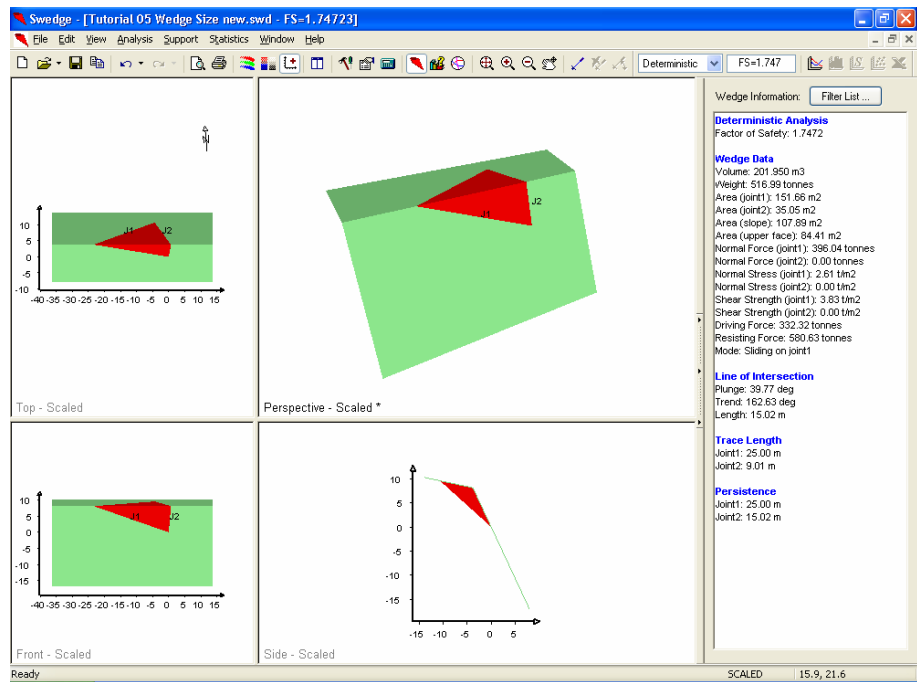


Wedge Size Tutorial



This tutorial will demonstrate the options which can be used to define or limit the size of wedges computed by *Swedge*.

Topics Covered in this Tutorial

- Slope Height
- Bench Width
- Slope Length
- Scale Wedge
- Minimum Wedge Size
- Persistence Analysis

To begin this tutorial we will read in a file.

Select: File → Open

Navigate to the Examples > Tutorials folder in your *Swedge* installation folder, and open the file **Tutorial 05 Wedge Size.swd**.

Wedge Dimensions

To help estimate wedge dimensions visually, you can turn on the display of axes on the model.



Select: View → Axes

The axes are displayed in the Top, Front and Side views, and help you to estimate the dimensions of the wedge. Note:

- the origin of the coordinate system for the axes is the lowermost vertex of the wedge on the slope face (i.e. the intersection of Joint 1, Joint 2 and the slope face). This defines the point (0, 0, 0).
- the units of the axes correspond to the unit system you are using, as selected in the Project Settings dialog (in this case, meters).

