



Drill and Blast Tutorial

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Product

Surpac™ 6.6.1

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Introduction

Overview

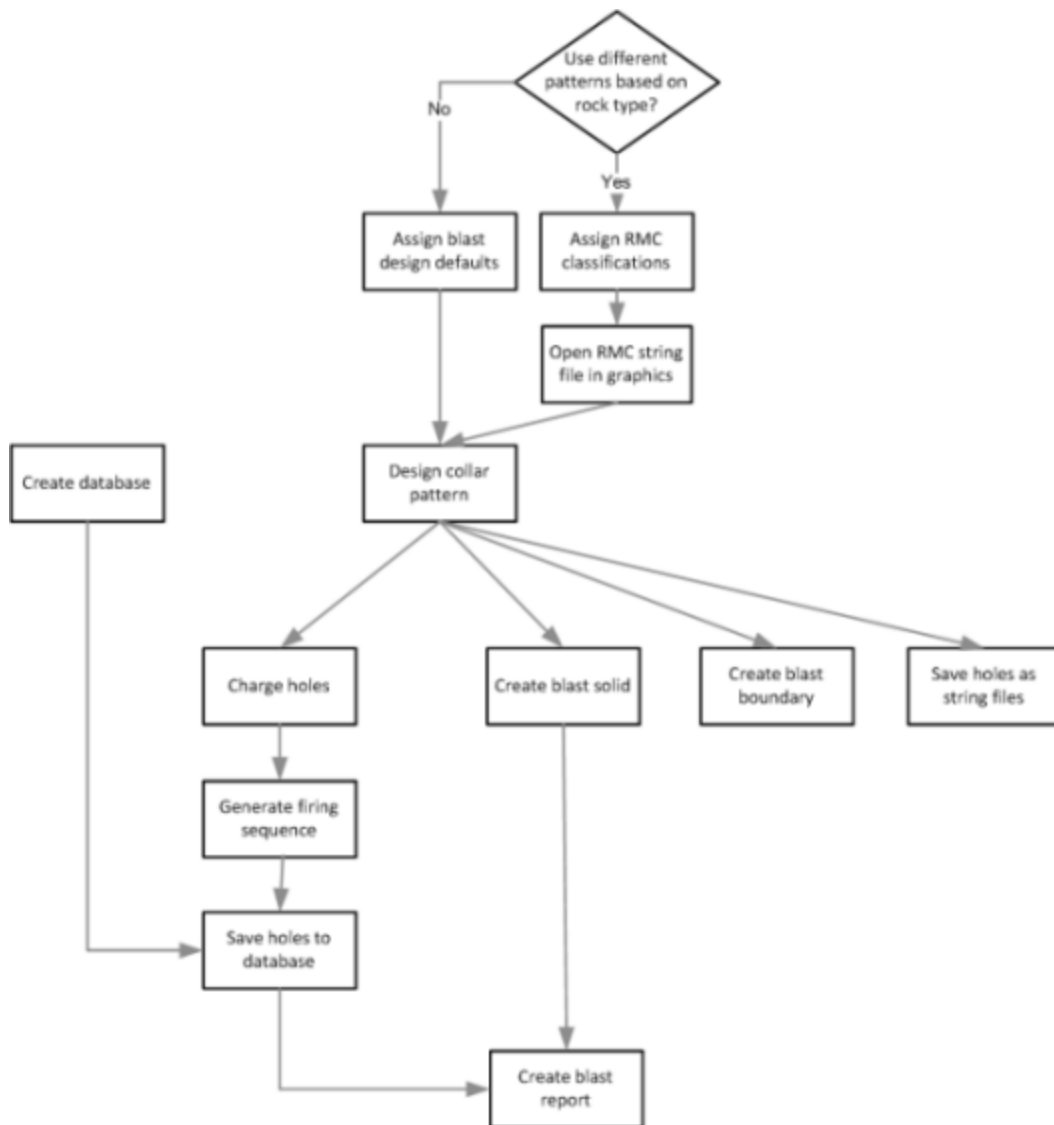
The drill and blast functions allow you to create and charge vertical and inclined holes in rectangular patterns, along segments, or in a straight line between any two points digitised in **Graphics**.

Requirements

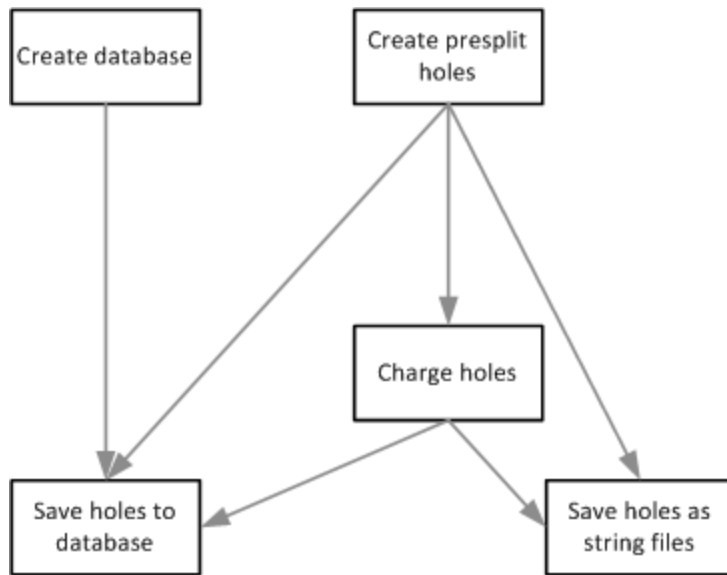
Before you begin this tutorial, you must have:

- a good understanding of the basic Surpac concepts of strings, segments, DTMs, and string tools
- Surpac installed on your computer
- the data set accompanying this tutorial

Workflow - blast Patterns



Workflow - presplit holes



📌 **Note:** These workflows demonstrate the steps in this tutorial. There are other ways to achieve a result.

Drill and blast concepts

There are several terms and concepts specific to this tutorial that are explained in this chapter. Not all terms are the same in all countries, and you might need to apply your preferred terminology in some cases. A lot of the terminology used in this document is specific to the mining and quarrying industries.

Drilling

Drilling parameters that you can customise include:

Bearing – also referred to as azimuth.

Burden – the distance between rows.

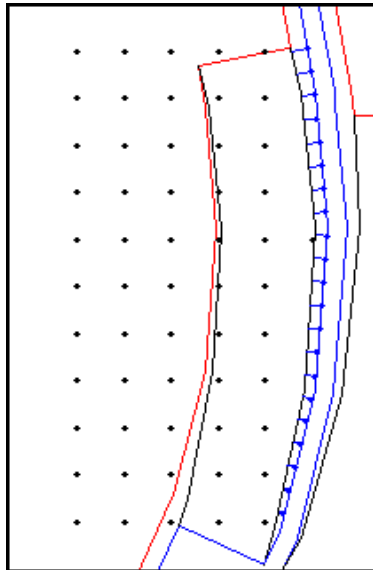
Collar – the starting point of a drill hole.

Diameter – the diameter of drill hole in units of measure (that is, metres or feet).

Dip – the angle of a hole above or below the horizontal.

Pattern – a set of blast holes which will be collectively drilled, sampled, charged, and blasted.

An example of a pattern is shown below. Each dot represents one blast hole.



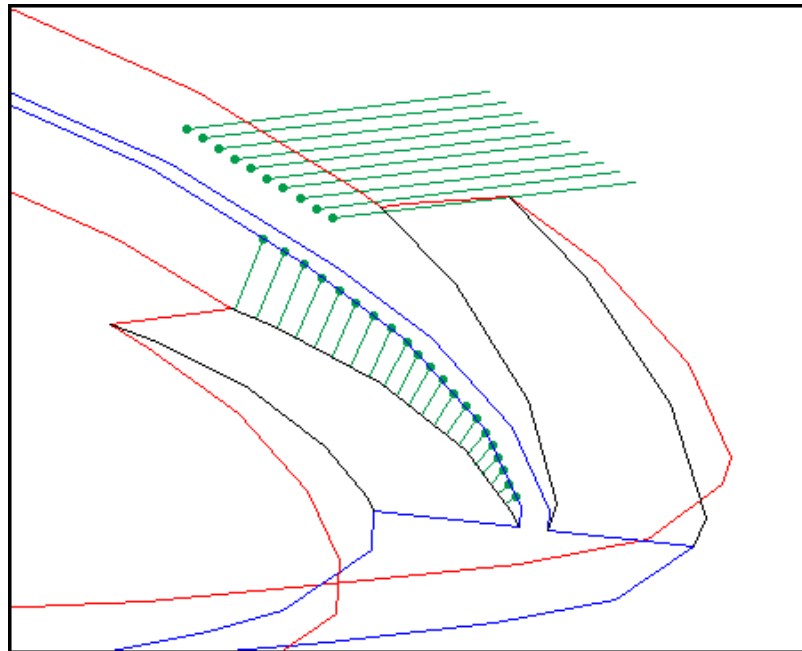
Spacing – the distance between holes in a row.

Subdrill distance – extra drilling length to add to each hole.

Toe – the bottom or ending point of a drill hole is referred to as the toe. A line defining the base point of a slope can also be referred to as a toe.

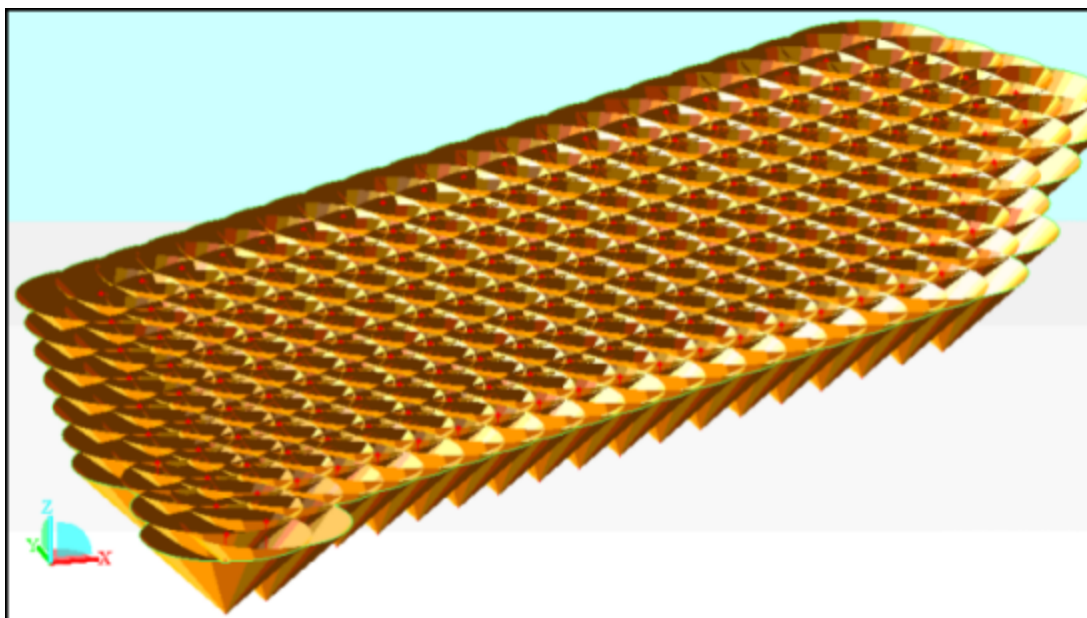
Presplit holes

Often holes are drilled at closely spaced along a planned fracture plane. These holes are referred to in Surpac as presplit holes. Surpac can create presplit holes along a straight line or along a segment. The following example shows presplit holes created along a segment, and in a straight line. One set of holes is created from one segment, the crest of a bench, to another segment, the toe of the ramp. The horizontal holes, which could be used as drains in a pit wall, or for sampling, were created along a straight line.



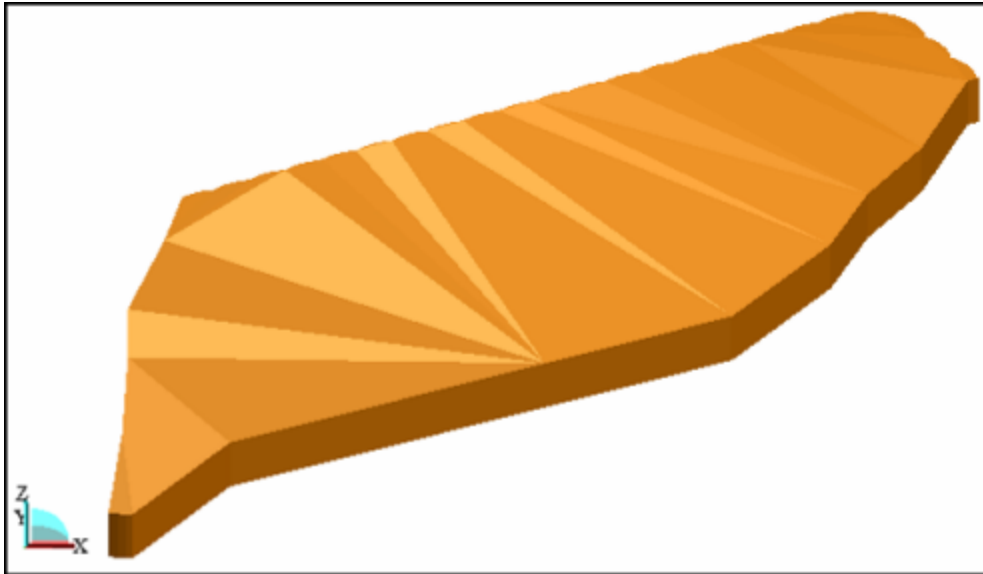
Blast boundary

You can generate a blast boundary for a designed pattern using blast cones around each drill hole. The outermost segments of each cone are joined to create the blast boundary.



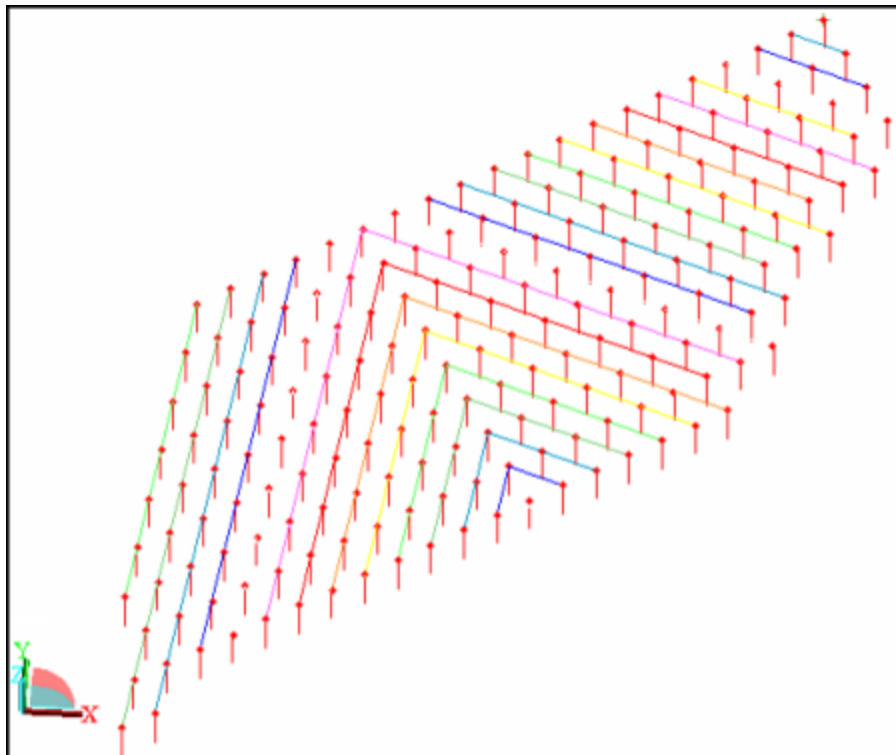
Blast solid

You can generate a blast solid by using the blast boundary and projecting it down to a design elevation or to a DTM surface.



Tie in patterns

You can generate a tie in pattern using one of the standard templates, or you can select holes/tie in lines individually to generate a customised pattern.



Blasting

Charging parameters which you can customise include:

Booster name – can be selected from Anzomex G (PG), Anzomex H (PH), Anzomex K (PK), Anzomex P (PPE), Anzomex PP D (PPD), Anzomex PP P (PPPE), Jumbo prime (PJ) or Stopeprime (PSP DL).

Charge depth – can be automatically adjusted to hole depth.

Charge interval – multiple charge intervals separated by stemming are allowed.

Database – all of the drilling and blasting information for each hole can be saved to a database. Surpac supports Access, and any database connectable via ODBC (Open DataBase Connectivity). The recommended database type is Access.

Delay time – the delay time in milliseconds, the default is 400 milliseconds.

Depth of stemming – rock chips, dirt, or other non-explosive material placed on top of the charge.

Detonator name – can be selected from Excel LP, Nonel LP, Nonel MS, connectadet, or enduradet.

Detonator position in the hole – can be selected from top, middle, or bottom of the hole.

Explosive – can be selected from ANFO 0.8, 0.9 or 1.0, Power Gel, air, or stemming.

Reports and volume calculations

You can generate three types of reports using the drill and blast functions:

- **Blast summary** – contains a rundown of all the blast design and costing details, including total drilling length, explosive products, mass of explosive down each hole, powder factor, blast volume, drilling cost, and explosive cost.
- **Pattern setout** – contains a list of hole numbers and their coordinates.
- **Work order** – contains details of the total number of explosive products to be used in a blast, including the number and type of detonators in the blast, total mass of explosive, kilograms of explosive per hole, and number of boosters required.

Setting up for this tutorial

Setting the work directory

A work directory is the default directory for saving Surpac files. Files used in this tutorial are stored in the folder `<shared_files>\demo_data\tutorials\drill_and_blast`.

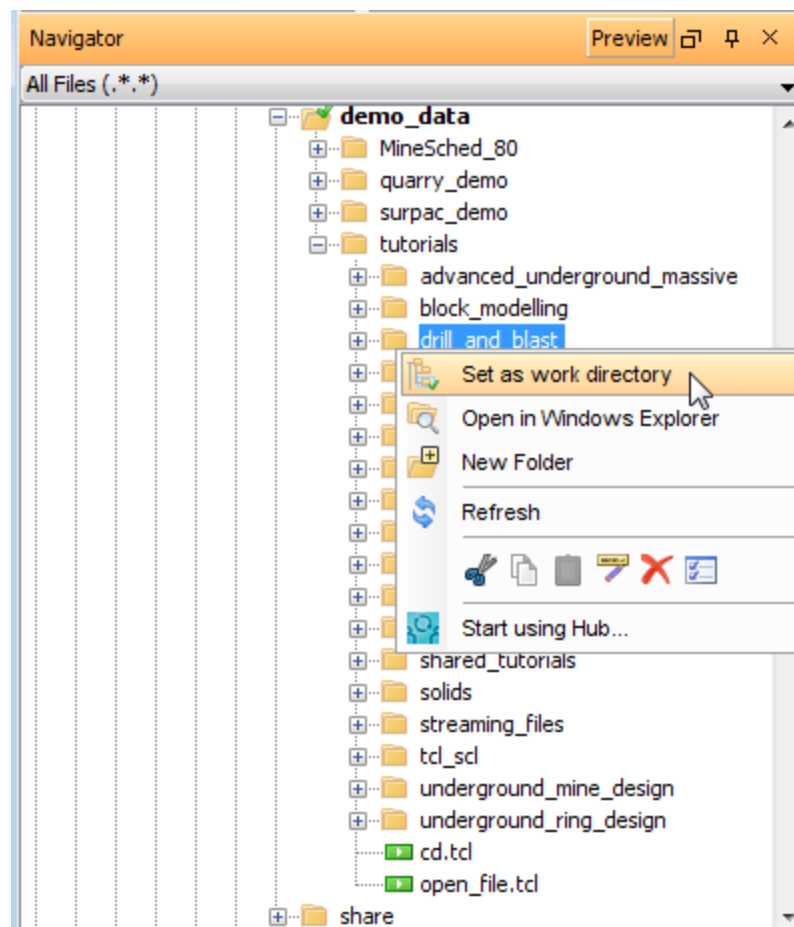
Where `<shared_files>` is the directory in which the Surpac shared files were installed.

In Windows 7, and Windows 8, the default path is

C: \Users\Public\GEOVIA\Surpac\66\demo_data\tutorials\drill_and_blast.

Task: Set the work directory

1. In the **Navigator**, right-click the **drill_and_blast** folder.
2. From the shortcut menu, select **Set as work directory**.



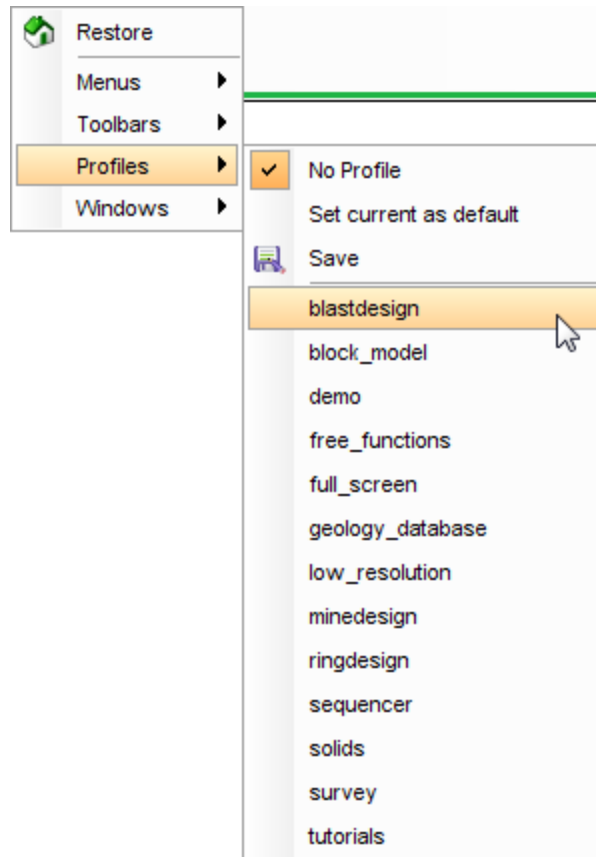
The name of the work directory is displayed in the title bar of the Surpac window.

Displaying the toolbar and menubar

Task: Display the blastdesign toolbar and menubar

When working with the drill and blast tools, it is helpful to use the blastdesign profile. This displays the **Blast design** menu bar and toolbar.

1. Right-click in the blank area next to the menus at the top of the Surpac main window.
2. From the shortcut menu, choose **Profiles > blastdesign**.



Note: For more information on setting up profiles and customising menus and toolbars, see the **Introduction** tutorial.

Viewing blast design defaults

Task: View the blast design defaults


1. Choose **Blast design > Drill and Blast Settings**.

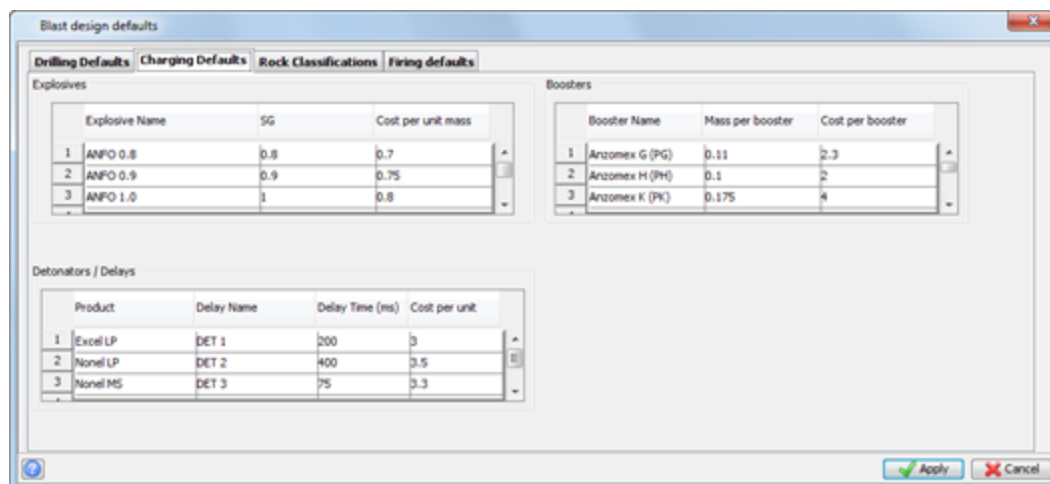
The *Blast design defaults* form opens on the **Drilling Defaults** tab.

