Generalized Anisotropy – Exporting from Slide3 to Slide2

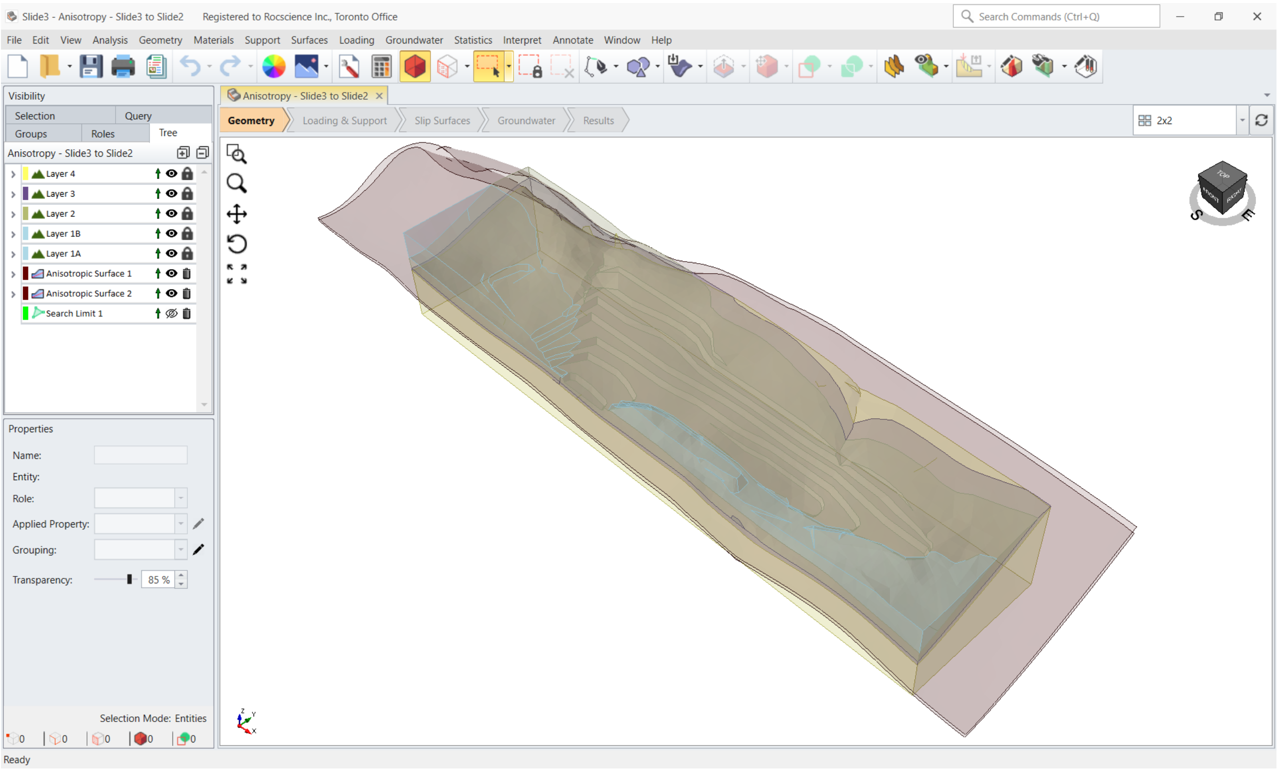
1.0 Introduction

This tutorial will go over the process of exporting 3D anisotropic surfaces from **Slide3** to Slide2 and what you need to know in the process.

NOTE: For a video introduction to this feature, see the webinar snippet here:

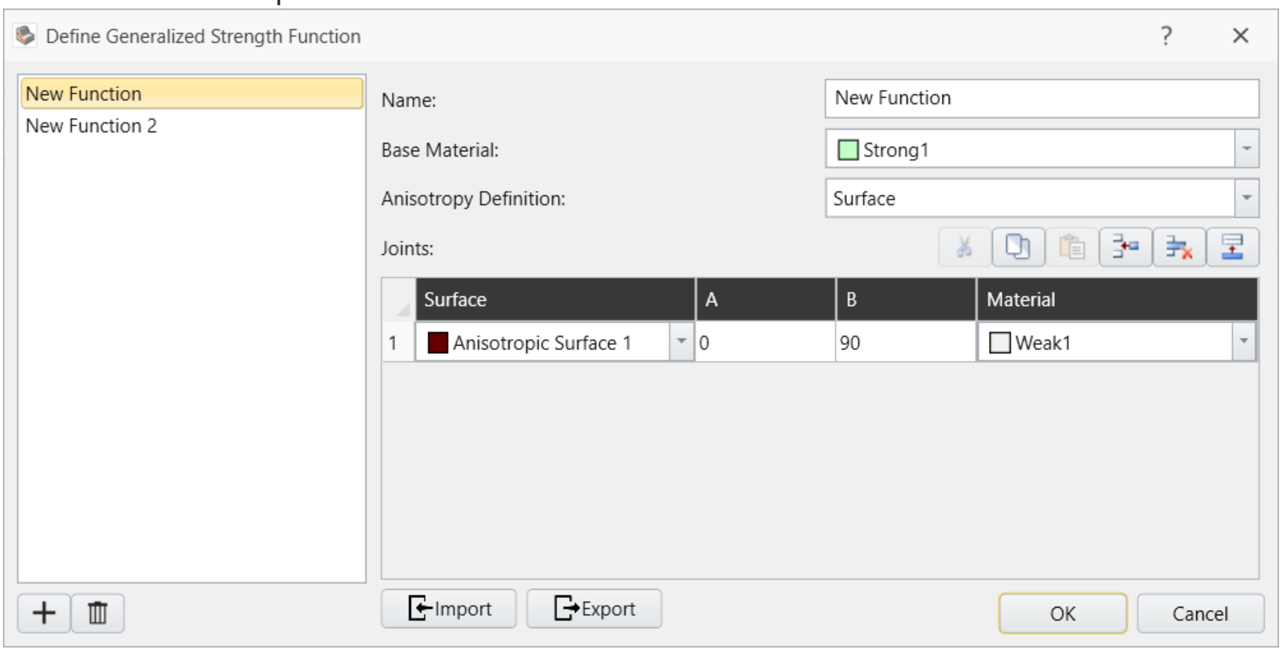
2.0 Model Review

1. In **Slide3**, select **File > Recent > Tutorials Folder** in the menu and open the file *Anisotropy - Slide3 to Slide2.* The model will look as shown.



