

TIPS

from



Tech Support

Using Complex Slopes in MineSight® Economic Planner (MSEP)

Introduction

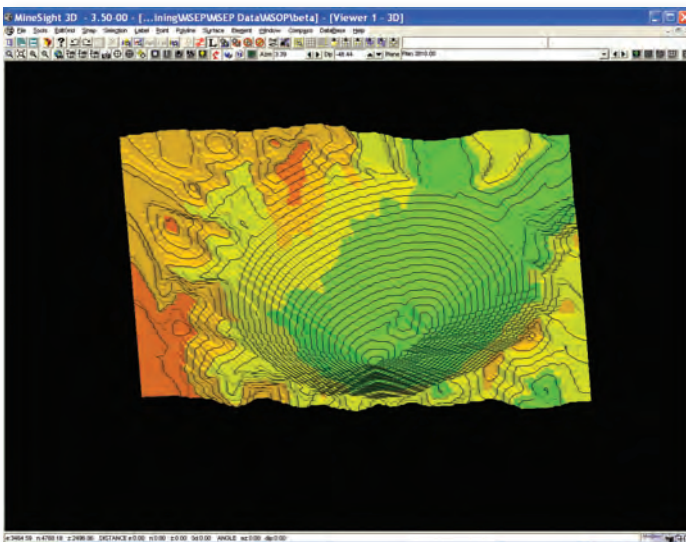
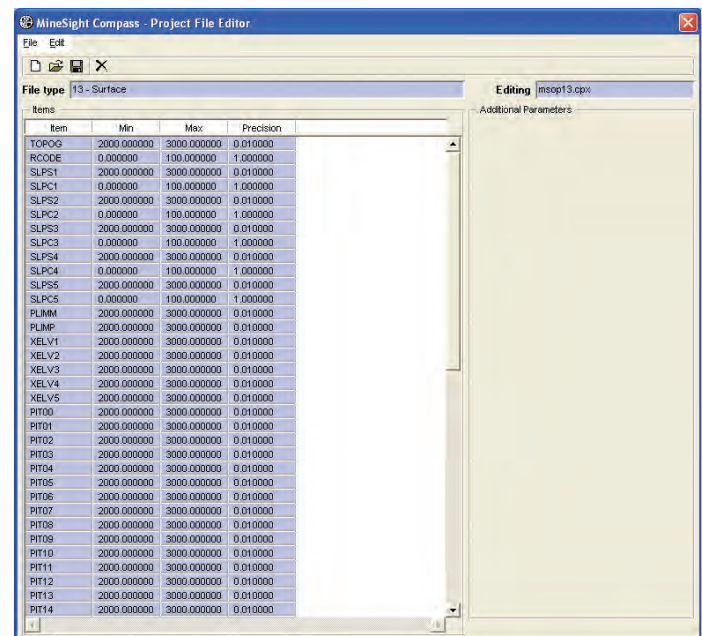
The Beta version of MineSight® Economic Planner (MSEP) has already been released to our clients. This new module contains the latest enhancements in Mintec, Inc.'s open pit optimization programs, which can be used to develop a series of pushbacks and/or a final pit limit using either the Lerchs-Grossman or the Floating Cone algorithms. This module also includes a program that can be used to develop long-term mine schedules and cutoff analysis throughout the life of the mining project.

Please contact Mintec if you are interested in becoming a Beta tester of this new program.

One of the many features of MSEP is the ability of working with Complex Slopes. In addition to assigning different slopes by azimuths in the horizontal direction, you can also define sectors where the slopes vary in the vertical direction. This article will show you how to set up your MineSight® files to use Complex Slopes in your pit optimization design in MSEP.

MSEP works with two main files: the **3-D Block Model** file (3DBM), from which most of the information is read, and a **Gridded Surface File** (GSF) where the starting surface and the resulting surfaces of the optimization process are stored. The GSF used by MSEP is a special kind of GSF also called MSEP GSF or Optimization GSF.

