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Surpac 6.3

Underground Mine Design

3DEXPERIENCE

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Table of Content

Workflow

Terminology

▶ **Centreline** – a line which represents the centre of a drive. The centreline can be used to create solid models, or outlines for plan view plots.

▶ **Drive** – a tunnel, or opening in rock, also known as a drift, or crosscut

▶ **Stope** – a 3-dimensional area (usually ore) which is to be mined out by blasting a series of long holes or ring design holes
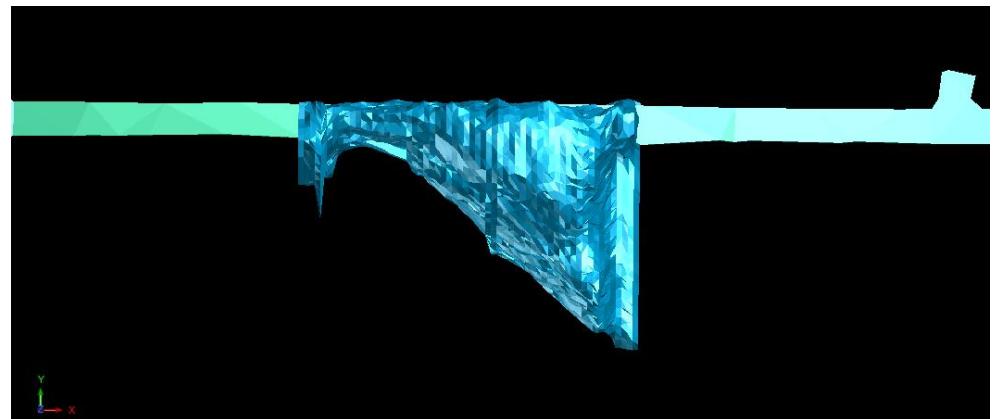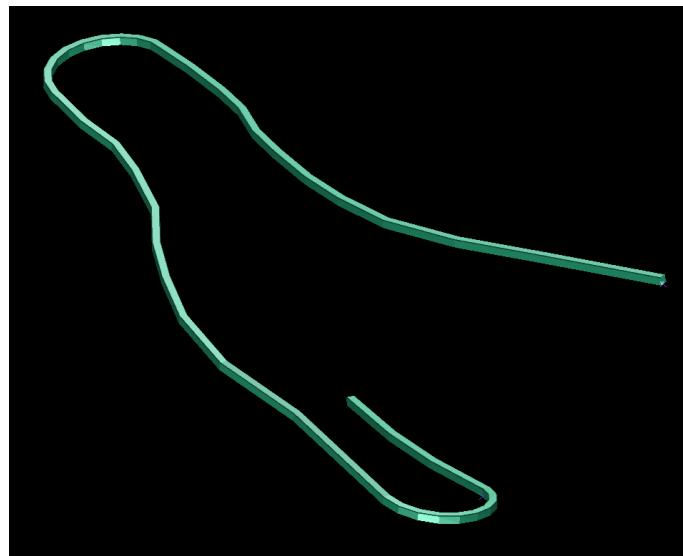
Underground Design Concepts

▶ There are many different scenarios where underground mine designs are to be created.

▶ In this tutorial, you will use:

▷ 3D solid models of designed stopes.

▷ Strings representing ore outlines at each level where a design is to be created.

▷ A point representing the location on the surface which is an entrance to the underground mine.

▶ You will open files containing this data into graphics, and then use various editing and point creation

▶ tools to create the underground mine design.

Creating a centreline design

▶ Open **stopes1.dtm. This file represents two parallel ore zones.**

▶ Open **ugdes_final1.dtm**

➢ Hide the stopes layer

➢ Hide the triangle faces

➢ Display strings 10,11 with numbers

➢ Strings 10 and 11 represent the centreline string numbers in the final design.

➢ The centreline string is displayed.
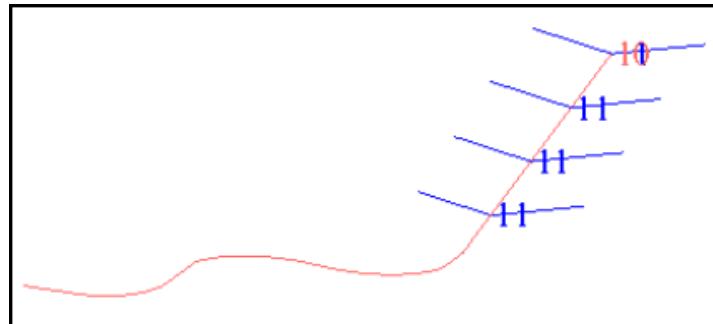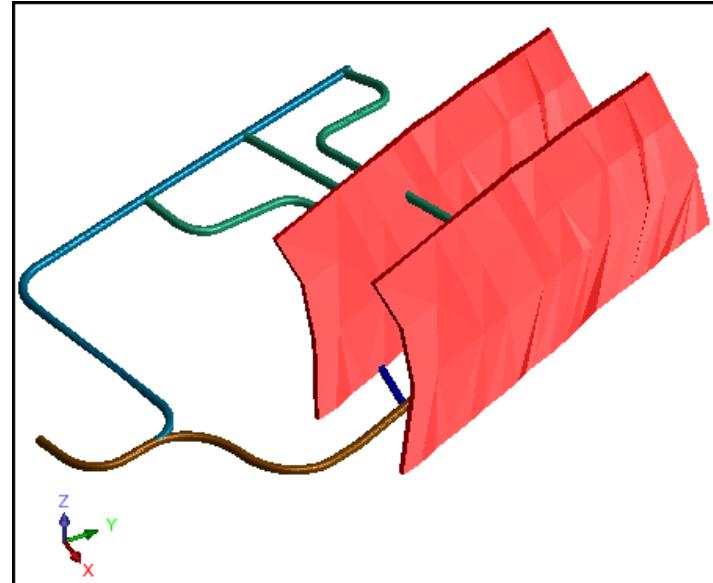
Creating a centreline between orezones

- ▶ Click the Reset graphics icon .

- ▶ Open lev215.str. Open stopes1.str.

- ▶ Spin the data around to get an idea of how the strings are formed in 3D space.

- ▶ Choose Display > Strings > With string numbers to display all strings with numbers.

- ▶ Choose Inquire > Point properties, and click several different segments.

    - ▷ Note: The string numbers correspond with the Z value of the strings.

- ▶ Choose Display > Hide everything.

- ▶ Choose Display > Strings > With string numbers.

- ▶ Enter 200 as the string range, and then click Apply.

- ▶ Make sure the main graphics layer is set as main.

- As shown in the final design previously, the string used to create the main drive between the two ore zones is string 10.

- Click the Design string number button displayed on the Status bar at the bottom of the main Surpac window.

- Enter the string number as 10.

- Choose Create > Digitise > New midpoint.

- Click two points on the north end of the ore zones to create a point midway between the two selected points, as displayed:

- Click two points on the south end of the

  ore zones to create another point midway

  between the two selected points,

  as displayed:

- Press Esc
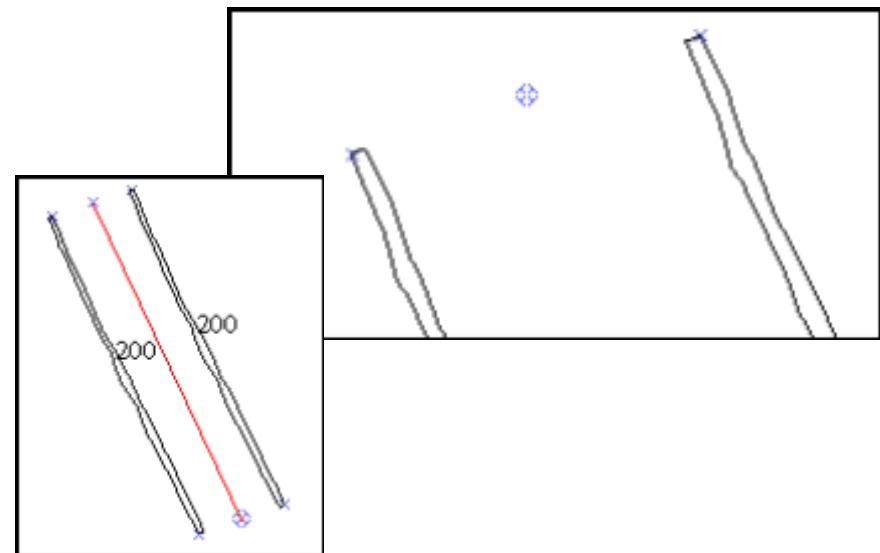
▶ Choose Create > Points > Insert point mode.

▶ Choose Create > Points > Multiple points by subdividing.

▶ Click the northern end of string 10, then the southern end of string 10.

▶ Subdivide horizontally, every 50 m.

▶ A centreline string will be displayed.

➢ These points will be the starting points for the access drives to the orezone.

