

Decline Manual

27th October 2015



Overview

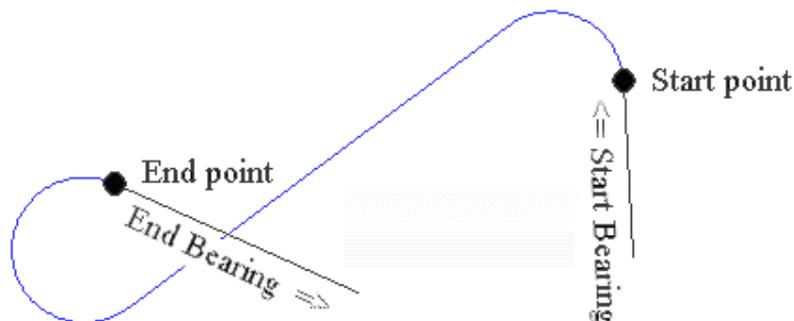
Decline is a three dimensional design tool that allows mining engineers to quickly and easily design a decline path. The tool will design a decline path in seconds as compared to the long tedious process that is required with *Surpac*'s native methods.

Two decline design algorithms are provided;

- Point to point curve
- Specified Path

Point to Point Curve

Point to point curve is a design tool which will allow the user to design a decline centreline path starting from one point, at a given bearing, and ending at a second point, at a given bearing. The centreline path will be made up of two curves, and one or more straight sections. The user will select the start and end points graphically, and then fill in a form with the curve radius, gradient of the curves, and the gradient of the straight sections. An example of a simple case is shown below.



The algorithm can generate the four potential decline paths between the selected points using the given parameters such as curve radius and gradient.



Specified Path

Specified path provides a spreadsheet style interface for designing the decline path. It allows you to specify a series of straight and curved sections of a decline centreline. Straight sections are defined by a bearing, distance, and gradient. Curved sections are defined by a direction, either clockwise or anticlockwise, an angle, radius, and chord distance along the curve at which points will be created. Additionally, the centre points of any curves can be created

Edit Path

The Edit path functionality allows you to select a decline path displayed in graphics and will then present the path definition in the spreadsheet view showing the curve and straight sections. This information can then be edited to correct or change any portion of the path.

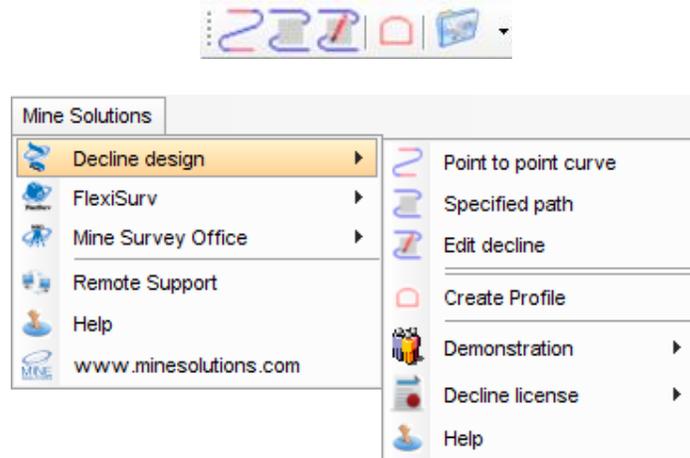
Create Profile

The create profile function provides a system quickly and easily create drive profiles that can then be used to generate a 3DM of the decline path. Several profiles are included such as arched, square, round corners, circle, and shanty.



User Interface

All functions are available from the *Decline* toolbar and menu (found under the Applications menu in *Surpac*)

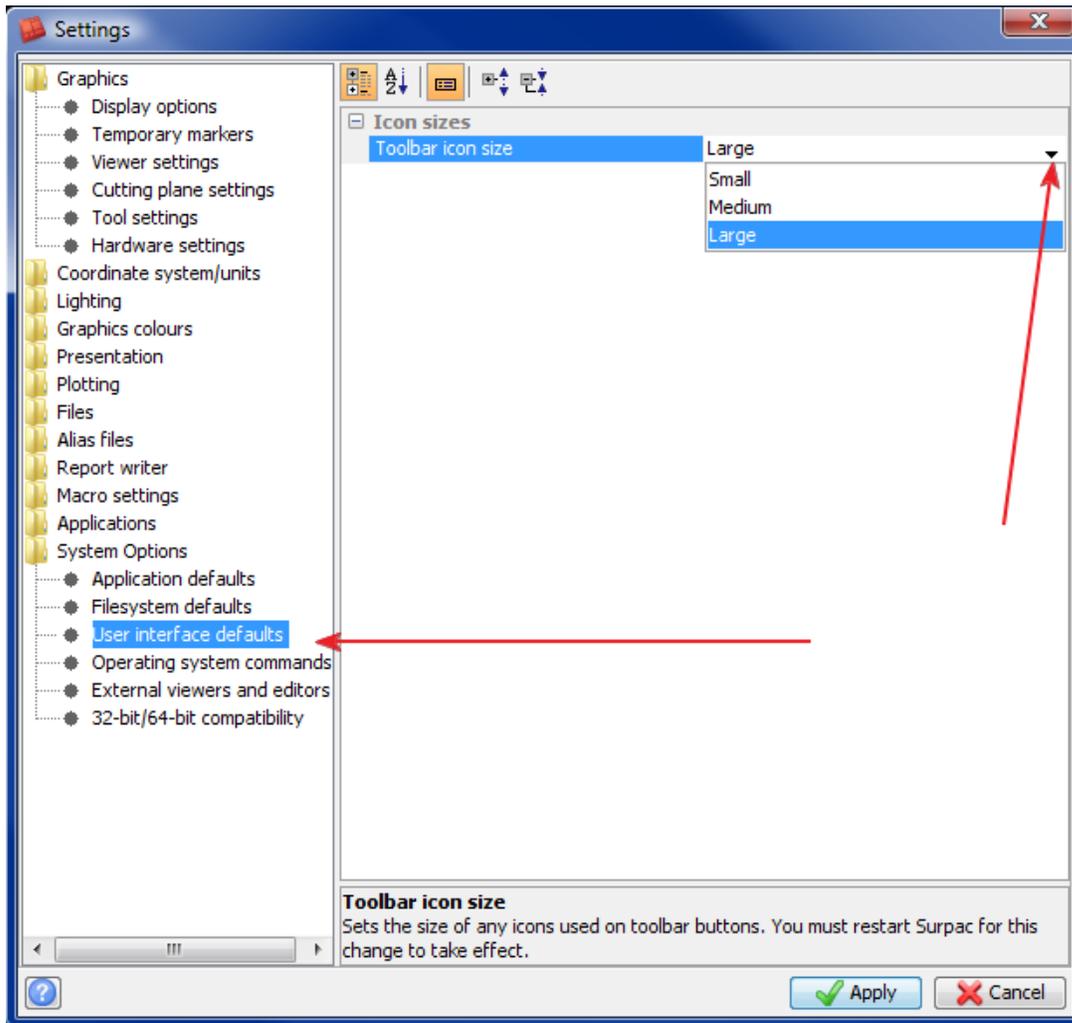


Icon Description

	Point to Point Curve	
	Specified Path	
	Edit Decline	
	Create Profile	
	Administration Submenu	
		Create share point
		Remote support client
		View license details
		Get site code
		Register license



Decline supports the 3 different icon sizes that are available in *Surpac V6.3* and later. By default *Surpac* will use medium size icons for the toolbars. You can change this setting in the *Surpac* default preferences editor as shown below using menu option Customise → Default preferences.