2. Select **Materials > Define Materials** . Notice that materials GA1 and GA2 are generalized anisotropic material types which follow anisotropic surfaces.

3. In material **GA1** click **More** (pencil icon) to view the strength function. The material follows an anisotropic surface as shown:



4. Click **Cancel**.

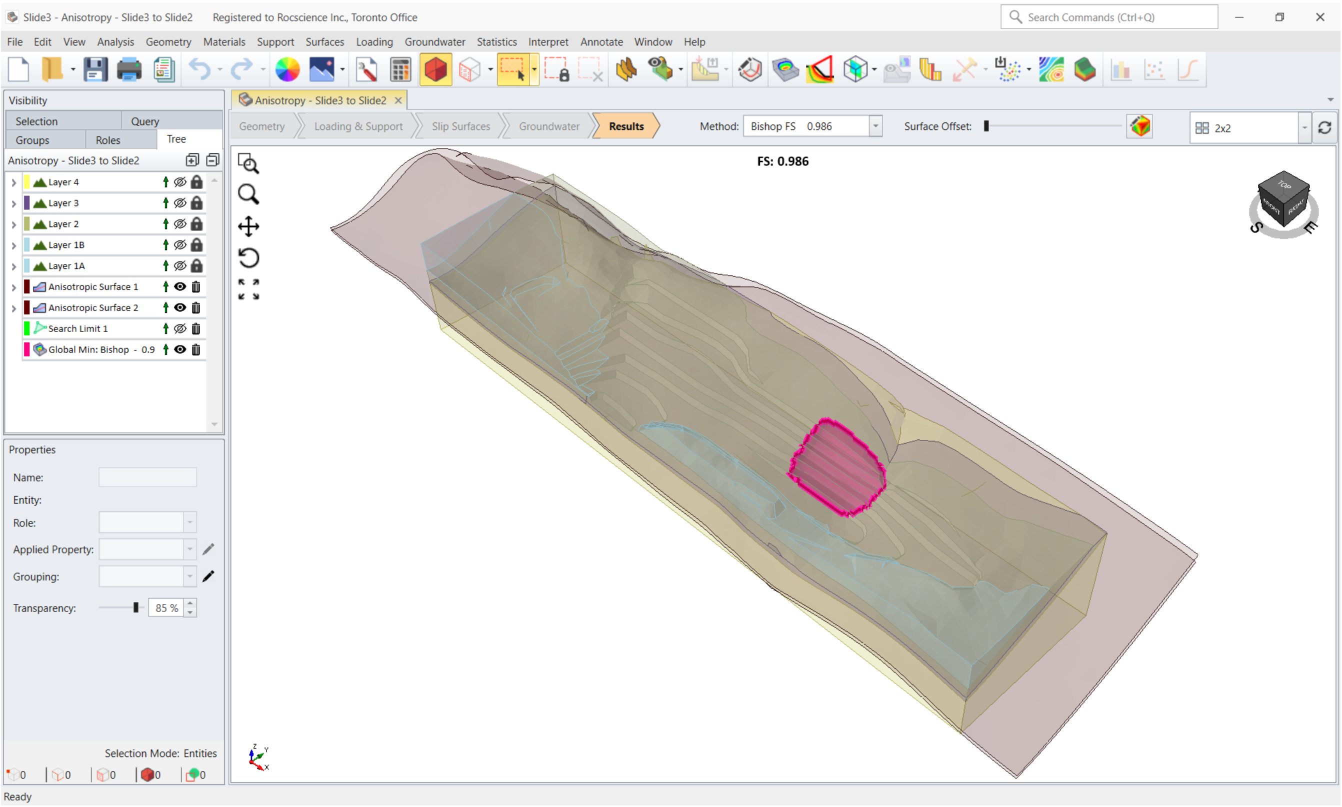
5. Play around with the model to locate the generalized anisotropic materials and their corresponding anisotropic surfaces.

3.0 3D Results

1. Select **Analysis > Compute** or click on the **Compute** icon in the toolbar.

2. Select the **Results** tab.

The factor of safety is just below 1 as shown:



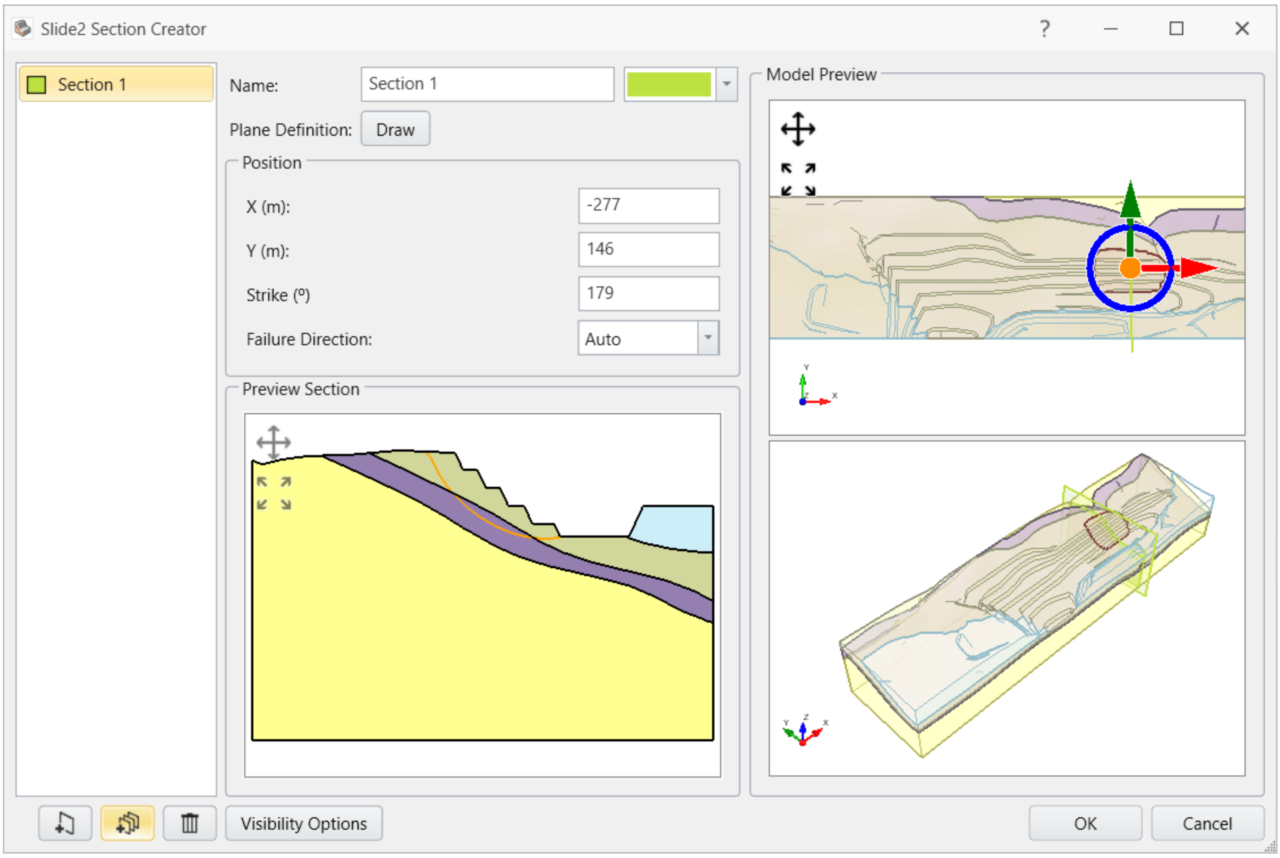
4.0 Export to Slide2

We will now create the Slide2 section for export.

1. Select **View > Slide2 Section Creator**  .

2. Click **Create Single Section**.

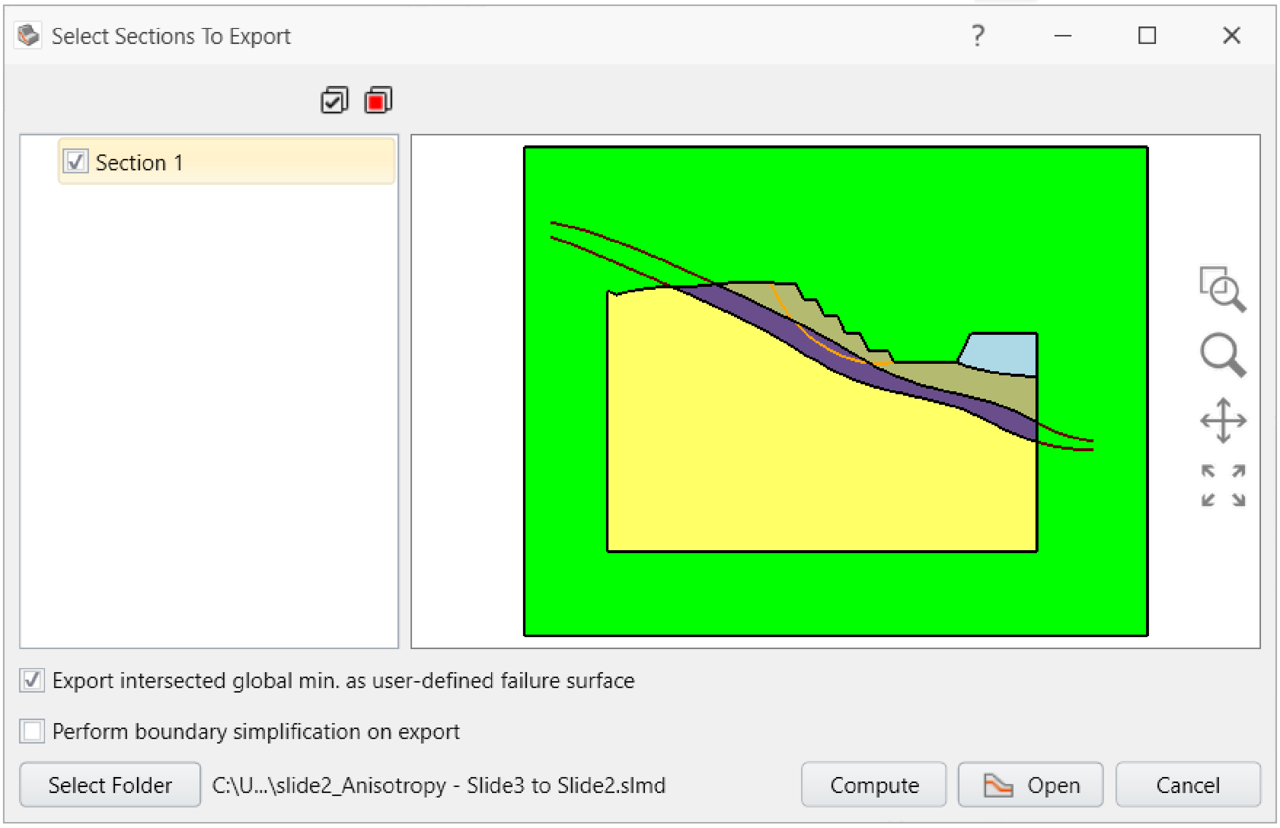
3. Define the section in the direction of failure by using the **X**, **Y**, and **Strike** inputs shown:



X (m)	-277
Y (m)	146
Strike (º)	179

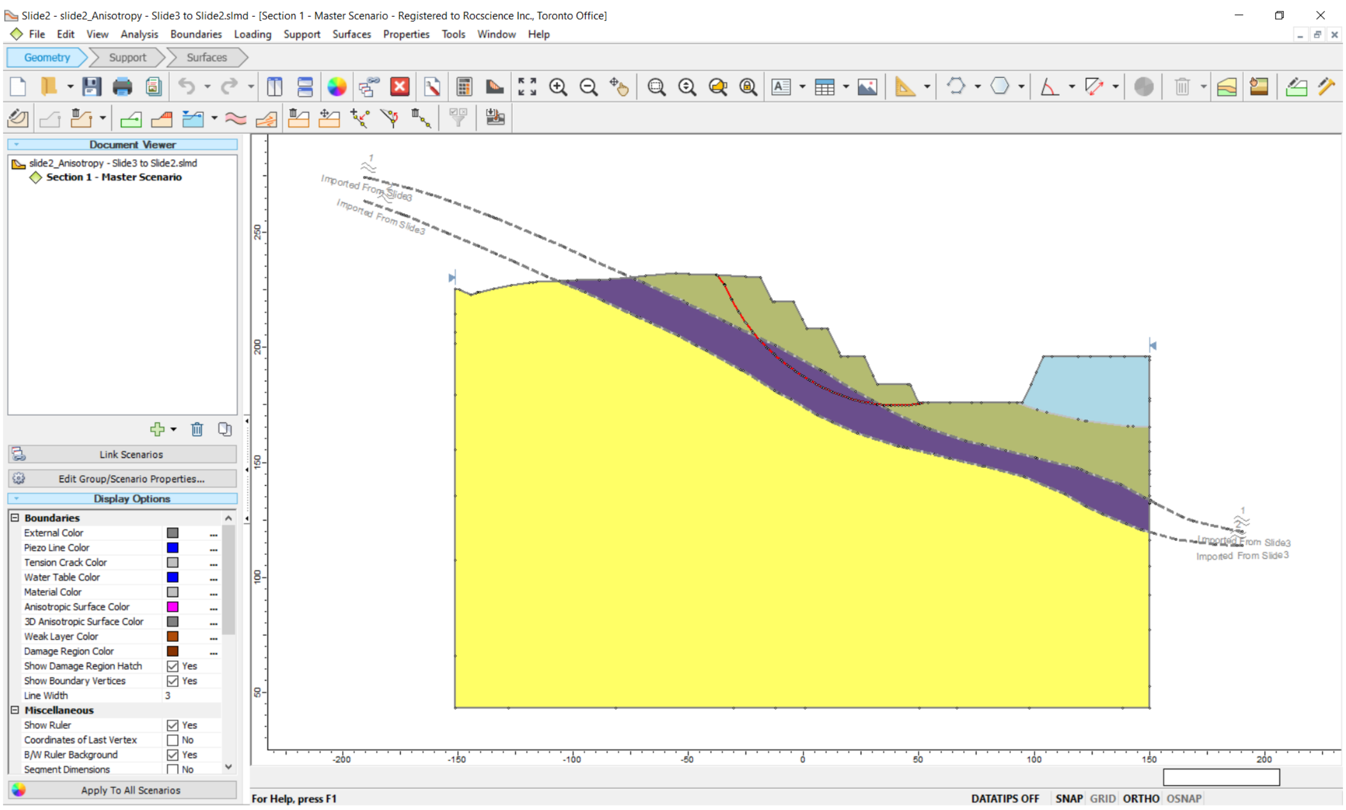
4. Click **OK**.

5. Select **Analysis > Slide2 Integration > Compute/Export to Slide2**



6. Ensure **Section 1** is selected. Click **Open**.

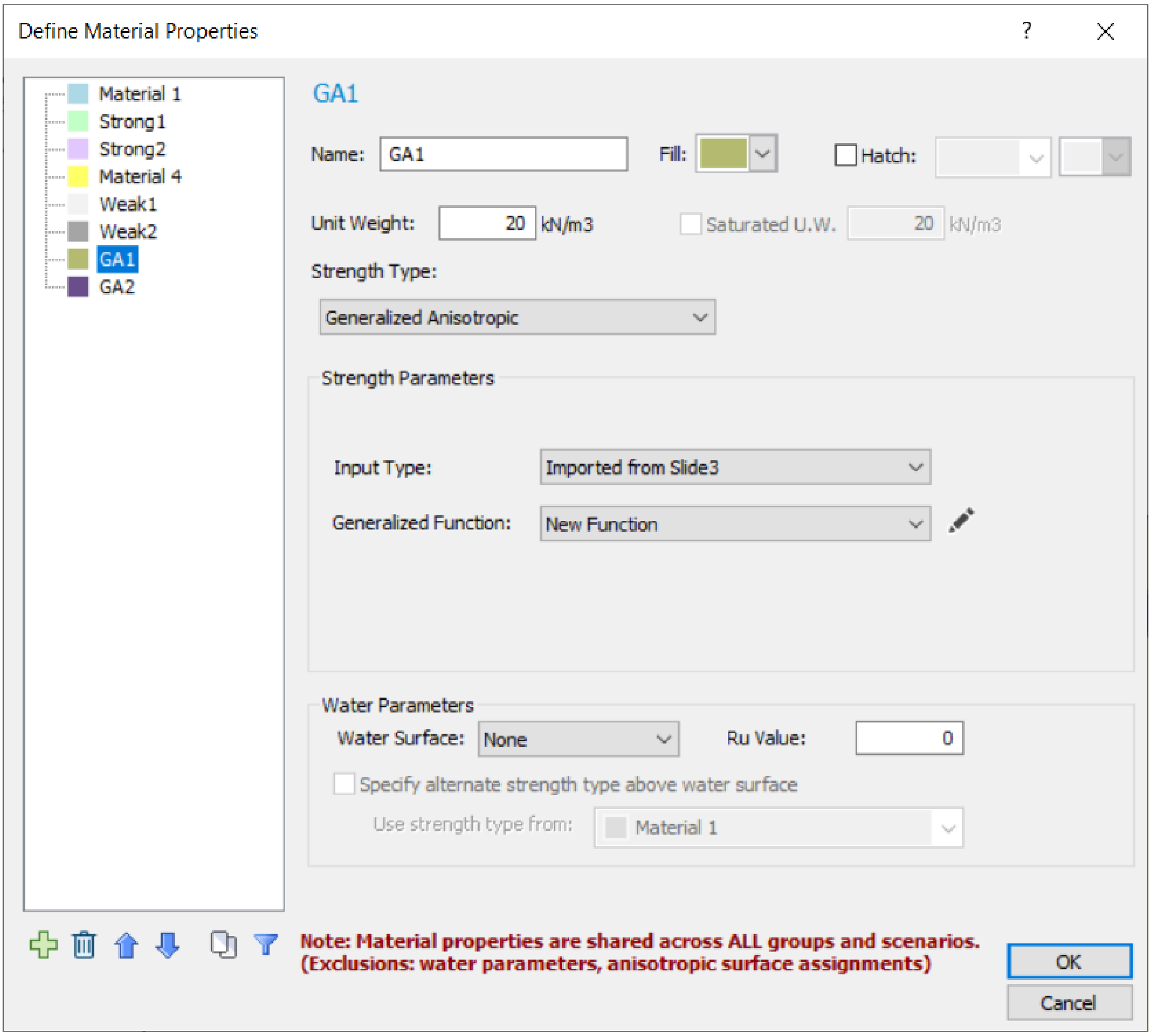
7. Your Slide2 model will look as shown:



Notice that the anisotropic surfaces are labeled as “Imported from Slide3.” We will now review the material parameters.

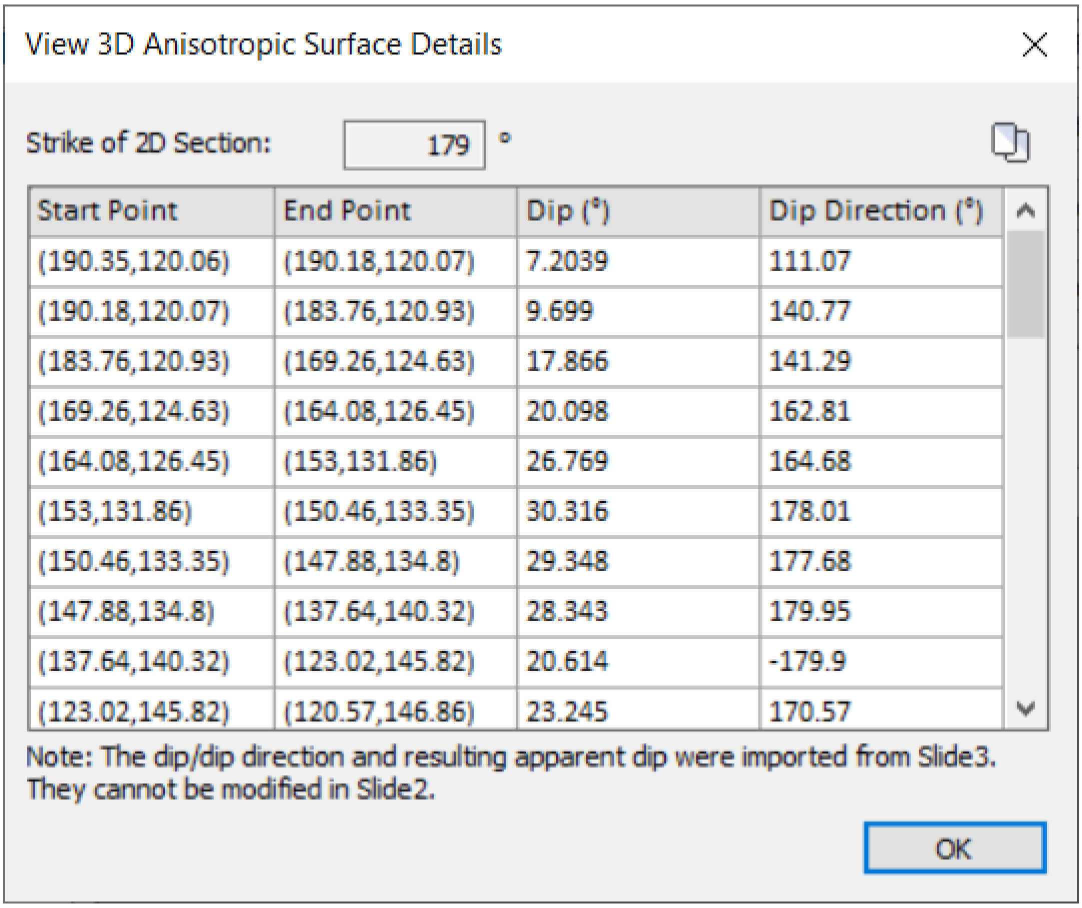
8. Select **Properties > Define Materials**

9. Click on **GA1**.



Notice that the **Strength Type** is **Generalized Anisotropic** and the **Input Type** is **Imported from Slide3**. This Input Type will only be available for models that were exported from Slide3.

10. Click on the **Edit**  icon next to the function. The function dialog looks the same as it did in **Slide3** with the following differences:
    a. There is a 3D Details column.
    b. There is a 3D Anisotropy Handling option.
11. First click **View** in the 3D Details column.



Start Point	End Point	Dip (°)	Dip Direction (°)
(190.35,120.06)	(190.18,120.07)	7.2039	111.07
(190.18,120.07)	(183.76,120.93)	9.699	140.77
(183.76,120.93)	(169.26,124.63)	17.866	141.29
(169.26,124.63)	(164.08,126.45)	20.098	162.81
(164.08,126.45)	(153,131.86)	26.769	164.68
(153,131.86)	(150.46,133.35)	30.316	178.01
(150.46,133.35)	(147.88,134.8)	29.348	177.68
(147.88,134.8)	(137.64,140.32)	28.343	179.95
(137.64,140.32)	(123.02,145.82)	20.614	-179.9
(123.02,145.82)	(120.57,146.86)	23.245	170.57

We can see the strike of the 2D section we defined in Slide3, and the 3D dip and dip direction of the anisotropic plane at each segment along the anisotropic surface.