The MSEP GSF has a number of specific items, all of which are required for the correct functioning of the programs in MSEP. In order to create one of these files you can either create a new GSF from the **Project File Editor** in MineSight® Compass™ and select the **Special Pit Optimization GSF** option or you can use procedure **p60110.dat** from the MSEP menu. In both cases you will require a pre-existent GSF as a source file from which to copy the gridded original topography (TOPOG).



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Among the items included in an MSEP GSF there are two groups that will be of great importance when working with Complex Slopes: the Slope Surface items (SLPS1, SLPS2, SLPS3, and SLPS4) and the Slope Code items (SLPC1, SLPC2, SLPC3, and SLPC4).

• **Slope Surface items:**

Up to four surfaces are allowed to define the vertical sectors for Complex Slope. These surfaces should be identified in items SLPS1, SLPS2, SLPS3, and SLPS4. The order of the surfaces is from top to bottom, with SLPS1 being the top most surface and SLPS4 the lowest (model bottom). If you have less than four surfaces, start by filling these codes from SLPS1 and progressing to your lowest surface. You need to have at least one surface defined in order to use Complex Slopes in MSEP.

• **Slope Code items:**

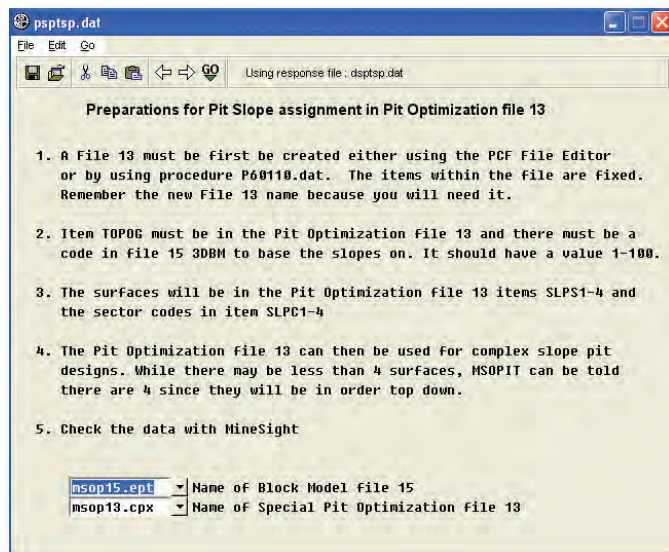
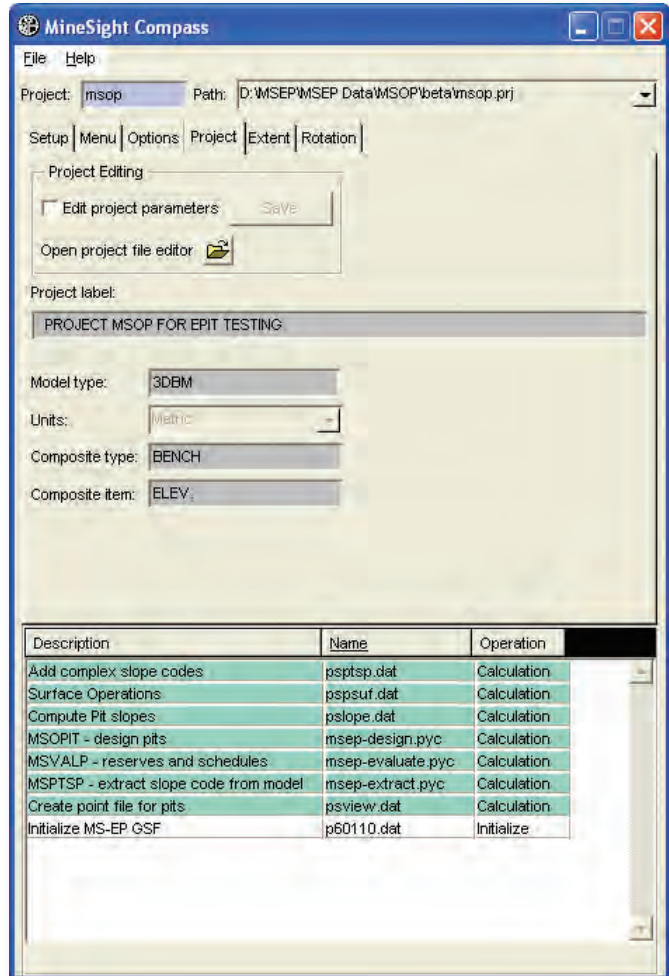
For each of the slope surfaces there is a corresponding slope item (SLPC1, SLPC2, SLPC3, and SLPC4) where the slope codes will be stored. The slope codes should be integer numbers from 1 to 99, which will then get assigned positive numbers in degrees through the panels of MSEP. Each of the slope codes stored in these items will apply to the blocks above the surface where they are defined (including the bottom) up to the next upper surface. In other words, the slope code for each (x,y) location in a surface will determine the slope code for the entire vertical column in the sector between the corresponding surface and the one above.