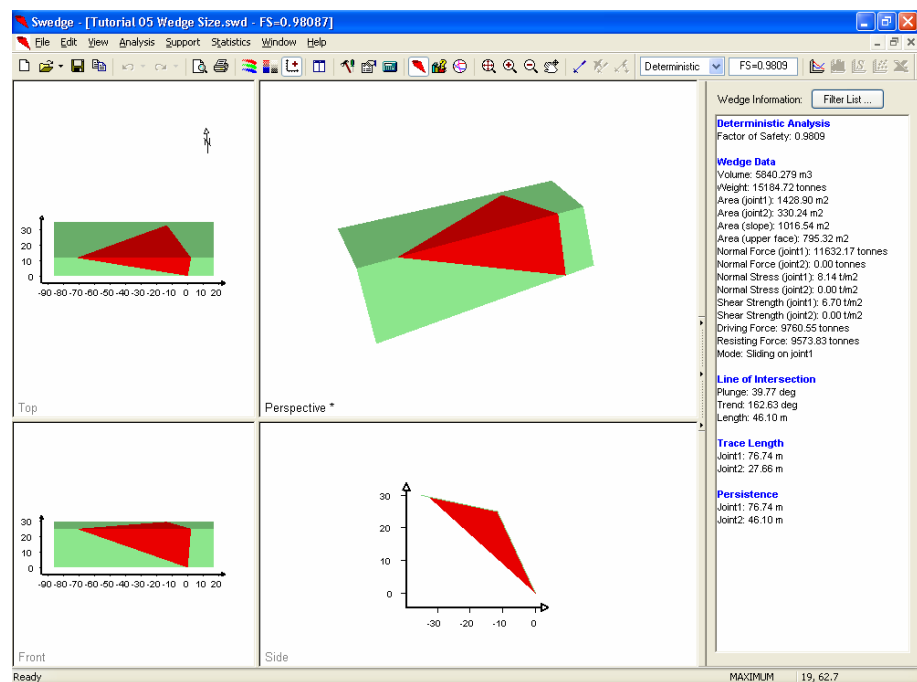


Figure 1: Axes displayed on wedge view.

Using the axes as a guide, you can estimate the dimensions of the wedge.

Exact dimensions of the wedge, including trace lengths, surface areas and volume, can be found listed in the Sidebar information panel at the right of the screen. This information is also available in the Info Viewer.

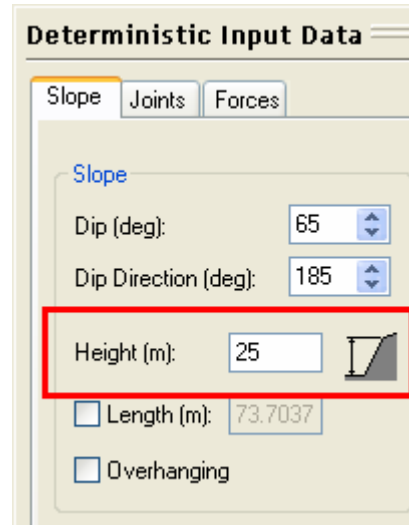
Slope Height

Let's take a look at the input data for this model.



Select: Analysis → Input Data

The **Slope Height** is always required input data for an *Swedge* model. If no other wedge sizing options have been specified, then the wedge size is determined by the Slope Height.



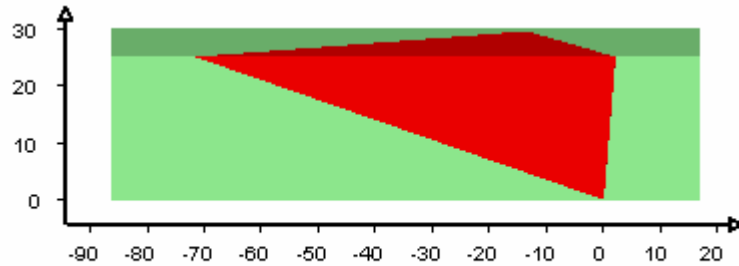
The Slope Height in *Swedge* is defined as the **vertical** distance from the base of the slope to the crest of the slope (i.e. the line of intersection of the two slope planes). The Slope Height for this model is 25 meters.

Select the Joints tab in the Input Data dialog, and notice the strength properties of the joints:

- Joint 1: cohesion = 1, phi = 35
- Joint 2: cohesion = 0, phi = 35

Select Cancel in the Input Data dialog.

Double-click the mouse in the **Front** view to maximize this view. As you can see from the Axes, the height of the wedge is equal to the Slope Height (25 meters), demonstrating how the Slope Height determines the wedge size.



Front *

Figure 2: Wedge size determined by Slope Height (25 meters).

Double-click again in the Front View to restore the 4-view display.

Note the following:

- The failure mode for this wedge (displayed in the Sidebar) is Sliding on Joint1.
- If you click and drag on the wedge with the left mouse button, you can see that the wedge only slides on Joint 1, due to the orientation of the joint planes. Right-click and select **Reset Wedge Movement** to reset the wedge to its default position.
- Recall that the strength properties of Joint1 includes both cohesion and friction components. Because the strength of joint1 includes cohesion, the safety factor of this wedge will depend on the size of the wedge.
- The wedge is very large with a weight of about 15,000 tonnes.
- The wedge safety factor = 0.98.

Slope Length

The **Slope Length** is an optional input parameter which we can use to scale or limit the size of wedges.

Return to the Input Data dialog.



Select: Analysis → Input Data

Select the Slope tab in the Input Data dialog, select the **Slope Length** checkbox, enter a Slope Length = 50 meters, and select OK.

Deterministic Input Data

Slope Joints Forces

Slope

Dip (deg): 65

Dip Direction (deg): 185

Height (m): 25

Length (m): 50

Overhanging

The model should appear as follows.