The screenshot shows the 'Blast design defaults' dialog box with the 'Drilling Defaults' tab selected. The 'Measurement system' is set to 'metric' and 'Hole Diameter' is 0.1. 'Mass units' is 'Kilogram', 'Length units' is 'Meter', and 'Volume units' is 'Cubic meter'. The 'Drills Rigs' table has two rows: '1 Rig-1' and '2 Rig-2'. A context menu is open over the table, with 'Add' highlighted. The 'Apply' and 'Cancel' buttons are at the bottom right.

📌 **Note:** You can add a row to the **Drills Rigs** table by right clicking a row number and selecting **Add**. You can add the names of any drill rigs you have on site to this list. You can then assign the drill rigs to a blast pattern when designing a blast.

- Click the **Charging Defaults** tab.

 **Note:** You enter all your explosives product information in this tab. You can then select any of these products when charging the holes in a blast design.



Blast design defaults

Charging Defaults

Explosives

Explosive Name	SG	Cost per unit mass
1 ANFO 0.8	0.8	0.7
2 ANFO 0.9	0.9	0.75
3 ANFO 1.0	1	0.8

Boosters

Booster Name	Mass per booster	Cost per booster
1 Anzomex G (PG)	0.11	2.3
2 Anzomex H (PH)	0.1	2
3 Anzomex K (PK)	0.175	4

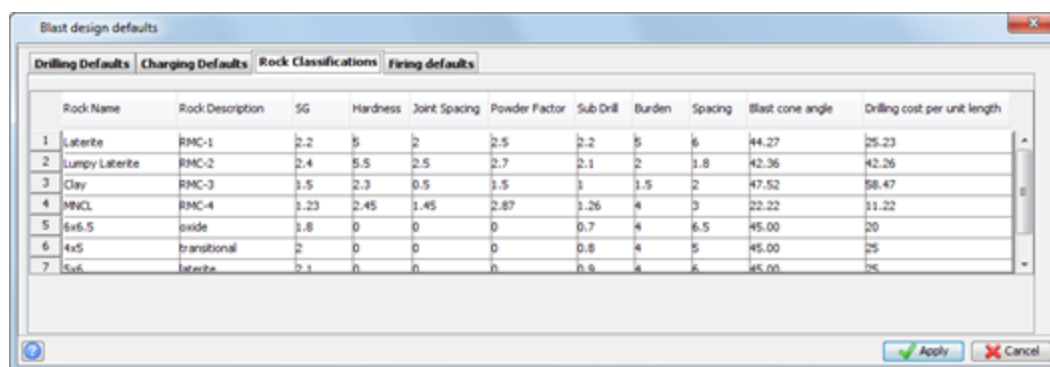
Detonators / Delays

Product	Delay Name	Delay Time (ms)	Cost per unit
1 Excel LP	DET 1	200	3
2 Nonel LP	DET 2	400	3.5
3 Nonel MS	DET 3	75	3.3

Apply Cancel

- Click the **Rock Classifications** tab.

 **Note:** You enter all the Rock Mass Classification (RMC) information in this tab.



Blast design defaults

Rock Classifications

Rock Name	Rock Description	SG	Hardness	Joint Spacing	Powder Factor	Sub Drill	Burden	Spacing	Blast cone angle	Drilling cost per unit length
1 Laterite	RMC-1	2.2	5	2	2.5	2.2	5	6	44.27	25.23
2 Lumpy Laterite	RMC-2	2.4	5.5	2.5	2.7	2.1	2	1.8	42.36	42.26
3 Clay	RMC-3	3.5	2.3	0.5	3.5	3	3.5	2	47.52	58.47
4 MNCL	RMC-4	3.23	2.45	1.45	2.87	3.26	4	3	32.22	31.22
5 5x5.5	oxide	3.8	0	0	0	0.7	4	6.5	45.00	20
6 4x5	transitional	2	0	0	0	0.8	4	5	45.00	25
7 5x6	laterite	2.1	0	0	0	0.9	4	6	45.00	25

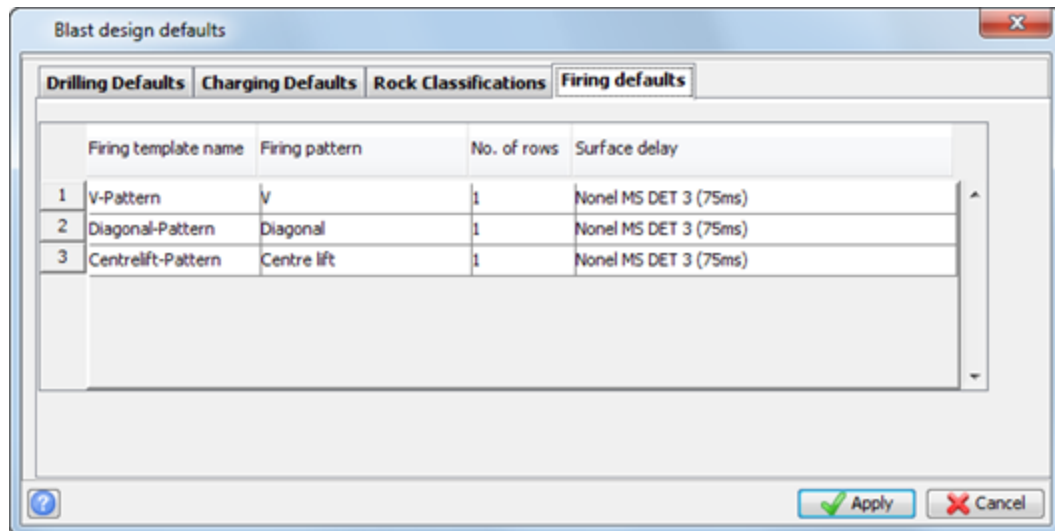
Apply Cancel

- Click the **Firing defaults** tab.

This tab contains template details for the three most common firing patterns.

If you have a blast design that is suited to using one of these firing patterns, you can generate a firing sequence using one of these standard templates. An example of how to generate a firing sequence from a standard template is given later in this tutorial.

- Check that each entry for **No. of rows** is 1.



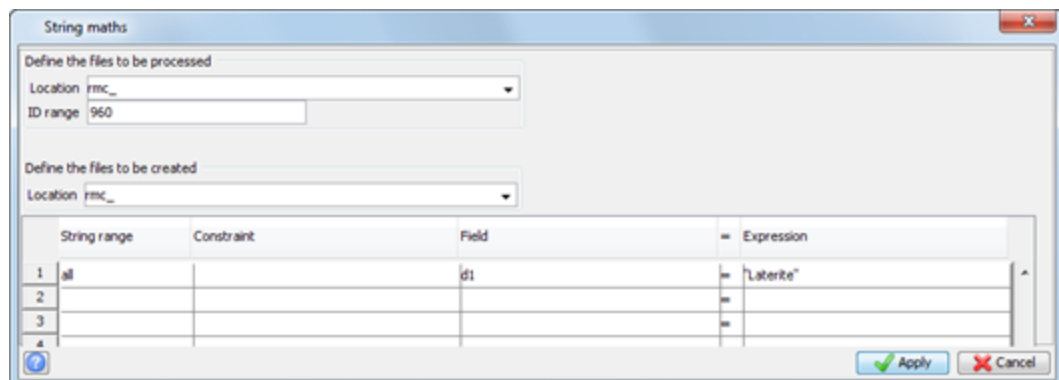
Note: **No. of rows** is the number of rows that will be connected together to fire on the same time delay.

- Click **Apply**.

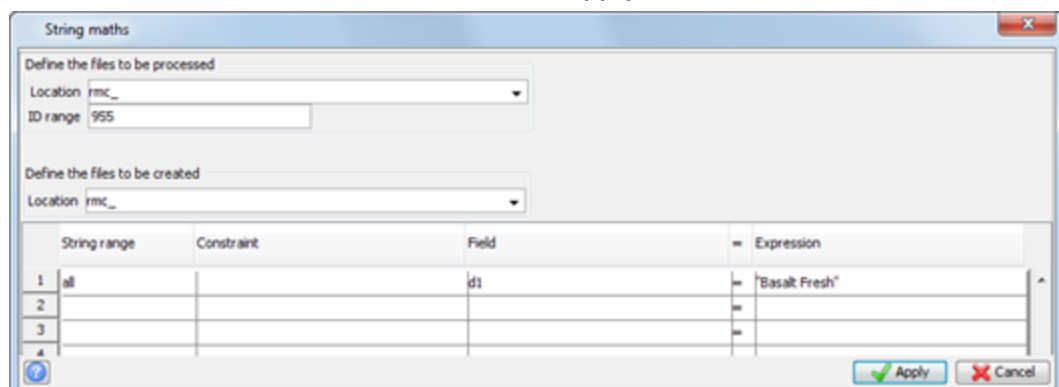
Task: Modify rock mass classification (RMC) polygons

Next, you will use string maths to modify some string polygon files. The files must be modified so that you can use the **Modify burden and spacing by polygon** option when designing your blast pattern.

- Choose **File tools > String maths**.
- Enter the information as shown, and click **Apply**.




- Choose **File tools > String maths**.
- Enter the information as shown, and then click **Apply**.

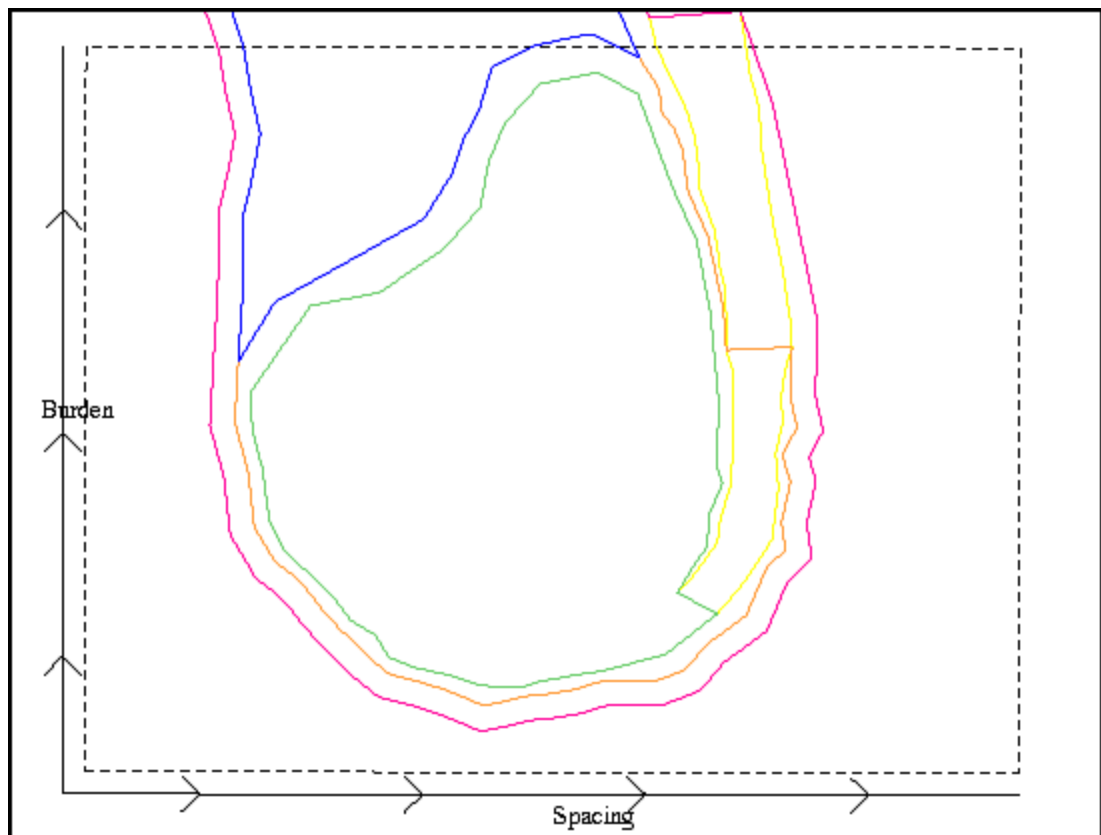


- ✎ **Note:** The data entered is case sensitive.
- ✎ **Note:** To see all of the steps performed in this chapter, run **01_data_setup.tcl** . You need to click **Apply** on any forms presented.

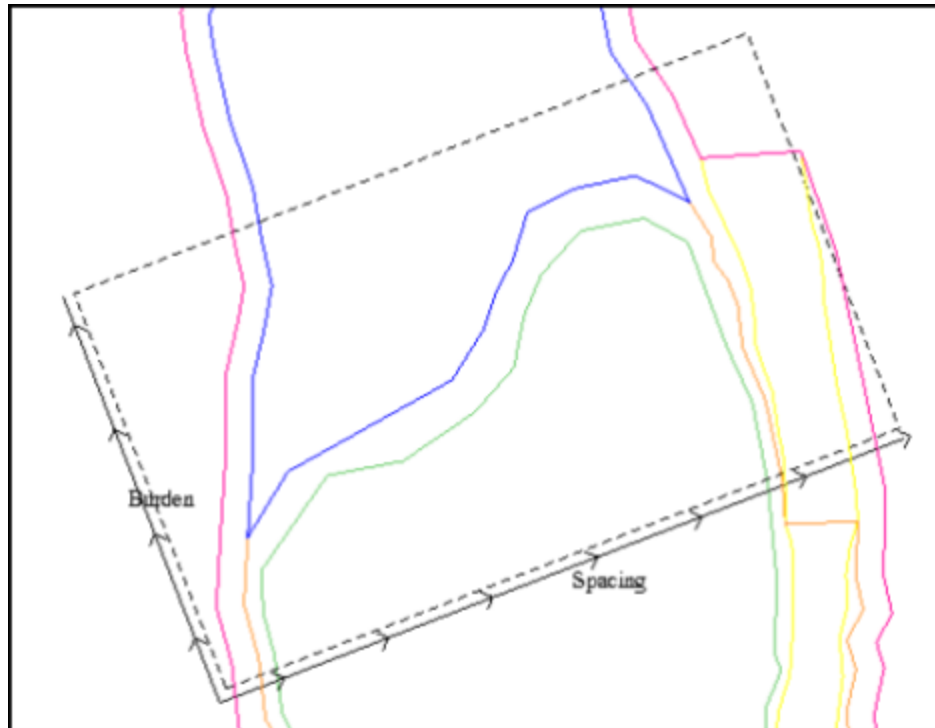
Designing blast patterns using RMC polygons

Task: Design a blast pattern using auto spacing and burden from polygons

1. Open **bench960_950.str** in **Graphics**.
2. Open **rmc_960.str** in **Graphics**.
 **Note:** The polygon file must be in the active layer to use the auto spacing and burden from polygons option. This is why you open the polygon file into **Graphics** last.
You will design a blast pattern for the upper bench in the pit pickup, and align it with one section of the “free face”.
3. Choose **Blast Design > Create blast pattern**.
You are prompted to "**Select area for blasting holes**". In this case, you will select an area larger than you wish to blast and then trim the blast.
4. Click and drag an area similar to that shown.



5. Hold CTRL and left-click and drag to rotate the selected area as shown.
6. Click and drag to move the selected area as shown.
7. The blast pattern is aligned with the longest section of the free face.



8. Press F2.
The *Blast pattern design* form is displayed.
9. On the **Pattern settings** tab, enter the information as shown.

Blast pattern design

Pattern settings | **Hole settings**

Blasting grid

Origin
 X: 105.442
 Y: 588.038

Grid height: 154.057
 Grid width: 288.106
 Grid angle: -31.442

Blast settings

Pattern identifier: BP1
 Drill rig: Rig-1
 Blasting method: row by row
 Ground water level: 0

Burden and spacing

Modify burden and spacing by polygon

Burden/spacing by polygon
 Rock classification attribute: D1


	Rock name	Burden	Spacing	Subdrill
1	Laterite	6	5	2.2
2	Lumpy Lat...	2	1.8	2.1
3	Clay	1.5	2	1
4	MNCL	4	3	1.26

Blast layout

Staggered
 Rectangular

Hole order

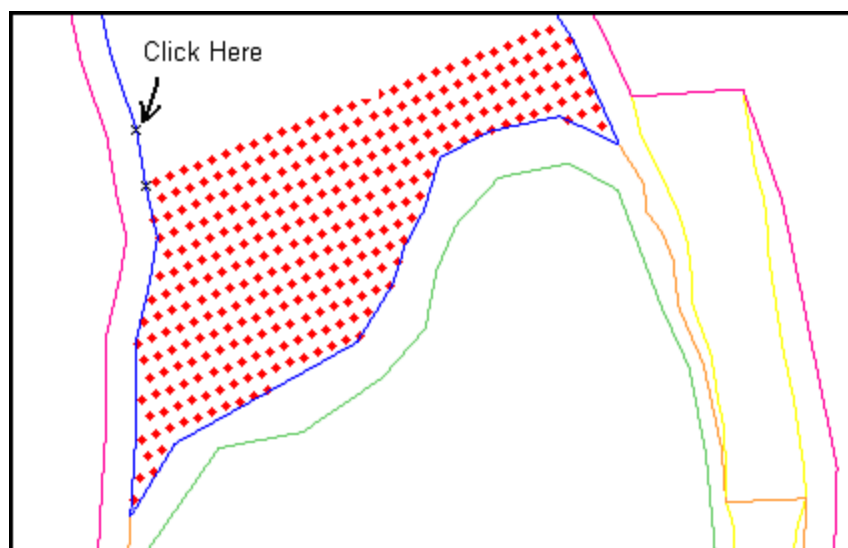
Regular
 Zig-Zag

 **Note:** The coordinates of the Blasting Grid **Origin**, **Grid height**, **Grid width**, and **Grid angle** will be different for you, but should be of similar magnitude.

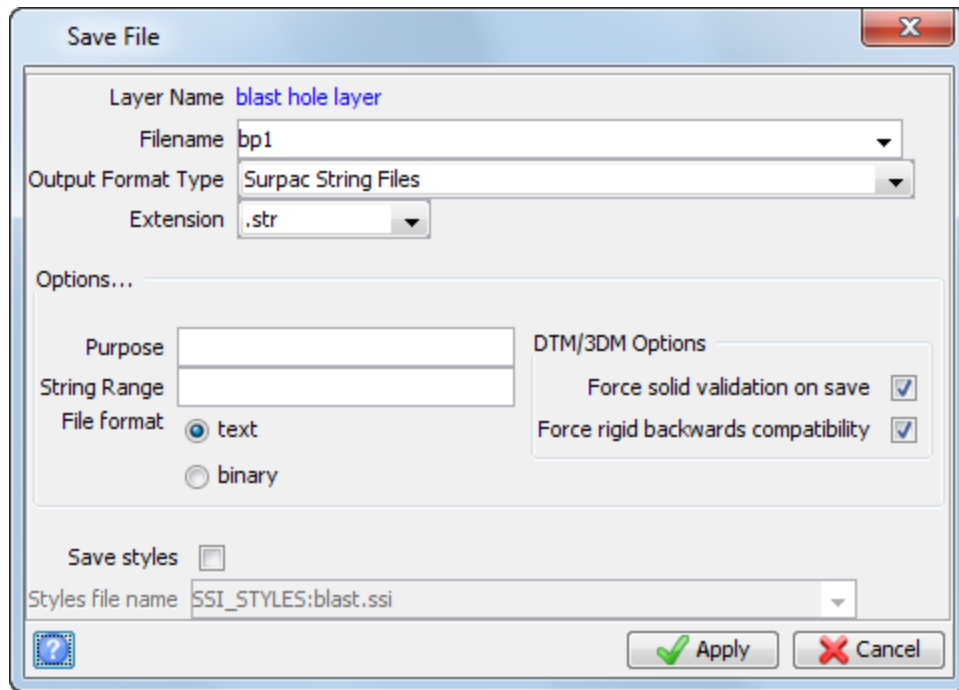
10. Click the **Hole Settings** tab.
11. Enter the information as shown, and click **Apply**.

A blast pattern is generated.

12. Choose **Delete > Outside boundary**.
A prompt is displayed stating **Select a closed segment**.
13. Click any point on the top bench outline.
The trimmed blast pattern is displayed.



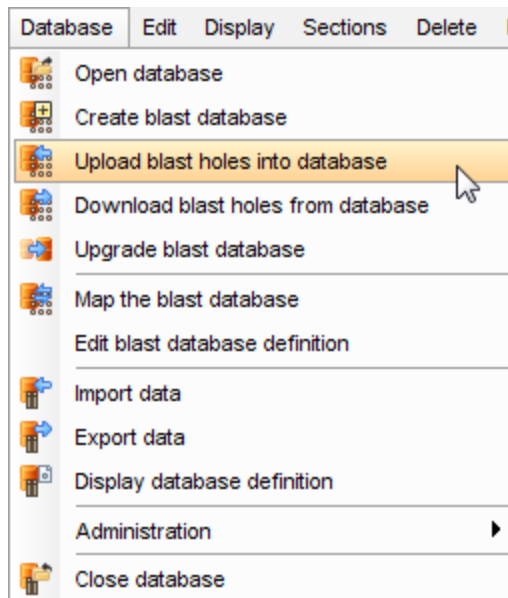
14. Press ESC.
15. Choose **File > Save > string/DTM**.
16. Enter the information as shown, and click **Apply**.



Note: After loading a blast pattern to the database, the string layer is deleted and holes from the database displayed. This is to avoid having two copies of the blast pattern in graphics at the same time, because if two layers were open they could contain conflicting information and cause an error. You do not have to save the string file, because you can download a pattern from a blast database back into string file format.

17. Choose **Database > Upload blast holes into database.**

Note: Make sure you are using the **blastdesign Database** menu as shown, and *not* the one from the **Geological Database** menu.



18. Enter the information as shown, and click **Apply**.

The screenshot shows a dialog box titled "Select database". It has a close button (X) in the top right corner. Below the title bar is a text field labeled "Database Name" containing the text "blast_tutorial". At the bottom left is a help icon (question mark in a square). At the bottom right are two buttons: "Apply" with a green checkmark icon and "Cancel" with a red X icon.

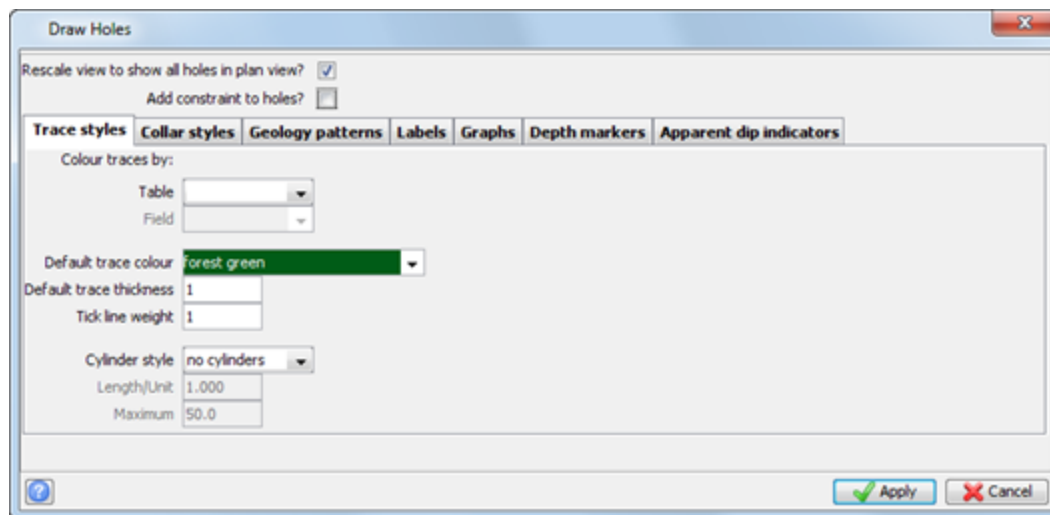
19. Enter the information as shown, and click **Apply**.