12. Click **OK**.

Now let's explore the **3D Anisotropy Handling** option. There are two options in the dropdown. They are explained below:

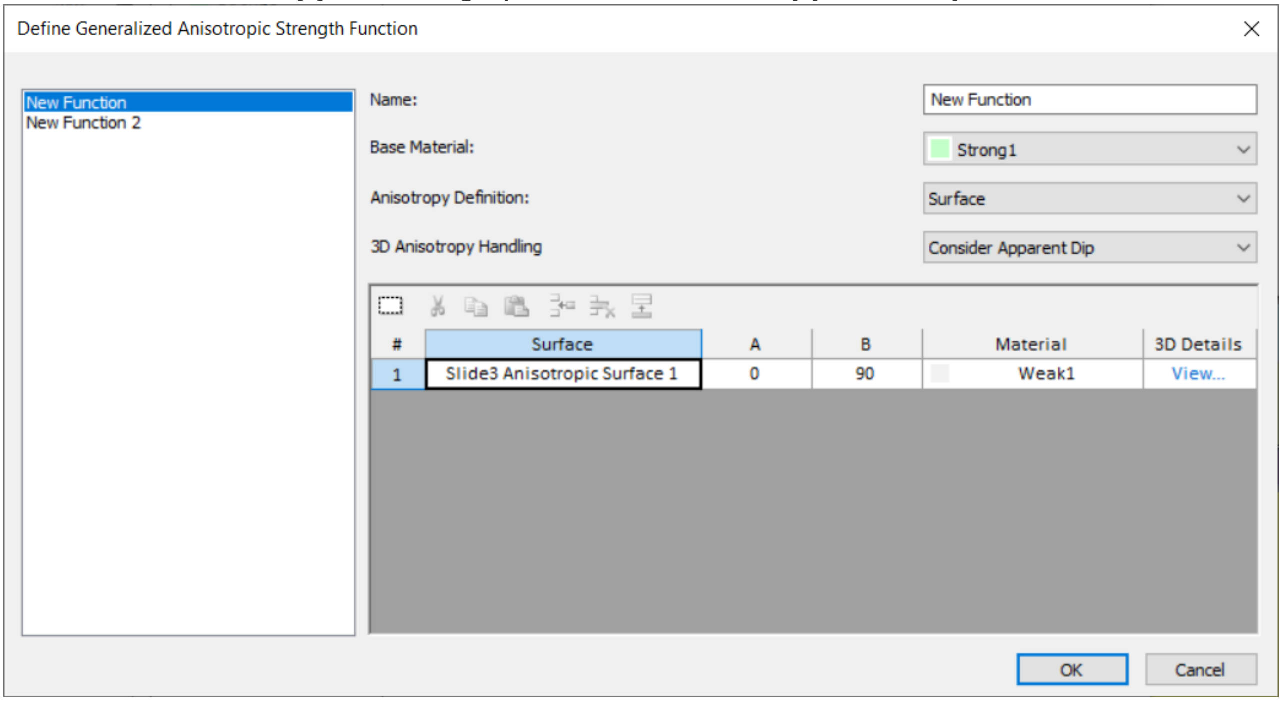
- **Consider Apparent Dip**: cut the anisotropic surface at the location of the Slide2 section. This is a pure 2D analysis where the 2D section doesn't know about the 3D anisotropy around it.
- **Consider 3D Anisotropy**: since we are taking a 2D section inside of our 3D model, we want the 2D model to be aware of the true 3D anisotropic surface so that our 3D and 2D results are comparable.

5.0 2D Results

5.1 Consider Apparent Dip

We will first try the pure 2D analysis.

1. Set the **3D Anisotropy Handling** option to **Consider Apparent Dip**.



2. Click **OK.**

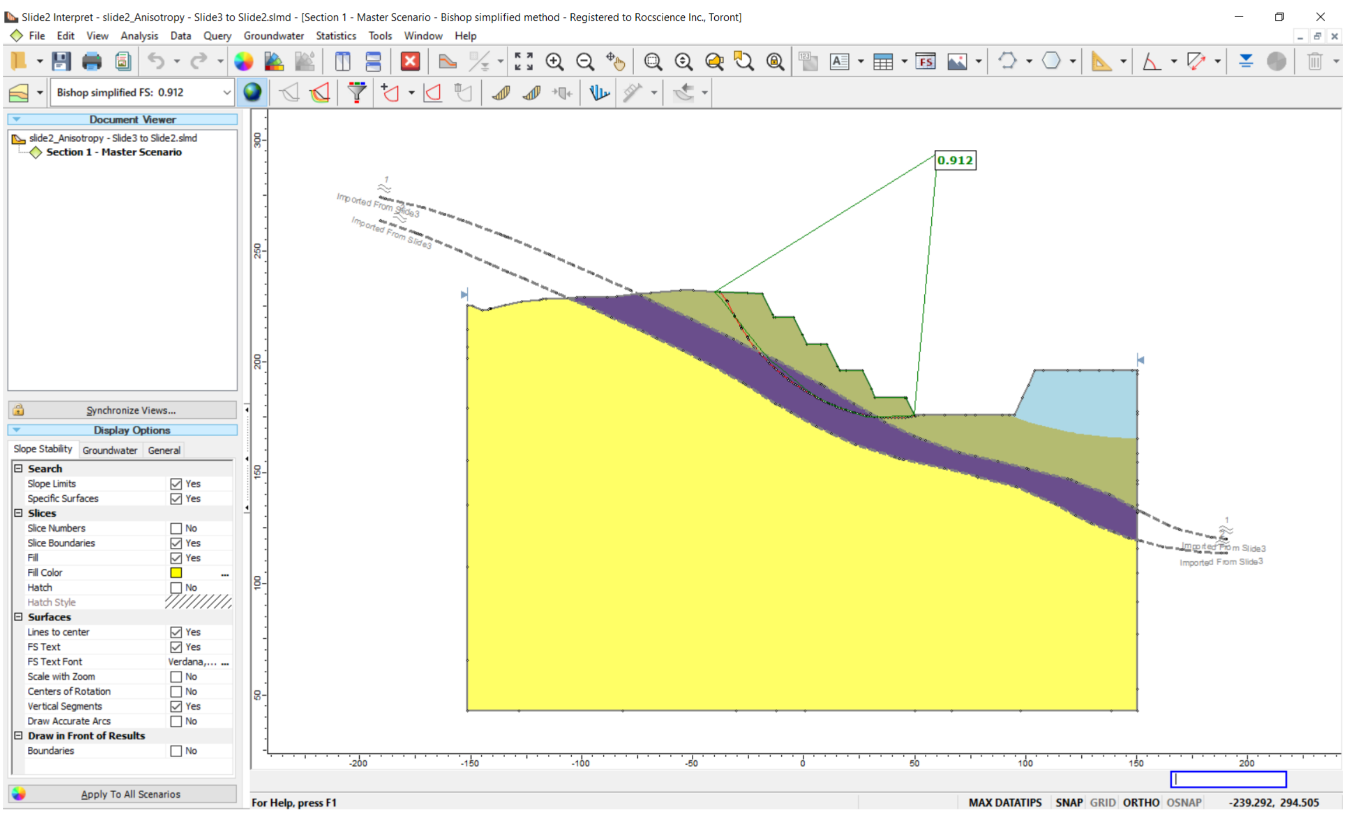
3. Click on **GA2** in the dialog and click the **Edit** icon.