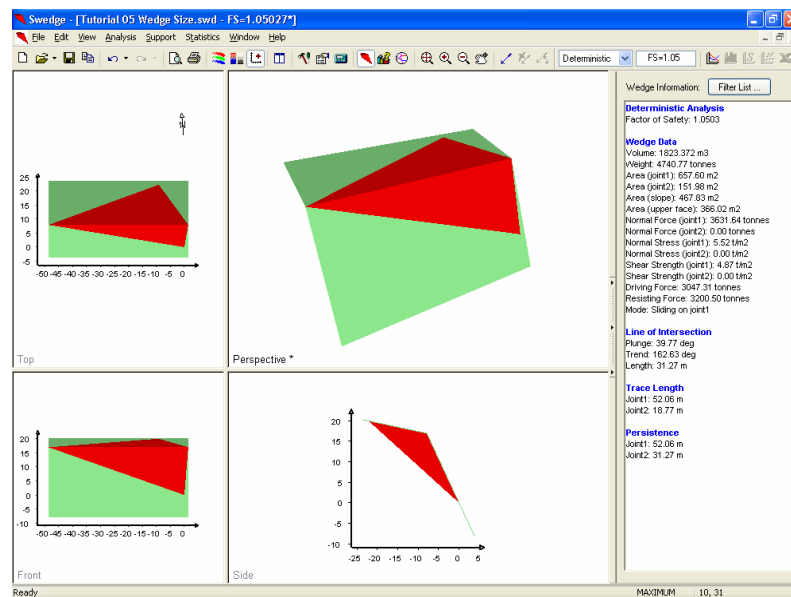
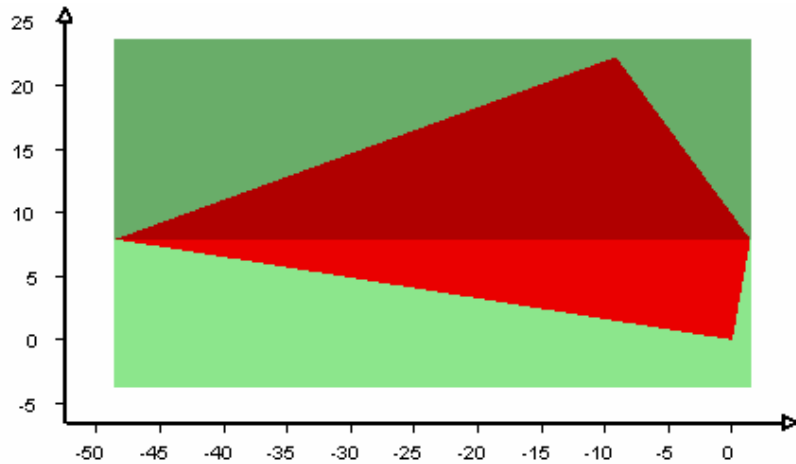


Figure 3: Wedge size determined by Slope Length (50 meters).

Because the Slope Length (50 meters) defines a **smaller** wedge than the Slope Height (25 meters), the wedge size is now determined by the Slope Length rather than the Slope Height.

Double-click the mouse in the **Top** view to maximize this view. As you can see from the Axes, the length of the wedge is equal to the Slope Length (50 meters).



Top *

Figure 4: Wedge size determined by Slope Length (Top View).

Double-click again in the Top View to restore the 4-view display.

In general, when multiple wedge size parameters are in effect (in this case, the Slope Height and the Slope Length), the wedge size is determined by the parameter which gives the smallest wedge (in this case, the Slope Length).

If we had entered a Slope Length which was **GREATER THAN** the current wedge length, then the wedge size would not be affected.

NOTE:

- The wedge weight (in the Sidebar) has been reduced to about 4700 tonnes.
- The wedge safety factor = 1.05.

Bench Width

Another optional parameter which we can use to scale or limit the size of wedges is the Bench Width.

Return to the Input Data dialog.



Select: Analysis → Input Data

Select the **Bench Analysis** checkbox, enter a Bench Width = 10 meters, and select OK.

Upper Face

Dip (deg): 12

Dip Direction (deg): 185

Bench Analysis

Width (m): 10

Use Slope Dip Direction

The model should appear as follows.