The screenshot shows a complex dialog box titled "Load blast holes to database". It has a close button (X) in the top right corner. The main area is divided into two columns. The left column is titled "Duplicate holes in database" and contains a table with 4 rows: 1 | 1000(BP1), 2 | 1001(BP1), 3 | 1002(BP1), 4 | 1003(BP1). Below this table is a checkbox labeled "Overwrite with new blast holes" which is checked. The right column is titled "Extra holes in database" and contains a table with 4 rows: 1 | 10(BP1), 2 | 100(BP1), 3 | 101(BP1), 4 | 102(BP1). Below this table is a checkbox labeled "Delete holes from database" which is checked. Below these columns are two tabs: "Charging Data" (selected) and "Sample Data". Under "Charging Data", there is a checkbox "Load charging data" which is unchecked, and a dropdown menu "Table name" set to "charge". At the bottom of the dialog is a section "Database Load Report" with a dropdown "Report file name" set to "bp1" and another dropdown "Format" set to ".not - Surpac Note File". At the very bottom are a help icon (question mark in a square) and two buttons: "Apply" with a green checkmark icon and "Cancel" with a red X icon.

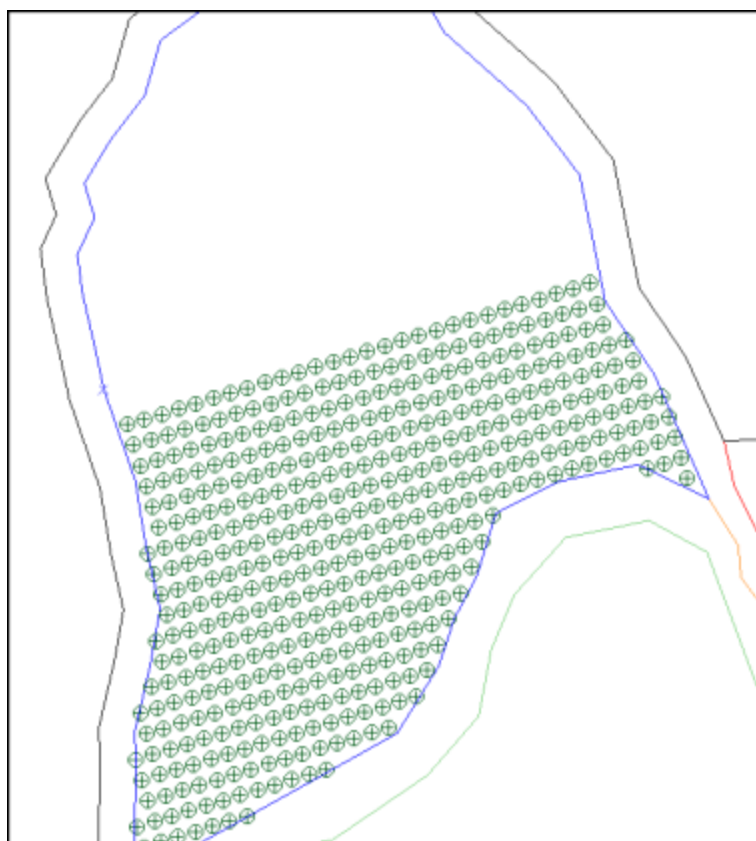
Note: There are two panels at the top of this form, **Duplicate holes in database** and **Extra holes in database**. These two panels warn you when a blast pattern with the same identification already exists in the blast database, and gives you the option of what to do. There are two situations where you would have a duplicate blast pattern.

- When you mistakenly type in a duplicate **Pattern Identifier** on the **Blast Pattern Design** form. In this case, you should cancel the **Load Blast Holes to Database** form and edit the **Pattern Identifier** before continuing the **Load Blast Holes to Database** operation.
- When you have modified an existing pattern and now want to overwrite the original pattern stored in the blast database with new information.


20. Enter the information as shown, and click **Apply**.

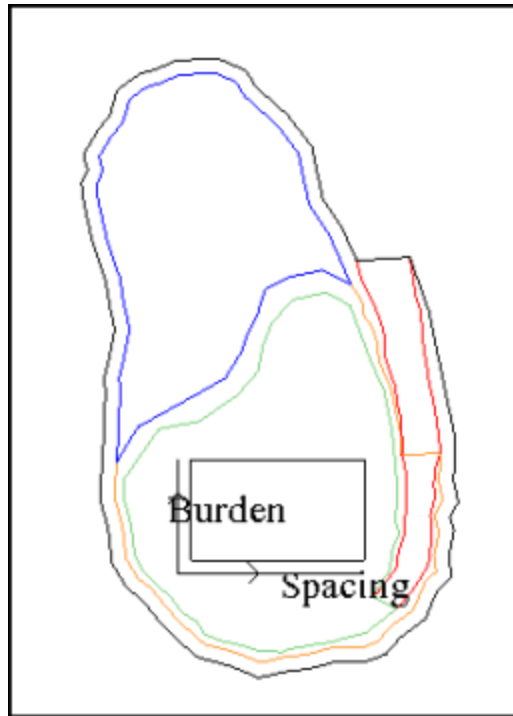


The drillholes are displayed.



Task: Design a blast pattern with east/west orientation

1. Click **Reset graphics**  .
2. Open **bench960_950.str** in **Graphics**.
3. Open **rnc_955.str** in **Graphics**.
4. Choose **Blast design > Create blast pattern**.
A prompt is displayed stating **Select area for blasting holes**.
5. Create an area similar to that shown.



6. Press F2.
7. On the **Pattern settings** tab, enter the information as shown.

Blast pattern design

Pattern settings | **Hole settings**

Blasting grid

Origin
 X: 181.77
 Y: 634.06

Grid height: 70.426
 Grid width: 90.327
 Grid angle: 0

Blast settings

Pattern identifier: BP2
 Drill rig: Rig-1
 Blasting method: row by row
 Ground water level: 0

Burden and spacing

Modify burden and spacing by polygon

Burden/spacing by polygon
 Rock classification attribute: D1

	Rock name	Burden	Spacing	Subdrill
1	Laterite	6	5	2.2
2	Lumpy Lat...	2	1.8	2.1
3	Clay	1.5	2	1
4	MNCL	4	3	1.26

Blast layout

Staggered
 Rectangular

Hole order

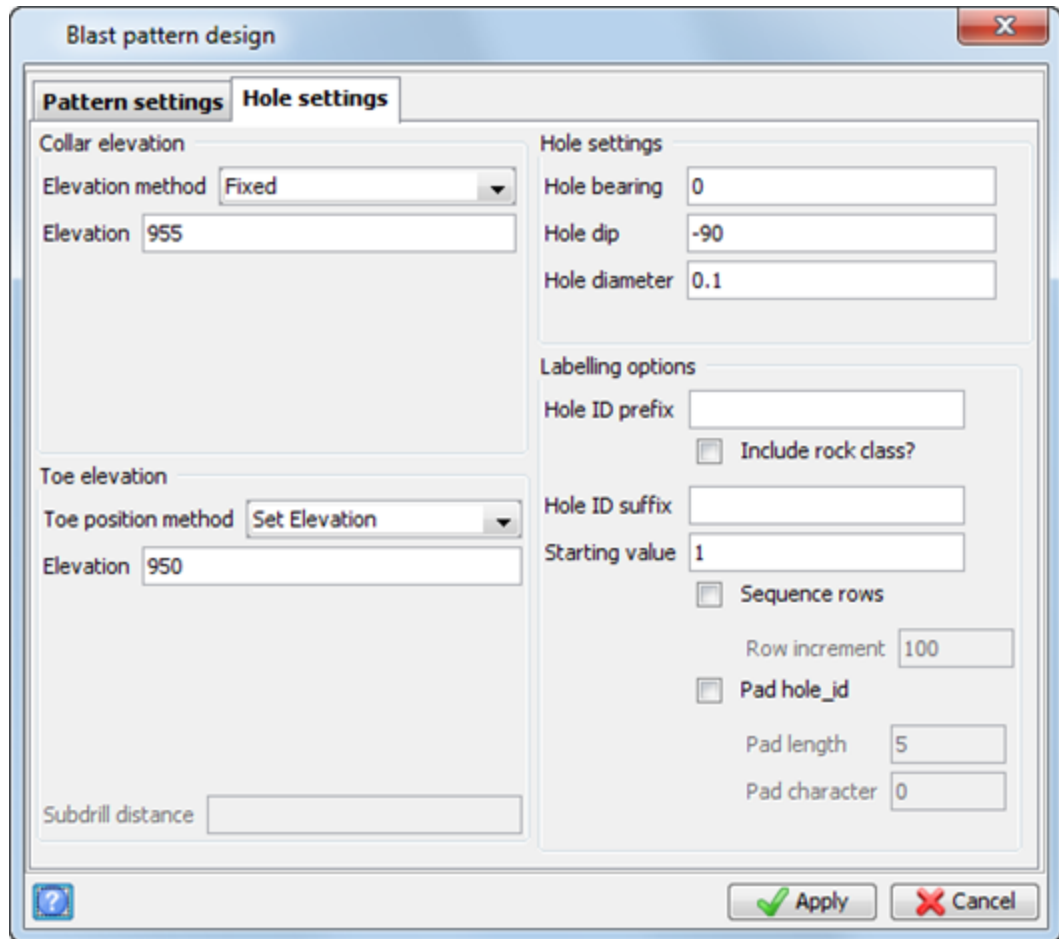
Regular
 Zig-Zag

Apply Cancel

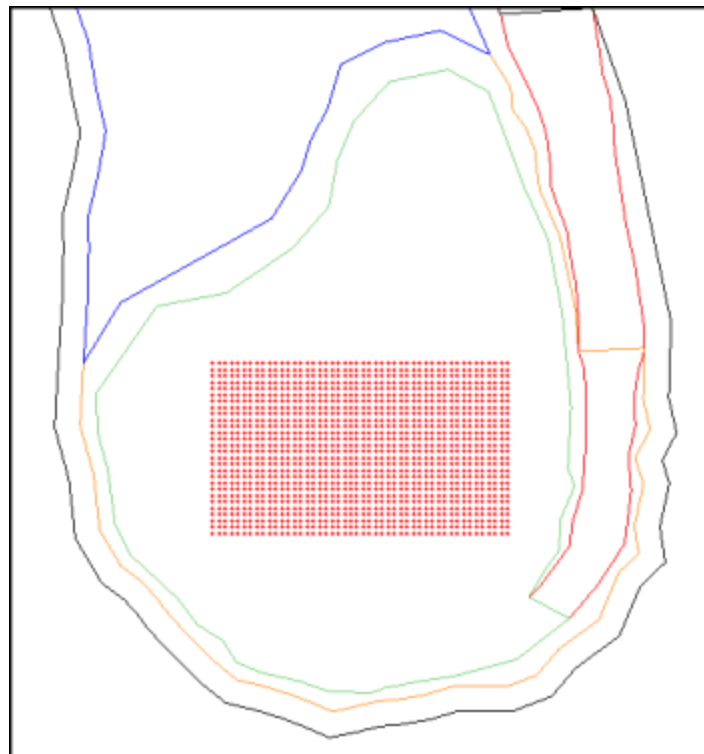
Note: The coordinates of the Blasting Grid **Origin**, **Grid height**, **Grid width**, and **Grid angle** will be different for you, but should be of similar magnitude.

- Click the **Hole settings** tab.


9. Enter the information as shown, and click **Apply**.

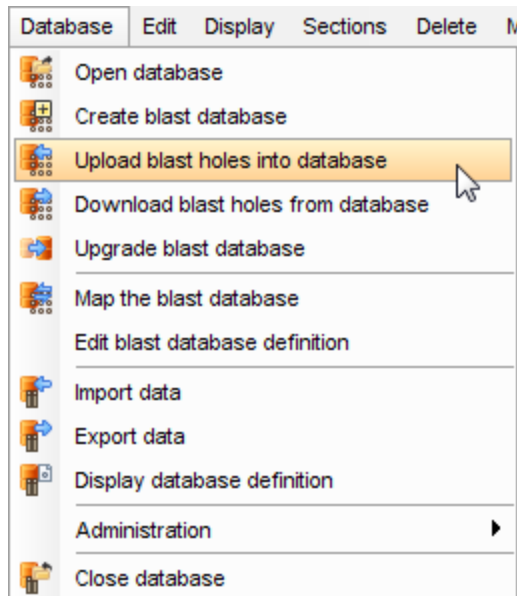


The blast pattern is displayed.

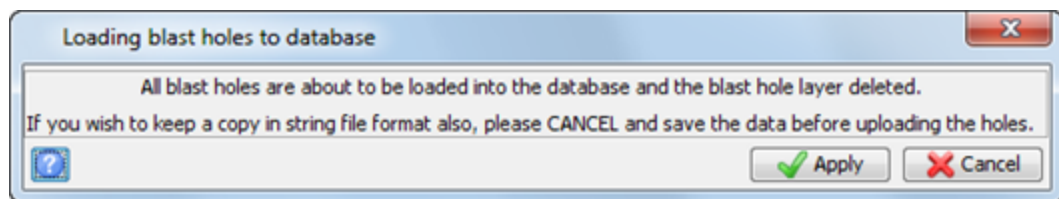


10. Choose **Database > Upload blast holes into database**.

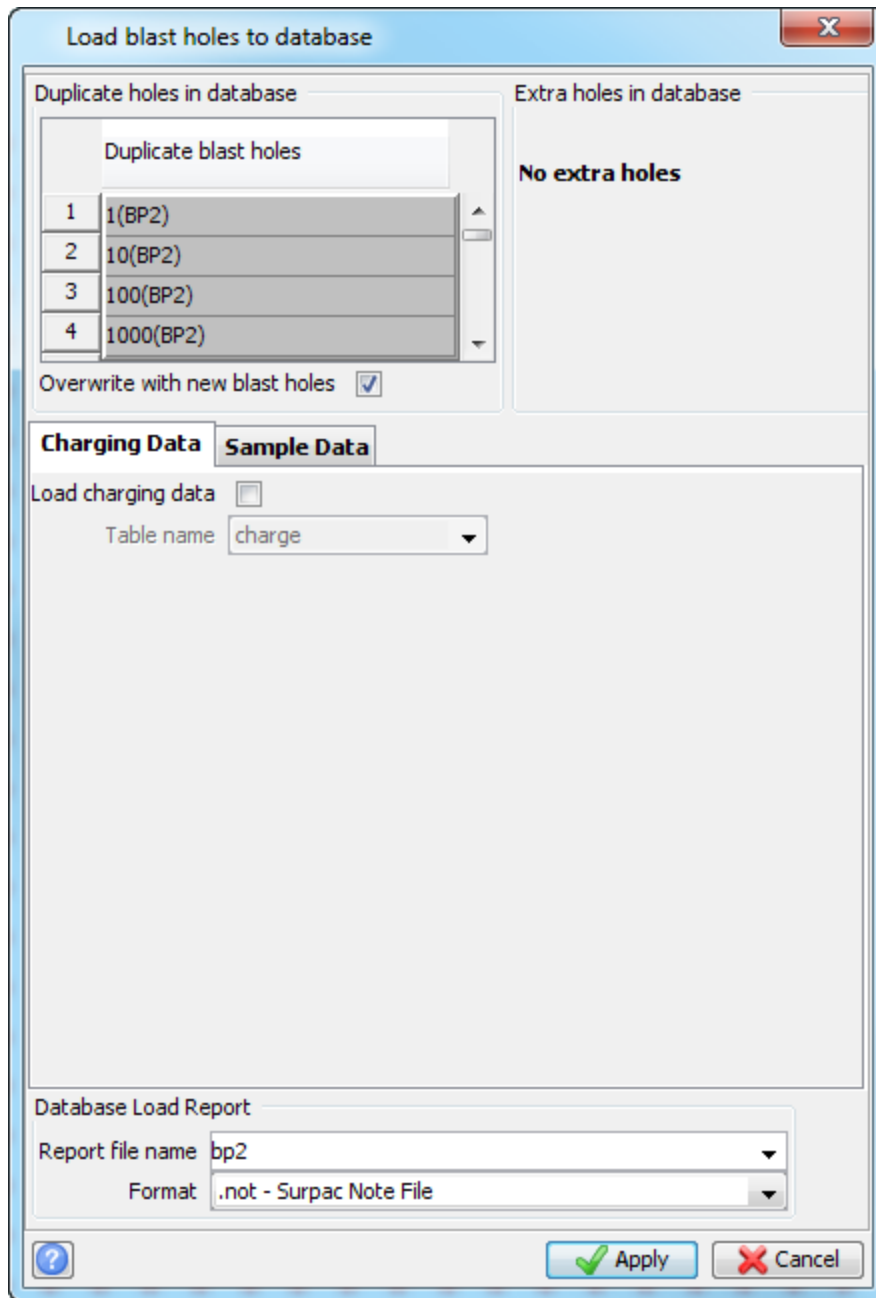
 **Note:** Make sure you are using the blastdesign Database menu as shown, and *not* the one from the Geological Database menu.



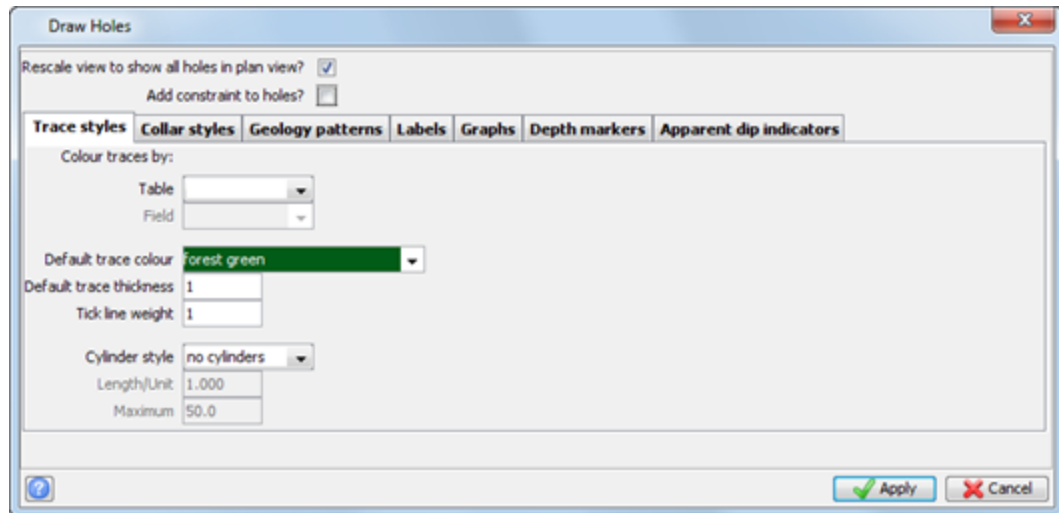
11. Click **Apply**.



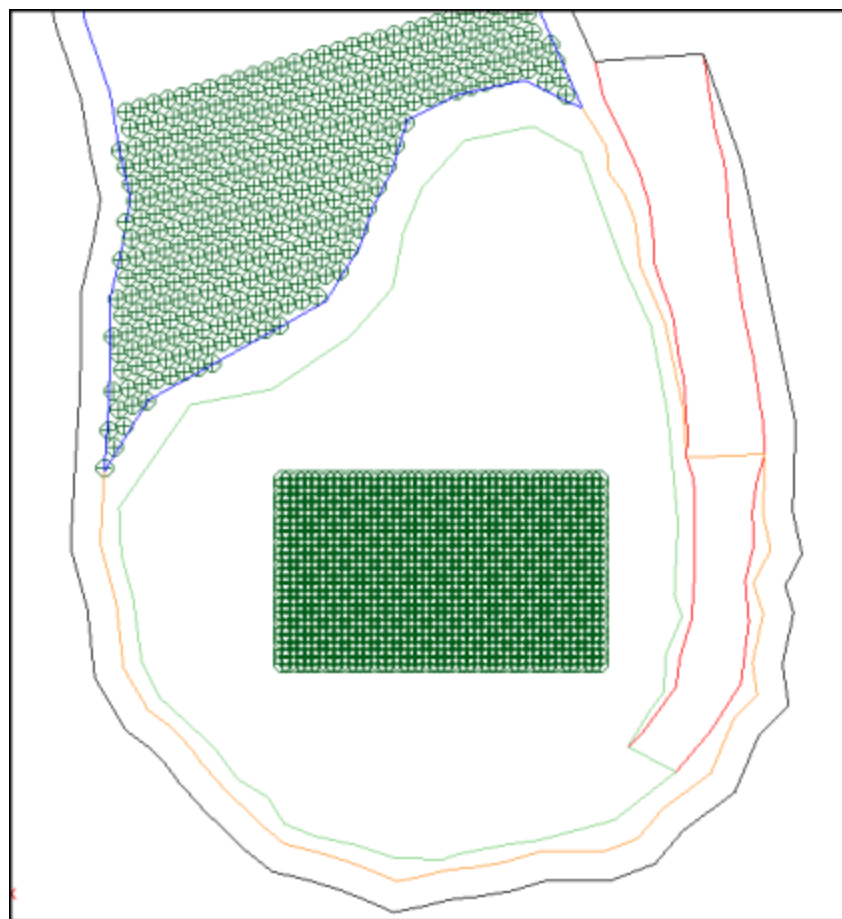
12. Enter the information as shown, and click **Apply**.




13. Click **Apply** on the **Draw Holes** form.



The drillholes are displayed.

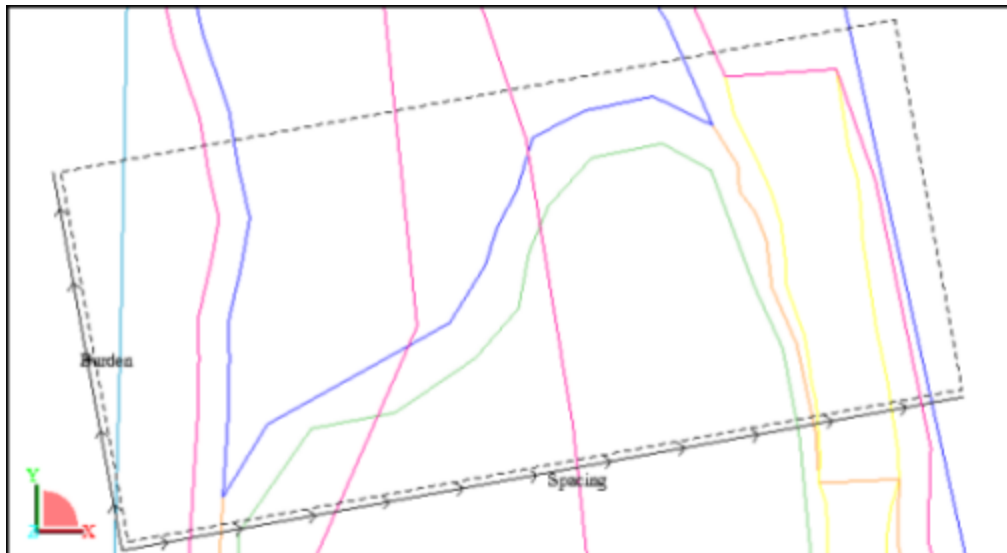


 **Note:** Because you did not apply any constraints, all holes in the database are displayed, including bp1.

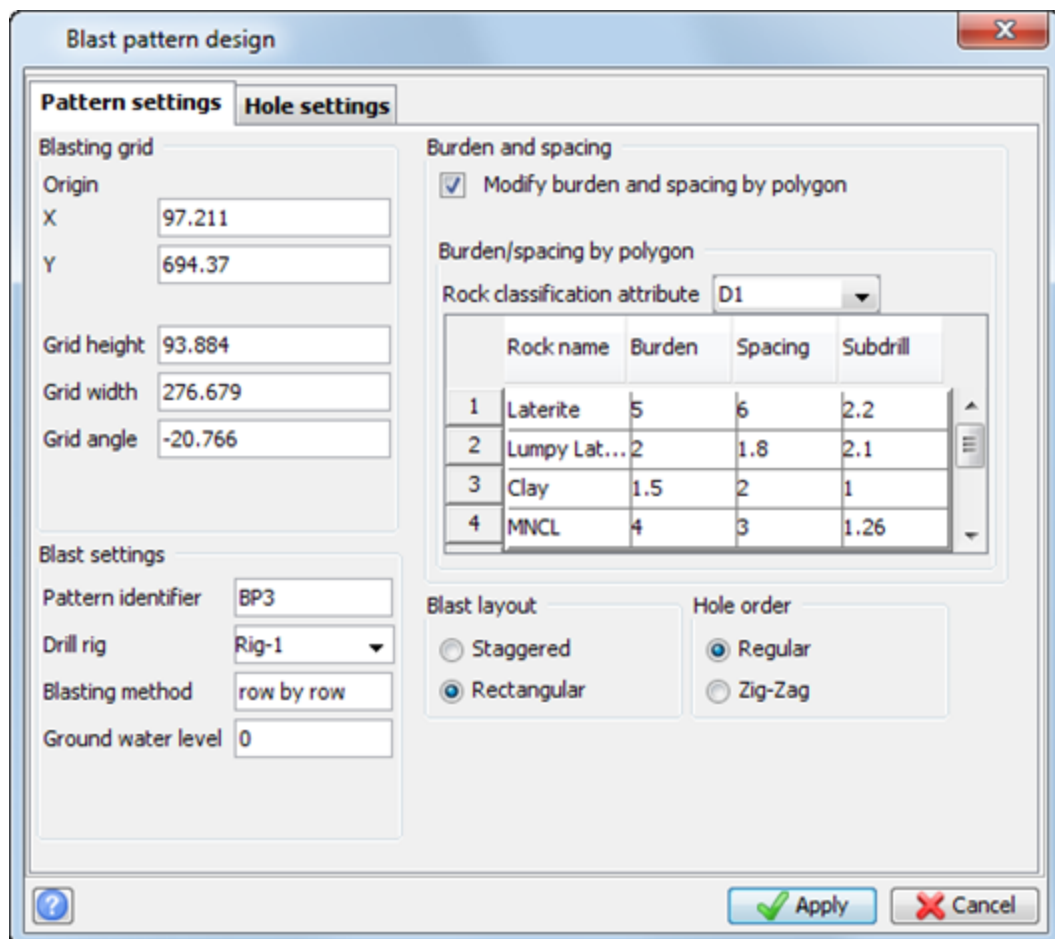
Task: Design a blast pattern with more than one burden and spacing


1. Click **Reset graphics** .
2. Open **bench960_950.str** in **Graphics**.

3. Open **multiple_rmc_zones.str** in **Graphics**.
4. Choose **Blast design > Create blast pattern**.
A prompt is displayed stating **Select area for blasting holes**.
5. Create an area similar to that shown.