4. Set the **3D Anisotropy Handling** option to **Consider Apparent Dip**.

5. Click **OK** in this dialog and in the **Material Properties** dialog.

6. Select **Analysis > Compute** or click on the **Compute** icon in the toolbar.

7. Select **Analysis > Interpret** to launch the Slide2 Interpreter.



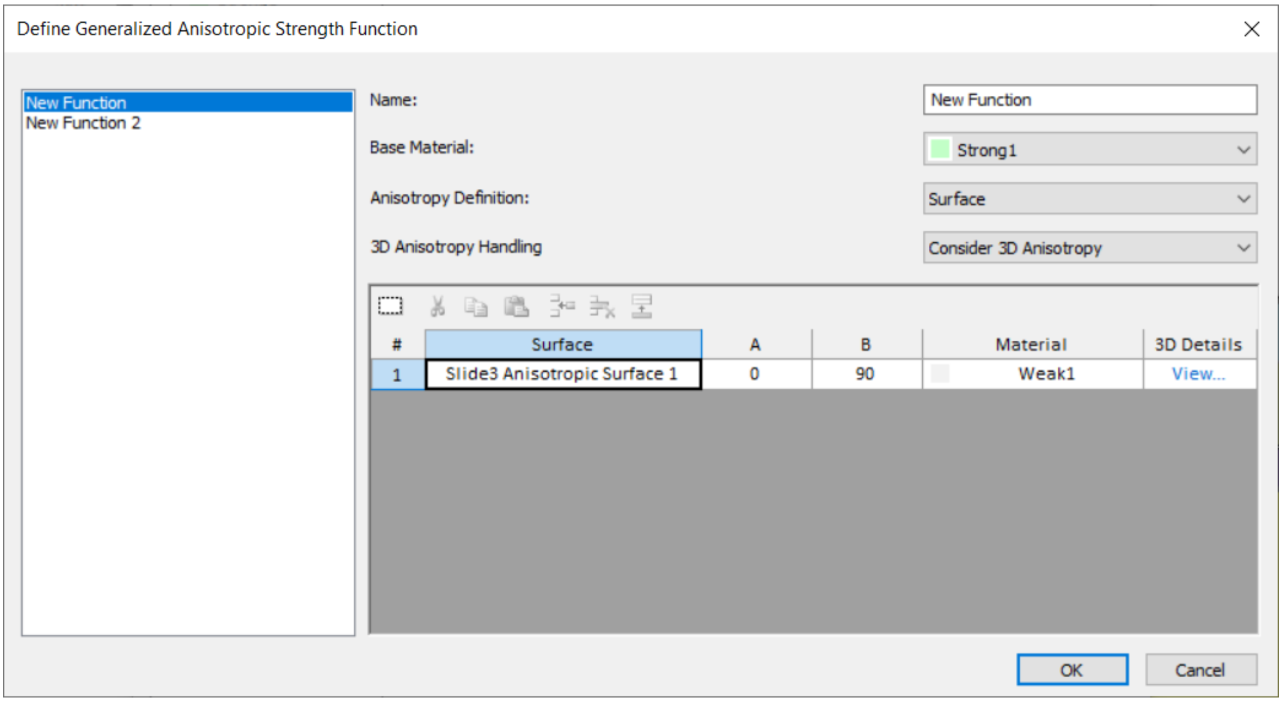
The factor of safety in Slide2 is very similar to the one in Slide3. As well the slip surface in Slide2 (in green) is very similar to the Slide3 surface (in red).

By selecting **Consider Apparent Dip**, this analysis assumes that the anisotropic surfaces are purely 2D and are simply the ones we see on the screen. They are equivalent to the regular 2D anisotropic surface.