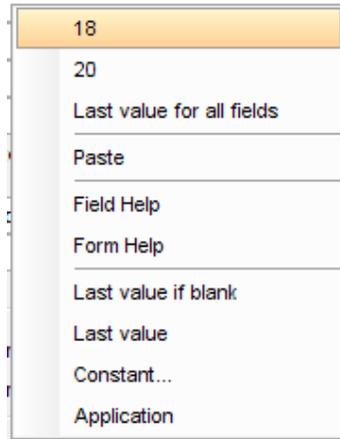




Form Defaults Management

The user interface includes linking into to the *Surpac* defaults management system. This is active on all forms for all *Decline* functions.

If you right click in the active field on a form you are now presented with the following popup menu.



At the top of this menu you will be presented with the last 5 values that have been previously entered into this form which you can quickly select. (Note the example above only has 2 previous values shown)

You can also select the Last value for all fields option which will set all fields on the form the their last entered values

You also have access to help via the Form Help and Field Help items

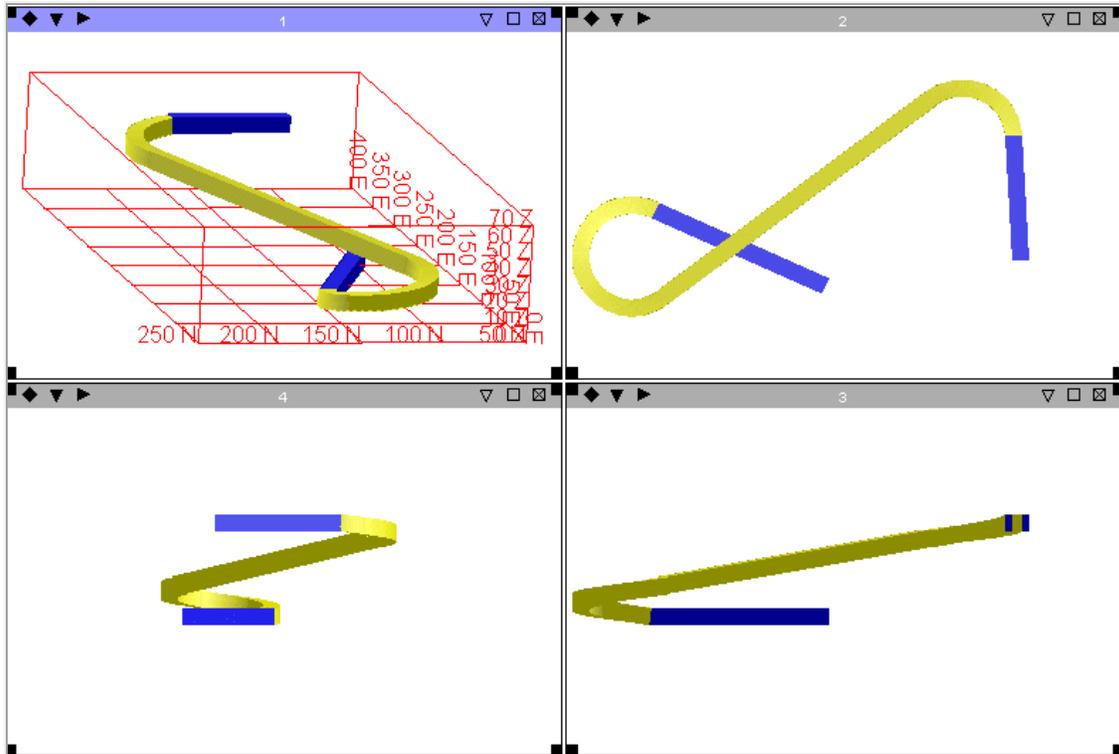
The last 4 options on the menu allow you to set the default behaviour for the active field. This will be persistent for the form on all future runs.

- Last value if blank defaults this field to its last value when the input field is blank (ie *Decline* hasn't put a particular value into this field)
- Last value defaults this field to its last value all the time
- Constant allows you specify a value that will always be the default for this field
- Application has no effect in *Decline* forms



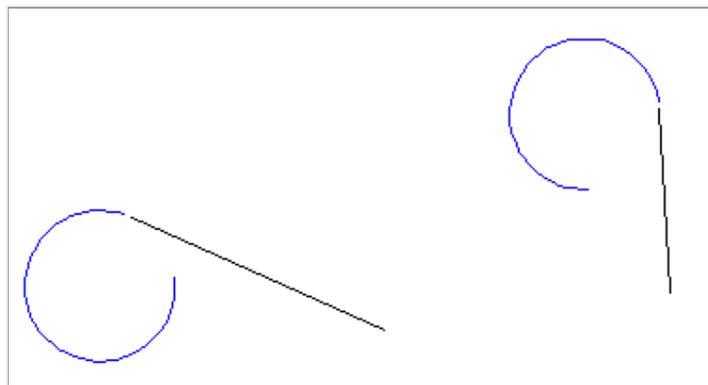
Current methods of designing a curve

The centreline path that is designed can be used to construct a three dimensional solid model of the decline, as shown below. The images represent the following views: 1) isometric 2) plan 3) section (looking north) 4) long section (looking west)



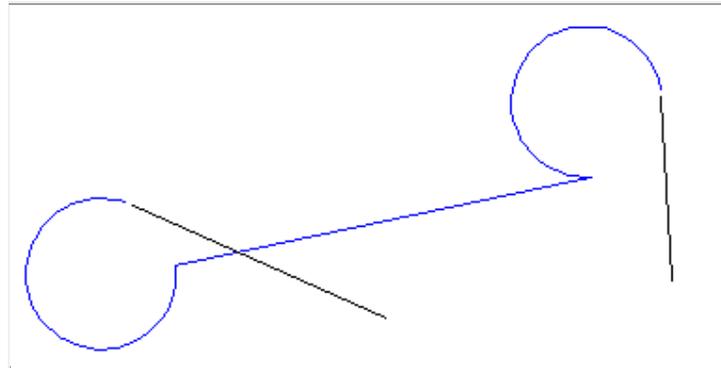
A method currently used to construct the centreline path is as follows:

- 1) Create arcs longer than necessary at the end of each segment

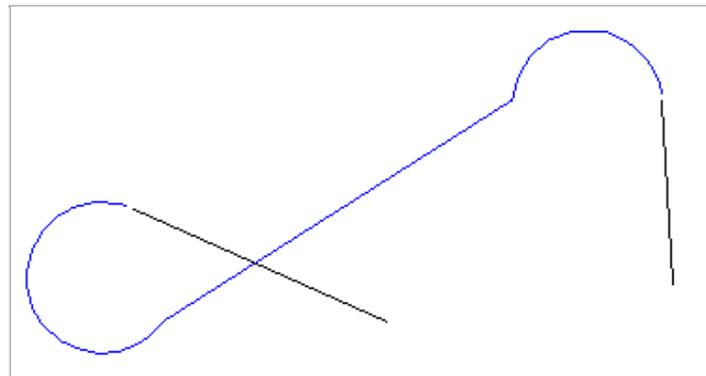




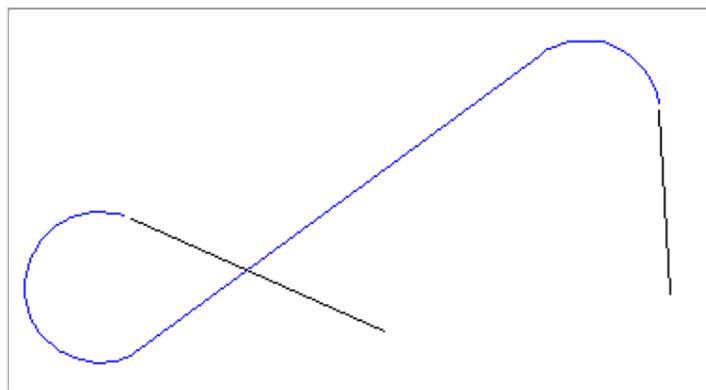
2) Join the two arcs together



3) Delete points from each arc

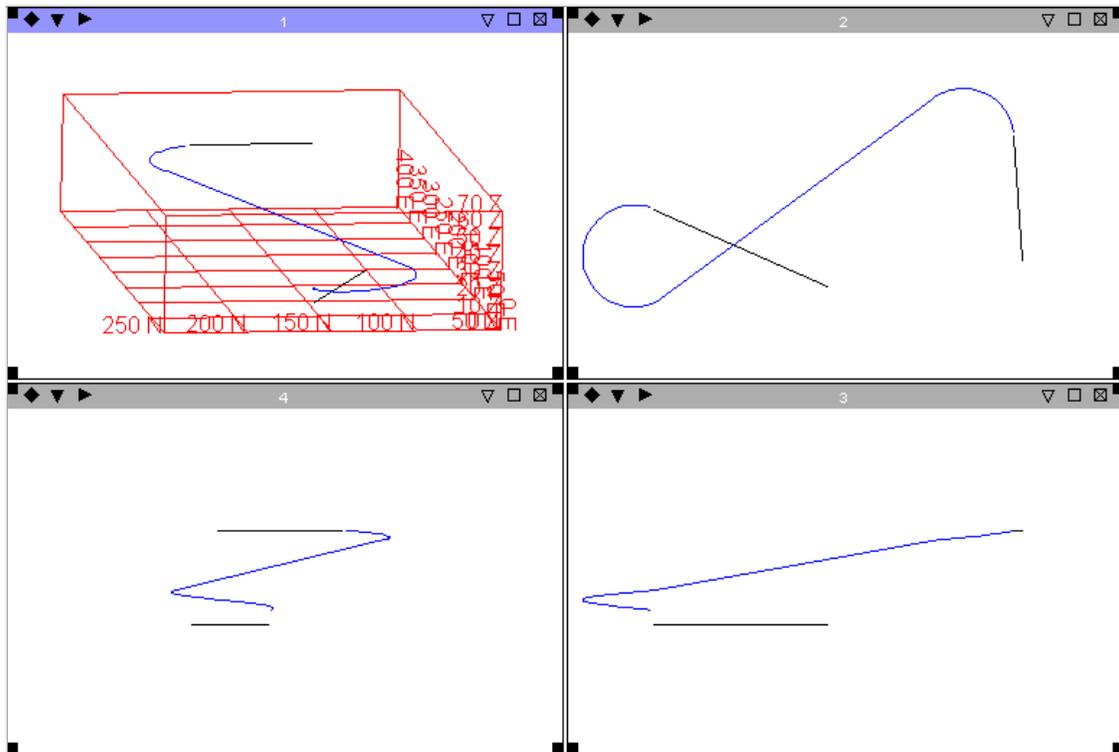


4) Until a point of tangency is approximated





5) The gradient for the curved sections is often different than the gradient for the straight sections. After the gradients have been applied, the elevation of the end of the path is checked against the elevation of the desired end point. If the difference in elevation is within some tolerance value (such as .01 meters), the path is accepted. In the case shown below, after applying the design gradient, the vertical difference between the two points is 8.7 metres, which is unacceptable.

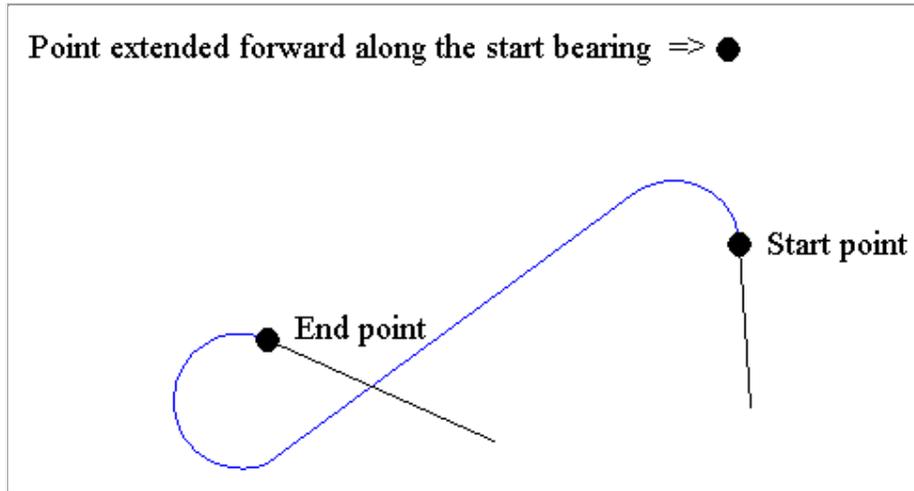


6) In the first iteration of this method, there is usually a difference in the elevation between the desired endpoint and the as-designed decline. When the situation shown above occurs, the path needs to be lengthened. What can be done in this case is one of two things:

- a) extend the path forward along the start bearing
- b) extend the path backward along the end bearing
- c) increase the radius of the curve