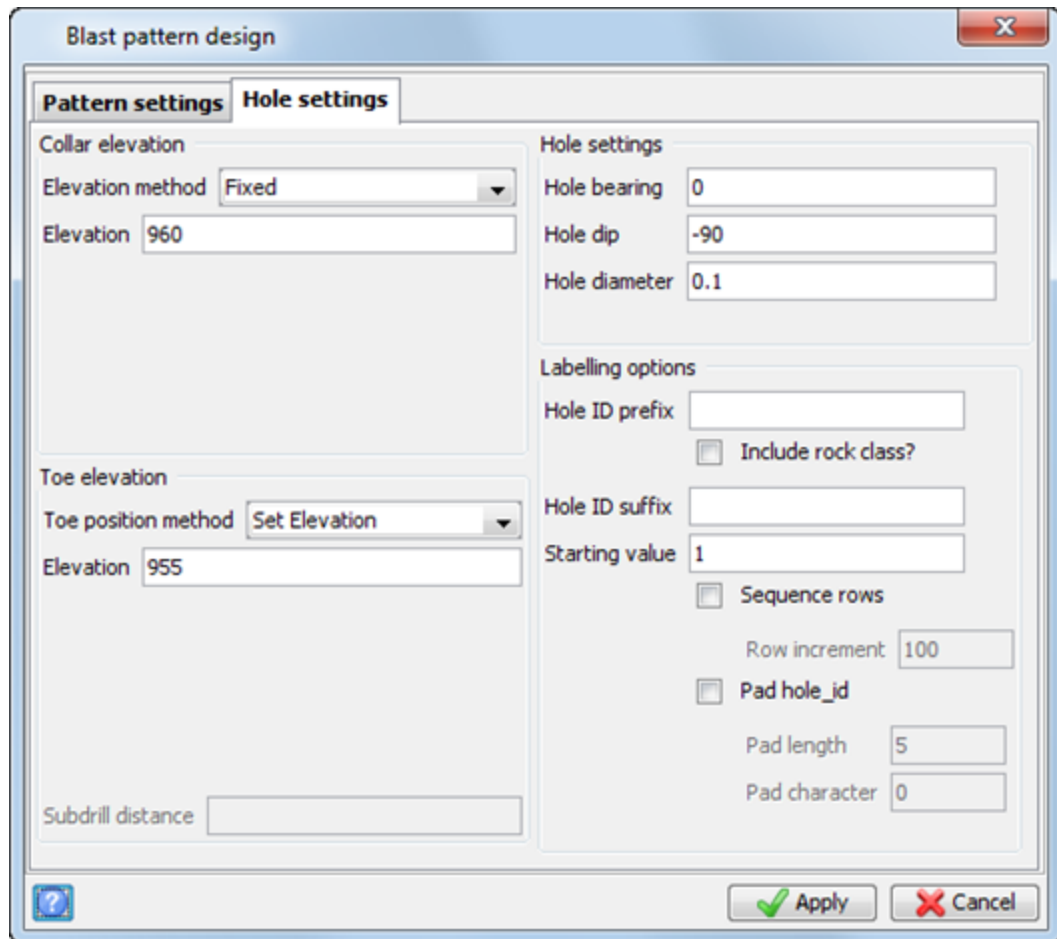


6. Press F2.
7. On the **Pattern settings** tab, enter the information as shown.



 **Note:** The coordinates of the Blasting Grid **Origin**, **Grid height**, **Grid width**, and **Grid angle** will be different, but should be of similar magnitude.

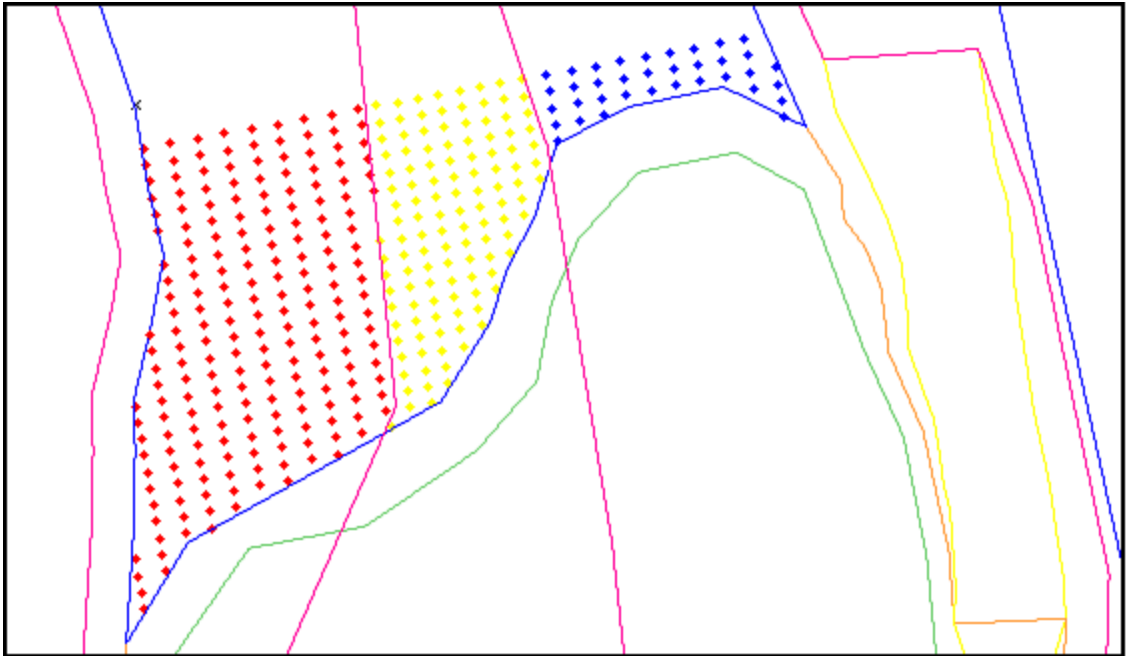
8. Click the **Hole settings** tab.
9. Enter the information as shown, and click **Apply**.




The screenshot shows the 'Blast pattern design' dialog box with the 'Hole settings' tab selected. The dialog is divided into two main sections: 'Collar elevation' and 'Toe elevation' on the left, and 'Hole settings' and 'Labelling options' on the right. At the bottom, there are 'Apply' and 'Cancel' buttons.

Section	Field	Value
Collar elevation	Elevation method	Fixed
	Elevation	960
Toe elevation	Toe position method	Set Elevation
	Elevation	955
Hole settings	Hole bearing	0
	Hole dip	-90
	Hole diameter	0.1
Labelling options	Hole ID prefix	
	<input type="checkbox"/> Include rock class?	
	Hole ID suffix	
	Starting value	1
	<input type="checkbox"/> Sequence rows	
	Row increment	100
	<input type="checkbox"/> Pad hole_id	
Pad length	5	
Pad character	0	
Subdrill distance		

10. Choose **Delete > Outside boundary**.
A prompt is displayed stating **Select a closed segment**.
11. Click any point on the top bench outline.
The blast zones are displayed:



 **Note:** You will need to edit some holes at the contact zone between different RMC areas, because the burden and spacing conditions cannot be met in all cases at these locations.

12. Press ESC.
13. Choose **Blast Design > Renumber holes.**
14. Enter the information as shown, and then click **Apply.**

Renumber holes

Single Holes

Renumber Hole Groups

All Holes

Hole ID Prefix

Hole ID Suffix


Starting Value

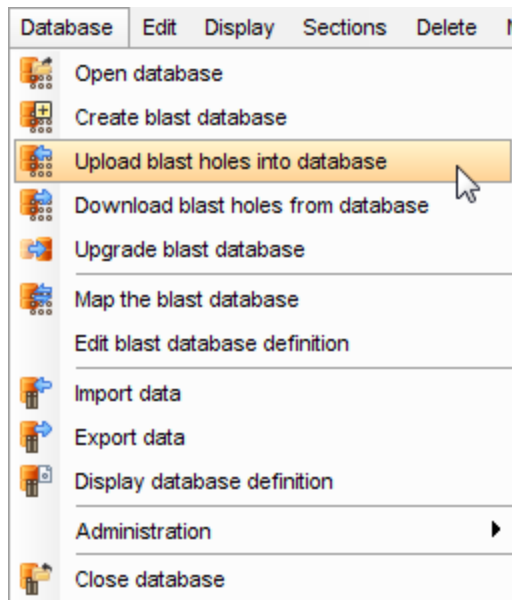
Pad Hole_Id

Pad Length

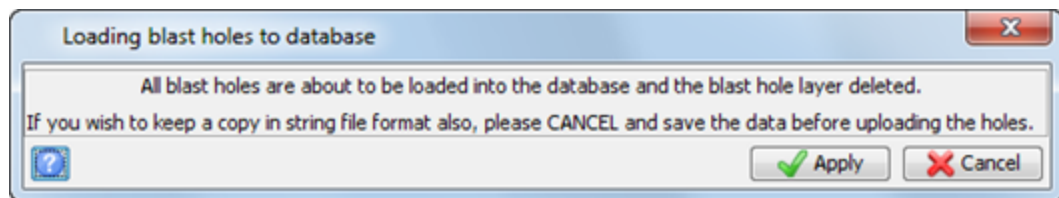
Pad Character

15. Choose **Database > Upload blast holes into database.**

 **Note:** Make sure you are using the blastdesign Database menu as shown, and *not* the one from the Geological Database menu.



16. Click **Apply**.



17. Enter the information as shown, and click **Apply**.

Load blast holes to database

Duplicate holes in database: No duplicates

Extra holes in database: No extra holes

Charging Data | Sample Data

Load charging data

Table name: charge

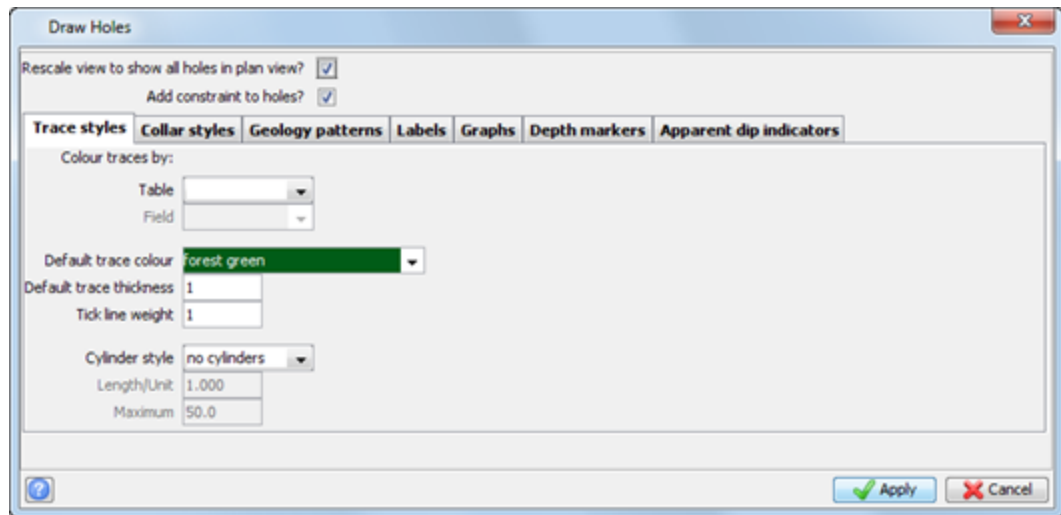
Database Load Report

Report file name: bp3

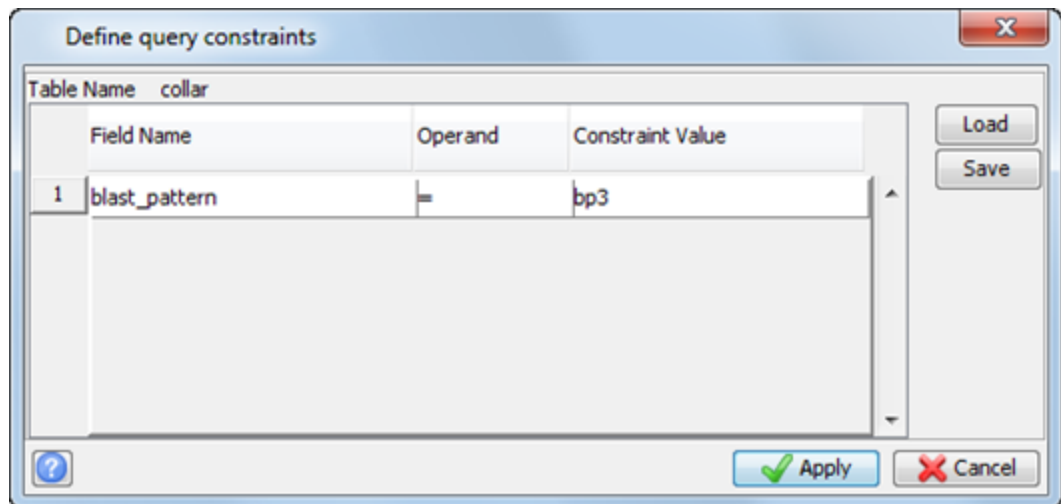
Format: .not - Surpac Note File

Apply Cancel

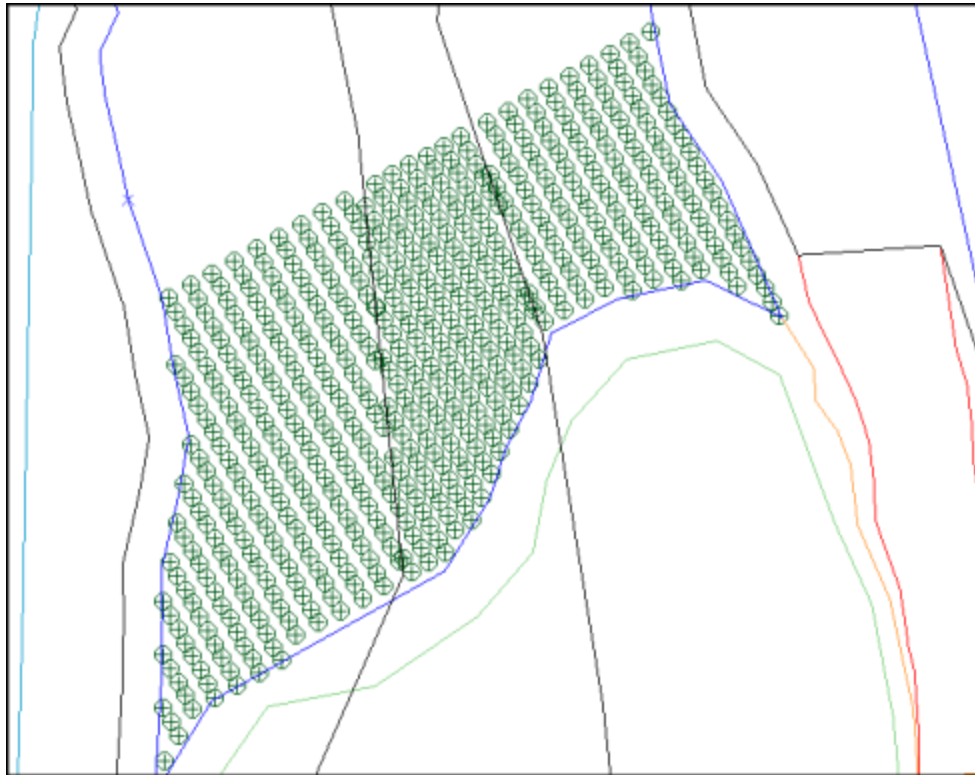
18. Click **Apply** on the **Draw Holes** form.




19. Enter the information as shown, and click **Apply**.



The drillholes are displayed.

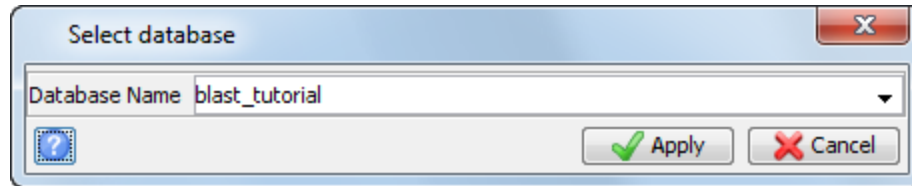


 **Note:** To see all of the steps performed in this section, run `02_auto_rmc_patterns.tcl` . You need to click **Apply** on any forms presented.

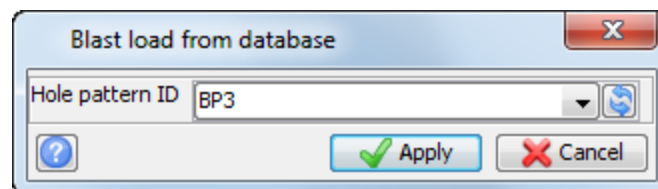
Load and tie in a firing pattern

Task: Unload a blast pattern from the blast database

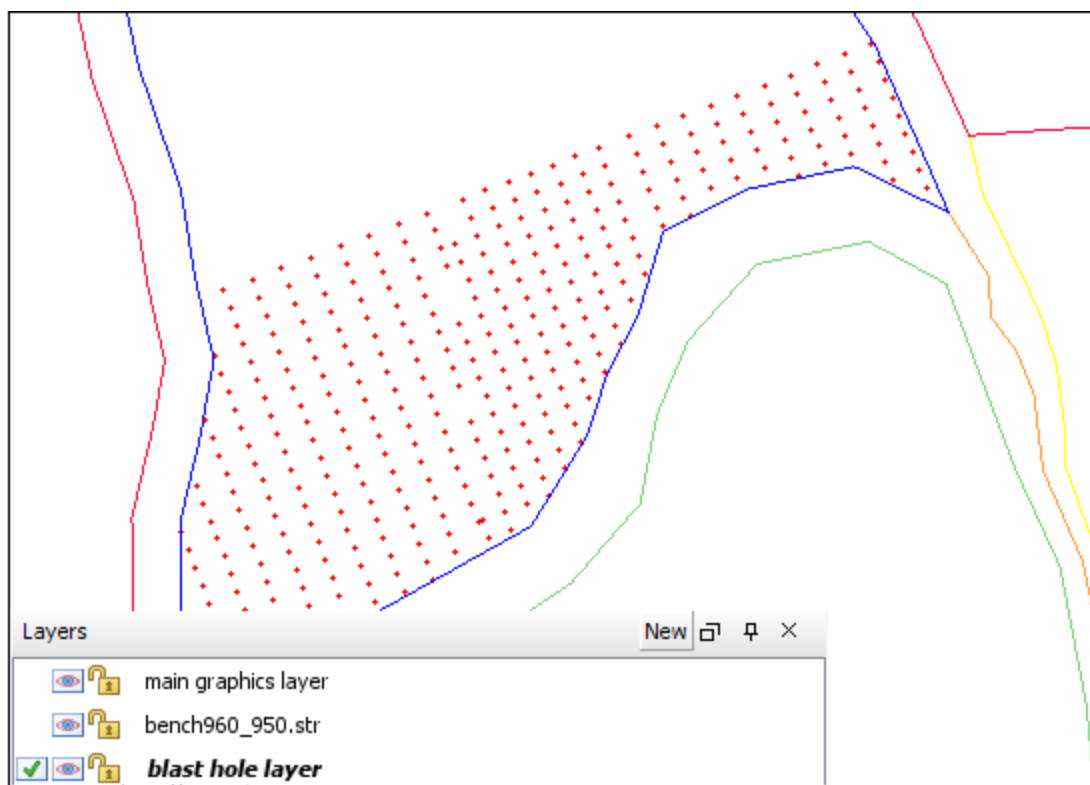
1. Click **Reset graphics** .
2. Open **bench960_950.str** in **Graphics**.
3. Choose **Database > Download blast holes from database**.
4. Enter the information as shown, and click **Apply**.