Coding Your GSF File

There are two main ways of coding the SLPS and SLPC items in your MineSight® GSF file. The first is reading the information directly from the 3DBM and the second one is coding the corresponding items through the tools available in MineSight® 3-D.

1. Transferring the slope codes from the 3DBM to the MSEP GSF File:

In this case you would need to have the slope codes (1 to 99) already assigned to an item of your block model (this is usually done through calculations using procedure **p61201.dat**). Once your 3DBM is coded with the slope code you can use procedure **psptsp.dat** (**Add complex slope**) to transfer the codes from the 3DBM to the corresponding slope surface and slope code items in the MSEP GSF file.



Procedure **psptsp.dat** will automatically determine the different surfaces and their

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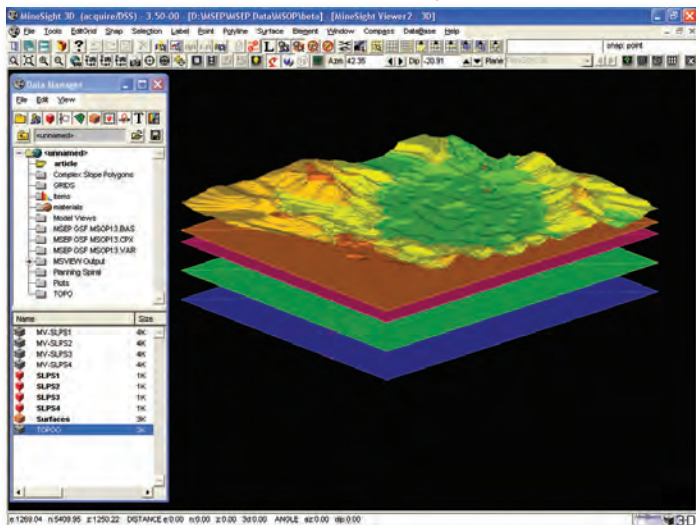
corresponding slope codes. This procedure works one column (IX,IY) a time, so if the surfaces don't have horizontal continuity throughout the whole model space you may end up with some strange surfaces. However, the slopes codes are also read column by column during the pit optimization process, so these horizontal discontinuities should have no effect in your final result.

Should more than four different codes exist in a column, the less significant group of codes will be merged with the more significant ones to keep the number of surfaces within four. This is similar to taking the majority code during geology coding. (An alternative to reducing the number of surfaces in your 3DBM could be trying a first optimization run with constant slope to determine your minimum surface and then use that surface as your TOPOG (plus some tolerance distance - use with care for LG method). This process should help decrease the number of surfaces involved in the optimization process (by eliminating some of the upper original surfaces) so the number of surfaces stay under the allowable maximum.

Procedure `msep-extract.pyc` (MSPTSP - extract slope code from model) is the MineSight® Grail version of procedure `psptsp.dat`.