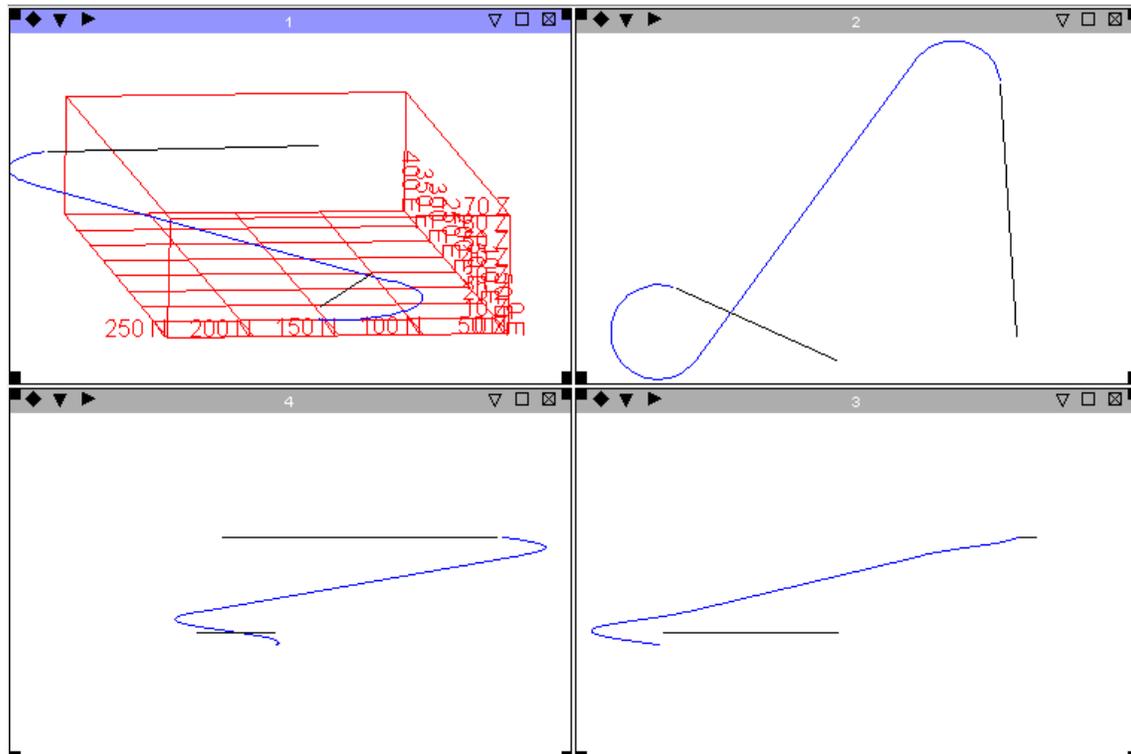
The first case is shown below:





7) After the starting point or ending point is moved, the original path is deleted, and steps 1 to 5 are repeated. Once the path has been regenerated, and the gradients for the curved sections and the straight section have been set, the elevation of the end of the path is compared to the elevation of the desired endpoint.

In the example shown below, the path ends below the desired endpoint. A "binary search", explained below, for the extension distance is carried out until the difference in elevation is within a given tolerance.





In our case, let's say that the first point was extended by 100 meters, which was too much. A binary search is implemented by halving this distance, and comparing the resulting elevation of the path with the desired elevation. In our case, we would extend the first point by 50 meters, then recalculate. If the path ends above the desired endpoint, the distance is too short, and so, the distance must be lengthened, again, by half of this distance. In our case, this would mean extending the distance by 25 meters to 75 meters, and trying again. The results of a binary search might be something like the following table:

Extension Distance	Elevation Difference
0	+8.787
100	-5.321
50	+3.762
75	-1.971
62.5	+1.003
68.75	-0.779
65.625	+0.254
67.1875	-0.094
66.406	+0.009

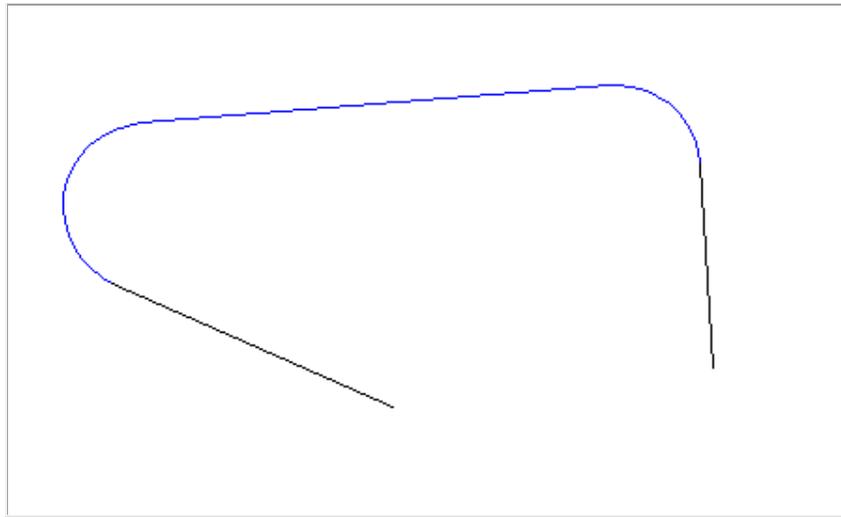
The binary search is stopped when the difference in elevation is within the tolerance. In our example, a difference in elevation less than 0.01 meters was found with an extension distance of 66.406. In other words, by extending the starting point 66.406 meters along the starting bearing, the resulting centreline path with a given set of gradient and radius criteria, will result in the path ending .009 meters above the desired endpoint. Since we specified that the design must come within .010 meters of the endpoint elevation, this path will be acceptable.



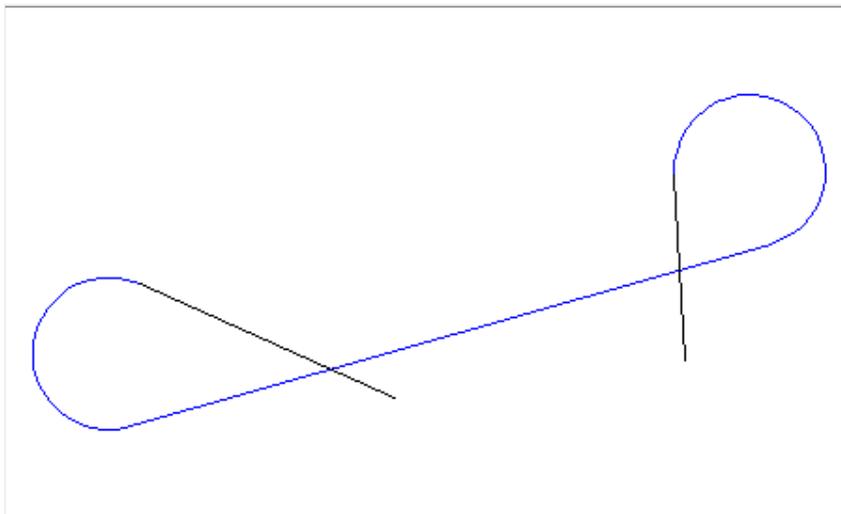
Other Paths

In addition to the example above, where the curve started anticlockwise and ended clockwise, there are three other possible solutions:

Start anticlockwise, end anticlockwise<

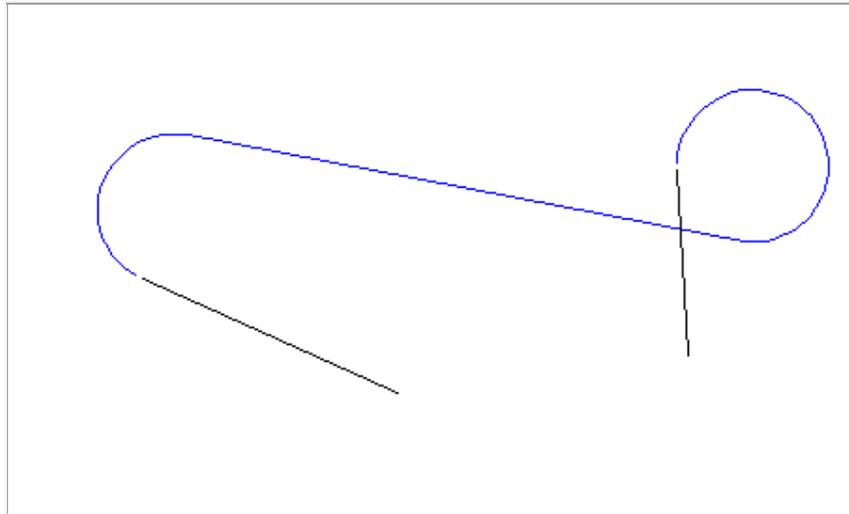


Start clockwise, end clockwise

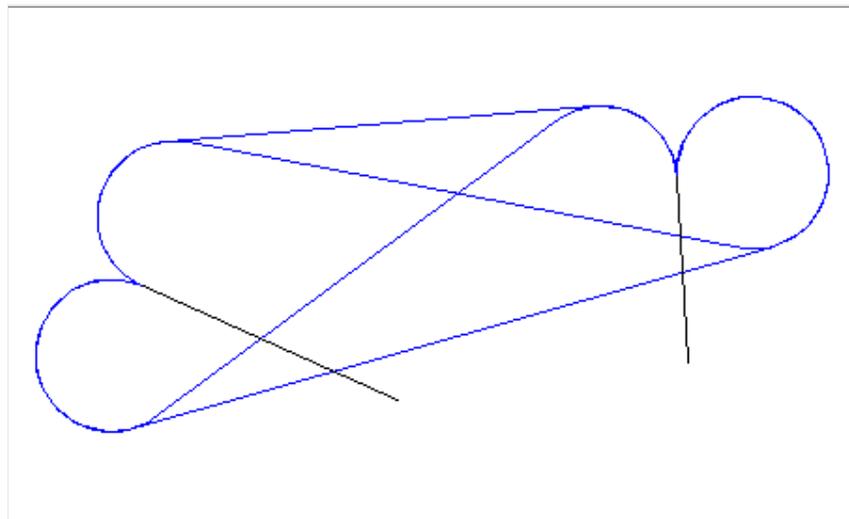




Start clockwise, end anticlockwise



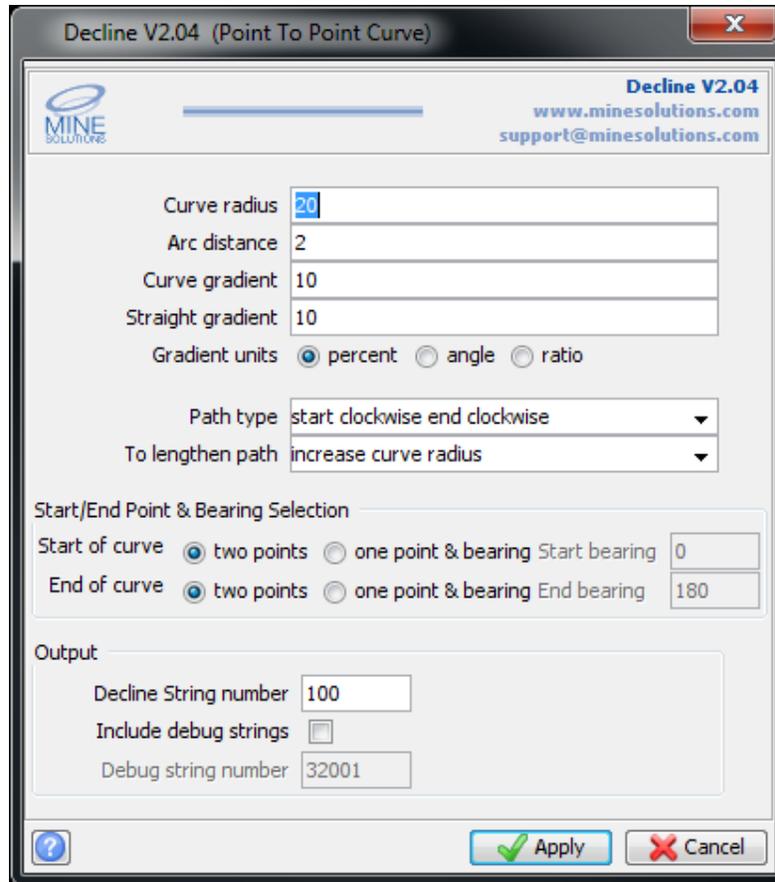
Sometimes, you might want to see all four possibilities, and then delete the ones you don't want.





Point to Point Curve

Point to Point Curve simplifies the design of a decline in *Surpac* by encompassing the above steps (Current methods of designing a curve) into a single algorithm. The function has a number of options described below to assist and it can produce all four possible designs in one step.



Decline V2.04 (Point To Point Curve)

MINE SOLUTIONS

Decline V2.04
www.minesolutions.com
support@minesolutions.com

Curve radius: 20

Arc distance: 2

Curve gradient: 10

Straight gradient: 10

Gradient units: percent angle ratio

Path type: start clockwise end clockwise

To lengthen path: increase curve radius

Start/End Point & Bearing Selection

Start of curve: two points one point & bearing Start bearing: 0

End of curve: two points one point & bearing End bearing: 180

Output

Decline String number: 100

Include debug strings:

Debug string number: 32001

Apply Cancel

Curve radius

Enter the minimum radius for curves. It can be any positive number

Arc distance

Enter the distance along curves where points will be created.

Curve gradient

Enter the maximum gradient for curves. It can be negative, zero, or positive.



Straight gradient

Enter the maximum gradient for straight sections of the path. It can be negative, zero, or positive.

Gradient units

Select the gradient units from percent, ratio, or angle.

Path type

A path will be generated which is tangent to both start and end points. For nearly all paths, this will mean a starting curve and an ending curve. Either curve can be clockwise or anticlockwise. The following options are available

1. start clockwise end clockwise
2. start clockwise end anticlockwise
3. start anticlockwise end anticlockwise
4. start anticlockwise end clockwise
5. all four paths
6. shortest path

To lengthen path

If the given design criteria and data geometry require a longer centreline path than initially calculated, the curve will be lengthened by one of these methods.