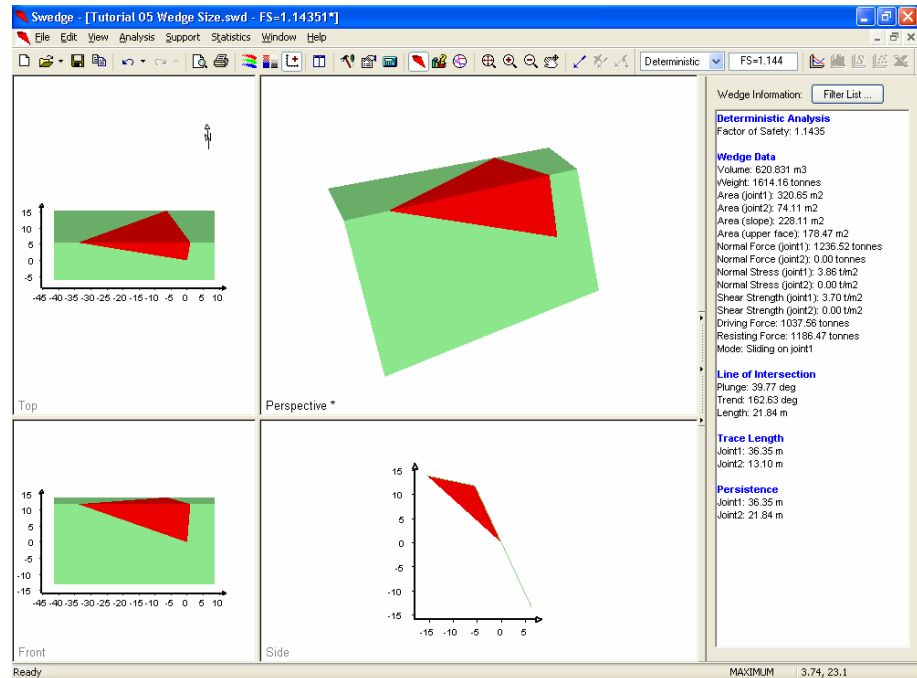
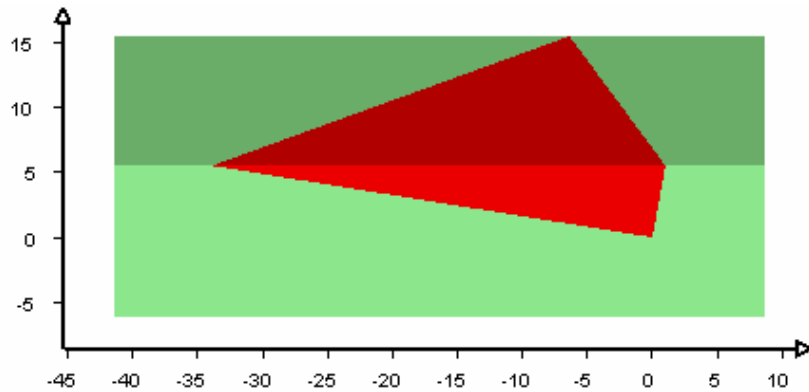


Figure 5: Wedge size determined by Bench Width (10 meters).

Double-click the mouse in the **Top** view to maximize this view. As you can see from the Axes, the dimension of the wedge on the Upper Face is equal to the Bench Width (10 meters).



Top *

Figure 6: Wedge size determined by Bench Width (Top View).

Because the Bench Width (10 meters) defines a **smaller** wedge than the Slope Height or the Slope Length, the wedge size is now determined by the Bench Width.

If we had entered a Bench Width which was GREATER THAN the current wedge width, then the wedge size would not be affected.

NOTE:

- The wedge weight (in the Sidebar) has been reduced to about 1600 tonnes.
- The wedge safety factor = 1.14.

Scale Wedges

Another option for scaling the size of wedges, is the **Scale Wedge** dialog in the Analysis menu.

Select: Analysis → Scale Wedge

The Scale Wedge dialog allows you to limit wedge size according to Trace Length, Joint Persistence, Wedge Weight or Wedge Volume.