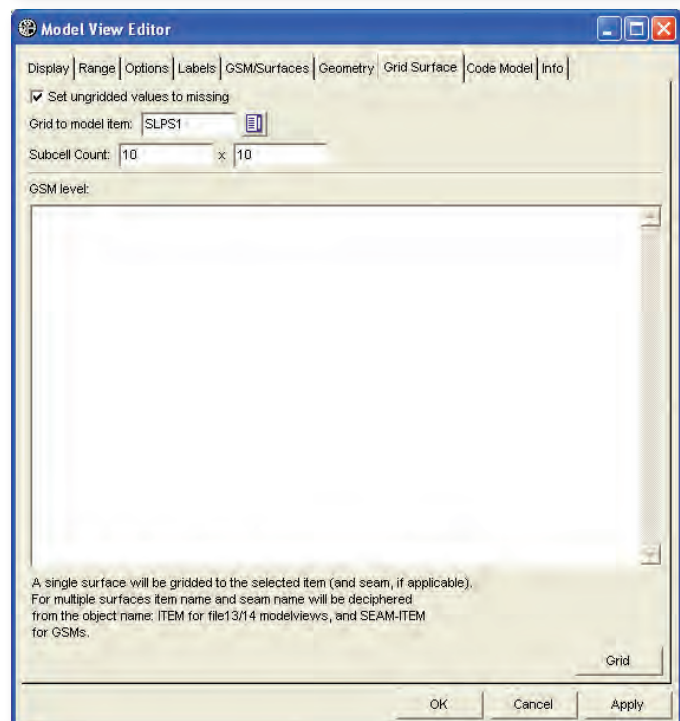
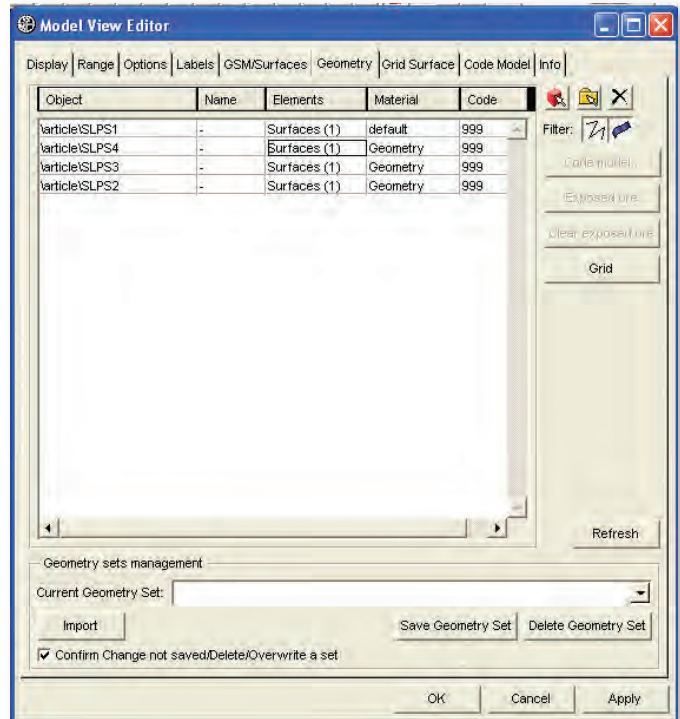
2. Coding Complex Slope items directly to the MSEP GSF:

If you don't have the slope codes already coded into your model, then you can choose to assign these codes directly to the MSEP GSF using some of the coding tools in MineSight® 3-D. In this case you would need geometry objects containing the surfaces that define the vertical sectors in your model space.



These surfaces would need to be gridded to the MSEP GSF using the **Grid** options from the **Model View** properties. In order to do this, go to the