1. extend forward along start bearing
2. extend backward along end bearing
3. increase curve radius

Start of curve

The start point and bearing of the decline can be defined by selecting one point, and entering a bearing, or by selecting two points. If two points are to be selected, the start bearing will be calculated as the bearing from the first point to the second point. The decline design will begin from the second point.

End of curve

The end point and bearing of the decline can be defined by selecting one point, and entering a bearing, or by selecting two points. If two points are to be selected, the end bearing will be calculated as the bearing from the end



point to the end bearing point. The decline design will end at the first point selected.

Output file location

Enter the output file location.

Output file Id

Enter the *Surpac* output file Id.

String number

Enter the string number used for the design from 1 to 32000.

Include debug strings

It can be helpful to understand why a curve was regraded if the circles used to construct the curves at the start and end are displayed, along with their centroids. If you tick this option, these circles will be created using the nominated debug string number.

Debug string number

The string number nominated here will contain the full circles used at the start and endpoints of the curves, as well as their centroids. The number can be between 1 and 32767.

Display log file

A log file with the nominated location name and ID will be created. Indicate here whether or not you want to see this file displayed after the design has been completed.

Point to Point Curve Limitations

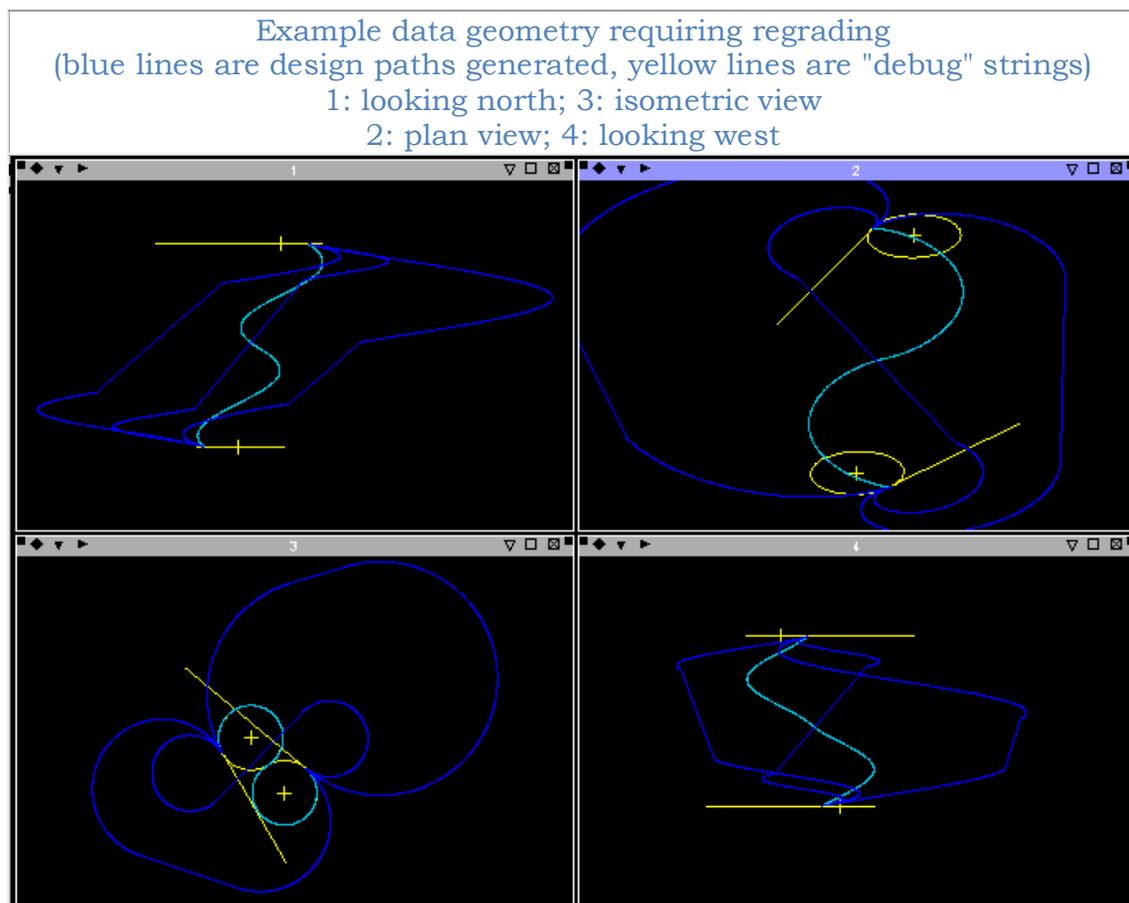
The point to point curve algorithm will not always produce the desired result for a given geometry. The tool provides a method to create a decline by starting and ending with a graded curve with a straight section in between. Depending upon the criteria you have given for adjustment of parameters the algorithm will always endeavour to produce a result but it will notify you in the message window that it had to increase the curve radius, or the gradient, etc. Please ensure that you check the message window after using the tool to see if the algorithm adjusted any of your given constraints.

One limitation of the algorithm is that it will not spiral, that is it will not produce a curve that loops beneath itself. This is by design as to produce



such a decline requires a different algorithm. If this is what you require try using the SHORTEST PATH command in *Surpac*.

As can be seen in the images below, one data geometry problem occurs when attempting to lengthen the design path by increasing the curve radius. There is a point at which, for clockwise-anticlockwise or anticlockwise-clockwise curves cannot be created beyond a given radius. The problem can be best described by panel 3 below, which displays the situation where the two circles (debug circles in yellow) touch, but the resulting path is not long enough. This maximum radius cannot be exceeded, as beyond this, there is no point of tangency for which the circles can be constructed and still maintain the start and ending points and bearings. This will result in a design which requires a gradient steeper than that specified.



Another problem exists in this situation where the user-defined minimum radius is greater than the maximum radius. In this case, no curve can be created, and *Decline* informs you of this situation in the message window.



Specified Path

The Specified Path function provides a convenient way to design a decline by presenting parameters in a spreadsheet style for easy manipulation. The spreadsheet form allows you specify a series of straight and curved sections of a decline centerline. Straight sections are defined by a bearing, distance, and gradient. Curved sections are defined by a direction, either clockwise or anticlockwise, an angle, radius, and chord distance along the curve at which points will be created. Additionally, the center points of any curves can be created

When invoked you are asked to select the decline start point. If you do not have one just click the mouse and you can enter the start point coordinates on the form.

This example defines a figure eight shaped decline.

