TIPS from Tech Support

Volume Calculations in MineSight® 3-D

With the addition of the new **Calculate Analytical Volume(s)** function on the MineSight® 3-D **Surface** menu, a number of questions have been fielded by Tech Support regarding the differences between this tool and the original **Calculate Volume** function, which remains an essential part of the MineSight® 3-D menu. This article will describe the uses and considerations for these two tools for calculating volumes.

Surface | Calculate Volume

This function has been part of the MineSight® 3-D menu since its inception, and the function itself has changed little, if any, since its introduction. This tool performs an integrated volume calculation, wherein each vertical column is first subdivided into a user-specified number of subcells. This setting is located on the **Volumes** tab of the **Project Settings** dialog, located on the MineSight® 3-D **File** menu, and defaults to 10 subcells in both the X and Y directions. For very complex or extremely small volumes, it is often useful to increase this number, increasing the accuracy of the calculation. However, there is an increase in the time required for the calculation as well, so some care should be exercised in the use of this option.

Once the subcells are calculated, the program generates a vertical ray for each subcell column, which locates the occurrence of surfaces down the column. The location of each surface occurrence is stored. The distance between surface occurrences is then measured, multiplied by the subcell area, and totalled to provide an integrated volume.

This function will calculate volume either within a (single) solid, or between two surfaces, and these geometry objects can be selected either from the MineSight® Viewer, or from the **Object Contents Browser** dialog. The solids used should be watertight, although a "small" number of openings or self-intersecting faces can be present without having a negative effect on the volume calculation. This "small" number is a variable, depending on the size and complexity of the solid, but if the number is exceeded, the tool will fail to return an accurate result.

Surface | Calculate Analytical Volume(s)

This new volume calculation function uses a matrix determinant calculation to determine the exact volume of a watertight, competent solid or group of solids. The solid(s) are selected from the **Viewer**, and when all desired solids are selected, a right-click begins the calculation; the results are displayed in the **Messages Window**. This function is available through the **Surface** menu and is also invoked upon the **Query of a solid**, when the **Analytical Volume** is listed in the **Query Window**.

The solids used must be entirely competent; any *opening*, *self-intersecting*, or *duplicate face* will cause this tool to fail without returning a result. In addition, special care must be taken when working with merged solids that share edges or faces. In this case, it is good practice to first **Explode** these entities, then **Calculate the Analytical Volume**.

Special Considerations

There are certain situations in which one of these Volume functions is superior to the other choice. In general, the original **Calculate Volume** function is the only choice when you wish to calculate the volume between two surfaces, such as a triangulated pit design and topographic surface. However, there is one special case when this function is not the best choice. If the bottom surface "folds back" on itself below the elevation of the top surface (see Fig. 1), the "phantom" volume between the two surfaces but outside the volume of interest is included in the calculation (see Fig. 2).

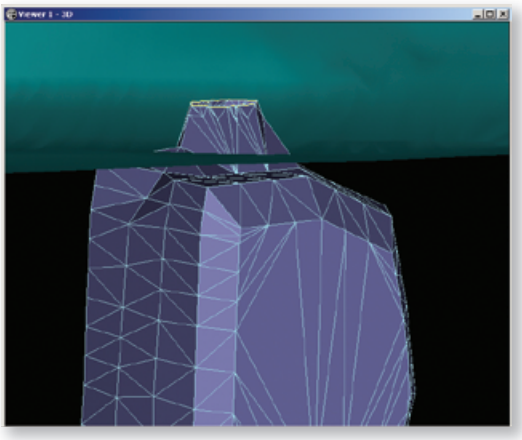

Fig. 1 Bottom "folds back" below top.

(continued on page 10)

(Volume Calculations in MineSight® 3-D continued from page 9)

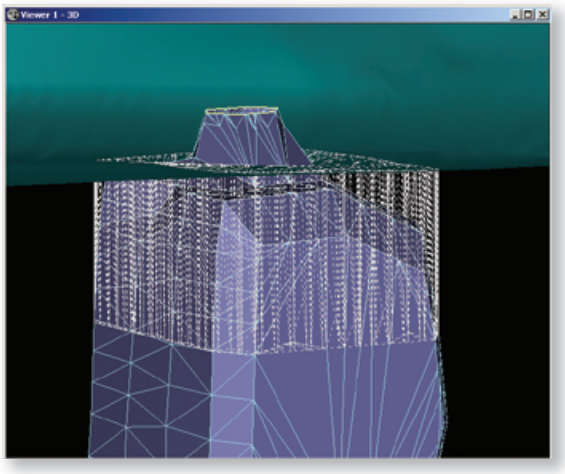

Fig. 2 "Phantom" volume.