➢ Save the centreline string as ugdes1.str.
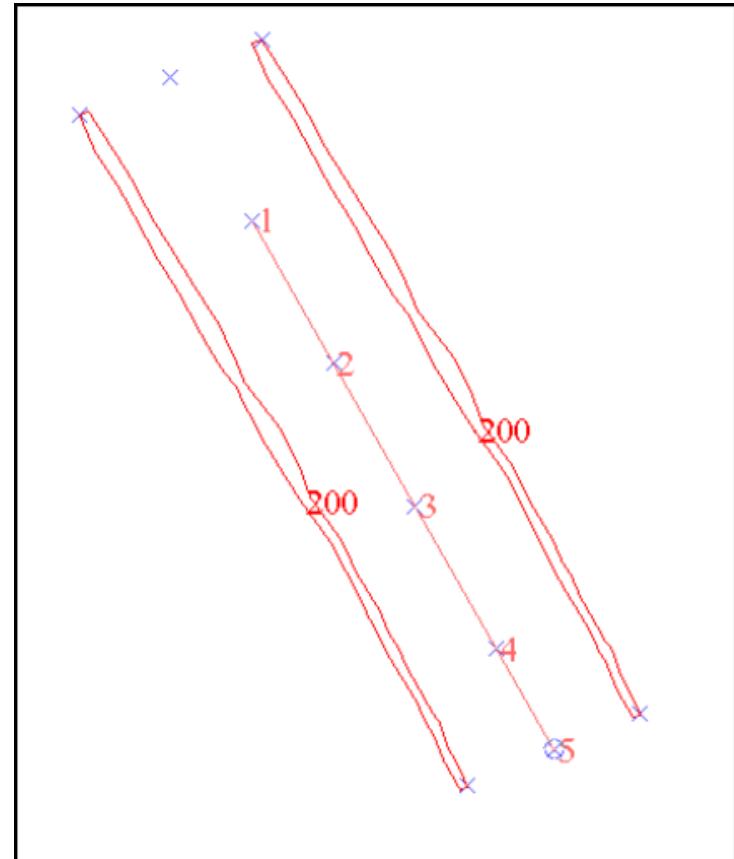
Creating access drives to the ore zones

▶ Click the Design string button on the Status bar at the bottom of the main Surpac window(currently displaying Str = 10).

▶ This will be string 11

▶ Choose Create > Points > Add point mode.

▶ Choose Create > Points > By angle.

▶ Click point 2, and then click point 1.

▶ Apply

▶ Without cancelling the previous

   function, click point 2, and then

   click point 1.

▶ Apply
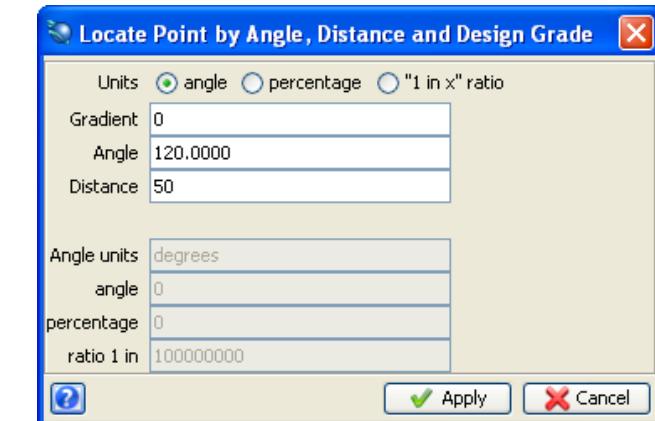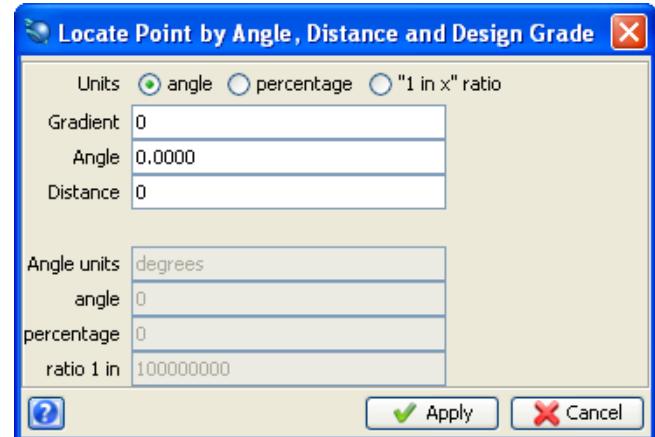
▶ This will create a new segment of string 11 that will extend beyond the western ore zone as shown.
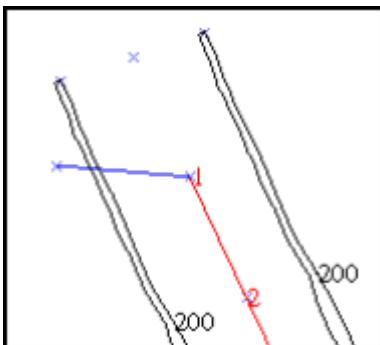
▶ Choose Create > New segment.

▶ Choose Create > Points > By angle.

▶ Click point 2, and then click point 1 again.

▶ Enter the information as shown.

▶ Without cancelling the previous function, once again click point 2, and then click point 1.

Locate Point by Angle, Distance and Design Grade

Units	⊙ angle ○ percentage ○ "1 in x" ratio
Gradient	0
Angle	0.0000
Distance	0

Angle units	degrees
angle	0
percentage	0
ratio 1 in	100000000

✔ Apply   ✖ Cancel

► Enter the information as shown.

Locate Point by Angle, Distance and Design Grade

Units	⦿ angle ◯ percentage ◯ "1 in x" ratio
Gradient	0
Angle	240.0000
Distance	50
Angle units	degrees
angle	0
percentage	0
ratio 1 in	100000000

✓ Apply   ✗ Cancel
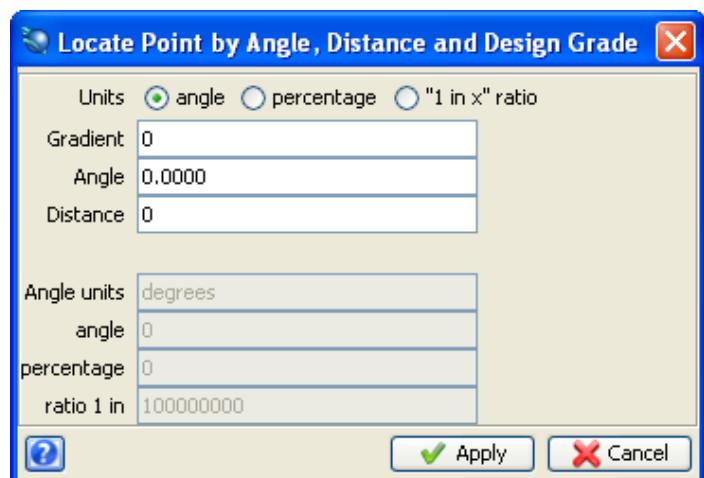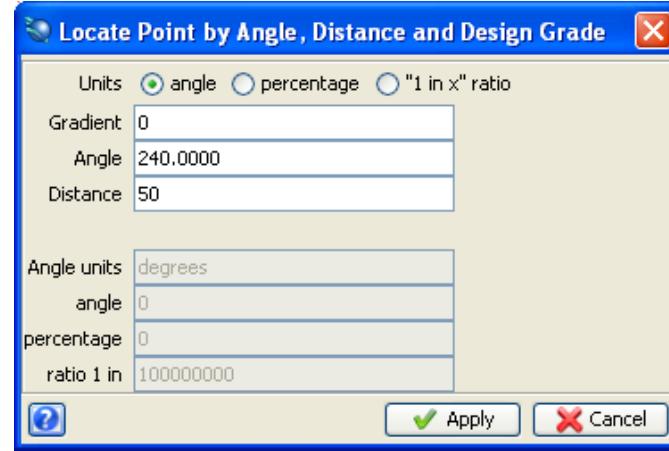
► You now have two segments of string 11 representing the centreline of ore access drives left and right off the main drive.

► Choose **Display > Hide temporary markers.**
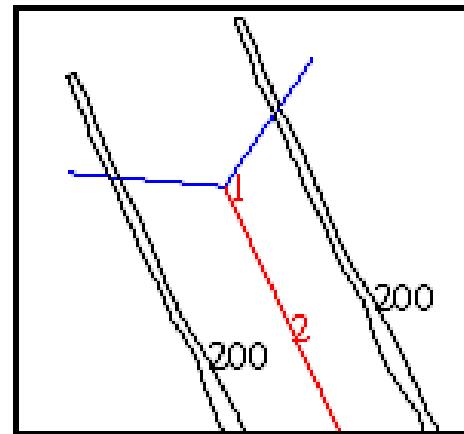
▶ Using the combobox on the Status Items toolbar, set the snap mode to Point.

▶ Choose Edit > String > Copy.

