

Sarma Non-Vertical Slices

1. Introduction

This tutorial introduces the Sarma approach.

The Sarma method satisfies all conditions of equilibrium. For each slice, horizontal and vertical force equilibrium and moment equilibrium are satisfied. The method can be applied to any shape of slip surface, and vertical or inclined slices can be used.

This tutorial will demonstrate the optimized slice angle option, where the critical set of slice angles is found by the program, constrained by the fact that slices cannot cross one another.

2. Vertical Slices

From Slide2, open the tutorial file. Go to **File > Recent Folders > Tutorials Folder** and select the *Tutorial 26 Sarma Non-Vertical Slices initial.slmd* file.

For the first set of analyses, we'll look at vertical slices. Open the **Project Settings**, go to the **Methods** page, and make sure that the **GLE/Morgenstern-Price, Spencer, and Sarma methods** are selected. The dialog should appear as shown below.

Project Settings ? X

- General
- Soil Profile
- Scenarios
- Methods**
- Groundwater
- Transient
- Seismic
- Statistics
- Random Numbers
- Design Standard
- Advanced

Methods

☒ Vertical Slices
☐ Sarma Non-Vertical Slices

Methods

- ☐ Bishop simplified
- ☐ Corps of Engineers #1
- ☐ Corps of Engineers #2
- ☒ GLE/Morgenstern-Price
- ☐ Janbu simplified
- ☐ Janbu corrected
- ☐ Lowe-Karafiath
- ☐ Ordinary/Fellenius
- ☒ Spencer
- ☒ Sarma

Convergence Options

Number of slices:

Tolerance:

Maximum iterations:

Interslice force function

Sarma Interslice Strength Options

☒ Computed Average Value
☐ User-Defined

Cohesion: kN/m²

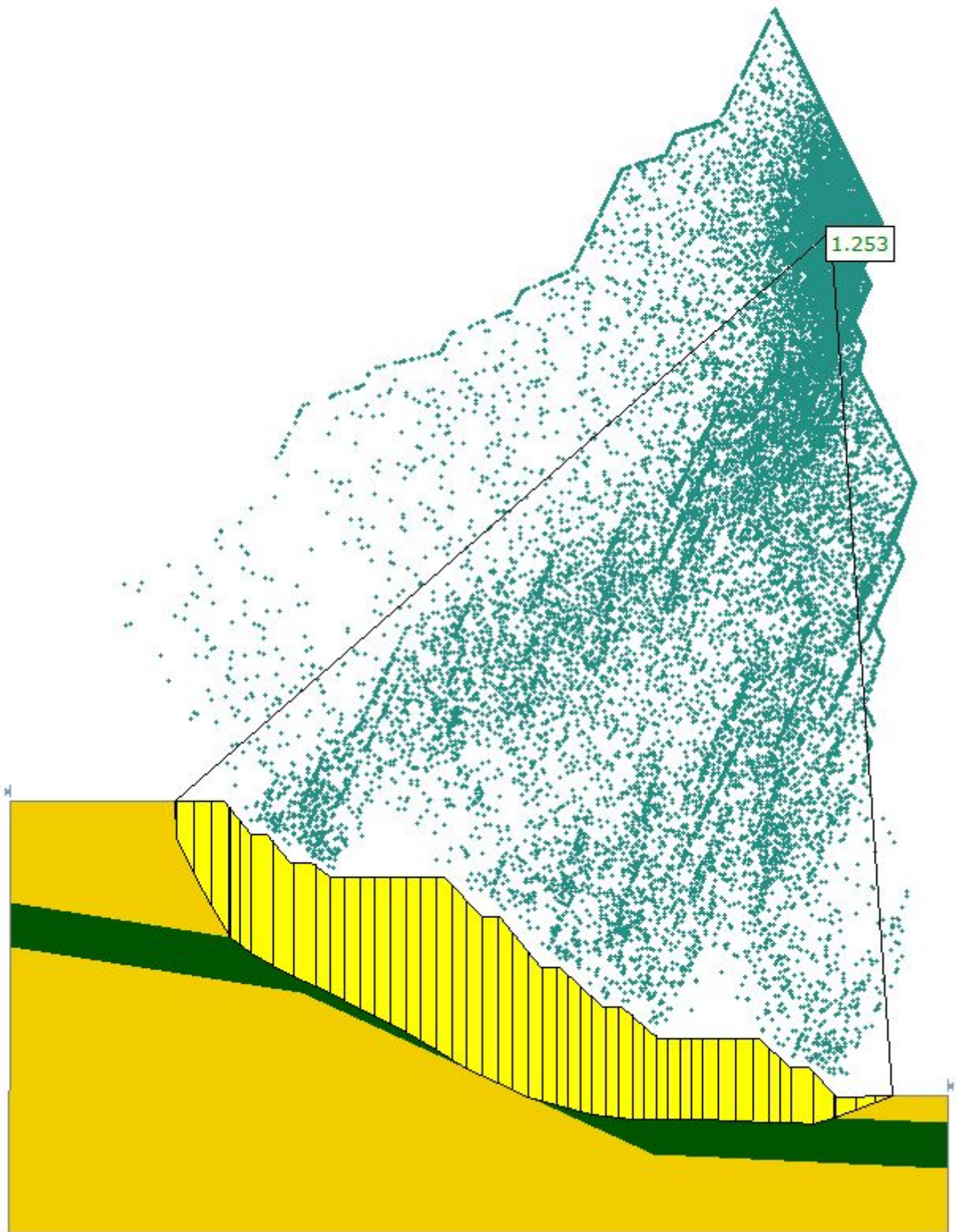
Phi: degrees

☒ Add slices at material intersections

RESULTS

Run the analysis and open **Interpret**. All three methods yield similar **Factor of Safety** results.

The results for the Sarma vertical slice analysis should appear as shown below. Use the **Query > Show Slices** menu option to turn on the slice view.



Results for Sarma vertical slice analysis

3. Sarma Method (Non-Vertical Slices)

Go back to the Slide2 modeller.

1. Right-click on the group and select **Add Scenario**. Do this twice.
2. Right-click again and select **Rename**. Rename the first scenario "**Vertical Slices**" and the second scenario "**Non-Vertical Slices**."

3. Click on the **Non-Vertical Slices** scenario and open the **Project Settings**.
4. In the **Methods** page, select the **Sarma Non-Vertical Slices** option. Leave the other inputs as the default values, and the dialog should appear as below.

The screenshot shows the 'Project Settings' dialog box with the 'Methods' tab selected. On the left is a tree view with categories: General, Soil Profile, Scenarios, Methods (highlighted), Groundwater, Transient, Seismic, Statistics, Random Numbers, Design Standard, and Advanced. The main area is titled 'Methods' and contains two radio buttons: 'Vertical Slices' and 'Sarma Non-Vertical Slices' (which is selected). Below these is a 'Methods' list with checkboxes for various methods: Bishop simplified, Corps of Engineers #1, Corps of Engineers #2, GLE/Morgenstern-Price, Janbu simplified, Janbu corrected, Lowe-Karafiath, Ordinary/Fellenius, Spencer, and Sarma (which is checked). To the right of the 'Sarma Non-Vertical Slices' radio button are three input fields: 'Number of slices' (25), 'Tolerance' (0.0001), and 'Maximum iterations' (75). Below these is a 'Slice Angles' section with 'Optimized' selected and 'User-Defined' as an option, with a 'Method' dropdown set to 'Global Minimum'. Further down is the 'Sarma Interslice Strength Options' section with 'Computed Average Value' selected and 'User-Defined' as an option. Below this are input fields for 'Cohesion' (0 kN/m2) and 'Phi' (35 degrees). At the bottom right is a checked checkbox 'Add slices at material intersections'. At the bottom left is a 'Defaults...' button, and at the bottom right are 'OK' and 'Cancel' buttons.

Project Settings

Methods

☐ Vertical Slices
☒ Sarma Non-Vertical Slices

Methods

- ☐ Bishop simplified
- ☐ Corps of Engineers #1
- ☐ Corps of Engineers #2
- ☐ GLE/Morgenstern-Price
- ☐ Janbu simplified
- ☐ Janbu corrected
- ☐ Lowe-Karafiath
- ☐ Ordinary/Fellenius
- ☐ Spencer
- ☒ Sarma

