New Kinematic Analysis Features in Dips 7.0

In Dips 7.0 several important new features were added to the Kinematic Analysis options. This article highlights the new options, some of which you may not have discovered yet.

1. Kinematic sensitivity analysis
2. Terzaghi weighting can be applied to kinematic results
3. Declination can be applied to the slope dip direction
4. Slope plane can be highlighted on kinematic stereonet display
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**Kinematic Sensitivity Analysis**

The *Kinematic Analysis* option in *Dips* now offers an additional feature: *Kinematic Sensitivity Analysis* of slope parameters.

*Kinematic analysis template for planar sliding*

With the **Kinematic Sensitivity** option, you can enter a range of values for:

- slope dip
- slope dip direction
- friction angle
- lateral limits

and plot the results for different failure modes (e.g. planar sliding, wedge sliding, toppling). The plots allow you to quickly see the effect of individual variables, while keeping others constant at their mean values.
In the following graph, the probability of planar sliding is analyzed for a 0 to 360 degree range of slope dip direction. The mean values of each variable are listed at the bottom of the plot.

Sensitivity graph of planar sliding vs. slope dip direction

You can plot multiple graphs on a single plot, for example the following plot shows slope angle and friction angle varied over ranges of 0 to 90 and 0 to 60. If you click on any point on a graph, the stereonet will display the slope parameters used to generate that particular value.
When you plot multiple variables on one graph, the horizontal axis is in terms of percent of range for all variables.
Terzaghi Weighting applied to kinematic analysis results

In the previous version of *Dips* 6.0, the kinematic analysis results (i.e. the counting of poles or intersections in critical zones) was based on the raw pole data, with no accounting for directional sampling bias due to data collection on traverses. The Terzaghi weighting option had no effect on the kinematic analysis results in *Dips* 6.0.

In *Dips* version 7.0, if the **Terzaghi Weighting** checkbox is selected in the sidebar, the kinematic analysis results will now be reported in terms of weighted counts of poles or intersections. The weighting is applied to each pole based on the angle between the plane and the traverse, and all pole counts and “critical percent” values for all failure modes, are reported using the weighted count values.

The legend will report weighted results for the kinematic analysis when the Terzaghi Weighting is applied. The weighting affects the critical count, the total count and the percent critical value for the kinematic analysis, for poles, and for intersections (used for wedge sliding and direct toppling modes).

Note that the Info Viewer reports both weighted and unweighted results together, so that you can easily compare results and see the effect of the weighting.

**Planar Sliding**

<table>
<thead>
<tr>
<th>Planar Sliding</th>
<th>Critical</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Vectors</td>
<td>15</td>
<td>2.31%</td>
<td>650</td>
</tr>
<tr>
<td>All Vectors (Weighted)</td>
<td>34</td>
<td>1.84%</td>
<td>1827</td>
</tr>
</tbody>
</table>

Whenever you use Terzaghi weighting you should understand the significance of the weighting method and its application to design.
Declination applied to slope dip direction for kinematic analysis

In the previous version of Dips (6.0), when you entered the Slope Dip Direction used for the kinematic analysis (entered in the sidebar), it was assumed that this value was corrected for Declination (i.e. if a Declination value was entered in Project Settings, this value was NOT used to correct the Slope Dip Direction for kinematic analysis in Dips 6.0). Therefore it was up to the user to apply the declination manually.

In Dips 7.0, there is now an option which allows you to apply the Declination value (entered in Project Settings) to the Slope Dip Direction used for kinematic analysis (entered in the sidebar).

The declination is applied by selecting the small “compass needle” button, beside the input edit box for the Slope Dip Direction.

This works as follows:

1. If the declination button is selected, then you should enter the raw (uncorrected) value of Slope Dip Direction in the edit box.
2. In this case, the corrected value of Slope Dip Direction will be used for the kinematic analysis (i.e. the display of the slope plane on the stereonet, and the kinematic results, will use the corrected value).
3. NOTE that the value you enter in the edit box, will REMAIN the uncorrected value (i.e. the declination correction does not affect the value you see in the edit box).

Also note:

- If you have a Declination value defined in Project Settings, you DO NOT HAVE TO USE the declination option for the kinematic slope dip direction. This is optional. You can still apply the correction manually, if desired, in which case you would enter the corrected value without selecting the declination button beside the edit box. This is equivalent to the assumption used in Dips version 6.0.

If you are using the Kinematic Sensitivity option, the declination correction button is also available in this dialog, and is equivalent to selecting the declination button in the sidebar. The same rules apply as described above: if the button is selected, you should enter the uncorrected values for the range of slope dip direction in the sensitivity dialog.
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Highlight Slope Plane Display Option

One more small but useful feature for the Kinematic Analysis, is found in the Kinematic Analysis dialog:

This option allows you to highlight the slope plane only, on the stereonet, when you are viewing the kinematic analysis results. You can also customize the colour and line width of the slope plane display (in the Colors and Properties sections).

One suggested use of this feature, is as follows:

- Turn OFF the Construction Lines display
- Turn ON the Highlight Slope Plane option
- Turn ON the Highlight (critical region) option

Then you can view only the Slope Plane and the Critical Failure zone, without displaying all of the other Construction Lines used for the analysis. You may find this useful for demonstrating the Kinematic Analysis results. This is illustrated in the figure below.
That concludes this review of the new kinematic analysis features in *Dips* 7.0.

If you have any suggestions for new features that you would like to see in *Dips*, please let us know, we are always happy to hear them!