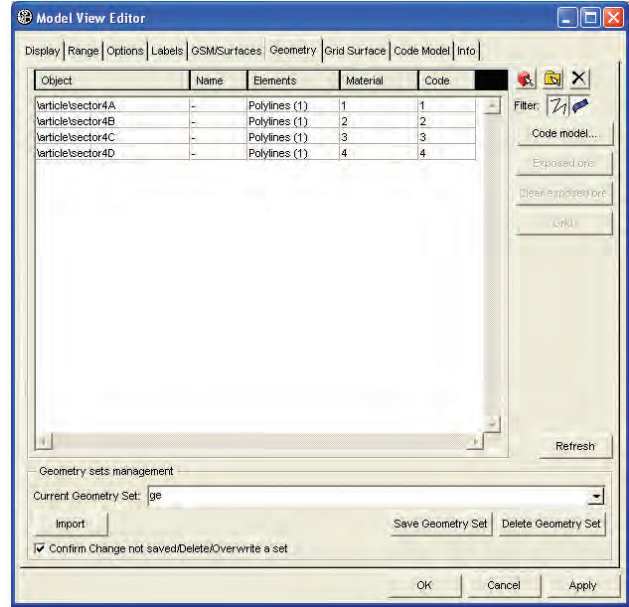
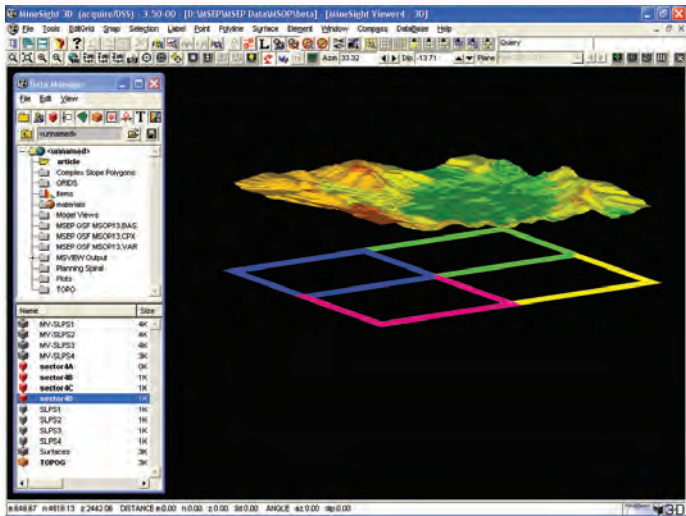
Geometry tab of the **Model View Editor** window and browse (using the red cube icon) for your first surface. Then click on the **Grid** button and assign the GSF item to which the gridded surface values will be stored. Finally click on the **Grid** button at the bottom of the panel to load the surface to your MSEP GSF. **Note:** If you name your surfaces the same as the slope surface items (SLPS1 - 4), MineSight® 3-D will automatically recognize the names of the surfaces so you can load them all at once.



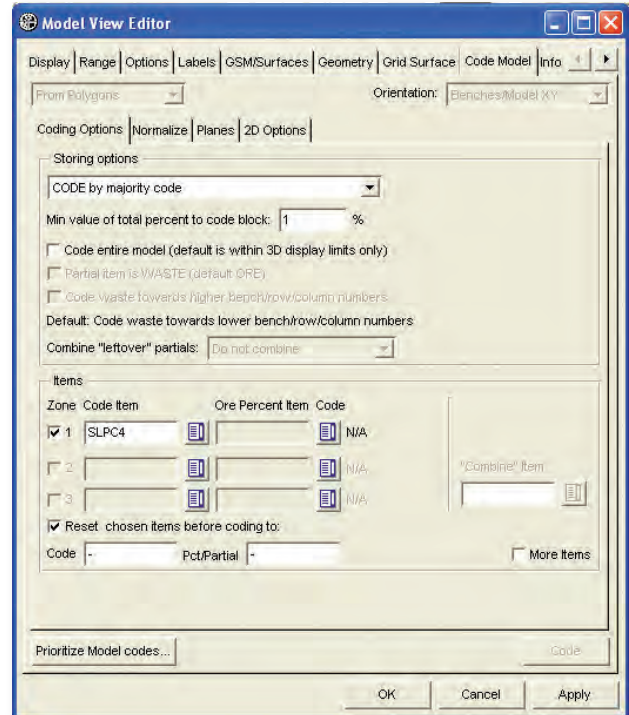
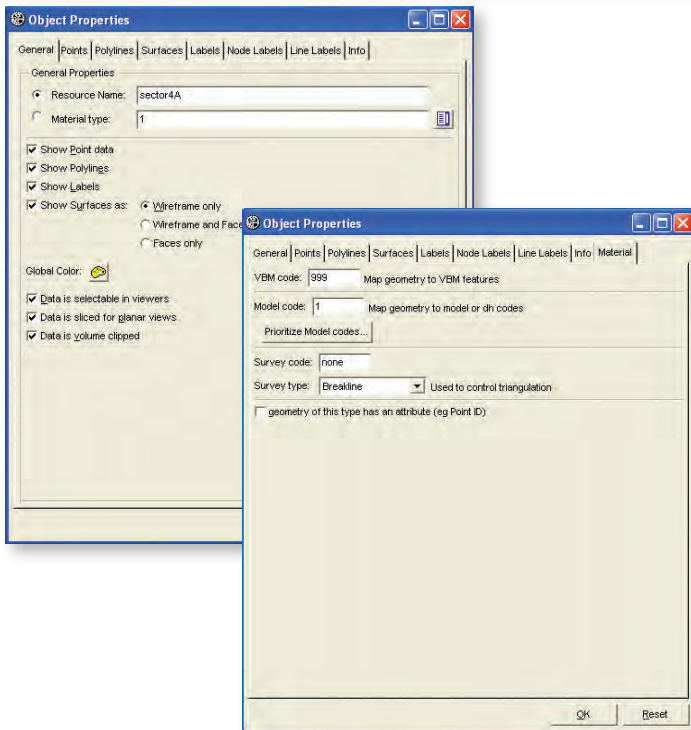
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Once your slope surfaces are coded to the MSEP GSF you can assign values to the slope code items associated to each of the surfaces. To do this, you will need geometry objects with either polygons or solids defining the horizontal sectors for each of the surfaces. These geometries will also need the correct material and model code associated with them, so the correct code gets transferred to the slope code items (SLPC1 - 4).