5. Enter the information as shown, and click **Apply**.

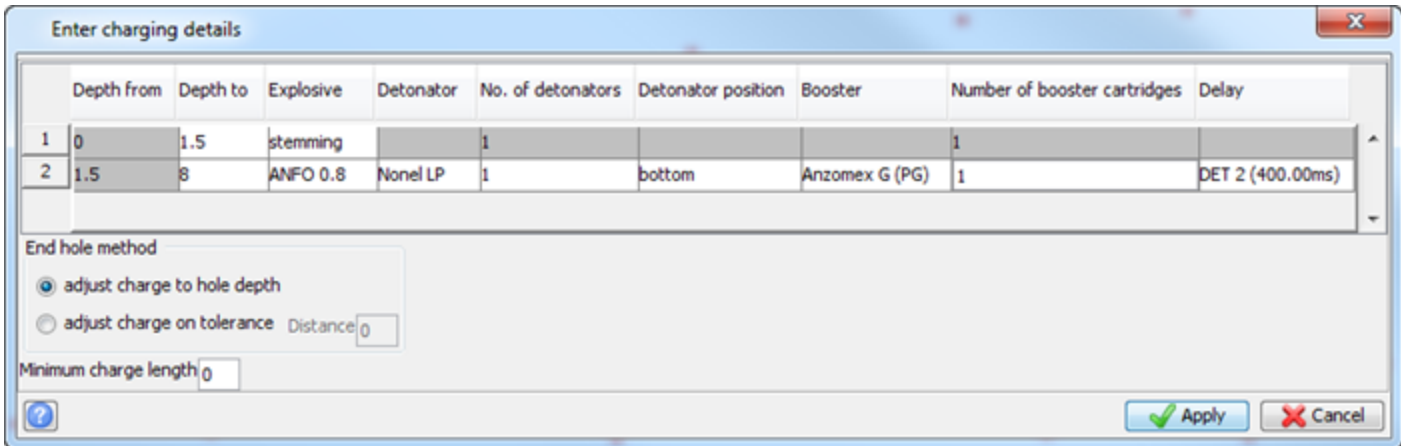


The blast hole layer is displayed:

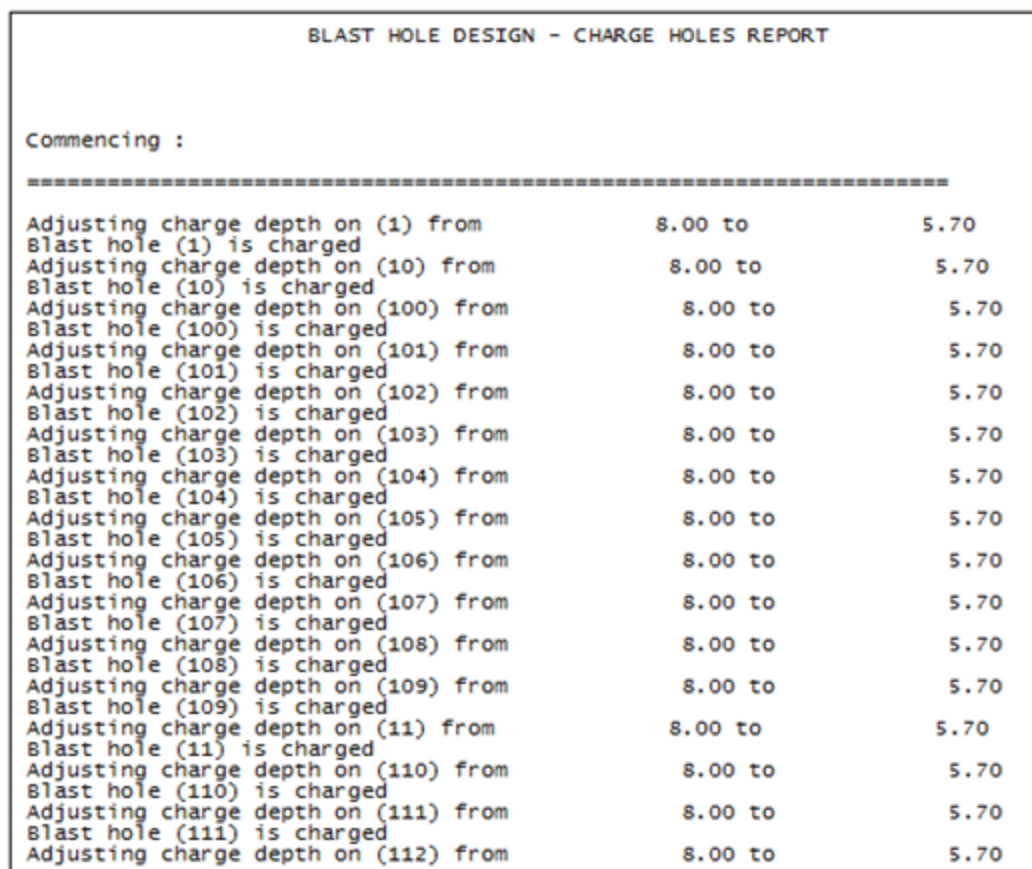


Task: Charge all holes

1. Choose **Charge > All holes**.
2. Enter the information as shown, and click **Apply**.



The charge holes report is displayed:

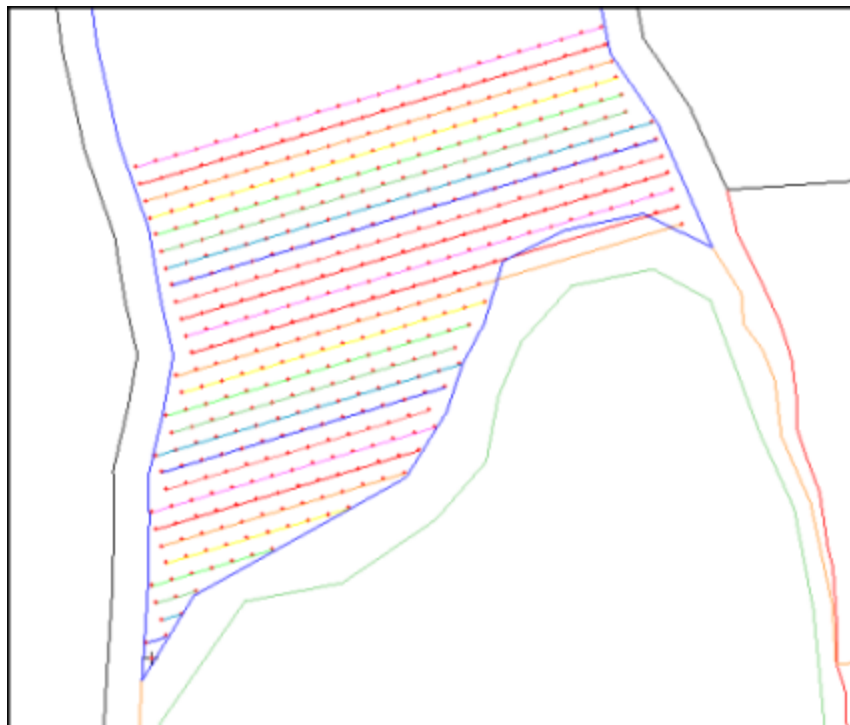


3. Close **charging.log**.

Task: Tie in a diagonal firing pattern

1. Choose **Firing sequence > Generate firing sequence**.
2. Enter the information as shown, and click **Apply**.

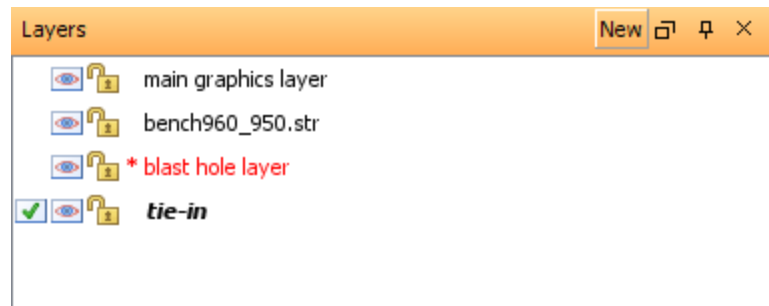
3. Click and drag over the first row of the pattern to identify the tie in. The blast holes are displayed.



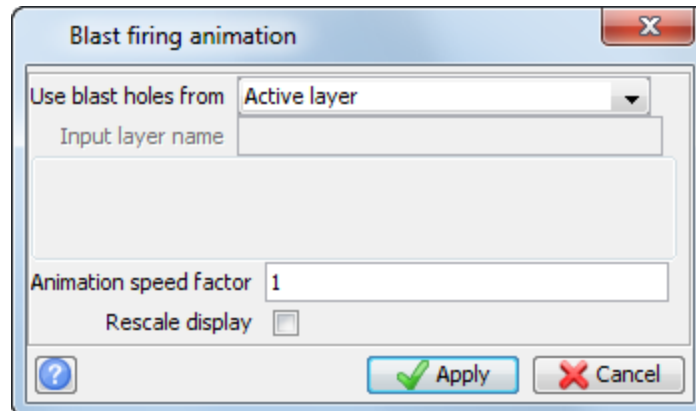
The tie in delay information is written into the description fields of each of the blast holes, which allows you to save and upload the information to the blast database.

The tie in lines have been created in the new layer, in this case called **tie_in**. If you want to keep a copy of this data for visualisation or plotting, make **tie_in** the active layer and save the file. The data in this layer is not saved automatically when you upload the tie in information to the blast database.

4. In the **Layers** pane, right-click **tie-in** and choose **Make active**.



5. Choose **Firing sequence > Firing animation** to animate the blast.
6. Enter the information as shown, and click **Apply**.



The blast animation is displayed.

Task: Upload tie in pattern to the blast database

1. Choose **Database > Upload blast holes into database**.
2. Enter the information as shown, and click **Apply**.

Load blast holes to database

Duplicate holes in database

Duplicate blast holes	
1	1(BP3)
2	10(BP3)
3	100(BP3)
4	101(BP3)

Overwrite with new blast holes

Extra holes in database

No extra holes

Charging Data **Sample Data**

Load charging data

Table name

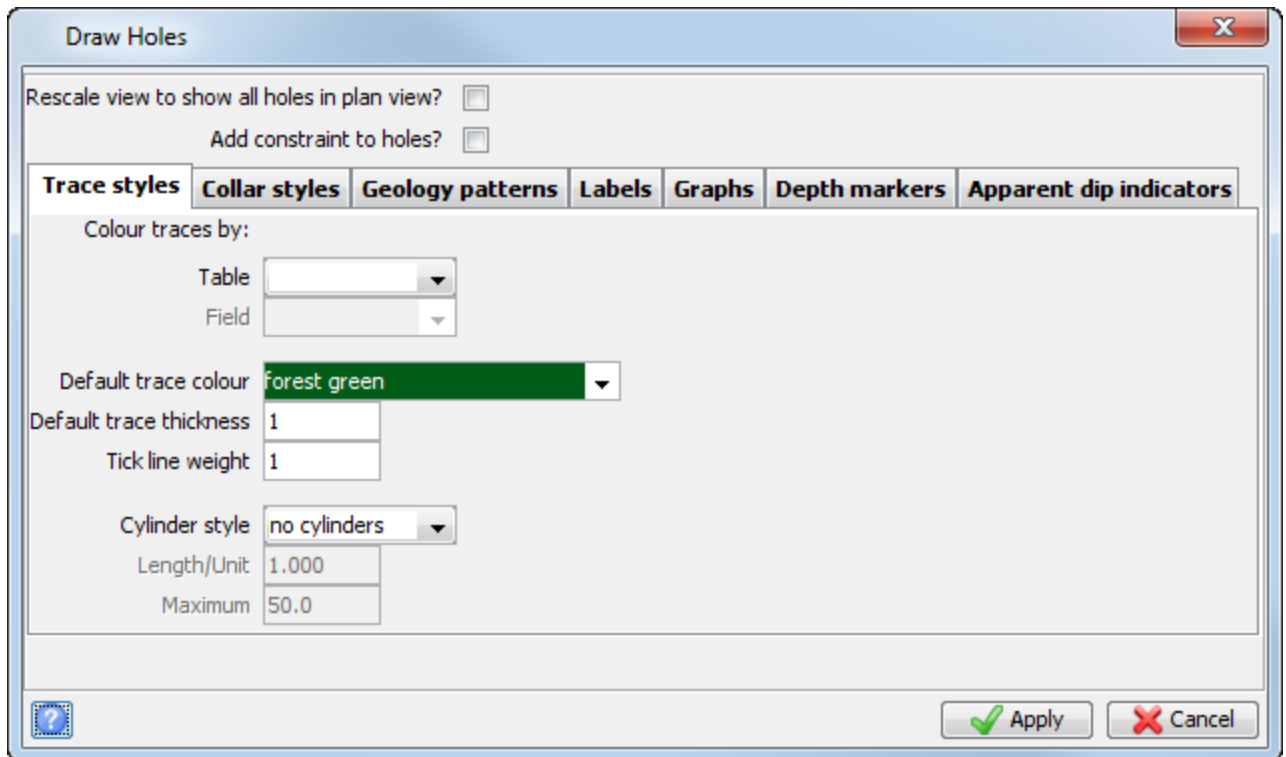
Database Load Report

Report file name

Format

Note: Make sure you select **Overwrite with new blast holes**, because you want to replace the original data with the new pattern, including the firing sequence information.


3. Enter the information as shown, and click **Apply**.

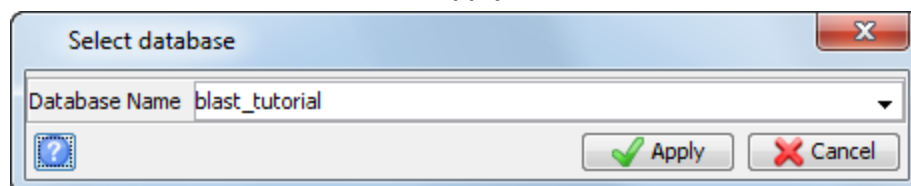


The firing sequence information is loaded to the blast database and the holes contained within the database are displayed in **Graphics**.

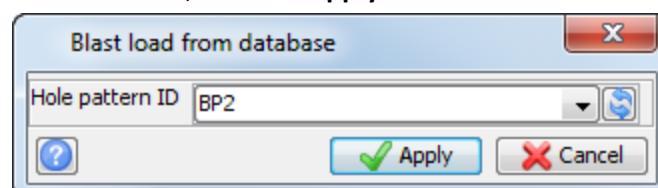
Note: To see all of the steps performed in this and the previous task, run macro **03a_load_&_tie_pattern1.tcl**. You need to click **Apply** on any forms presented.

Task: Tie in a V firing pattern

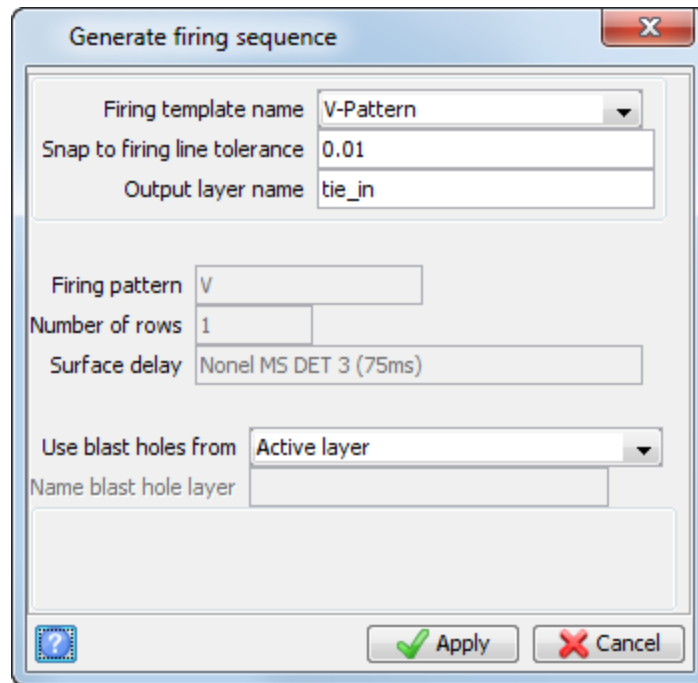
1. Click the **Reset graphics** icon .
2. Open **bench960_950.str**.
3. Choose **Database > Download blast holes from database**.
4. Enter the information as shown, and click **Apply**.



5. Enter the information as shown, and click **Apply**.



6. Choose **Firing sequence > Generate firing sequence**.
7. Enter the information as shown, and click **Apply**.



Generate firing sequence

Firing template name: V-Pattern

Snap to firing line tolerance: 0.01

Output layer name: tie_in

Firing pattern: V

Number of rows: 1

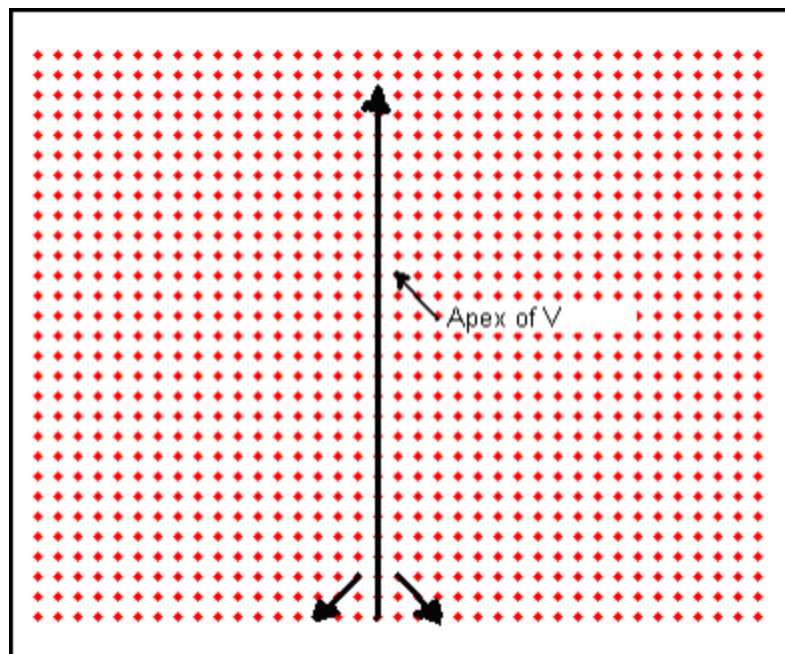
Surface delay: Nonel MS DET 3 (75ms)

Use blast holes from: Active layer

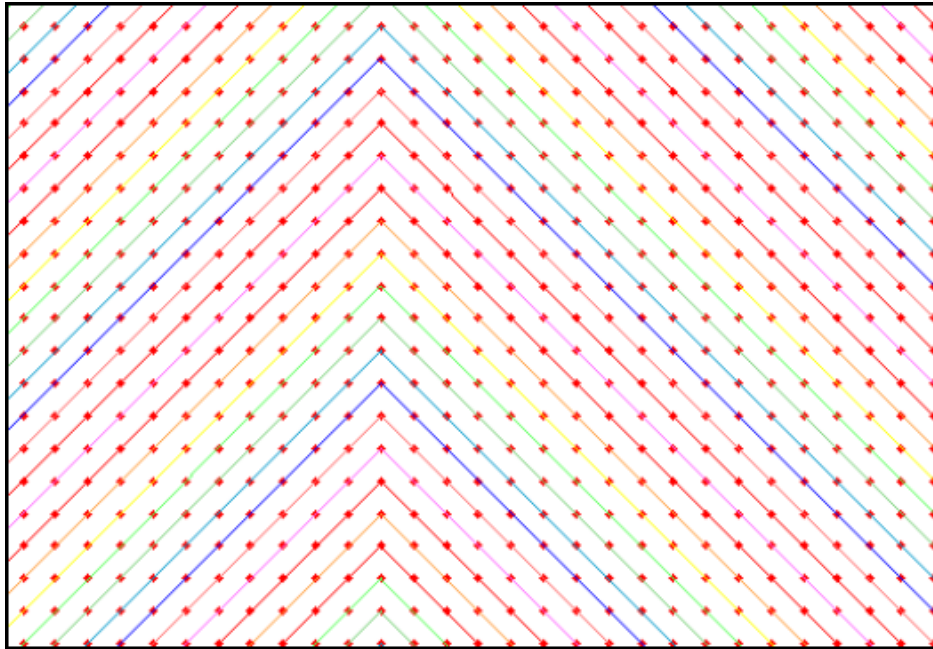
Name blast hole layer:

Apply Cancel

8. In response to the prompts, define the apex of the V pattern, and the two sides of the V, by clicking and dragging each line as shown.




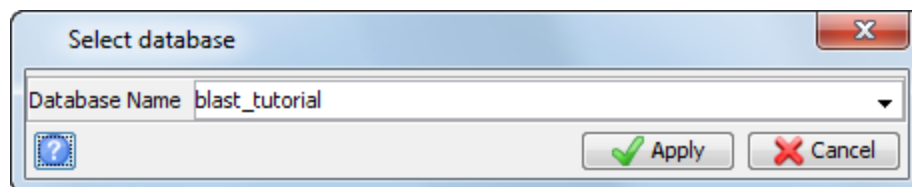
The "V" blast pattern is displayed.



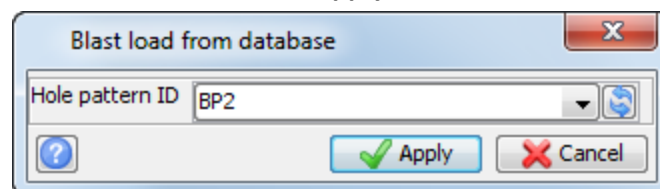
Note: To see all of the steps performed in this task, run macro **03b_v_pattern.tcl**. You need to click **Apply** on any forms presented.

Task: Tie in a customised firing pattern

1. Click the **Reset graphics** icon .
2. Open **bench960_950.str**.
3. Choose **Database > Download blast holes from database**.
4. Enter the information as shown, and click **Apply**.



5. Enter the information as shown, and then **Apply**.



6. Choose **Firing sequence > Customised firing sequence**.
7. Enter the information as shown, and click **Apply**.

Customised firing sequence

Output layer name

Use blast holes from

Name blast hole layer

Tie in line/row number

Inter row delay

Snap to firing line tolerance

Cumulative surface delay settings

Reset cumulative delay time

New cumulative delay time


The current cumulative surface delay time is

Blast hole selection method

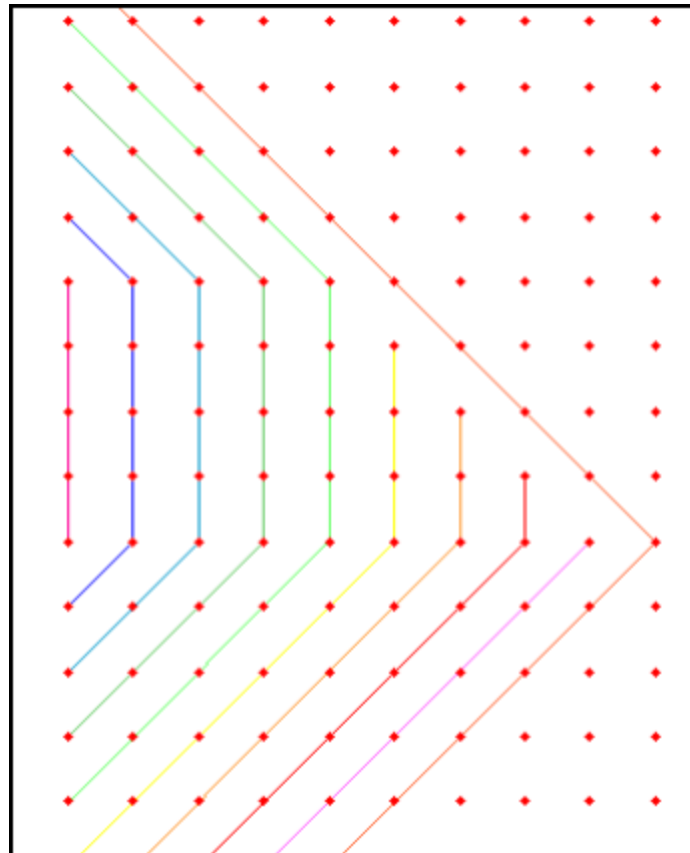
Select every blast hole collar


Snap to row ends

Snap to start, inflection and end points


 **Note:** For this example, no template has been used and you are able to tie in the holes in any order or pattern that you select.


8. Select holes to define the holes in the first row as shown.



 **Note:** The holes for each row are selected by clicking on the end points of the row, and then pressing ESC.

9. Choose **Firing sequence > Increment row number**.
10. Select the next row in the firing sequence by clicking on either the start point, any inflection points, or the end point.
11. Continue defining rows using the above process until you have completed all the rows as shown.

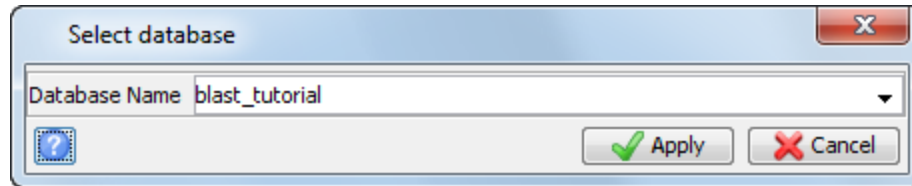
 **Note:** After you have finished a tie in row, press ESC. You will be prompted to start the next row. When you have completed all rows in the firing sequence, press ESC twice to finish.

 **Note:** To see all of the steps performed in this task, run macro **03c_custom_pattern.tcl**. You need to click **Apply** on any forms presented.