▶ Click string 11 near point 1, and drag to point 2.

▷ Note: In order to correctly select a string or segment in Surpac, do *NOT select a point* common to two or more strings. In this case, in order to select string 11, you would not want to position the cursor right on top of point 1, as this point is common to string 10 and string 11, and you could not be certain exactly which string you will select.


Copy a String

From Layer	main graphics layer
String	11
To Layer	main graphics layer
String	11

Apply   Cancel

Incorrect   Correct

200   200
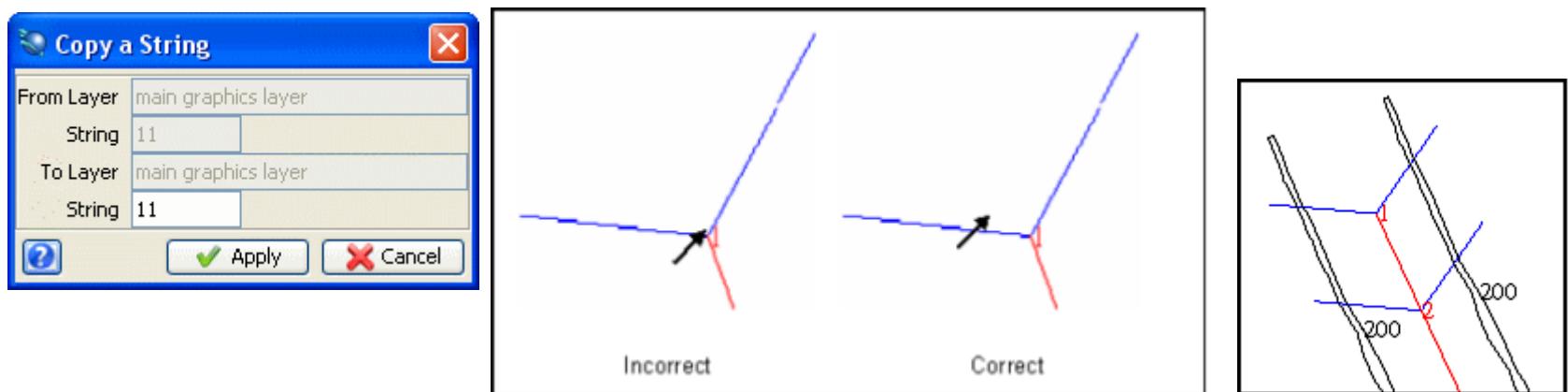
Note: There are two additional points on string 10 (point 3 and point 4) where you need access drives. You can continue using the **String Copy function to create drives for** these points.

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3S DASSAULT SYSTEMES | **IF WE** ask the right questions we can change the world.

▶ Click string 11 again near point 1, drag to point 3 and release.

▶ Enter the information as shown, and then click Apply.

▶ Press Esc.
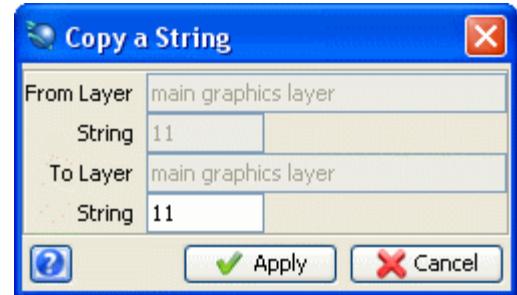
▶ Eight access drives are displayed.

▶ Return to plan view.
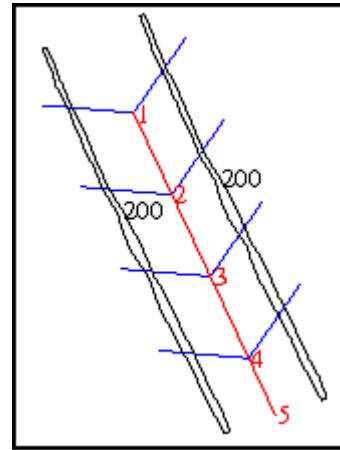
▶ Choose Edit > Trim > Clip by selected segment. Choose inside>apply.

▶ Click one segment of string 200, and then repeat for the other.

- Click Esc.
- You will see all portions of segments inside both ore zones removed.
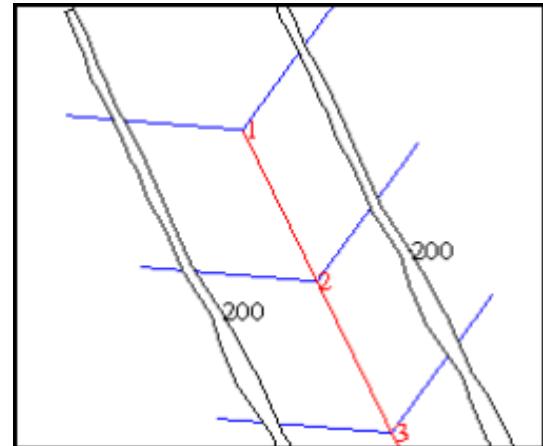
- Choose Edit > Segment > Delete
- Click the portion of each segment extended beyond the ore zones.
- Press ESC.
- Choose Display > Hide temporary markers.
- The drives are displayed.

- Save and overwrite.
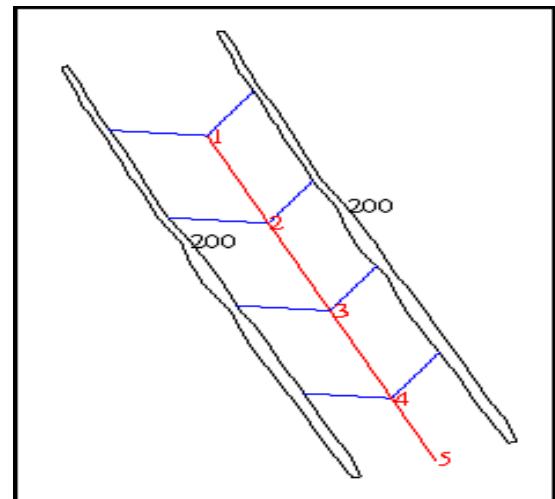
Creating the main decline

▶ Make lev215.str the active layer.

▶ Display all the strings with numbers in the layer.

▶ Choose Inquire > Point properties to determine the elevation of the two points.

▶ Choose Inquire > Bearing and Distance between two points.

▶ Click the end of string 1, then the beginning of string 1.

▶ Press ESC.

▶ Zoom out to see the access drives then zoom in to get a good view of points 4 and 5.

▶ Choose Inquire > Bearing and Distance between two points.

▶ Click point 5, then point 4 on string 10 in ugdes1.str.

▶ Press ESC.

▶ Set the main graphics layer as the current layer (ugdes1.str)

▶ Choose Create > Points > Add points mode.

▶ Set the snap mode to No Snap

- ▶ Set the design string to 10 and the design gradient to 0 (bottom of the window).

- ▶ Display the point numbers in string 10. Repeat for point markers.

- ▶ Choose Create > Curve at segment end.

- ▶ Click point 4, and then point 5.

- ▶ Enter the data as shown, and then click Apply.
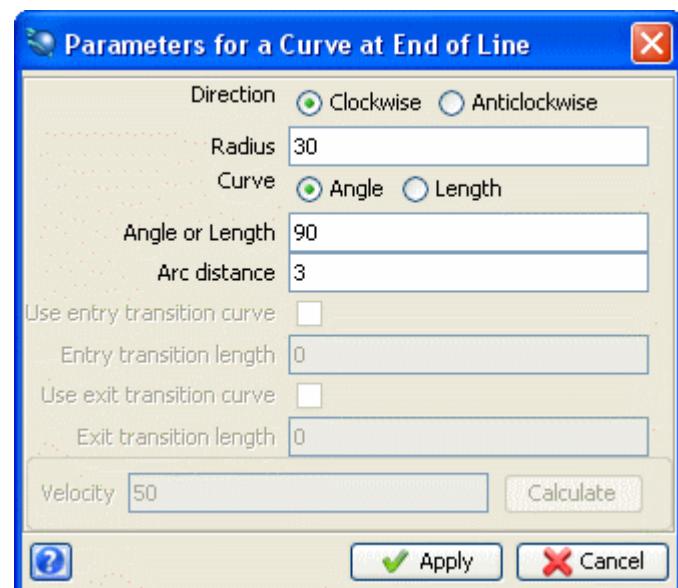
- ▶ Press Esc.

- ▶ Choose Edit > Segment > Join.

- ▶ Zoom in so that you can see the points clearly.

- ▶ Click point 5, and then point 7.

- ▶ Press ESC.

Parameters for a Curve at End of Line

Direction	◉ Clockwise ○ Anticlockwise
Radius	30
Curve	◉ Angle ○ Length
Angle or Length	90
Arc distance	3
Use entry transition curve	☐
Entry transition length	0
Use exit transition curve	☐
Exit transition length	0
Velocity	50	Calculate

✔ Apply   ✖ Cancel

Since the bearing of the main drive between the ore zones was 334.3332, you will construct the 5 metre straight section at a bearing 90 degrees less than that, or 244.3332.

