line to the materials and then draw the line on the profile. If you are modeling a partially submerged slope, the weight of the water will be automatically included in the analysis. A blue shaded zone will appear together with water force arrows which show that the resulting water force will be applied normal to the ground surface line.

Earlier we selected the entry and exit method to control the location of the trial slip surfaces. Choose Slip Surfaces from the DRAW menu. Use the cursor to define "zones" where the slip surface will enter and then exit the ground surface line.

Now the problem definition has been completed. You can double check your input in different ways. For example, select object information from the VIEW pull down menu. Click within any region to review the soil properties for that particular region. You can also view the information for any other geometric object.

Another way to review your input parameters is to use the DRAW: Contours feature available within DEFINE. You can contour various parameters such as soil properties and pore-water pressures. Notice that when you define a piezometric line in SLOPE/W, the software considers the pore-water pressures to be hydrostatic both below and above the piezometric line. You can also label the contours. You can go back to viewing the soil colors by using VIEW: Preferences from the drop down list, or using the appropriate preferences icon.

Choose Verify from the TOOLS drop down list and SLOPE/W will run a number of checks to see if there are any errors or warnings.

Now it's time to solve the problem.

Solve and Contour

Click on the SOLVE icon found on the Current Analysis Toolbar.

Select the start button to activate the solver. In the solver window you will see the computed factors of safety for each of the various methods. You can review the results directly by clicking on the CONTOUR icon in the current analysis toolbar. The critical slip surface appears along with the critical factor of safety.

Use the Draw: Slip Surfaces command to bring up a dialogue box that summarizes the factors of safety for all the different slip surfaces that were analyzed. When you click on any single slip surface, you will cause both the slip surface and the corresponding factor of safety to appear in the CONTOUR window.

You can also review the slice force information for the most critical slip surface. Move the cursor inside any particular slice and click the left mouse button to select the slice. The force information can be copied and pasted directly into a report or spreadsheet.

Although we told the program to use the Morgenstern-Price method of analysis, results were also obtained for three other methods including Ordinary, Bishop and Janbu. You can look at the results obtained for these methods by using the drop down menu or through the Method toolbar.

It is often helpful to look at how parameters vary across the slip surface. To create a graph, choose Graph from the Draw Menu. There are many different types of graphs that can be developed, including a plot of pore-water pressures across the slip surface. Both the graph and the raw data can be copied from SLOPE/W and pasted into a report or a spreadsheet for further analysis.

By default, the location of the critical slip surface is shown in CONTOUR; however you can also view the location of the other slip surfaces that were analyzed. Choose Preferences from the View menu. Select the number of slip surfaces that you would like to view simultaneously. The slip surfaces for the 10 lowest factors of safety are now drawn on the profile.

Sometimes it is helpful to think in terms of a failure “zone” as opposed to a specific slip surface location. A safety map can be drawn on the profile to indicate a zone where slip surfaces with very similar factors of safety could develop.

New to GeoStudio 2007 is the reporting feature. If you need to generate a report for both your input and output; select Report from the View menu. Once you save the report file, your default word processing program will open with a generated report. You can now insert pictures, apply style templates or add and delete data.

If at any time you need help with understanding a dialogue box, you can click on the question mark in the top left corner to access the on-line help or use F1 on your keyboard. You can also switch to the Analysis Start Page which has PDF copies of all the

engineering books for GeoStudio under the documentation section. These books are very helpful in describing the features in the software and the theory behind them. You can also search through the examples database using specific keywords. When you are done, you can return to your analysis by clicking on the analysis list.

Adding Additional Analyses

Another powerful feature in GeoStudio 2007 is the ability to conduct multiple analyses in a single project file. If you want to see what the results would be for different input parameters on the same geometry, you can add or clone analyses using the KEYIN: Analysis dialogue box. Watch this example where pore-water pressures are defined using a spatial pressure head function and a single grid and radius slip surface is analyzed.

In order to use a spatial pressure head function, you will need to first create it and then come back to the Analysis dialogue box and assign it before it can be contoured. Let's create and name a spatial pressure head function and then assign it to the analysis. Now we can go back and fully define and fine-tune the pressure head function. Since we have pressure heads showing in the contour option, the pressure head contours will update automatically as additional points are added. Points can be selected and moved around if necessary. Notice that the software computes the extent of ponded water based on the defined pressure head points.

A single slip surface can be defined by collapsing the search grid and radius into single points. For the search grid, collapse the 3-pointed grid box by clicking three times in the same location. The search radius is collapsed by clicking four times in the same location. The resulting slip surface must use the search grid as its centre and then pass through the defined search radius point. Sketching a circle will show you what the slip surface will look like.

Now resolve the analysis and review the results.

We have reached the end of this introductory lesson. Not all of the powerful features of SLOPE/W have been used or discussed during this lesson. Specific details about each command are given in the on-line help and in the supporting documentation for SLOPE/W.

Thanks for watching