Convergence Options

Number of slices: 25

Tolerance: 0.0001

Maximum iterations: 75

Slice Angles

☒ Optimized ☐ User-Defined

Method: Global Minimum

Sarma Interslice Strength Options

☒ Computed Average Value ☐ User-Defined

Cohesion: 0 kN/m2

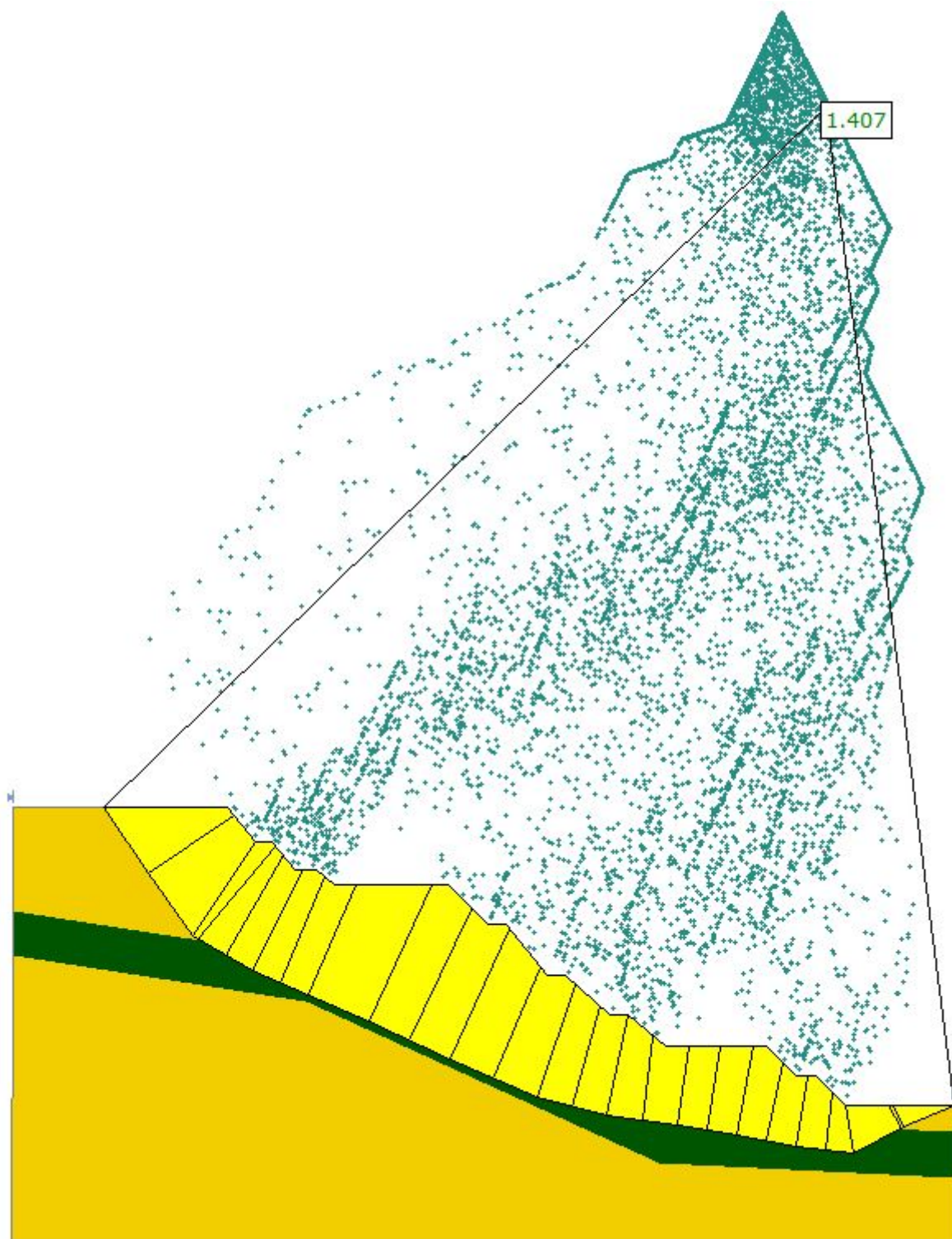
Phi: 35 degrees

☒ Add slices at material intersections

Defaults... OK Cancel

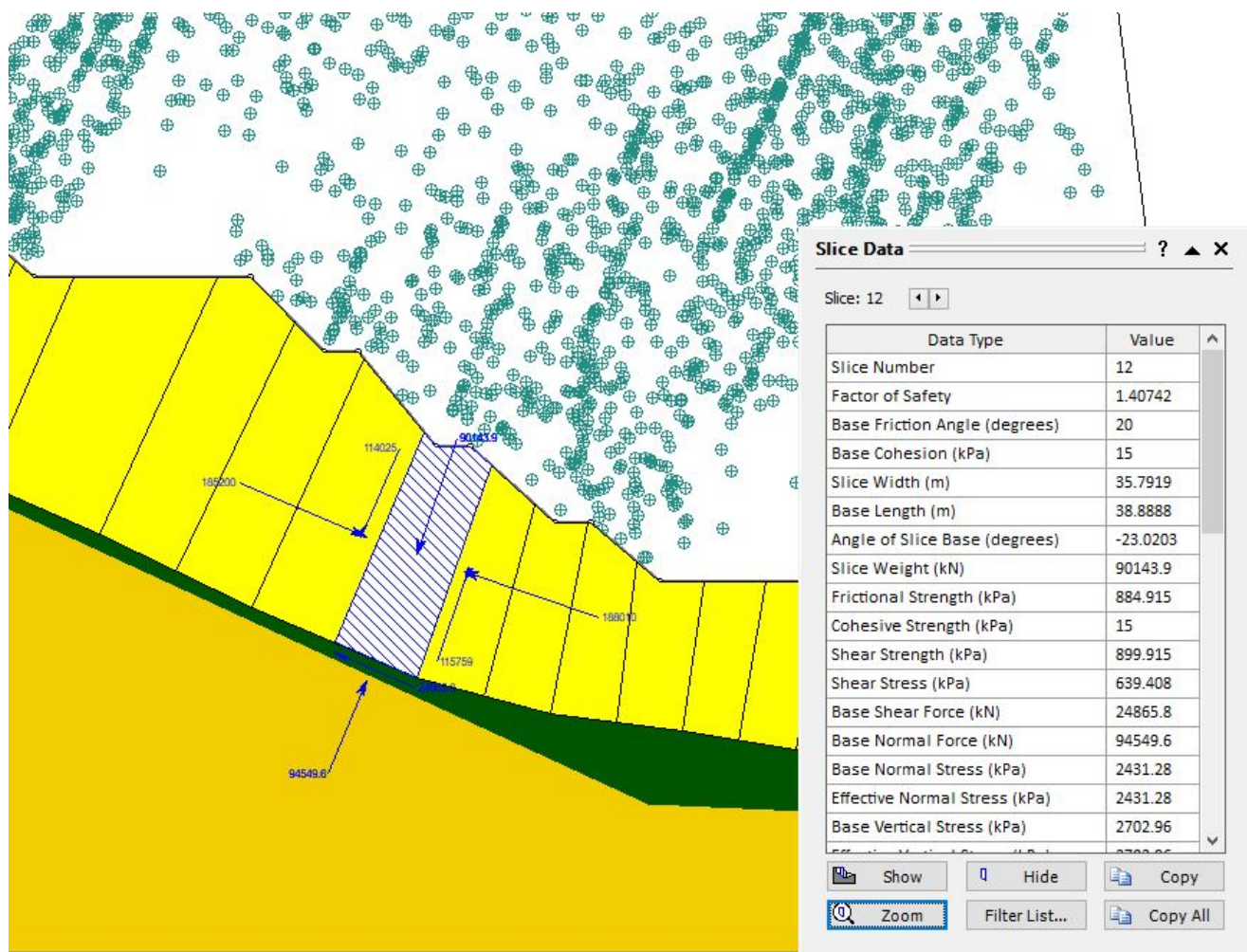
RESULTS

Run the analysis and open Interpret. Click on the Non-Vertical Slices scenario. Select **Query > Show Slices**. The results should appear as shown below.



Results for Sarma non-vertical slice analysis

If you select **Query > Query Slice Data** you can click on individual slices to view the slice data.



Detailed slice forces for Sarma non-vertical slices

SARMA ANALYSIS OPTIONS

Go back to the Slide2 modeller and open the Methods page in **Project Settings**.

For the Sarma Non-Vertical Slice Method, you can change the convergence options, similar to the Vertical Slice methods. You can also modify the Slice Angle calculation and interslice strength options.

For the Slice Angles, the default option is Optimized by Global Minimum (i.e. slice angles are only optimized for the Global Minimum slip surface). You can also optimize for All Surfaces. The user-defined slice angle methods are Bisection, Weighted Normal Average, and Vertical.

For more information on the Sarma analysis options, see the [Sarma Non-Vertical Slice Method page](#).