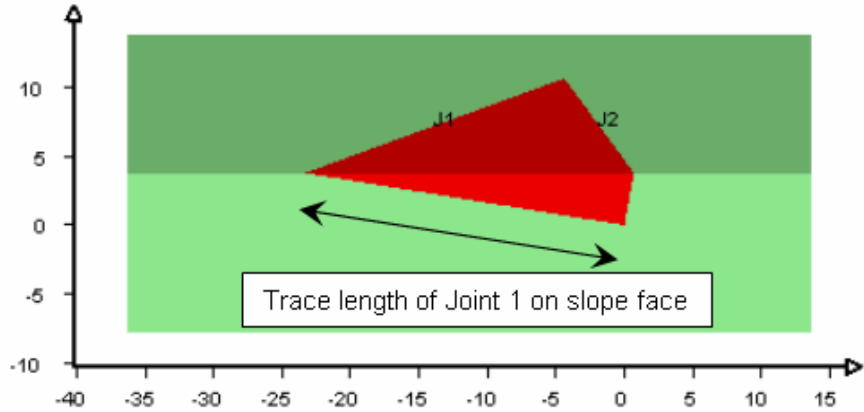
For example, select the **Joint1** checkbox for Trace Length, and enter a trace length of 25 meters. (Note that the current value of each parameter is listed in the dialog.) Select OK.

	Current Values	Scaling Values	
Trace Lengths			
<input checked="" type="checkbox"/> Joint 1: 40/170	36.351	25	m
<input type="checkbox"/> Joint 2: 70/235	13.1047	13.1047	m
Maximum Persistence			
<input type="checkbox"/> Joint 1: 40/170	36.351	36.351	m
<input type="checkbox"/> Joint 2: 70/235	21.8373	21.8373	m
Wedge Data			
<input type="checkbox"/> Volume:	620.831	620.831	m ³
<input type="checkbox"/> Weight:	1614.16	1614.16	tonnes

Because we entered a trace length (25 meters) smaller than the current value (36 meters), the wedge size has been reduced accordingly.

NOTE:

- the Trace Length may occur on EITHER the Slope Face or the Upper Face. The larger value is always used. If you are uncertain which trace length is applicable, this information is listed in the Info Viewer.
- In this case, the Trace Length of Joint1 on the Slope Face is used.



Top - Scaled *

Figure 7: Wedge size scaled by Trace Length of Joint1.

In the above figure, the Joint Labels (J1 and J2) have been displayed with the Display Options dialog.

NOTE:

- The wedge weight has been reduced to about 500 tonnes.
- The wedge safety factor = 1.28.

Similarly, the wedge size can be scaled by the Maximum Persistence. The persistence refers to the maximum dimension between any two points, as measured on the wedge failure surfaces (Joint 1 and Joint2).

Let's enter an additional scaling parameter.

Select: Analysis → Scale Wedge

In the Scale Wedge dialog, select the **Volume** checkbox and enter a wedge volume = 100 m³. Select OK.

	Current Values	Scaling Values	
Trace Lengths			
<input checked="" type="checkbox"/> Joint 1: 40/170	25	25	m
<input type="checkbox"/> Joint 2: 70/235	9.01263	9.01263	m
Maximum Persistence			
<input type="checkbox"/> Joint 1: 40/170	25	25	m
<input type="checkbox"/> Joint 2: 70/235	15.0183	15.0183	m
Wedge Data			
<input checked="" type="checkbox"/> Volume:	201.95	100	m ³
<input type="checkbox"/> Weight:	525.069	525.069	tonnes

The wedge size is again reduced. NOTE:

- The wedge volume (in the Sidebar) = 100 m³, and the wedge weight has been reduced to 260 tonnes.
- The wedge safety factor = 1.40.

In conclusion, we will re-iterate:

- When multiple scaling parameters are defined, the parameter which results in the smallest wedge will control the wedge size.

Wedge Size (Probabilistic Analysis)

In this tutorial example we have demonstrated wedge size options using a Deterministic analysis of a single wedge.

All of the options demonstrated in this tutorial can also be applied in a Probabilistic analysis.

Slope Length and Bench Width

In general it is recommended that the Slope Length and Bench Width options are used for a Probabilistic analysis. If the Slope Length and Bench Width are undefined, then very large wedges can be generated by the Probabilistic analysis, depending on the distribution of your joint orientations. This can lead to unrealistic or misleading analysis results, if the extremely large wedges are included in the analysis output.

Note: this also applies to Combination Analysis.
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Minimum Wedge Size

A Minimum Wedge size can also be defined for a Probabilistic analysis. This is used as a filter to avoid the calculation of safety factor for very small wedges (which may have very large or very small safety factors). Again, the computation of very small wedges may interfere with the interpretation of analysis results. See the *Swedge* help system for more information.

Note: this also applies to Combination Analysis.
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Joint Persistence Analysis

The Persistence Analysis feature allows you to use randomly generated values of joint persistence as a filter, to determine if a given wedge size can be formed. See the Persistence Analysis Tutorial or the *Swedge* help system for more information.