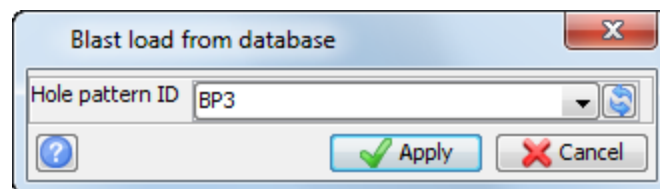
Creating a blast boundary and blast solid

Task: Unload a blast pattern from the blast database

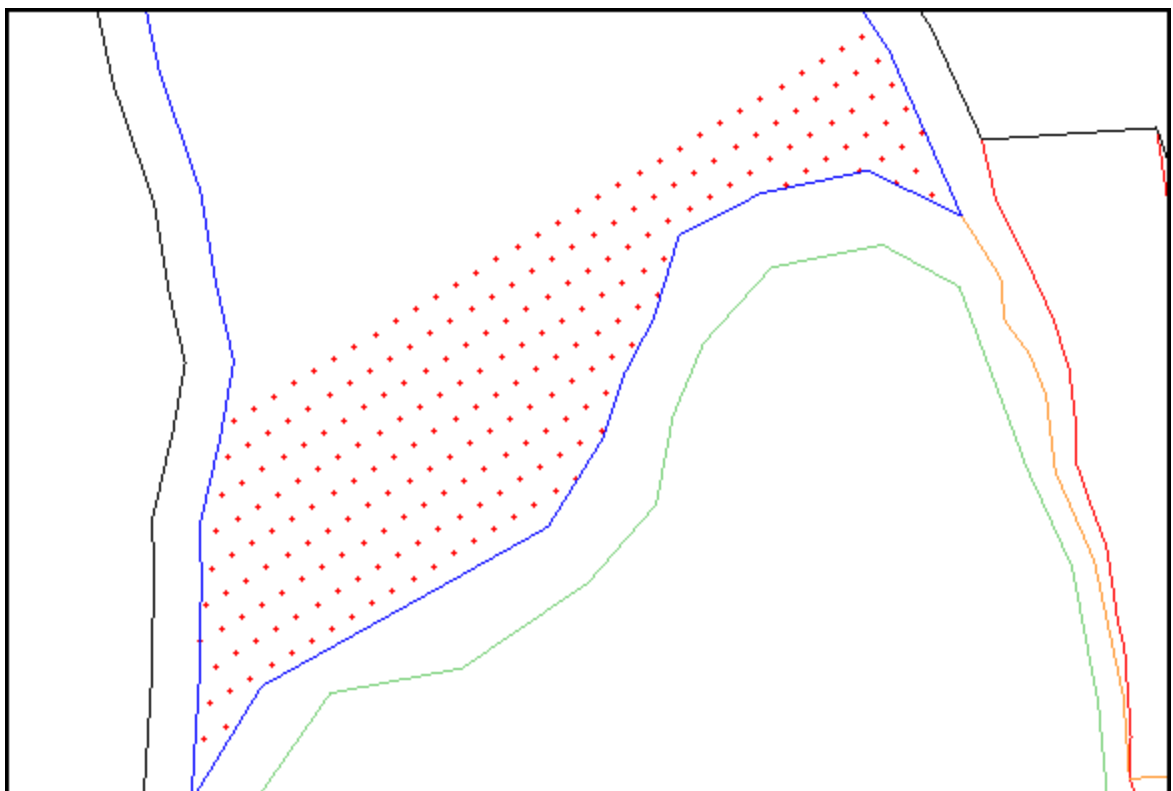
1. Click **Reset graphics** .
2. Open **bench960_950.str** in **Graphics**.
3. Choose **Database > Download blast holes from database**.
4. Enter the information as shown, and click **Apply**.



5. Enter the information as shown, and click **Apply**.



The blast holes are displayed.



Task: Create blast boundary string

1. Choose **Blast Design > Create blast boundary string**.
2. Enter the information as shown, and then click **Apply**.

True blast boundary

Define the blast boundary parameters

Define output layer

Pattern identifier

String number

Arc distance

Create cones

Object ID

Object name

Overwrite cone angle

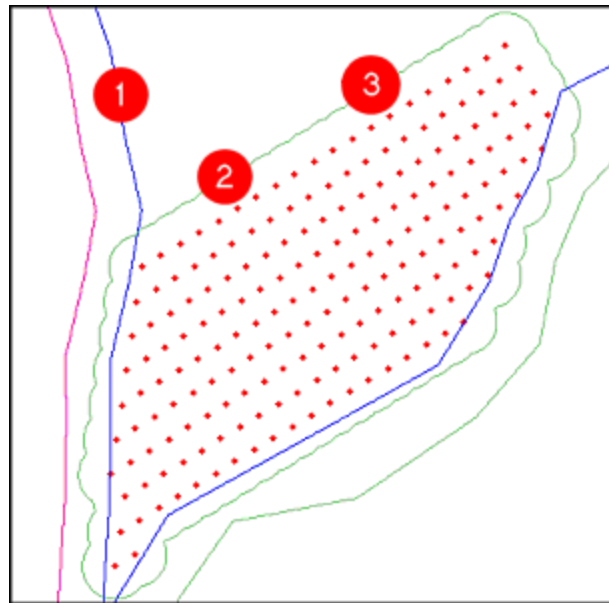
Cone angle

Define the collar elevation

Collar elevation

Elevation

The blast boundaries are displayed (this can take a while to process, look for the progress feedback in the bottom right of the Status bar).



3. Choose **Blast design > Clip blast boundary by crest string**.
4. Follow the prompts to clip the blast boundary:
 - a. (1) Select the crest segment of the free face to clip with.
 - b. (2) Select the true blast boundary segment.
 - c. (3) Select a point which lies on a part of the blast boundary to retain.

Create Blast Solid

Task: Create blast solid

1. Choose **Blast design > Create a blast solid**.
2. Enter the information as shown, and click **Apply**.

Blast solid

Output layer: blast solid layer

Blast pattern: BP1

Rock mass classification: Laterite

Top surface

Type: Fixed Use boundary elevation? Elevation:

Bottom surface

Type: Fixed Elevation: 954

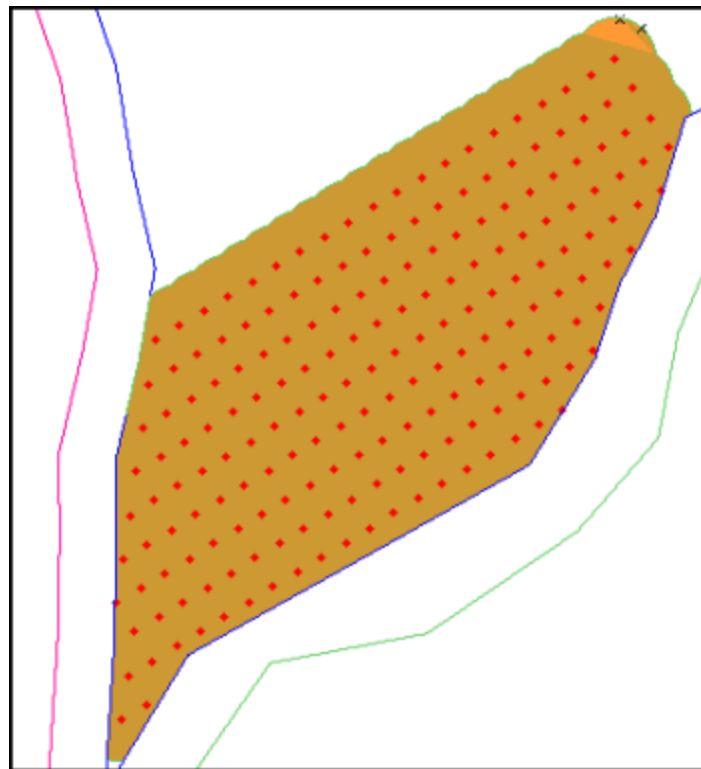
Trim blast solid to a free face?

Apply Cancel

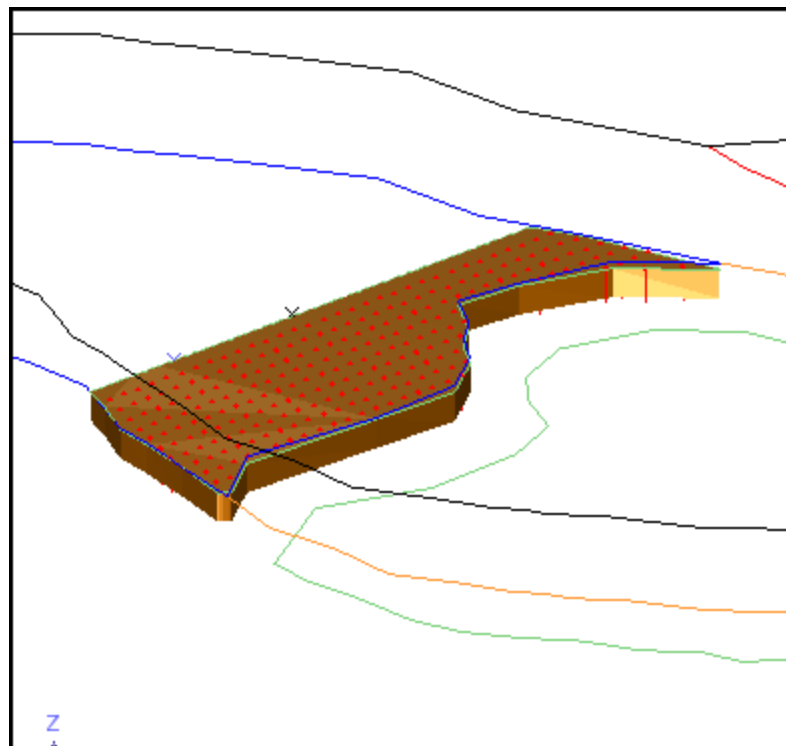
You are prompted to **Select the true blast boundary segment**.

3. Click on the blast boundary.

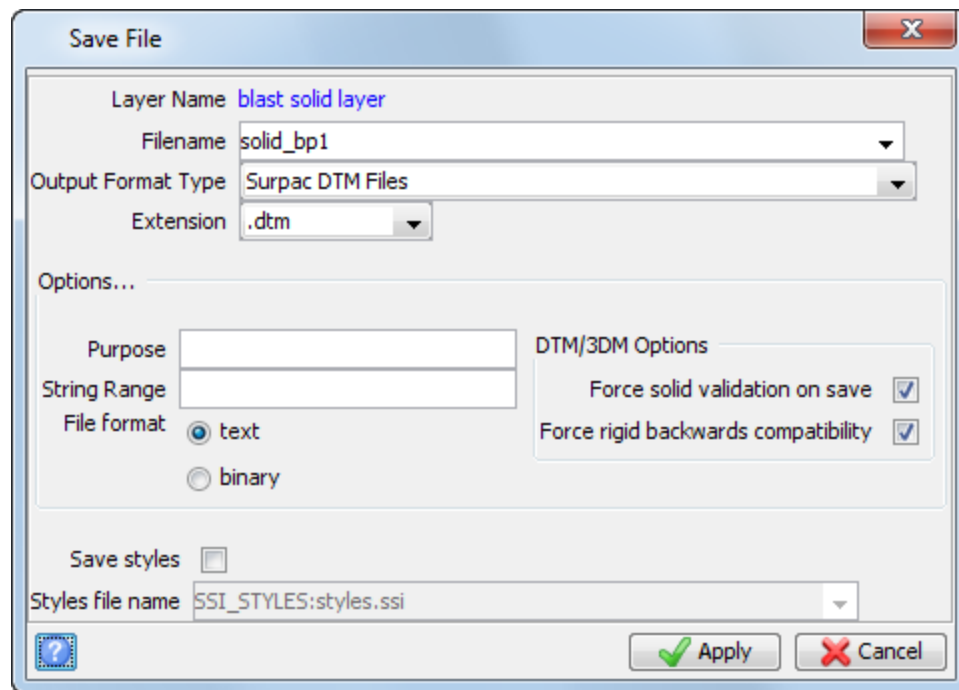
The blast solid is displayed.




4. Rotate the data to see how the solid is formed.



5. Choose **File > Save > string/DTM**.
6. Enter the information as shown, and click **Apply**.

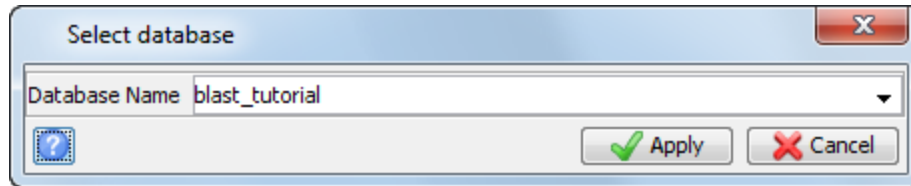


 **Note:** To see all of the steps performed in this task, run **04_blast_boundary_&_solid.tcl**. You need to click **Apply** on any forms presented.

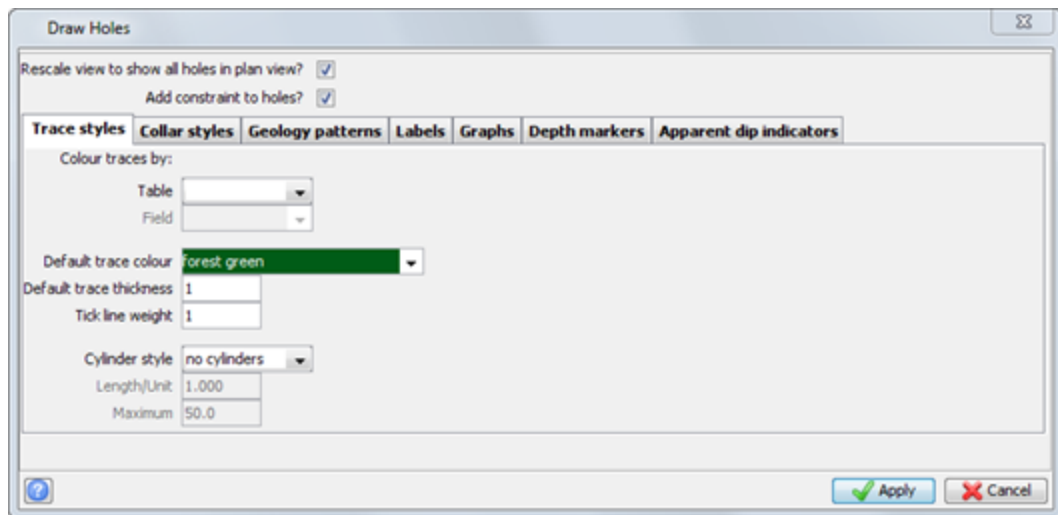
Creating a blast report

Task: Recall the pit pickup string file and blast pattern

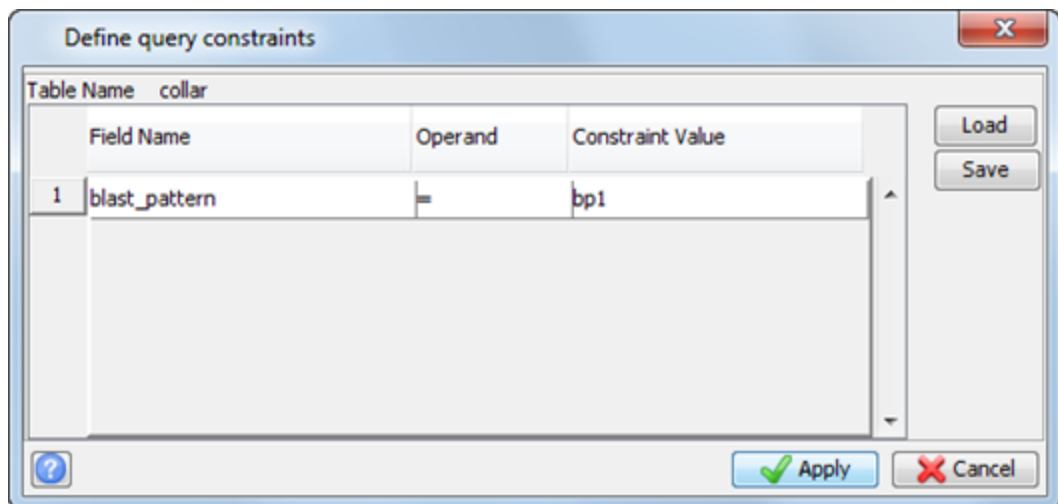
1. Click **Reset graphics** .
2. Open **bench960_950.str** in **Graphics**.
3. Choose **Display > Display loaded blastholes**.
4. Enter the following information, and click **Apply**.



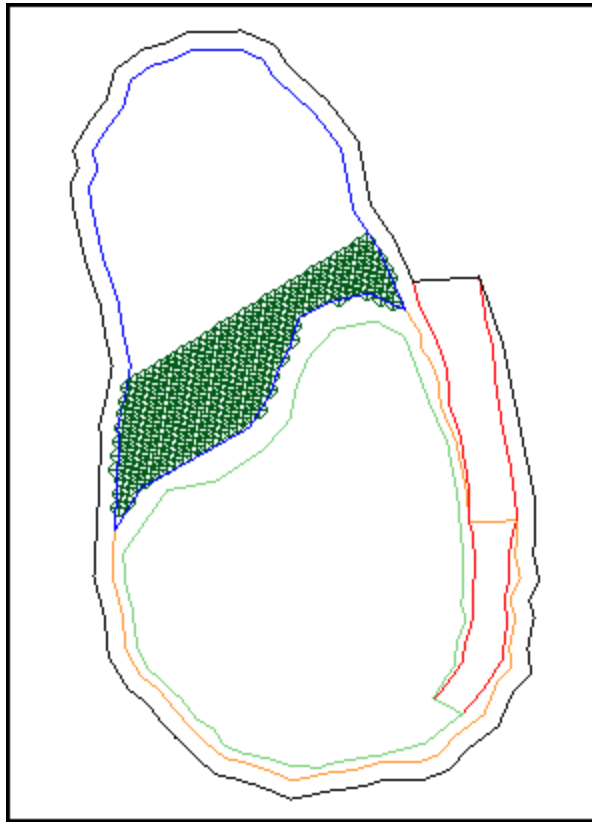
5. Enter the information as shown, and click **Apply**.



6. Enter the information as shown, and click **Apply**.



The blast pattern and pit pickup are displayed in **Graphics**.



Task: Generate a blast summary report

1. Choose **Report > Blast summary**.
2. Enter the information as shown, and click **Apply**.

Blast summary report

Define the report file header

Blasting notes

Define the report file to create

Location

Id number

Report Format

Report orientation Across the page Down the page

Report type Detailed Consolidated Both

Define the 3DM file

3DM file location

Id number

Define the blast pattern

All patterns Group of patterns Unique pattern Some patterns

Select a unique pattern

Pattern

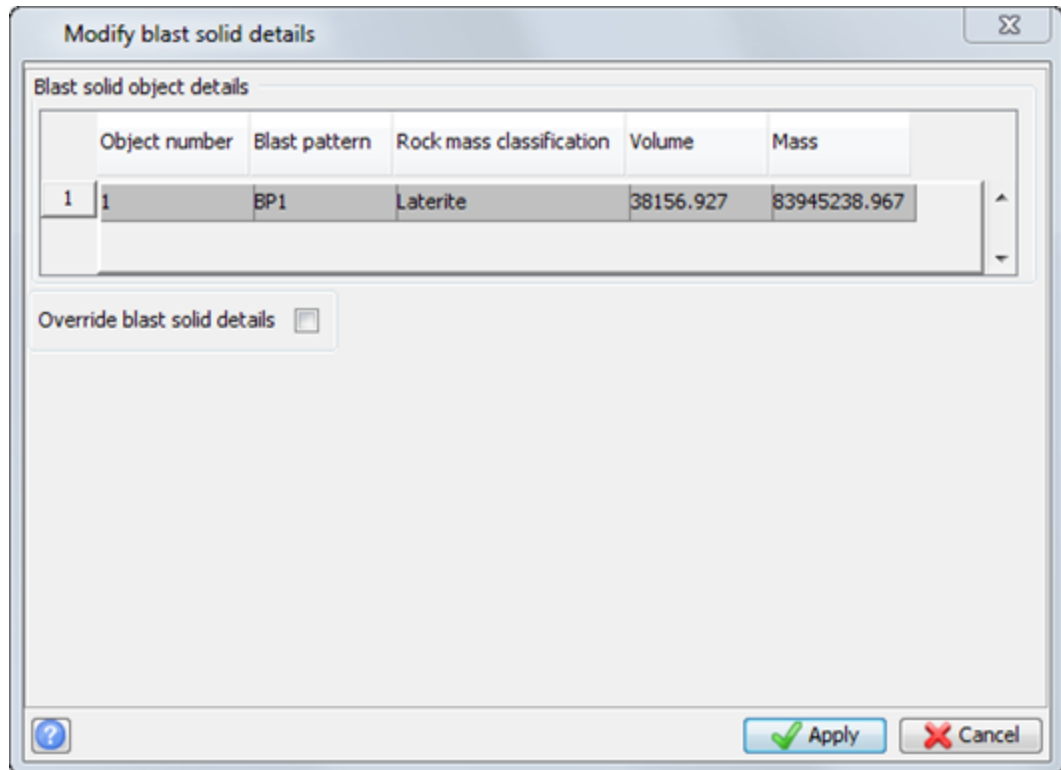
Define the attribute that contains the specific gravity for each rock

Use block model

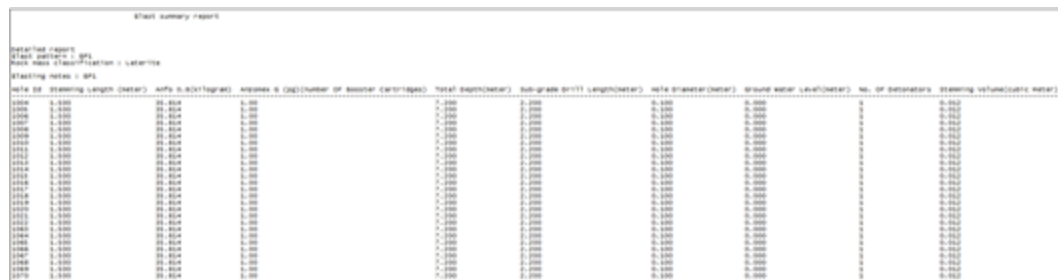
Specific gravity attribute

Note: There are three options for the report type. Usually, the consolidated report is the best option to select, because it will produce a report in most situations, even if some information is not available. For example, if the blast pattern contains two rock classifications but the blast solid contains only one object/trisolation, a detailed report cannot be produced. This is because there is no way to determine what proportion of the volume belongs to which rock classification. In this case the consolidated report will still produce a report using the total combined volume.

3. Enter the information as shown, and click **Apply**.



The file **bp1.not** is displayed.



Note: The option **Override blast solid details** allows you to temporarily override the blast solid details when producing a blast report. To generate a complete blast report, the blast solid detail entries for **Blast pattern** and **Rock mass Classification** *must match* the information stored in the database for the specified blast pattern. By selecting **Override blast solid details**, a second panel is enabled, from which you can select values to temporarily use to generate the blast report.

Note: To see all of the steps performed in this task, run macro **05a_blast_report.tcl**. You need to click **Apply** on any forms presented.

Task: Generate a blast work order report

1. Choose **Report > Work order**.
2. Enter the information as shown, and click **Apply**.

Blast work order report

Define the report file header

Prepared by: tutorial

Product requirement: Immediate

Blasting notes: Blast today 5.00 pm

Define the report file to create

Location: work_order_bp

Id number: 1

Report Format: .not - Surpac Note File

Report type: Detailed Consolidated Both

Define the 3DM file

3DM file location: solid_bp

Id number: 1

Define the blast pattern

All patterns Group of patterns Unique pattern Some patterns

Select a unique pattern

Pattern: BP1

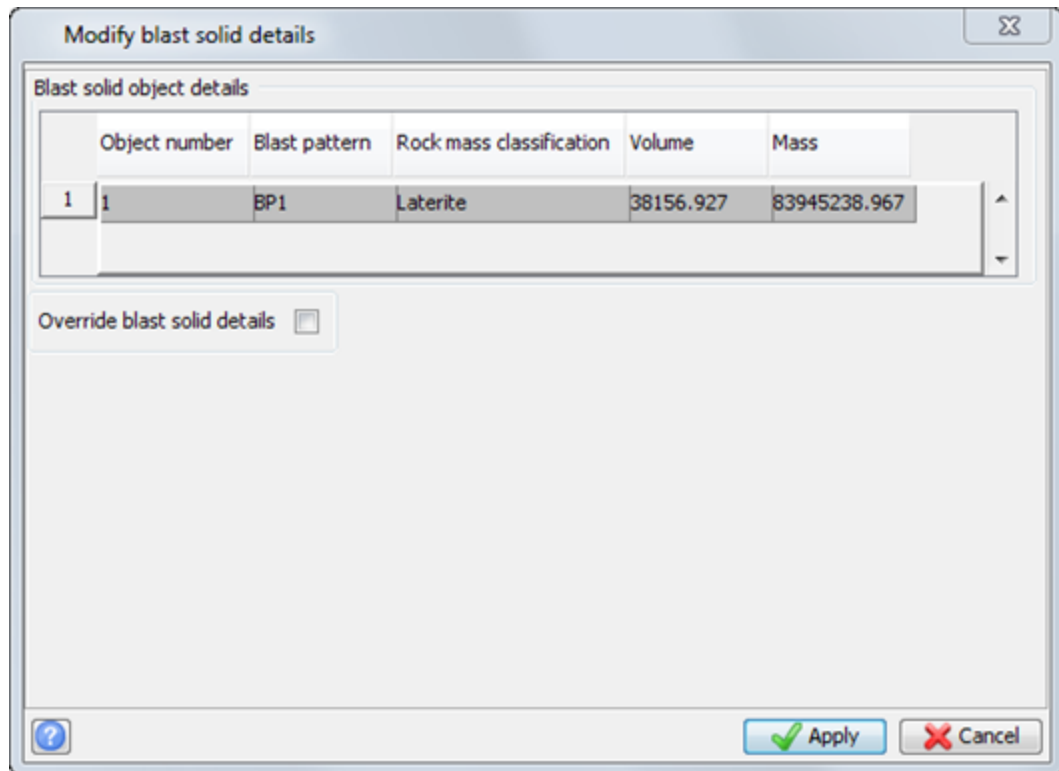
Define the attribute that contains the specific gravity for each rock

Use block model:

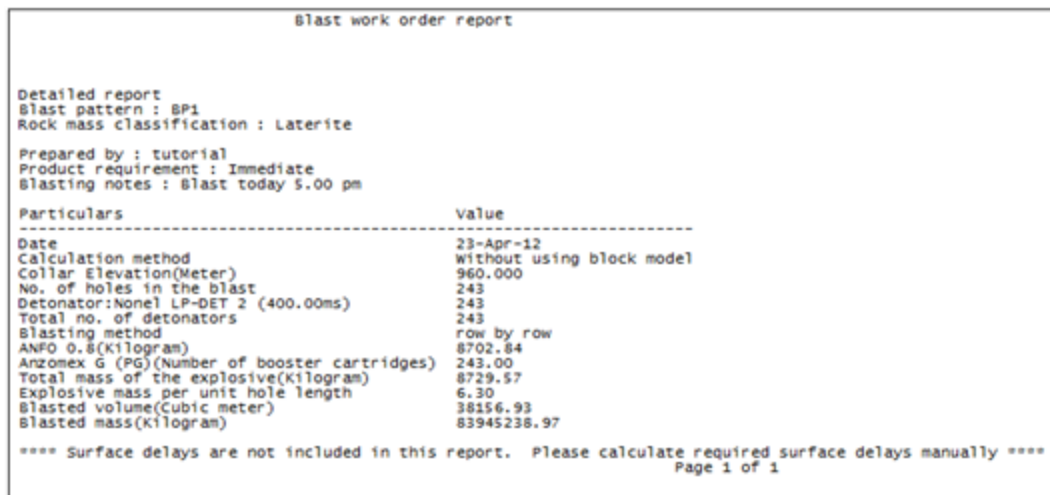
Specific gravity attribute: [dropdown]

Apply Cancel

3. Enter the information as shown, and click **Apply**.




The file **work_order_bp1.not** is displayed.