Decline V2.04 (Specified Path Definition)
X

Output strings

Centreline string

Create curve centre points

Curve centre points

Starting point

Y

X

Z

Start bearing

Gradient units

ratio

percent

angle

Design Options

Bearing is calculated automatically

entered manually

	Type	Gradient	Bearing	Distance	Direction	Angle	Radius	Chord Dist	Calc Brng	Calc Len	Calc Z
1	straight	-8	0	20					0.000	20.000	-253.000
2	curve	-8	0.000		clockwise	270	20	2	270.000	114.248	-264.781
3	straight	-8	270.000	40					270.000	154.248	-269.781
4	curve	-8	270.000		anticlockwise	270	20	2	0.000	248.496	-281.562
5	straight	-8	0.000	40					0.000	288.496	-286.562
6	curve	-8	0.000		clockwise	270	20	2	270.000	382.743	-298.343
7	straight	-8	270.000	40					270.000	422.743	-303.343
8	curve	-8	270.000		anticlockwise	270	20	2	0.000	516.991	-315.124
9	straight	-8	0.000	40					0.000	556.991	-320.124
10	curve	-8	0.000		clockwise	270	20	2	270.000	651.239	-331.905
11	straight	-8	270.000	40					270.000	691.239	-336.905
12	curve	-8	270.000		anticlockwise	270	20	2	0.000	785.487	-348.686
13	straight	-8	0.000	20					0.000	805.487	-351.686

?

Centreline string





The design centerline will be created with the string number specified here

Creat curve centre points

If you want to create points at the center of each curve, tick this box. If you do, one point in the nominated string number will be created at each curve center point

curve centre points

One point will be created at each curve centre point with the string number nominated here. String 30003 is recommended, as this string is defined as a marker in the default string style settings. You may, however, use any string number

Starting point

The decline design will start at the Y, X, and Z values nominated here. If you selected a point, the coordinates of the selected point will be displayed here. Even if a point was selected, you can modify the coordinates

Start bearing

The decline design will start using this bearing if you elect to begin with a curve segment. When beginning with a straight segment the initial bearing is given for the straight

Gradient units

The gradient may be specified as a percent, angle, or ratio. The nominated type of gradient will then be applied to the gradient values nominated in the second column of the table

Design options

NA

Type

The design centerline can consist of straight and/or curved sections. Each section must be specified. Rows where the type is left blank will be ignored

Gradient





The gradient value entered here, along with the gradient type (percent, angle, or ratio) will be applied to this entire section of the design. The gradient may be positive, negative, or zero

A point will be created from the last designed point (end of the last straight section or curve) at the specified bearing

Straight **Bearing & Distance**

A point will be created from the last designed point (end of the last straight section or curve) at the specified bearing and distance

Curve **Direction, Angle & Radius**

A curve will be created starting at the bearing of the last designed point (end of the last straight section or curve), using the direction, angle, and radius designated here

Chord distance

The chord distance is the distance along the curve at which points will be created. It is generally recommended to have a chord distance equal to 10 percent of the radius

Calculated bearing, length & Z value

The calculated bearing length and Z value at the end of the current design segment are displayed

Accepting or re-editing the design

Once the form is applied the design will be drawn in graphics. You can elect to accept the design by pressing the mouse button or you can re-edit your design by pressing the escape key



Edit Path

The Edit Path function provides a convenient way to edit any existing decline design. The decline does not have to have been created using the *Decline* tools.

To begin simply select any point on the decline string. The functions will then interpret the string and present the resulting definition of the decline in

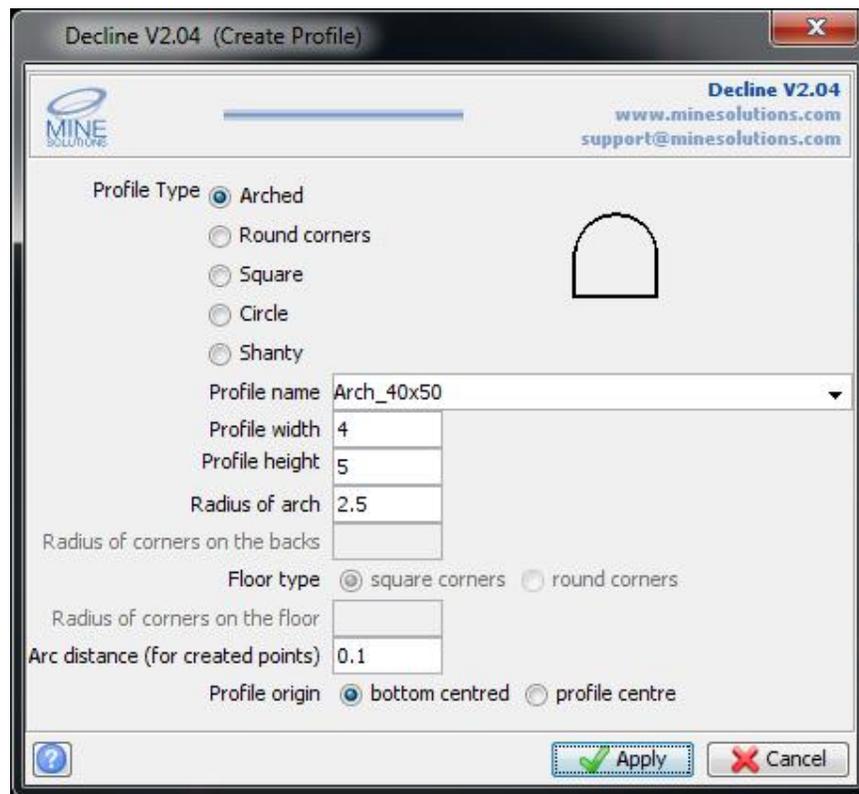




the specified path form. The function then behaves as described for the Specified Pth function above.

Create Profile

The Create Profile function provides a simple mechanism for generating profiles for use with other *Surpac* functions such as Triangulate using centreline and profile.



Profile Type

Select the type of profile to be generated. Options include Arched, Round corners, Square, Circle, and Shanty.

Profile name

Enter the string file name to save the profile into.

Profile width

Enter the width of the profile in metres





Profile Height

Enter the height of the profile in metres

Radius of arch

For arched profiles enter the radius of the arch; For circle profiles enter the radius of the circle

Radius of corners on the backs

For round corner profiles enter the radius for the corners on the backs (roof)

Floor type

For round corner profiles select whether the floor is to also have round corners

Radius of corners on the floor

For round corner profiles with a rounded floor, enter the radius for the corners on the floor

Arch distance for created points

Enter the value to use for curves created in the profile. Usually a value of 0.1 produces a well defined curve

Profile origin

Select where to place the origin (position 0,0) of the profile. Options are bottom centred or profile centre.