▶ Choose Create > Points > By bearing.

▶ Click the end of the newly created curve.
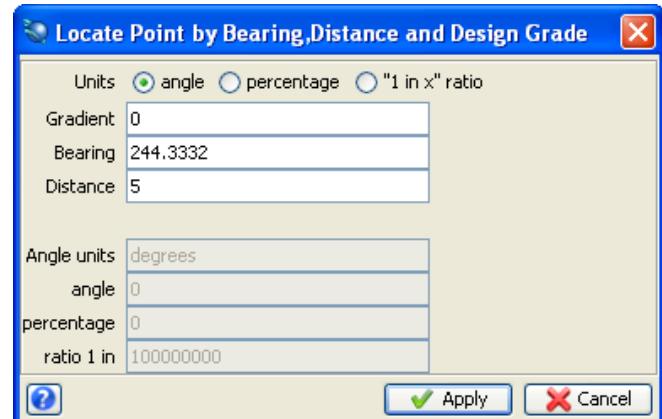
▶ Choose Create > Curve at segment end.

▶ Click point 21, and then point 22.
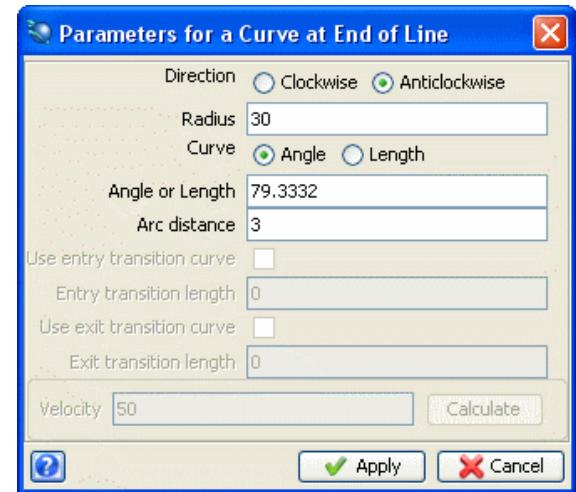
▶ Press Esc, then hide temporary markers.
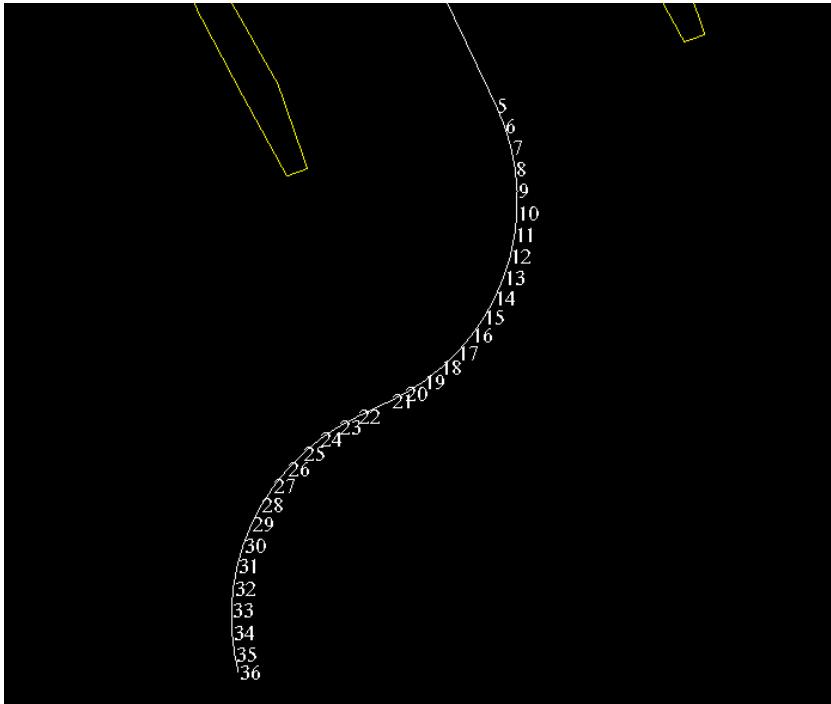
- ▶ Choose Edit > Segment > Change gradient.
- ▶ Click point 5, and then point 36.
- ▶ Enter the following information, and then click Apply.
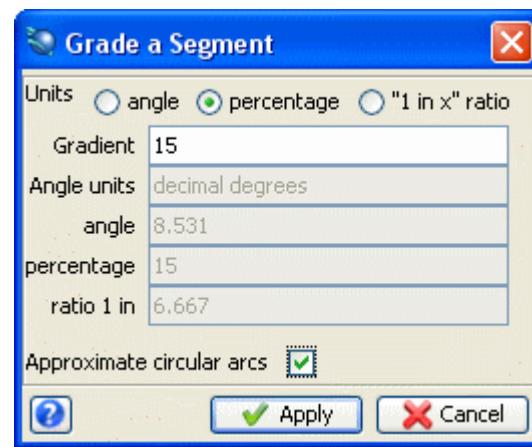
- ▶ Choose Inquire > Point properties.

- ▶ Click point 36.

- ▶ Choose Edit > Segment > Break.

- ▶ Click the segment between points 5 and 6.

- ▶ Choose Edit > Move segment constrained by > Bearing and distance.

- ▶ Click the segment with the two curves.
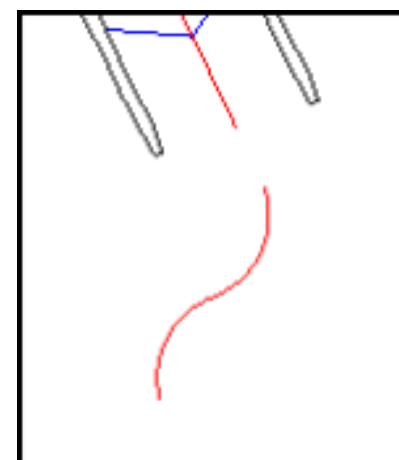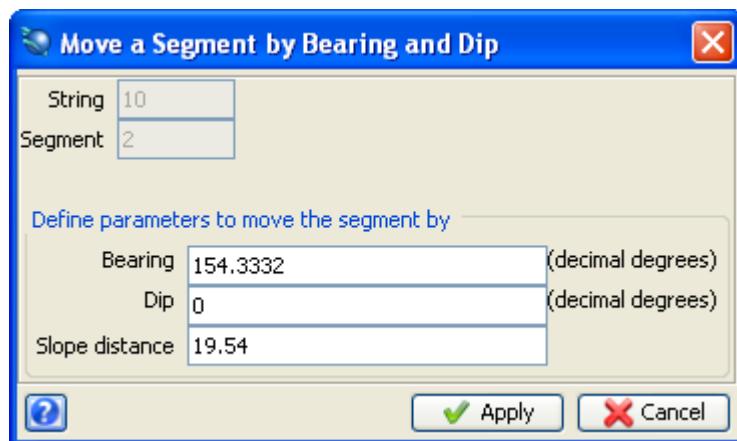
- ▶ Choose Edit > Segment > Join.
- ▶ Click the main drive first (at point 5), and then click the curves (at point 7).
- ▶ Choose Edit > Segment > Change gradient.
- ▶ Click point 5, and then click point 36.
- ▶ Enter the information as shown, and then click Apply.
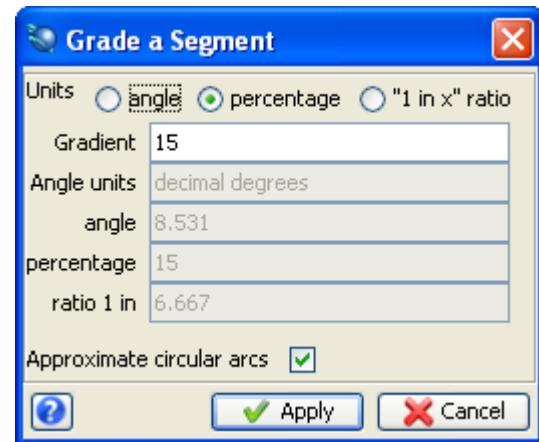
- ▶ Choose Inquire > Point properties.
- ▶ Click point 36 (i.e. the southern end of curve 2).
- ▶ Choose Create > Points > By bearing.
- ▶ Click point 36 (i.e. the southern end of curve 2).