In a situation such as this, the most reliable method to calculate the volume within the bottom surface and below the top surface is to create a solid using the **Intersect Surfaces** tool, and then calculate the volume of the solid.

Totally Contained Solids

In some cases, it is necessary to calculate the volume of a solid enclosed by another solid (see Fig. 3).

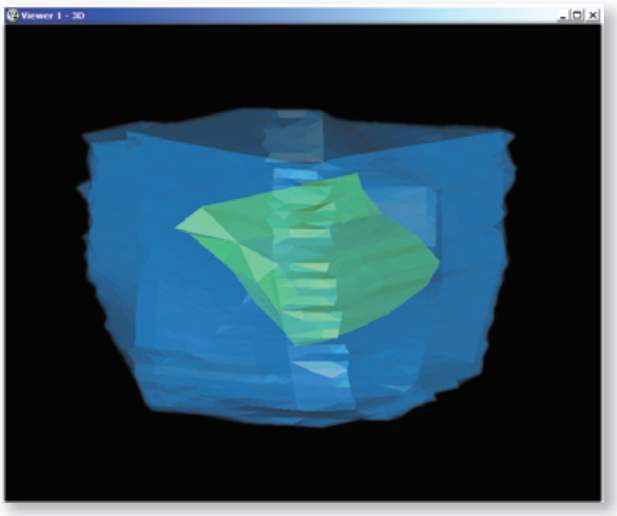

Fig. 3 Totally enclosed solid

In this situation, both the **Calculate Volume** and **Calculate Analytical Volume(s)** tools will produce a correct volume for each individual solid, and if the difference between the two (the volume of the outer shell) is desired, it is a simple calculation. However, in more complex cases, it is convenient to be able to create a "hollow" solid and calculate that volume directly. To do this, use the **Merge Selected** function, which merges the two surfaces into a single element, and then the **Calculate Volume** tool will correctly calculate the difference (the outer volume minus the inner volume). The **Calculate Analytical Volume(s)** tool will yield the sum of the two volumes, so it should not be used in this case.

Overlapping Solids

Finally, situations often arise wherein the solids of interest overlap, with neither solid totally contained within the other (see Figure 4).

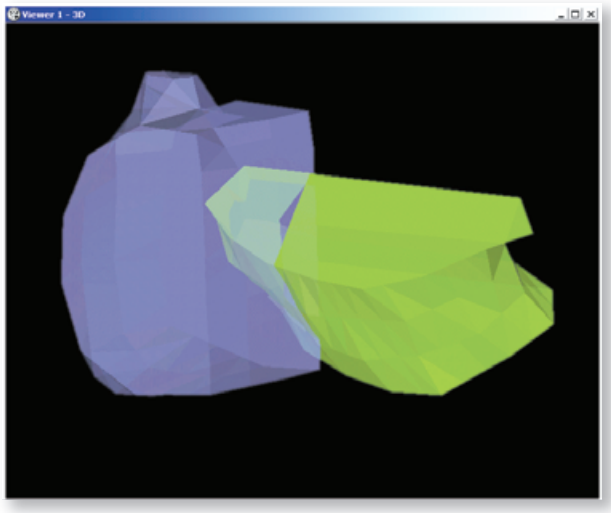

Figure 4 Overlapping solids.

In this case, the volumes of the individual solids can be calculated with either tool. If the volume of either the intersection or the union of the two solids is required, the solids should first be combined or intersected using the **Intersect Solids** tool from the MineSight® 3-D **Surface** menu.

Summary

The general rules for the types of data and the appropriate tools can be summarized as follows:

1) The volume of watertight competent solids can be accurately calculated with either tool; while a small difference is expected between the two methods, it is generally less than 0-.5% and is considered negligible.
2) The volume of a solid with small imperfections, such as small openings or a small number of self-intersecting faces, can be calculated with the **Calculate Volume** tool; the **Calculate Analytical Volume(s)** tool will not return a result in this case.
3) The volume between two surfaces can only be calculated with the **Calculate Volume** tool, but there is one special case (the bottom "folds back" below the top) where it is necessary to create a solid before calculating the volume.
4) The volume of individual contained solids can be calculated with either tool; however, to create a "hollow" solid, the surfaces should be merged. Then, only the **Calculate Volume** tool will yield the correct volume.
5) The volume of individual overlapping solids can be calculated with either tool; however, a combined volume such as an intersection or union requires that the individual solids first be combined with the **Intersect Solids** tool.