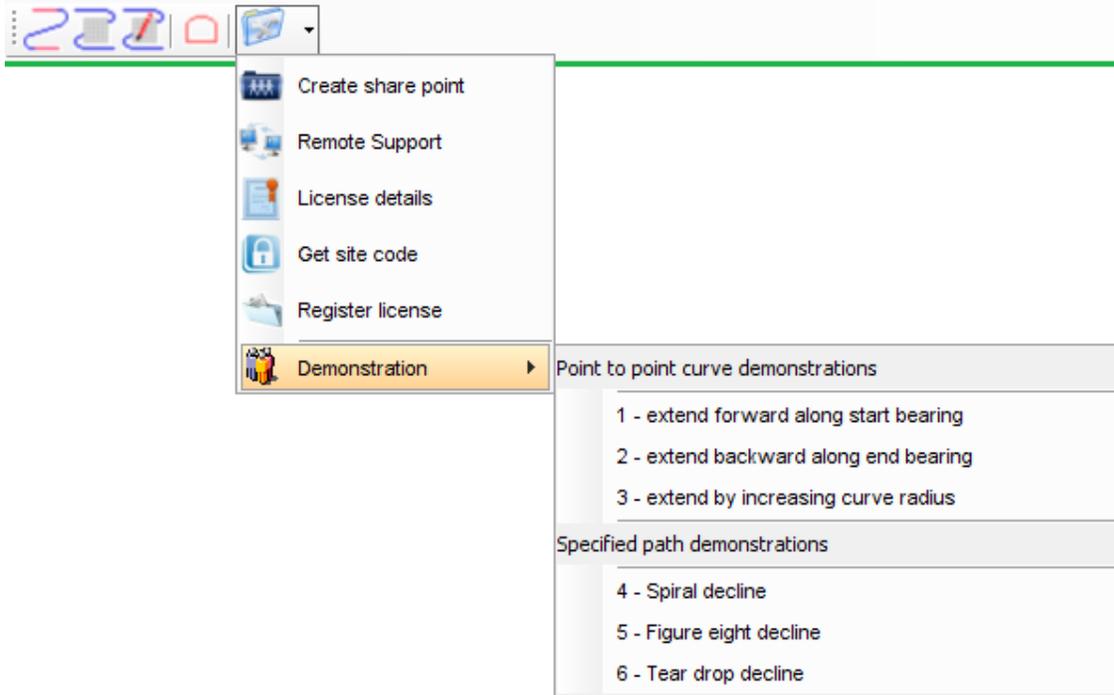
For drive profiles bottom centred would be the norm as this is the point at which *Surpac* presses the profile onto a centreline when creating a 3DM.

Profiles such as circle and square may require a centred origin as they may represent vent rises or escapeways where the centreline is in the middle of the profile.



Decline Administration Tools

The License and Utilities menu provides access to *Decline* administration tools and demonstrations.



Create Decline Share Point

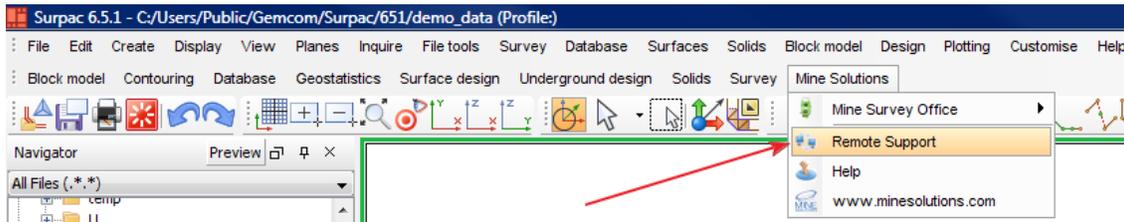
The share point system used for *Mine Solutions* products is not required for *Decline* at this point





Remote Support Option

You can access the remote support option from the *Mine Solutions* submenu (found on the *Surpac Applications* menu);



or the *Decline* toolbar;

Selecting this option will permit *Mine Solutions* support to remotely log onto your computer to assist with problem detection and resolution. As this is an internet link you will need to give the program permission to run. Once you have done this the remote client will display as follows



All that is required from here is for you to email the 9 digit ID number and 4 digit Password to support@minesolutions.com. Please note the password is session specific and that the remote client must be running to permit access to your computer.





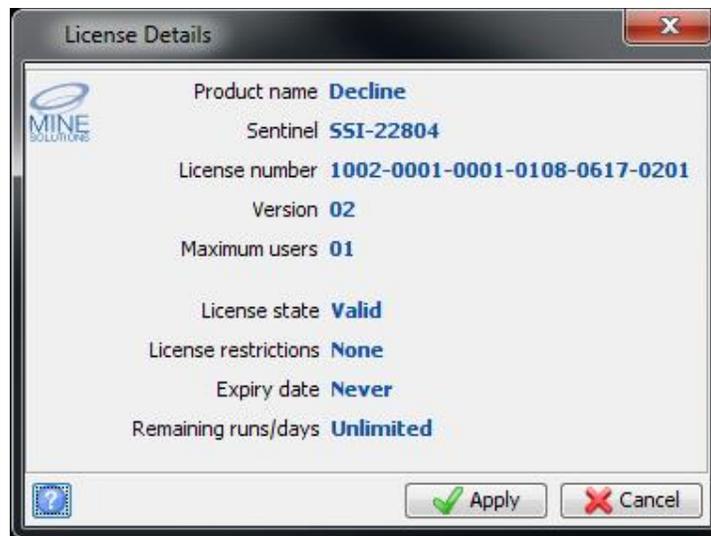
Decline License System

Decline uses the standard *Mine Solutions* licensing system which works on both standalone *Surpac* licenses and also the *Surpac License Manager* (SSILM). When using a *Surpac* network license the *Decline* token maybe registered on as many computers as required but only the licensed number of users can run at any one instance. For example if it is a 1 user license of *Decline* then only one user can run (be active) at any given moment, even if the license is registered on 3 computers.



View License Details

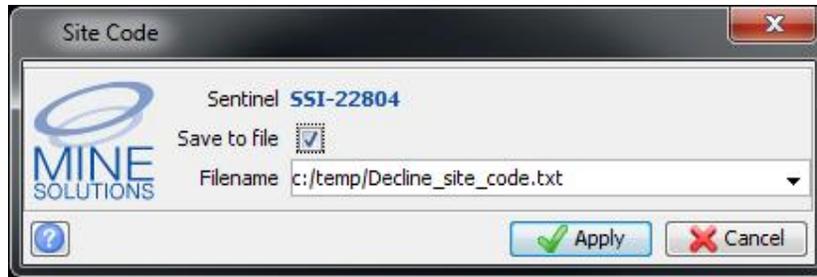
The view license details option displays the current status of your *Decline* License.





Get Site Code

Decline is licensed to a particular site code which is embedded in the *Surpac* sentinel. This option will retrieve that code. The code can be written to a file that can be emailed to *Mine Solutions* for generation of a license token.



Register License

This option allows you to register the *Decline* license token. Normally tokens are distributed in a *Mine Solutions* token file (.tok). If the file is copied into the base *Mine Solutions* directory then the license information will automatically be searched, and the form should be pre-filled.

Note that you need computer administration privileges to register a license. Even if your normal login allows administrator rights you will need to start *Surpac* by right clicking the desktop icon and elect to “Run as administrator”