▶ Fill in the form as shown and click apply.
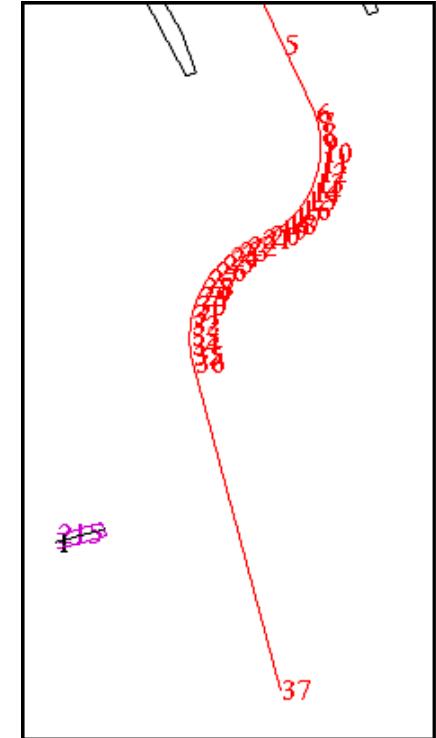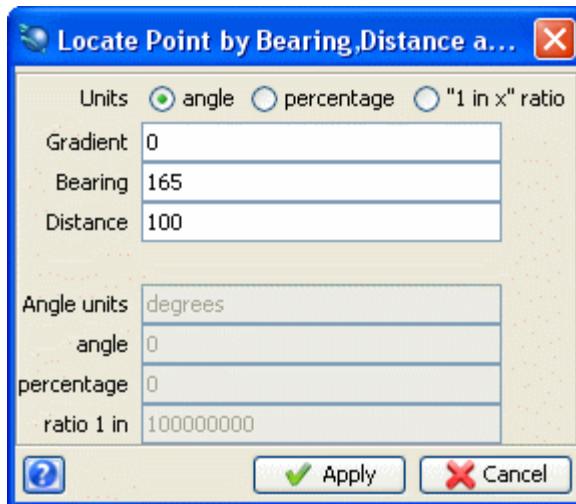

▶ Choose Create > Points > Change point mode.

▶ Choose Create > Points > At intersection of two lines.

▶ Click point 37, and then click point 36.

Note: It is important to select 37 first, as the first point selected will be moved.

▶ Next, click both of the endpoints of the centreline of lev215.str (i.e. string 1).

▶ Note: You may need to use the Assist key(F1) to allow you to zoom in on lev215.str so that you select the correct points. It does not matter which end you select first for this string, point 37 will still be moved to the correct position as shown.

▶ Press ESC.

▶ Set the Snap mode to Point:

▶ Choose Create > Points > Insert after an existing point.

▶ Click point 37 and drag it to the Access Point

▶ Click Apply on the form presented.

▶ Press Esc.

Enter/edit a point

Function INSERT
String   10
Y value   21597.941
X value   11224.988
Z value   216.983
Descriptions

Description
D1   78

✓ Apply   ✗ Cancel
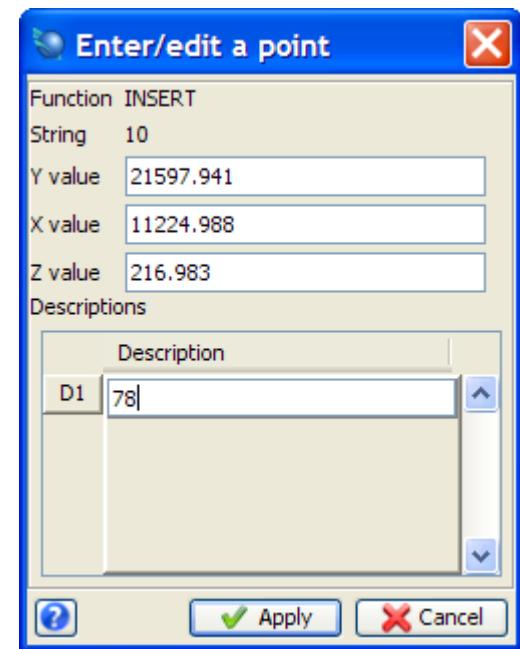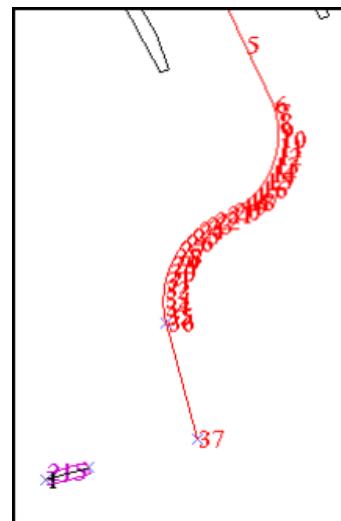
- ▶ Choose **Create > Points > Insert point mode.**

- ▶ Choose **Create > Curve from tangents.**

- ▶ Click point 36, and then click point 37.

- ▶ Click point 37 again, and then click point 38.

- ▶ Enter the information as shown,

  and then click **Apply.**
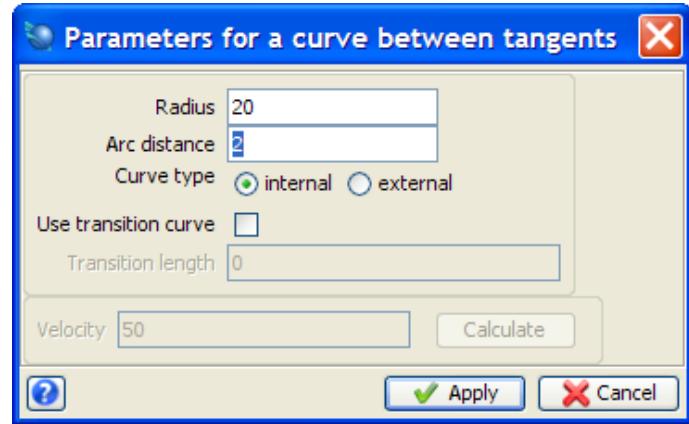
- ▶ Choose **Display > Hide point > Markers.**

- ▶ Enter the information as shown, and then click **Apply.**
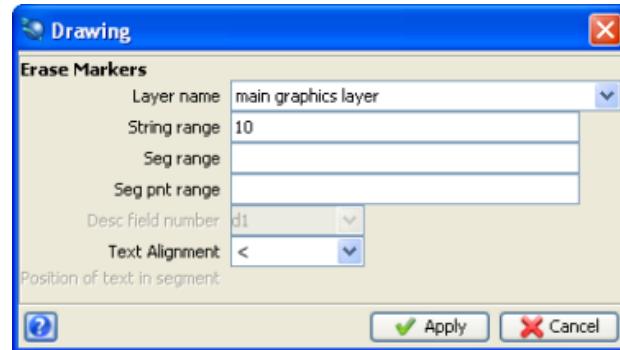
► Choose Display > Hide point > Attributes.
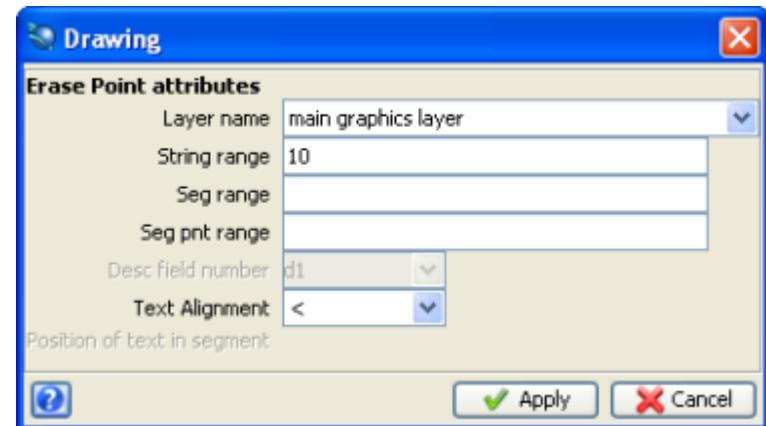
► Choose **Display > Hide temporary markers.**

► The centre string is displayed.er the information as shown, and then click Apply.
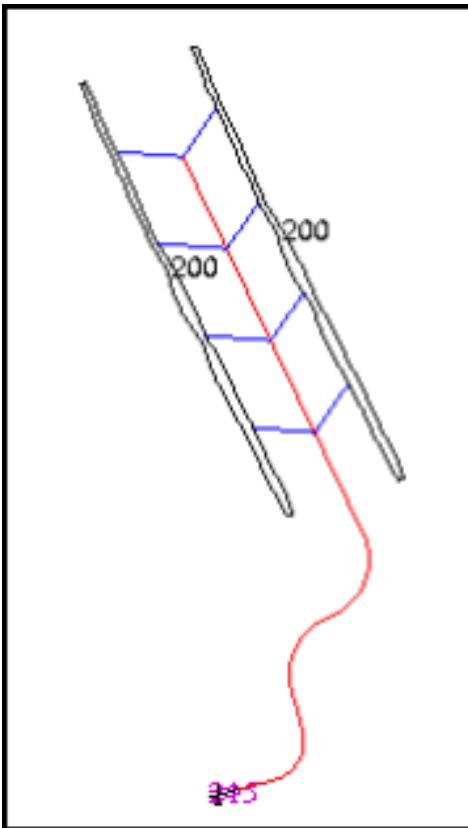
▶ Save the file as **ugdes1.str.**

Creating road outlines

▶ Click the Reset graphics icon .