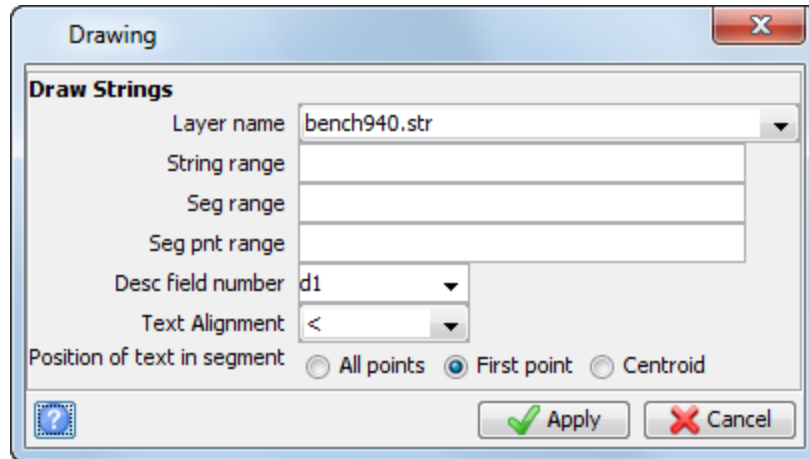


Note: To see all of the steps performed in this task, run macro **05b_blast_work_order.tcl**. You need to click **Apply** on any forms presented.

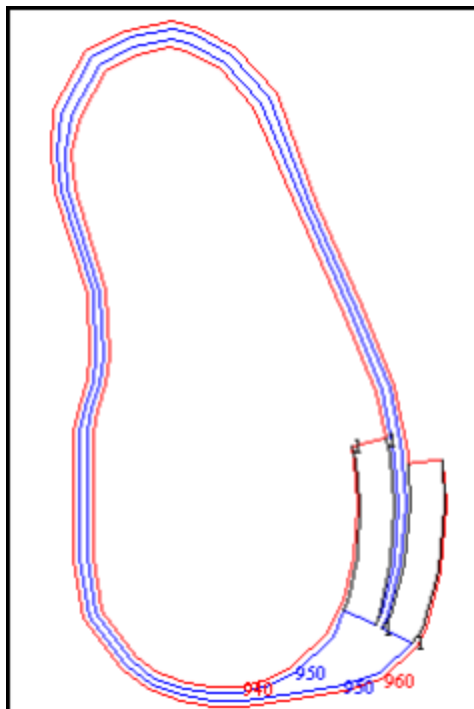
Creating pre-split holes

Task: Create pre-split holes along a segment

1. Click **Reset graphics** .
2. Open **bench940.str** in **Graphics**.
3. Choose **Display > Strings > With string numbers**.
4. Enter the information as shown, and click **Apply**.



The pit and ramp strings are displayed.

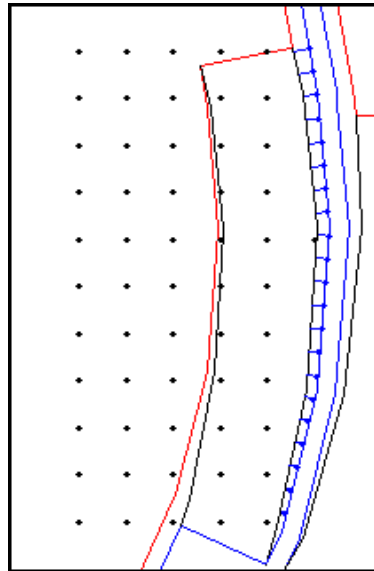



Notice that the following string numbers are used:

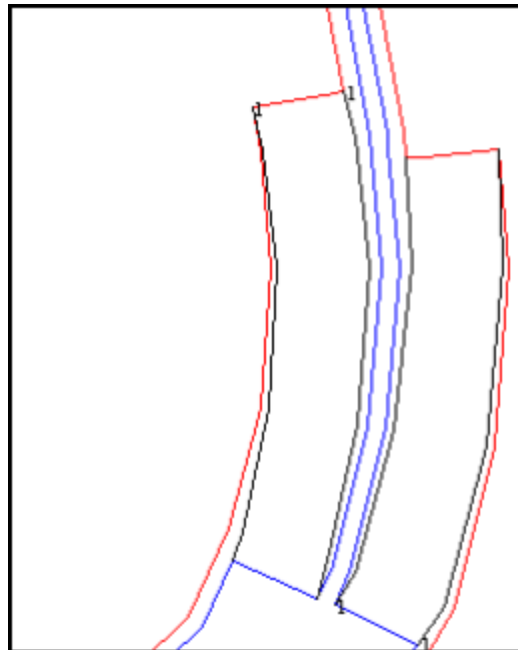
String	Description
1	ramp strings
940	940 elevation design toe
950	950 elevation design toe and crest
960	960 elevation design crest

You will create a pattern near the ramp from the 950 elevation to the toe of the ramp.

You will create the Pre-split holes on the ramp as displayed.

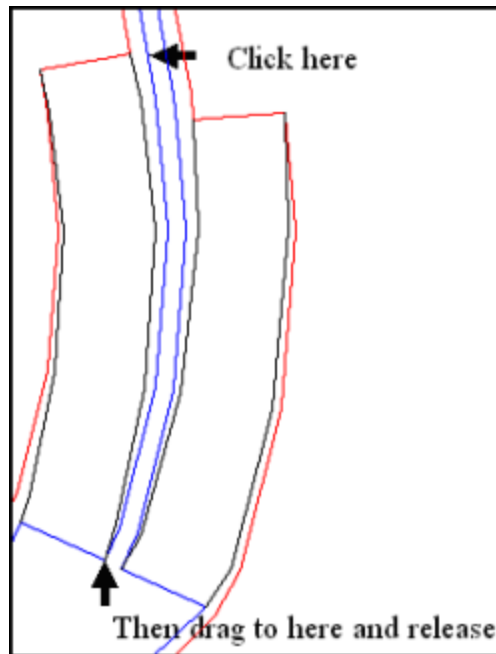



5. Click  to see the data in plan view.
6. Zoom in on the ramp area, as shown.



7. Choose **Blast design > Pre-split holes along a segment**.

- Click the 950 crest as shown, drag to the top of the ramp, and then release the mouse button.



 **Note:** If, as you were dragging, any other segment was highlighted, you might have selected a different string. If any other string was selected, press ESC and perform this step again.

- Enter the information as shown, and click **Apply**.

Pre-split parameters

Presplit segment
Segment length 112.417

Spacing method Spacing Spacing 5
 No. holes No. holes 23

Collar elevation
 Elevation method Selected Segment

Toe elevation
 Toe position method Set to Segment
 Segment offset 0
 Fix value Bearing
 Offset

Offset from line 0
 Subdrill distance

Hole settings
 Bearing Set bearing
 Perp. to segment
 Hole bearing 0
 Hole dip -90
 Hole diameter 0.076

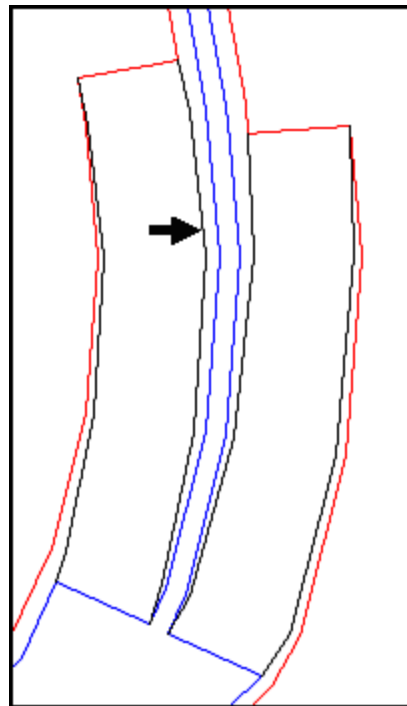
Labelling options
 Hole ID prefix 940-
 Hole ID suffix ps
 Starting value 101
 Pad hole_id
 Pad length 5
 Pad character 0

Blast settings
 Clip to boundary
 Rock name Laterite
 Pattern identifier 940-2ps
 Drill rig Rig-1

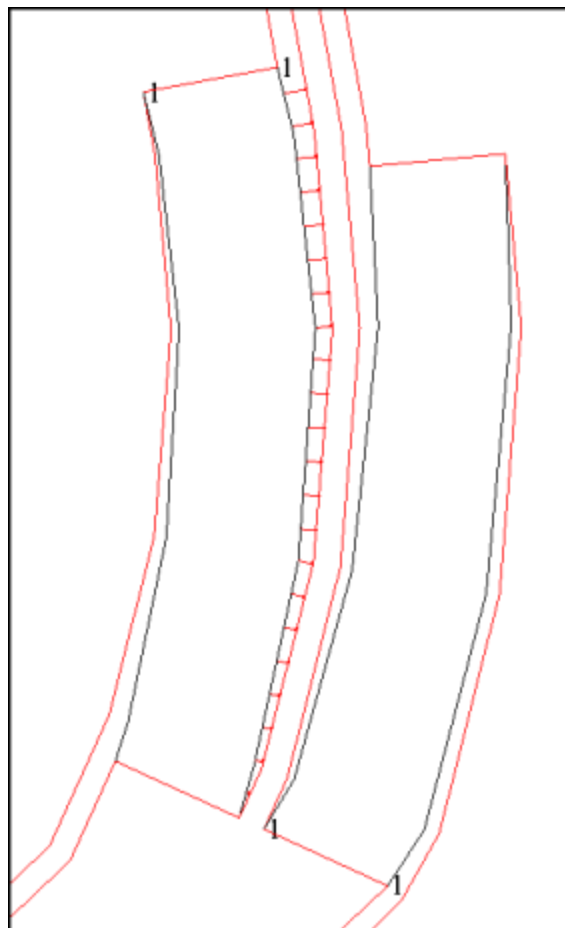
Apply Cancel

After applying the previous form, you will be prompted to select a target segment which will be used as the toe position.

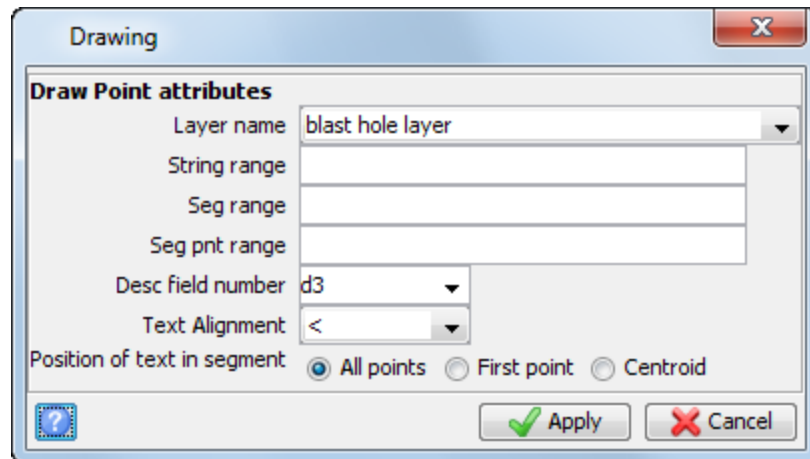
10. Select the ramp string as shown.



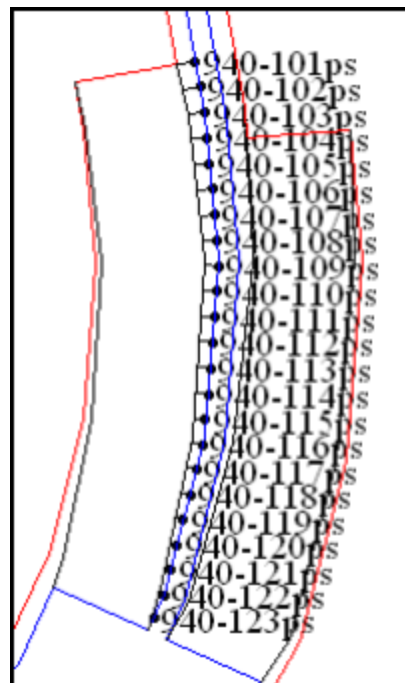
You will see the presplit holes created.



11. Choose **Display > Point > Attributes**.
12. Enter the information as shown, and click **Apply**.



The ramp and numbered holes are displayed.

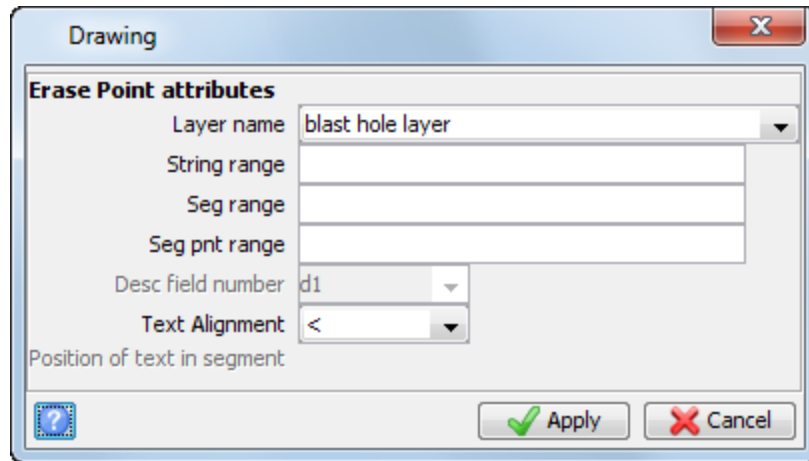


Note: The holes are numbered with the prefix 940-, suffix of "ps", and are drilled from the 950 crest down to the ramp toe.

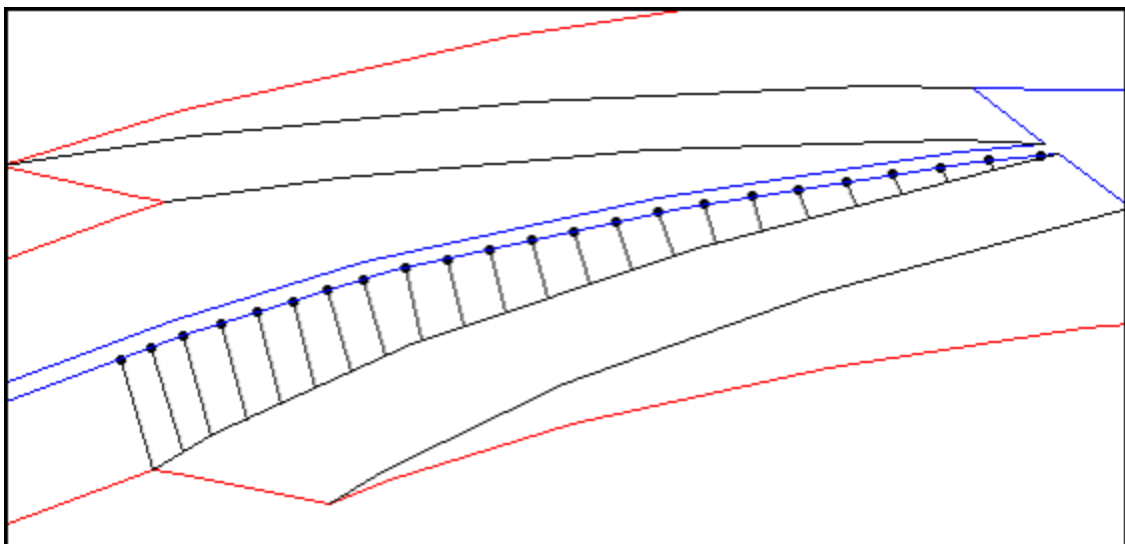
The result is a series of two-point segments in the layer **blast hole layer**, which represent individual holes. The first point of the segment is at the collar, and the second point of the segment is the toe, or end of the hole. If the layer **blast hole layer** does not exist, it is created. If there are no strings in the blast hole layer, or if the blast hole layer does not exist, the string number used for the holes will be the design string number. If there are strings in the blast hole layer, the string number assigned to the holes will be one greater than the maximum string number.

13. Choose **Display > Hide point > Attributes**.

- Enter the information as shown, and click **Apply**.



- Rotate the data in **Graphics**.
The ramp with holes is displayed.



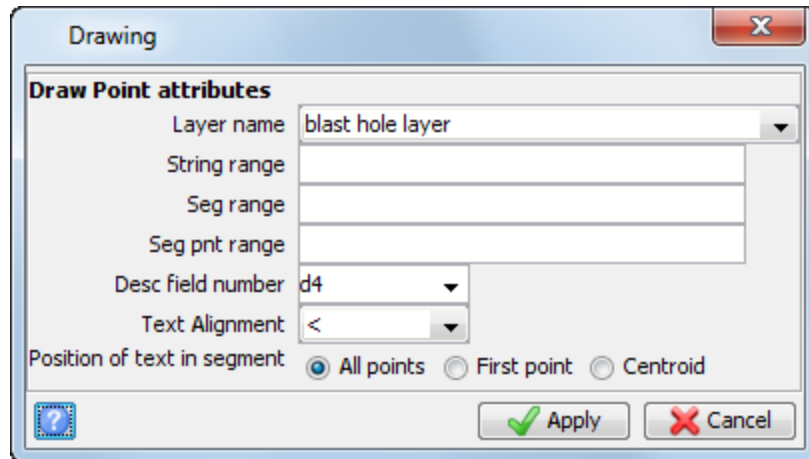
- Choose **Inquire > Point properties** and click on the collars and toes of some holes.
The following data is present in the string file:


	D1	D2	D3	D4	D5
Collar (start of segment)	DrillBlast1.1	Hole ID	Hole Number	Hole Length	Diameter
Toe (end of segment)	blank	blank	blank	blank	blank


In this example, you want to make sure that you only create holes which are at least 1.5 meters long, because anything shorter is not worth blasting.

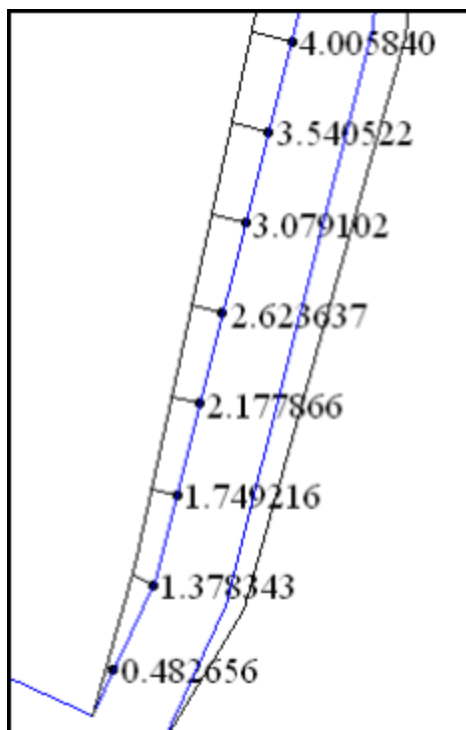
- Choose **Display > Point > Attributes**.

18. Enter the information as shown, and click **Apply**.

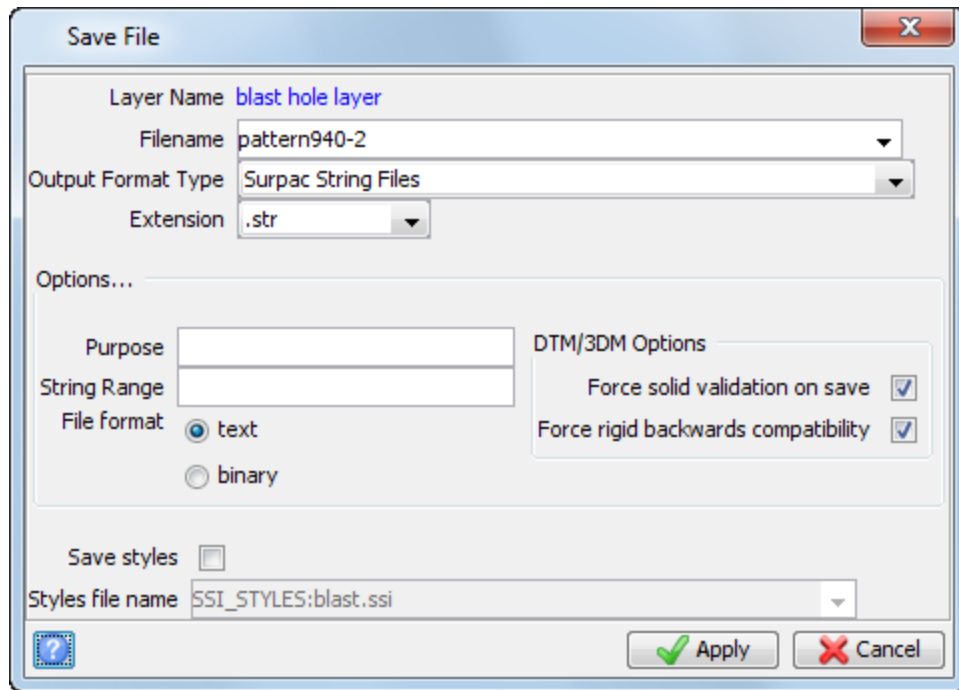


19. Click .
20. Zoom in on the southern end of the presplit holes.
You can see that at least one hole is less than 1.5 meters in length.