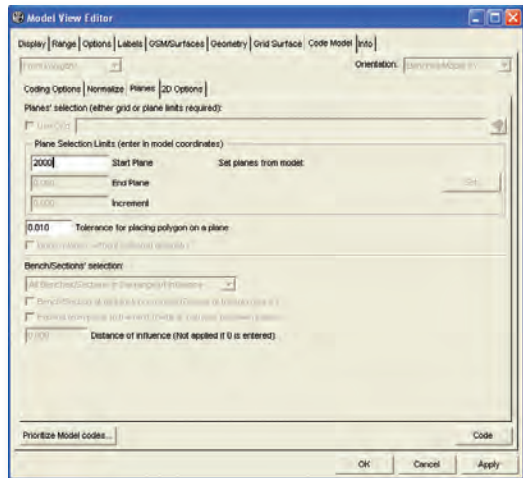
Then click on the **Model** button and assign the correct item (associated to the surface with which you are working) to which the slope code will be stored.



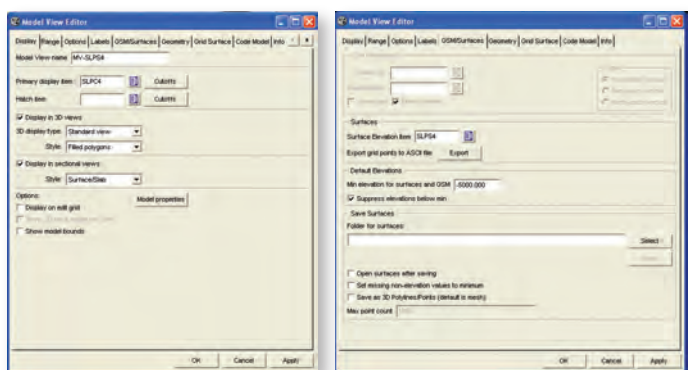
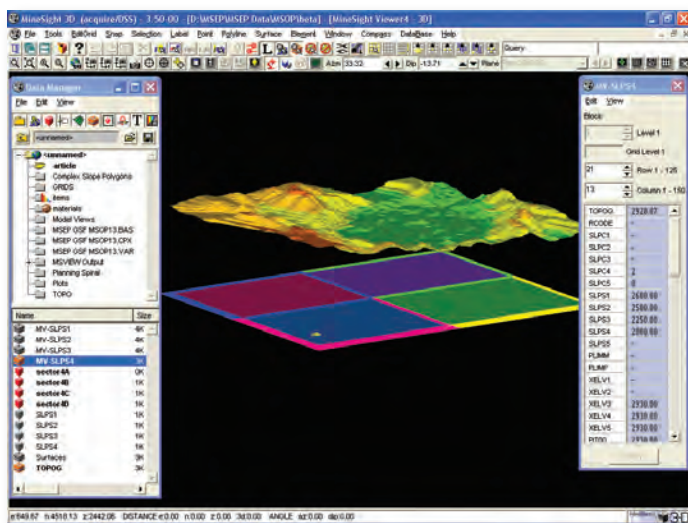
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Once the objects are defined, go to the properties of a **Model View** for the MSEP GSF. Once again you will need to browse the **Geometry** tab for the geometry objects defining the different horizontal sectors.