▶ Open ugdes2.str.

▶ Choose Display > Strings > With string numbers.

▶ Enter the information as shown, and then click Apply.

**Drawing**

Draw Strings

Layer name	ugdes_final1.dtm
String range	10,11
Seg range	
Seg pnt range	
Desc field number	d1
Text Alignment	<
Position of text in segment	○ All points ⦿ First point ○ Centroid

✔ Apply   ✖ Cancel
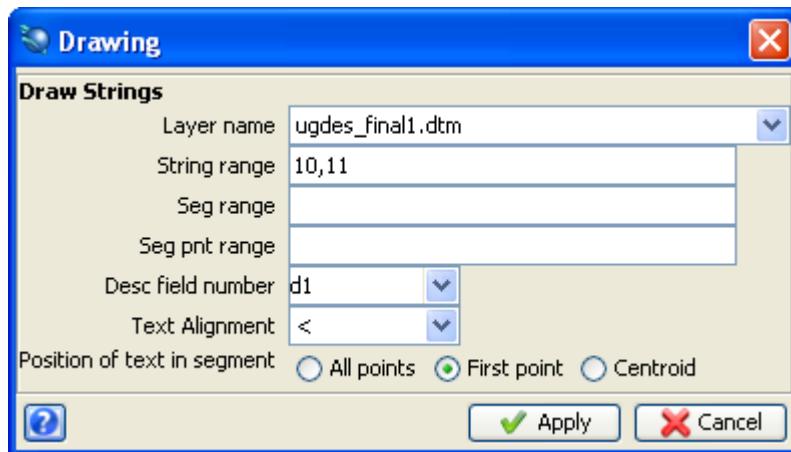
▶ Click the Design string number button displayed on the Status bar at the bottom of the main Surpac window.

▶ Enter 12 in the box and apply.

▶ Choose Design > Underground tools > Room & pillars from centreline.

▶ Enter the information as shown, and then click Apply.

Note: This sets the width of the road to be fixed at 5m for both strings 10 and 11.

▶ Save the string as ugdes_outline1.str
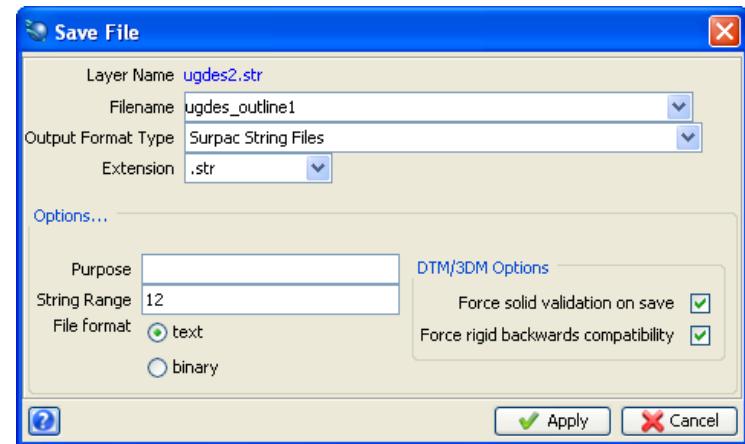
- ▶ Click the **Reset graphics icon .**
- ▶ Open **ugdes_outline1.str.**
- ▶ The road outline is displayed.
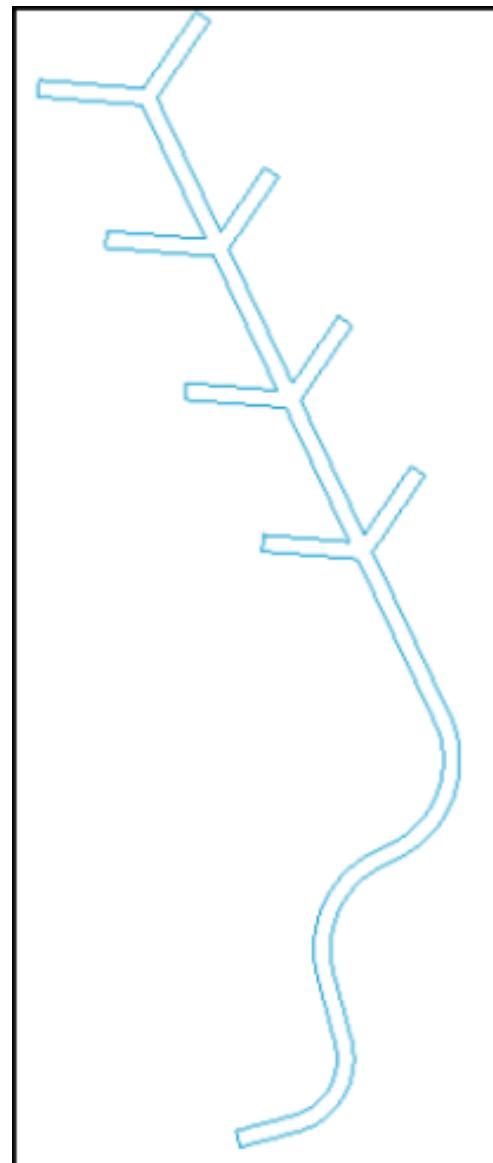
Creating road outlines of variable width

- ▶ Click the Reset graphics icon .
- ▶ Open ugdes2.str.
- ▶ Choose Display > Strings > With string numbers.
- ▶ Enter the information as shown, and then click Apply.
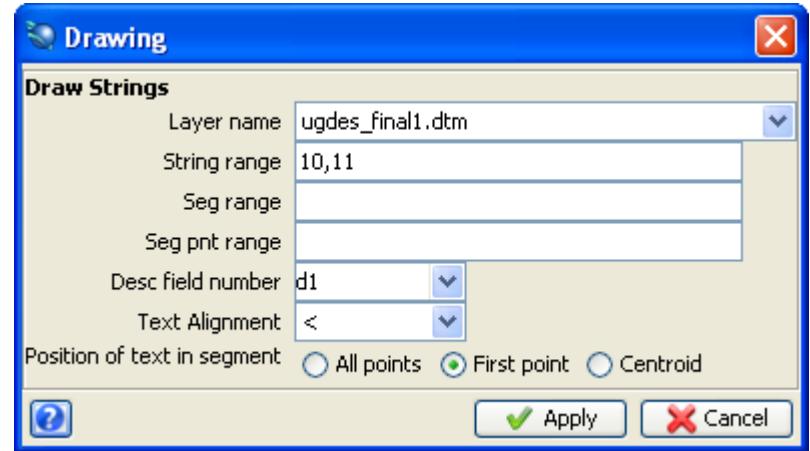
- ▶ Click the Design string number button displayed on the Status bar at the bottom of the main Surpac window.
- ▶ Set this to 12.

► Choose File tools > String maths.

► Enter the information as shown, and then click Apply.
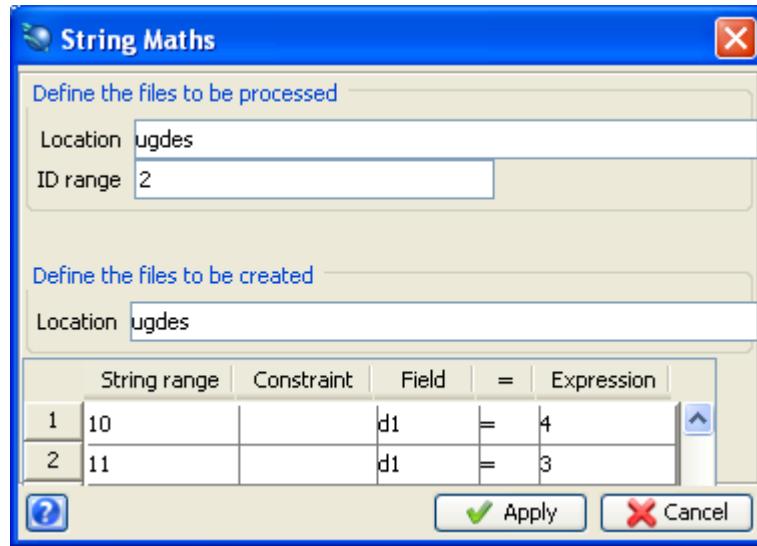

► Click apply the overwrite the file.

  Note: This sets the width of the centreline to be 4m, while the access drives are set to 3m.