5.2 Consider 3D Anisotropy

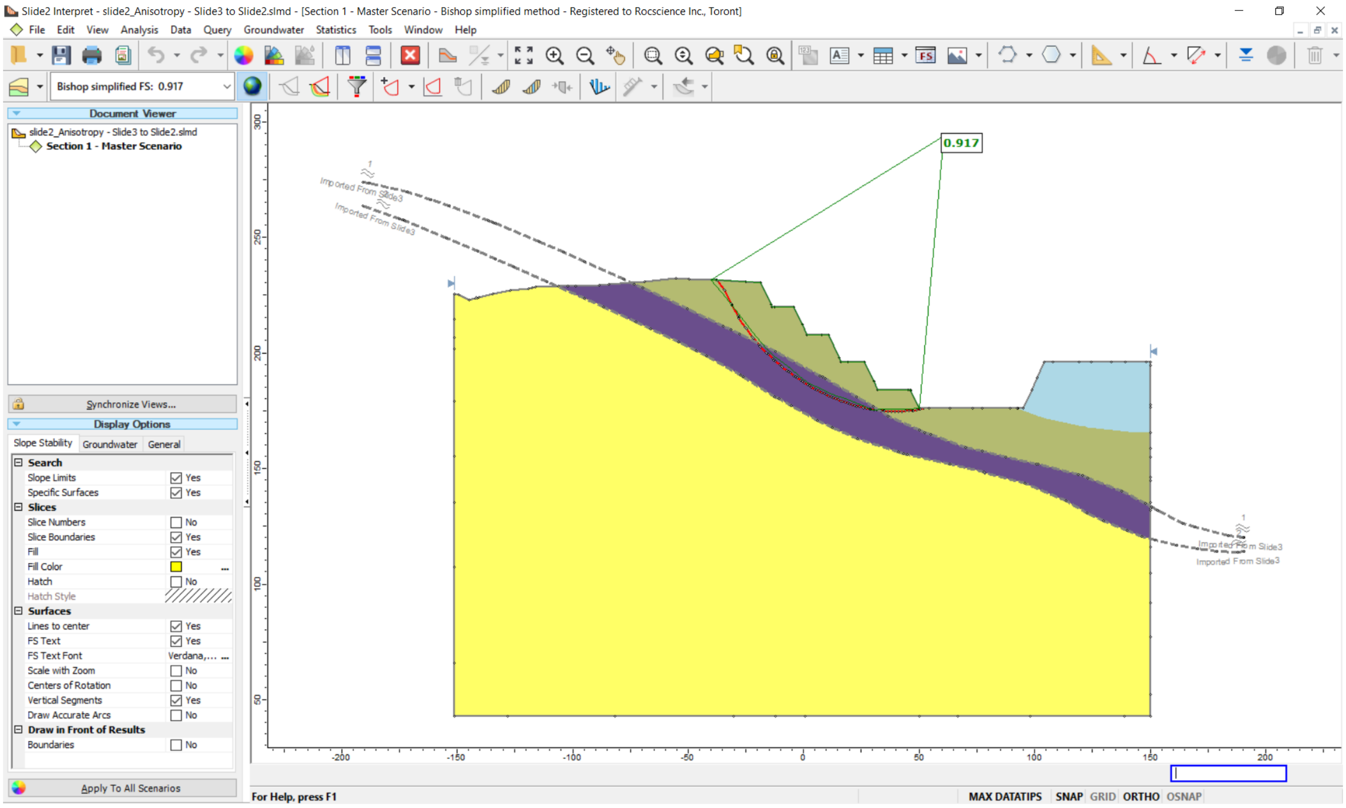
Now let's try to compute while considering the 3D orientations.

1. Select **Analysis > Modeler** to return to the Slide2 Modeler.
2. Select **Properties > Define Materials** .
3. This time, set **3D Anisotropic Handling** to **Consider 3D Anisotropy** for both **GA1** and **GA2**.



4. Click **OK** in both dialogs.
5. Select **Analysis > Compute** or click on the **Compute** icon in the toolbar.
6. Select **Analysis > Interpret**

The results will look as shown:



By selecting **Consider 3D Anisotropy**, this analysis is using the dip and dip direction at each segment along the anisotropic surfaces, so that we can imagine this as a 2D section with two 3D anisotropic surfaces.

6.0 Discussion

The results between the **Consider 3D Anisotropy** and **Consider Apparent Dip** are almost identical in both slip surface shape and factor of safety. This is because the anisotropic surfaces are approximately extruded along the x axis in the Slide3 model. In other words, the dip direction of the anisotropic planes is roughly the same as the dip direction of the Slide2 section. In this case, these methods will give very similar results.

6.1 Which method is correct?

Unfortunately, there is no black-and-white answer. No matter how you look at it, you are trying to represent a 3D object on a 2D plane. There's no "correct" way of doing it. You need an assumption that's best for your model. As a user, you must tell the software the type of analysis you want to compute:

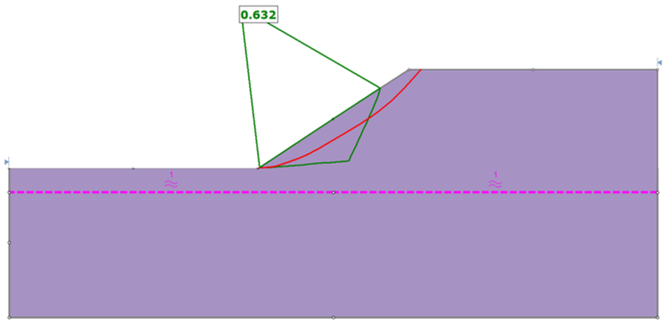
1. **Consider Apparent Dip**: cut the anisotropic surface at the location of the Slide2 section. This is a pure 2D analysis where the 2D section doesn't know about the 3D anisotropy around it.
2. **Consider 3D Anisotropy**: since we are taking a 2D section inside of our 3D model, we want the 2D model to be aware of the true 3D anisotropic surface so that our 3D and 2D results are comparable.

6.2 In which cases will the results be different?

When the direction of anisotropy is not similar to the direction of failure and the direction of the 2D section, the results will change drastically. For an example, see the webinar clip at the link: https://youtu.be/AKirBTmV0DM?t=2007

Consider Apparent Dip

i.e. “cut” the anisotropic surface



Consider 3D Anisotropy

i.e. bring in the 3D dip and dip directions along surface