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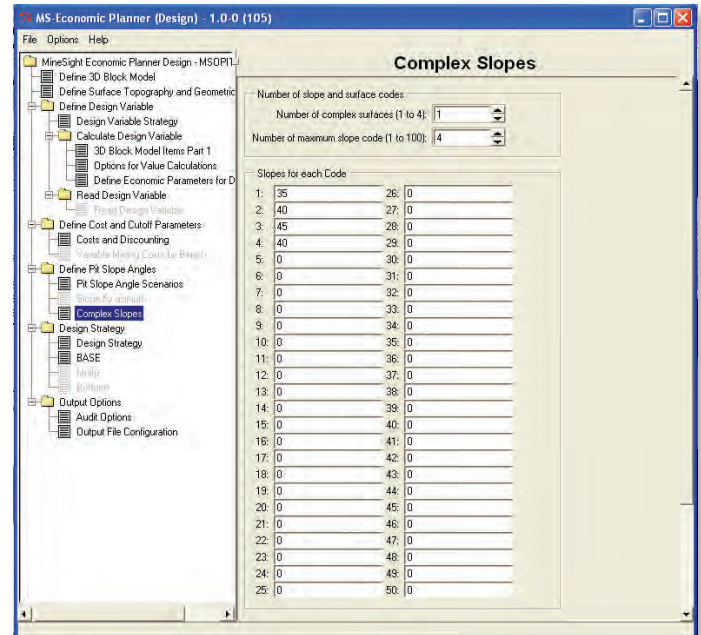


If you are using polygons, make sure you assign the correct **Start Plane** (minimum elevation) on the **Planes** tab so MineSight® can find the polygons you are using. Finally, make sure that the coding worked correctly by displaying the corresponding items in your **Model View**.



Now that the slope surfaces and slope codes are entered to the MSEP GSF, you can use the **Complex Slope** option in MSEP. Procedure **msep-**

design.pyc (MSOPIT - design pits) is the one that runs the optimization process in MSEP. You will be able to assign the corresponding slopes in degrees to each of the slope codes in this procedure from the **Complex Slopes** panel. In this panel you will also have to define how many surface codes you are using (**Number of complex surfaces**) and the maximum value for the slope code (**Number of maximum slope code**).



Additional Considerations for the Complex Slopes Case:

When you select the **Complex Slopes** option from the **Pit Slope Angle Scenarios** panel, some extra options, only applicable to the Complex Slopes case, become available in certain panels of MSEP.

From the **Design Strategy** panel the drop-down menu for **Complex Slope Cone Options** becomes active. The same option can be found in the **Lerchs-Grossmann** or the **Floating Cone** section depending on the methodology you have previously chosen. This menu contains two options from which to choose:

- **One Cone per Ore Block:**

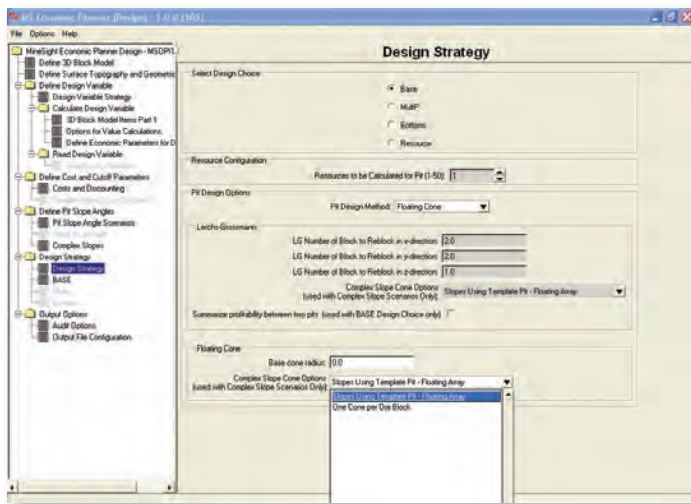
In this case the design template is computed for each ore block and a ray is generated from the block center at a specified azimuth. Along that ray, the slope is defined by the complex slope definition so that the ray reflects the geometry of the pit wall by calculating the elevation change from the base block. This process is repeated for 360 degrees and from these rays the template is computed for a base block. This is a very time consuming calculation and it may occur that many passes are needed before a decision can be made whether or not an ore block at the base can be mined.