▶ Choose Display > Points > Attributes.
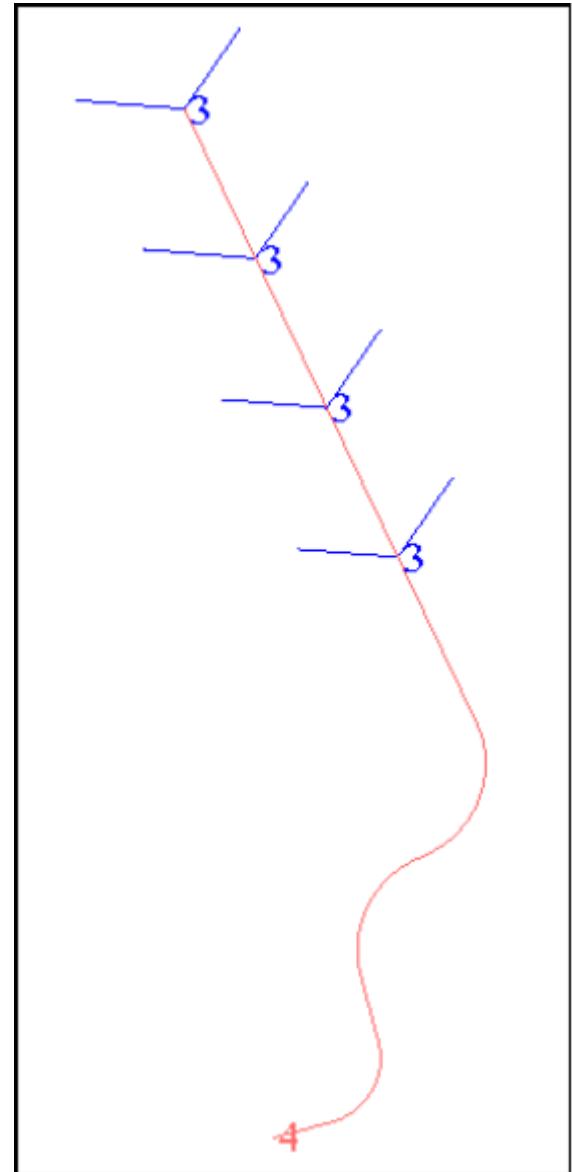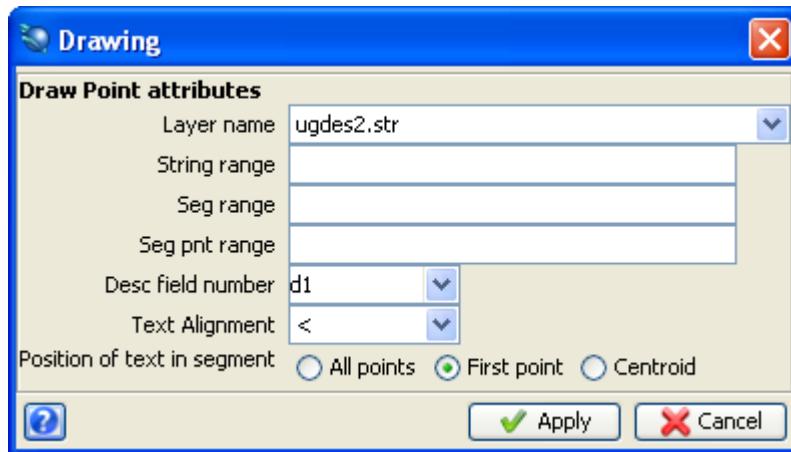
▶ Choose Design > Underground tools > Room & pillar from centreline.

▶ Enter the information as shown, and then click Apply.
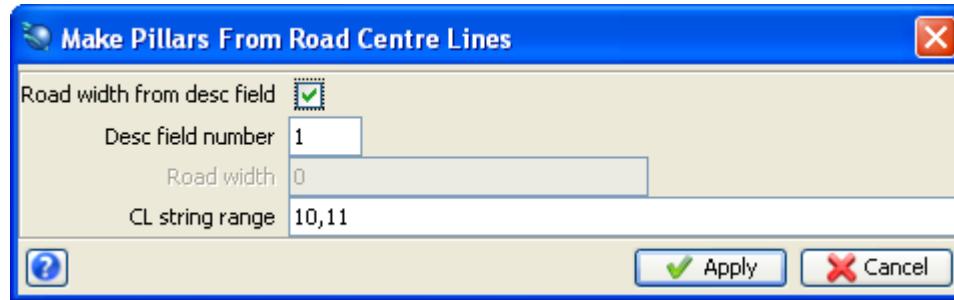
Note: This instructs the software to use the d1 field to determine the width of the road for each string. In this case you have already set d1 to 4m for string 10, and d1 to 3m for string 11.

► Save the string
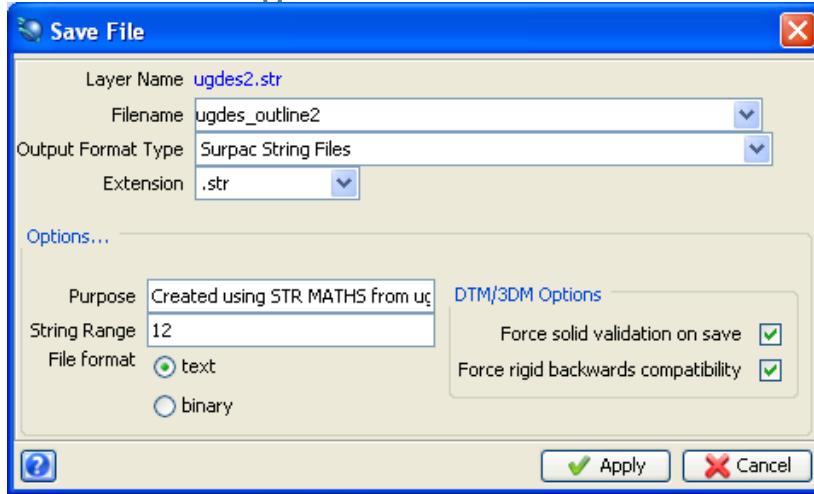
► Reset graphics and open the file
   you just saved.
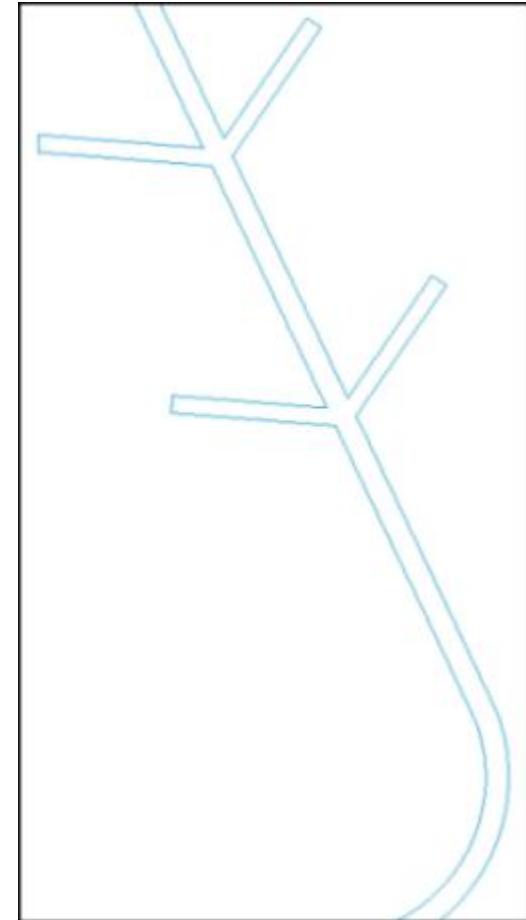
Creating a solid

- ▶ Click the Reset graphics icon .

- ▶ Open ugdes1.str.

- ▶ Choose Underground tools > Triangulate using centre line & profile.

- ▶ Enter the information as shown, and then click Apply.

- ▶ Click string 10.

- ▶ Notice that this profile is applied to string 10 only, i.e. the centreline string.

- ▶ Press ESC.
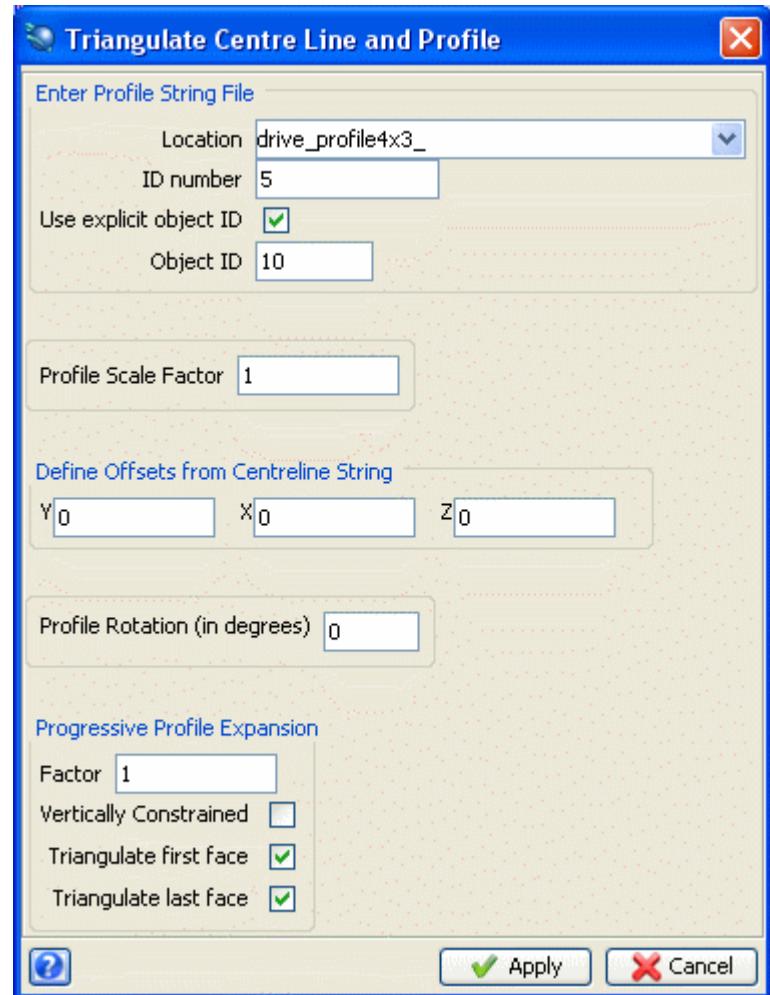
▶ A centreline solid is displayed
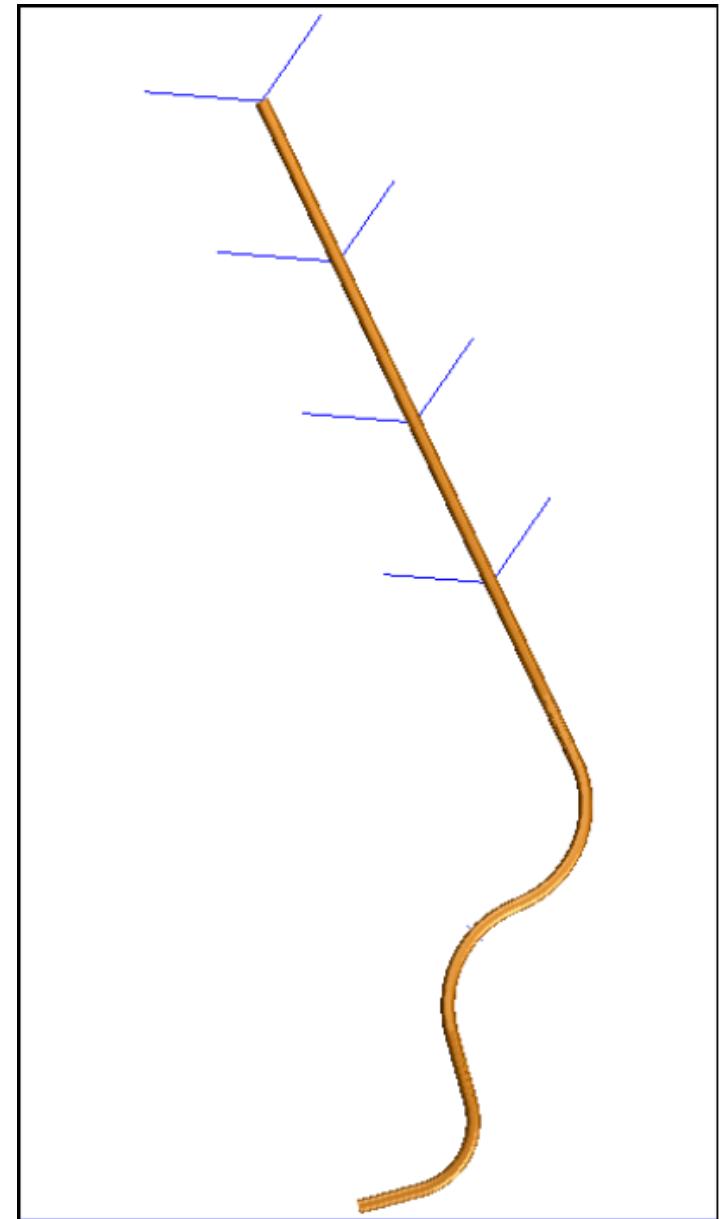
- ▶ Choose Underground tools > Triangulate using centre line & profile.
- ▶ Enter the information as shown, and then click Apply.
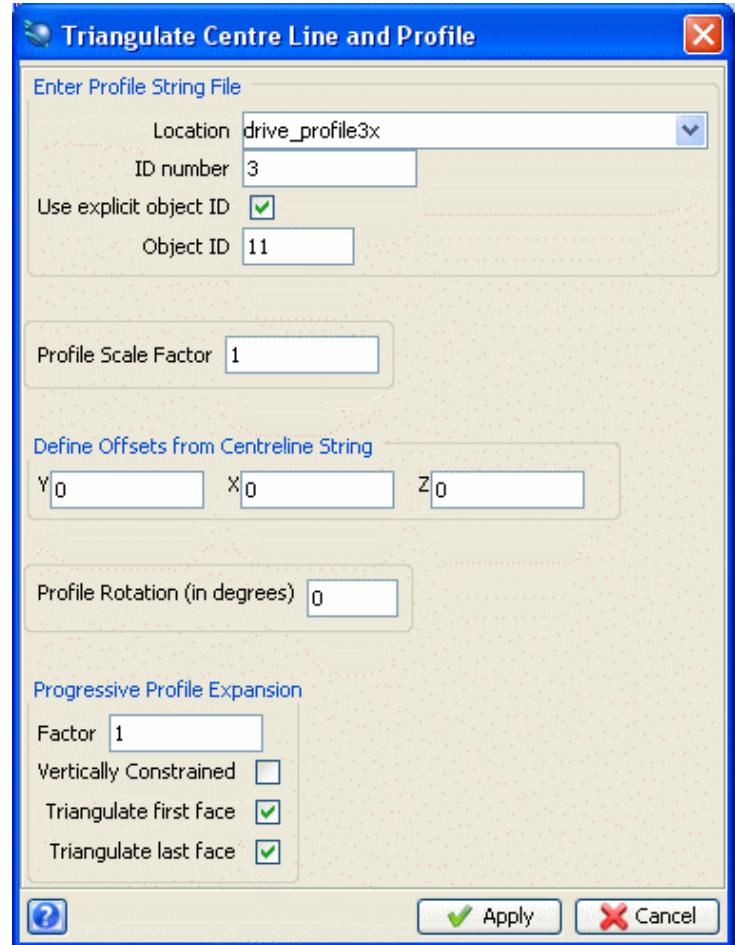
- ▶ Click each of the individual segments of string 11.
- ▶ Press ESC.
- ▶ Choose Solids > Validation > Validate object.

- ▶ Make sure your solids is valid.

- ▶ Choose Solids > Validation > Set object to solid or void.
- ▶ Enter the information as shown, and then click Apply.
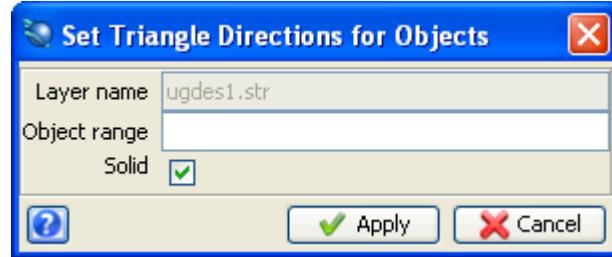
- ▶ Save the DTM as ugdes1.dtm.

Calculate volume

- ▶ Choose Solids > Solids tools > Report volume of solids.
- ▶ Enter the information as shown, and then click Apply.
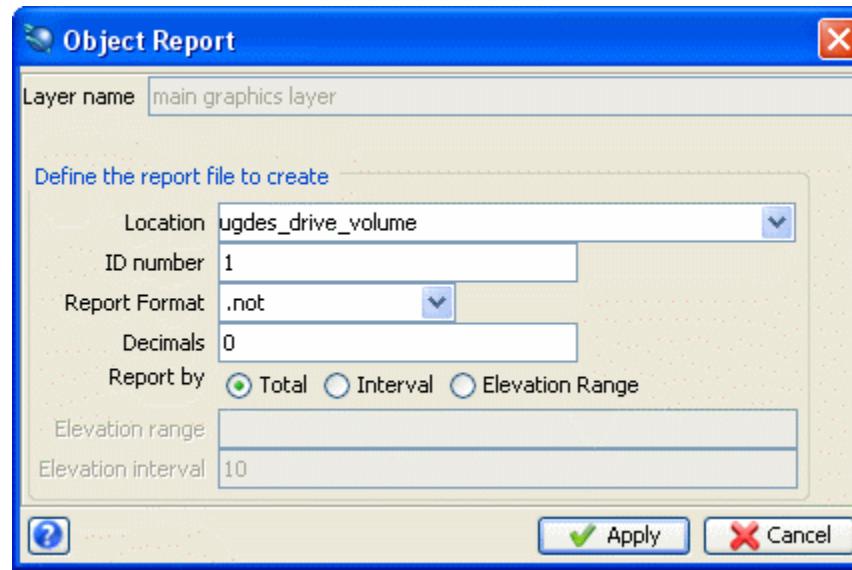
- ▶ The file ugdes_drive_volume1.not is displayed.