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• **Slopes Using Template Pit – Floating Array**

In order to minimize the number of times the cone is calculated in the previous methodology, we are introducing the Floating Ray method, which is based upon an approximation of the pit geometry. When this method is used the user specifies a pit limit, which usually has been computed using a constant slope perhaps with re-blocking. The template computed by this method does not represent the base block but the pit limit for the bench. The Floating Ray calculation is the same as for the base ore block except that, instead of starting the ray from the center of the block, the ray starts from the center of the outermost block on the current bench along the ray. The Floating Ray template approximates the slope for the whole bench, not just for one block. Note that this method requires each potential pit bottom to be specifically defined if there is more than one.

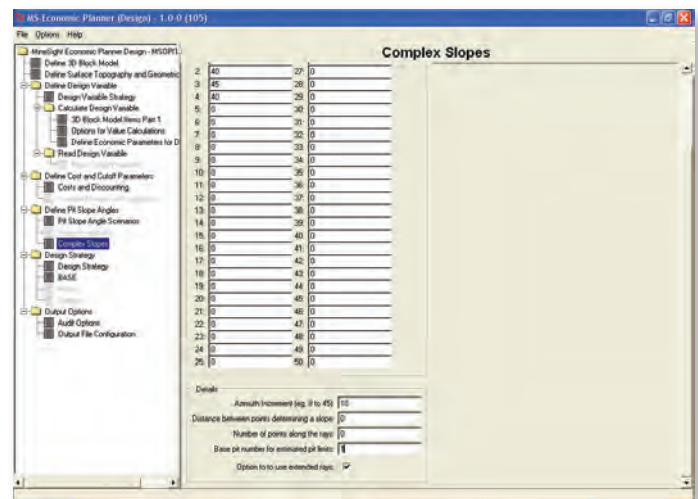


After you have defined your design methodology, you can go back to the **Complex Slopes** panel to assign the rest of the parameters concerning the Complex Slopes case. In the **Details** section we have the following options:

- **Azimuth Increment (e.g. eight to 45):** The azimuth increment is the degrees between rays used to compute slopes. The angle must be from eight to 45 degrees. Smaller angles are more accurate but cause the program to run slower. Default is 30 degrees.
- **Distance Between Points Determining a Slope:** The distance between points determines the accuracy of the slope. The distance should be about one block. Default distance is DX.
- **Number of Points Along Ray:** This should be left blank or 0 so the default is used.

- **Base Pit Number for Estimated Pit Limits:** This indicates the limit pit (PIT01 - PIT50) within the MSEP GSF that will be used when the Floating Ray method is chosen from the **Design Strategy** panel.

- **Option to Use Extended Rays:** This option only applies when the Floating Ray method is chosen from the **Design Strategy** panel. It should be used for those cases where there are indistinct final pit walls – this happens when there are ore blocks in the walls above the pit bottom. If this option is active, the calculations will push out the floating ray so it will better approximate the expected location of the final wall and better define the slope. Only use if the normal Floating Ray method does not result in acceptable slopes.



Finally, after running the optimization process with Complex Slopes, you could check your results using procedure **pslope.dat**. This procedure will assign the resultant slope values to a certain item in your MSEP GSF so you can easily review them.

User Sub-routines
 Does your site currently make use of any user-subroutines which will need to be re-compiled prior to switching to the MineSight® 2005 version? If so, are they available to submit to Mintec, Inc. for recompiling? Remember, this will need to be done before March 31, 2006!