 **Note:** Your hole lengths will not be exactly the same as those displayed in the following image.




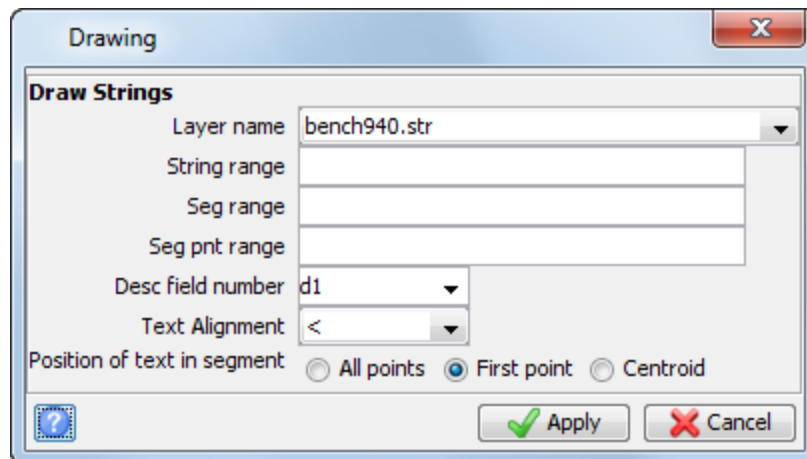
21. Choose **Delete > Single hole**.
22. Click all holes less than 1.5 meters in length, and then press ESC.
23. Choose **File > Save > string/DTM**.
24. Enter the information as shown, and click **Apply**.



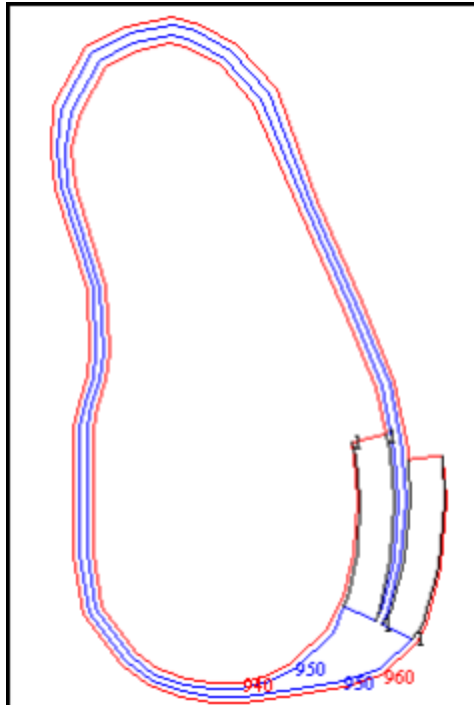
Note: To see all of the steps performed in this task, run macro `06a_presplit_holes_segment.tcl`. You need to click **Apply** on any forms presented.

Task: Create pre-split holes along a straight line

1. Click **Reset graphics** .
2. Open **bench940.str** in **Graphics**.
3. Choose **Display > Strings > With string numbers**.
4. Enter the information as shown, and click **Apply**.



The pit and ramp with string numbers are displayed.



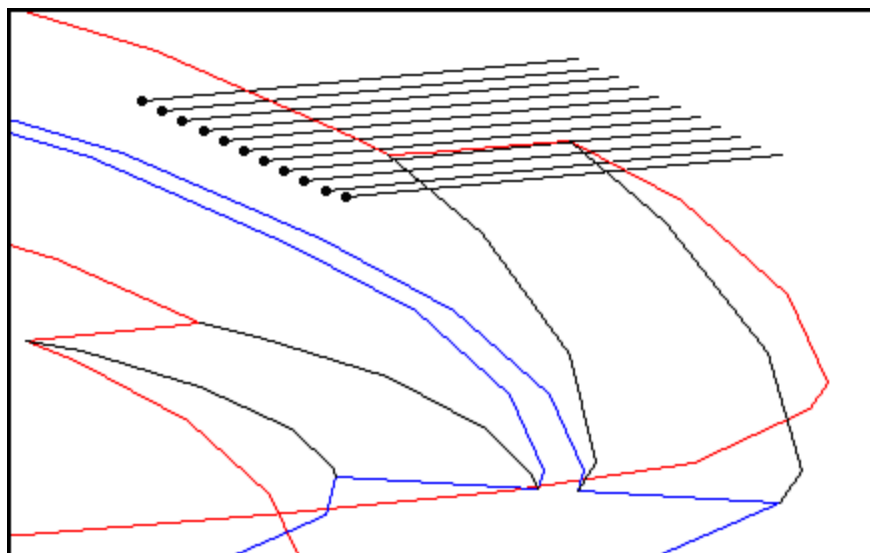
5. Rotate the data in Graphics and zoom in and out to become familiar with the contents of the file.

Notice that the following string numbers are used:

String	Description
1	ramp strings
940	940 elevation design toe
950	950 elevation design toe and crest
960	960 elevation design crest

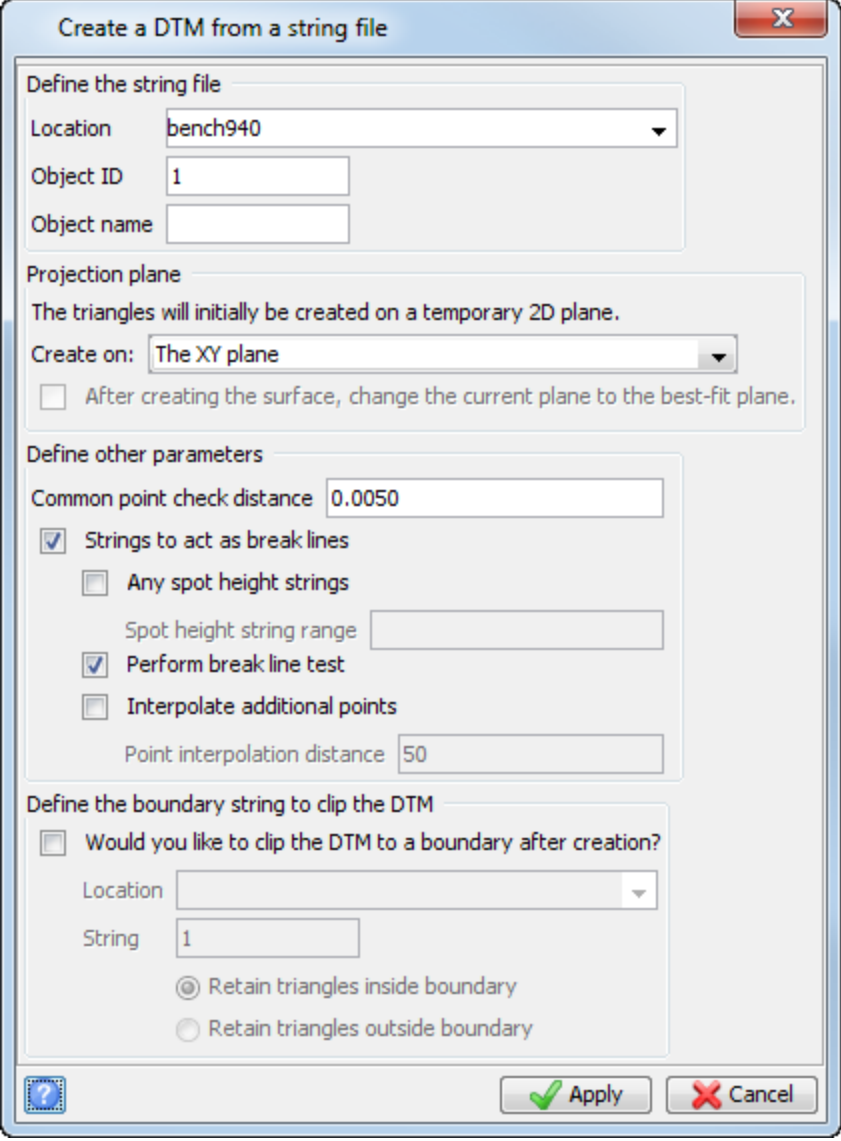
In this example, you will create horizontal drain holes on the pit wall.

The horizontal holes are as displayed.



You will use a DTM of the pit wall in this area to set the elevation of the holes.

6. Choose **Surfaces > DTM File functions > Create DTM from string file.**
7. Enter the information as shown, and click **Apply.**



Create a DTM from a string file

Define the string file

Location: bench940

Object ID: 1

Object name:

Projection plane

The triangles will initially be created on a temporary 2D plane.

Create on: The XY plane

After creating the surface, change the current plane to the best-fit plane.

Define other parameters

Common point check distance: 0.0050

Strings to act as break lines

Any spot height strings

Spot height string range:

Perform break line test

Interpolate additional points

Point interpolation distance: 50

Define the boundary string to clip the DTM

Would you like to clip the DTM to a boundary after creation?


Location:


String: 1

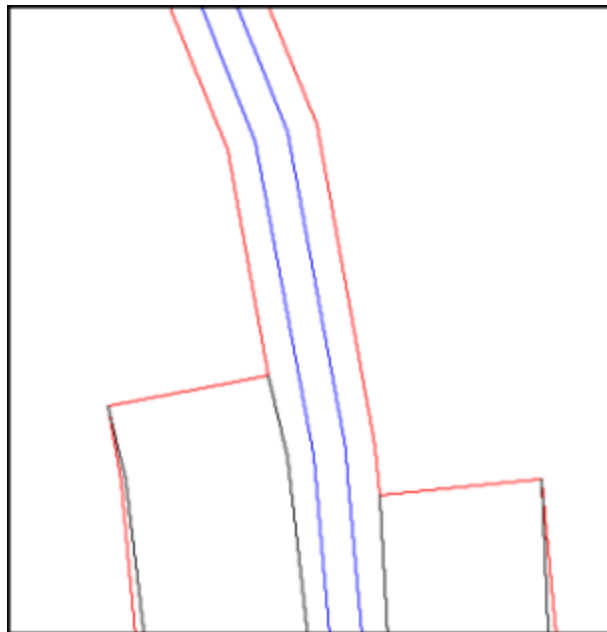
Retain triangles inside boundary

Retain triangles outside boundary

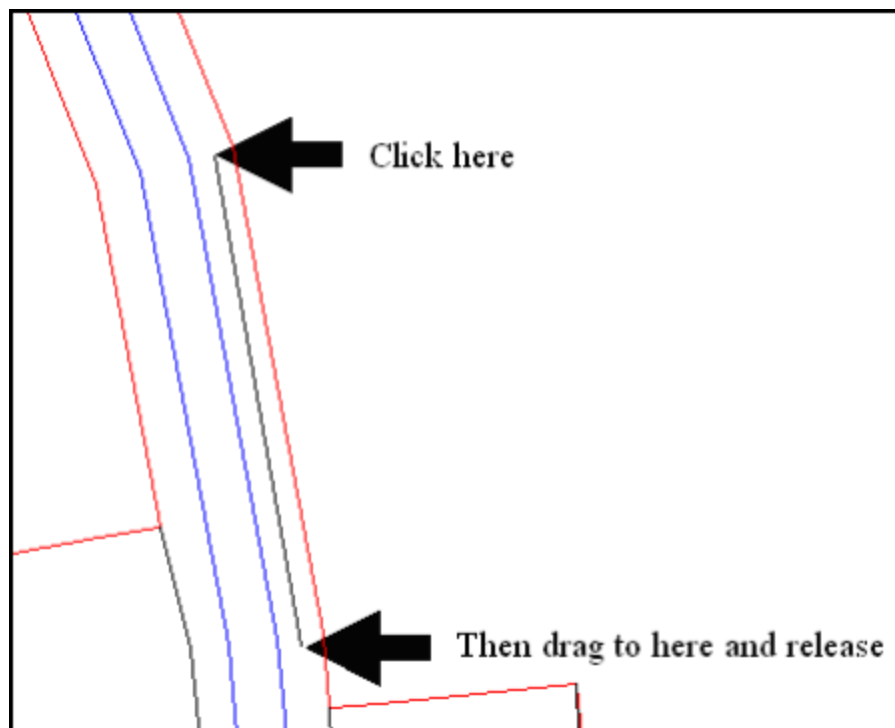
Apply Cancel

 **Note:** You do not need to display the file in **Graphics** to use it to create holes. A log file for the DTM opens in your default text editor.

8. Close the log file.
9. Click  to return to plan view.
10. Zoom in on the northern end of the two ramps, as shown.



11. Choose **Blast design > Pre-split holes along a line.**
 12. Click a point approximately halfway between the 960 crest and the 950 toe as shown, drag to a point just south of there, then release the mouse button.
- 📌 **Note:** If you have any problems, you can press ESC and try again.



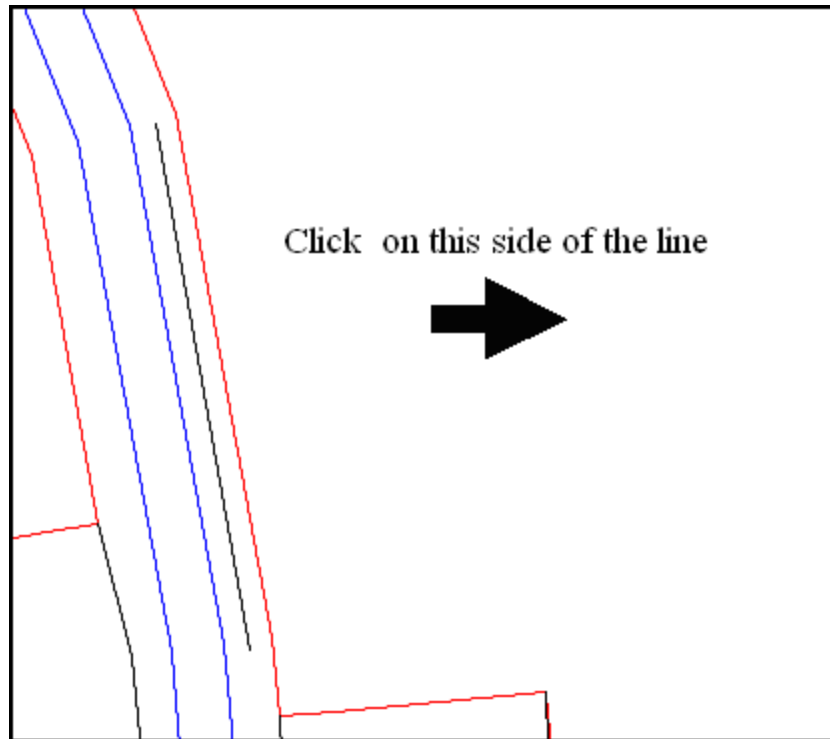
- Enter the information as shown, and click **Apply**.

Note: The coordinates of your Presplit line **Origin**, **Line Length**, and **Bearing** will be different, but should be of similar magnitude.

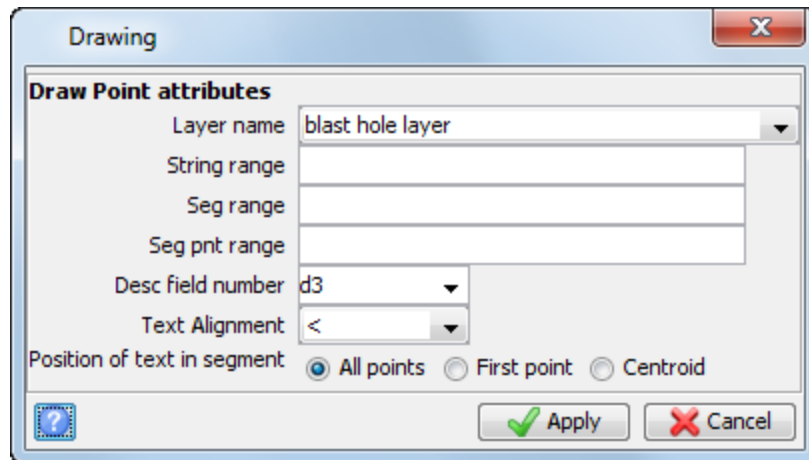
You are using a DTM file to set the collar elevations. The elevation of the holes created will be equal to the elevation of the DTM at the given XY coordinates of each hole. You are setting the bearing of the holes to be perpendicular to the segment (that is, perpendicular to the line you created). By setting the hole dip to zero degrees, you are creating horizontal holes. The holes will be numbered 950-701d, 950-702d, 950-703d, incrementing one for each additional hole.

After applying the *Pre-split parameters* form, you are prompted to select the direction in which the holes will be drilled.

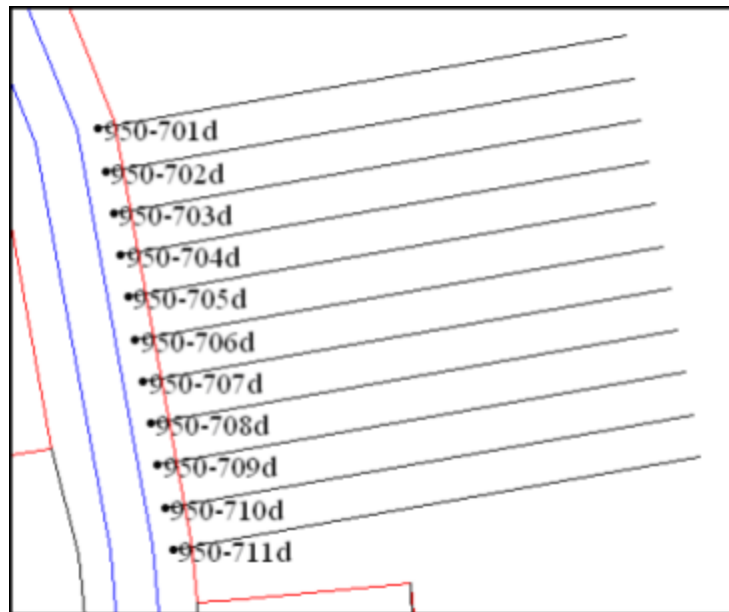
14. Select a point to the east of the line as shown.



15. Choose **Display > Point > Attributes**.
16. Enter the information as shown, and click **Apply**.



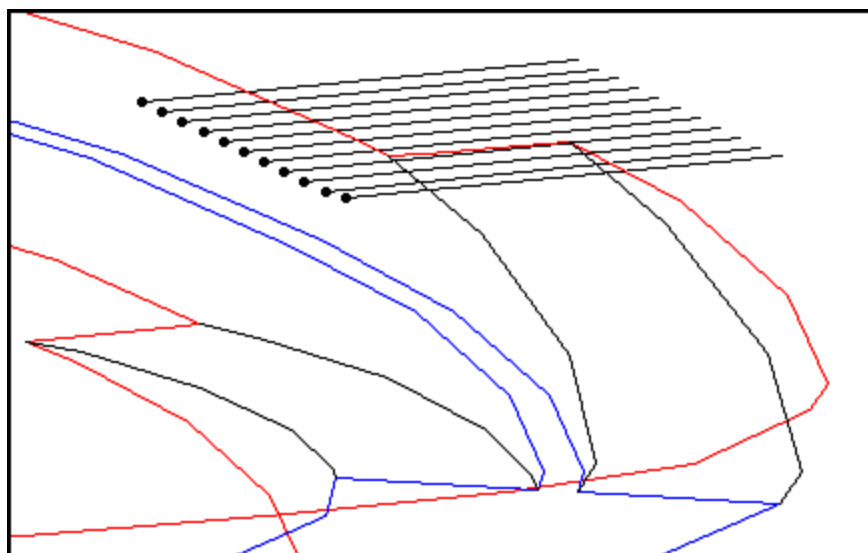
Horizontal holes with numbers are displayed:



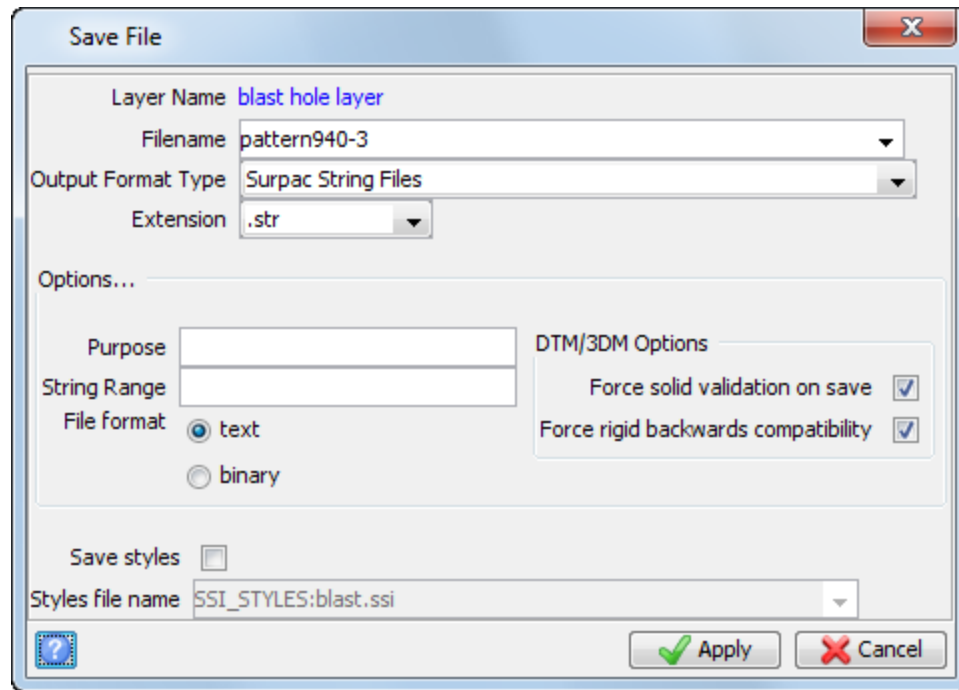
Note: The holes are numbered with the prefix 950-, suffix of "d", start at hole 701, and are horizontal.


The result is a series of two-point segments in the layer "blast hole layer", which represent individual holes. The first point of the segment is at the collar, and the second point of the segment is the toe, or end of the hole. If the layer "blast hole layer" does not exist, it is created. If there are no strings in the blast hole layer, or if the blast hole layer does not exist, the string number used for the holes will be the design string number. If there are strings in the blast hole layer, the string number assigned to the holes will be one greater than the maximum string number.

17. Rotate the data in **Graphics**.
The horizontal holes are displayed.



18. Choose **File > Save > string/DTM**.
19. Enter the information as shown, and click **Apply**.



 **Note:** To see all of the steps performed in this task, run macro **06b_presplit_holes_line.tcl**. You need to click **Apply** on any forms presented.

Blast database concepts

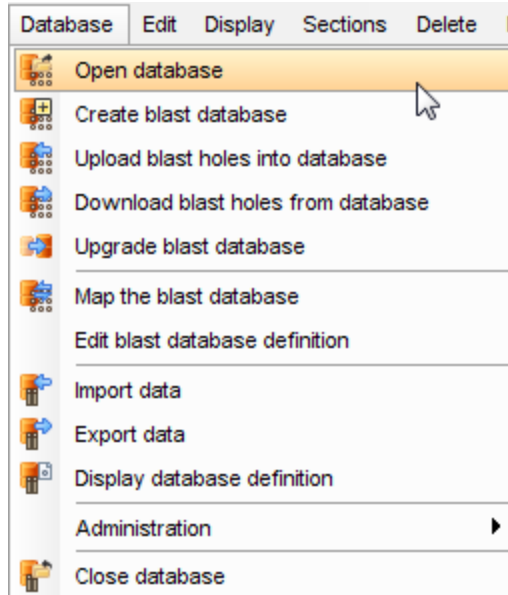
Task: Examine tables and fields in a drill and blast database


The tables and fields for a drill and blast database are as shown:

TABLES	Collar	Survey	Translation	Sample	Styles	Charging
FIELDS	hole_id	hole_id	table_name	hole_id	code	hole_id
	y	depth	field_name	samp_id	field_name	samp_id
	x	dip	code	depth_from	from_value	depth_from
	z	azimuth	num_equiv	depth_to	graphics_colour	depth_to
	max_depth		description		graphics_pattern	explosive
	hole_path				line_colour	detonator
	blast_pattern				line_style	delay
	blasting_method				line_weight	booster
	delay				marker_size	det_position
	drill_rig				marker_style	Num_of_boosters
	ground_water_level				plotting_colour	Num_of_dets
	hole_diameter				plotting_pattern	
	rock_class				style_type	
	subdrill				table_name	
	surface_delay				to_value	

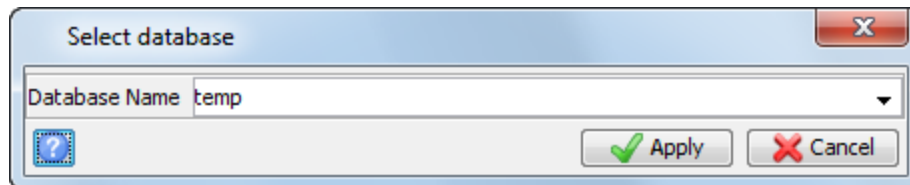
Task: Create a new drill and blast database

1. Click **Reset graphics** .
2. Choose **Database > Close database**.
3. Choose **Database > Open database**.



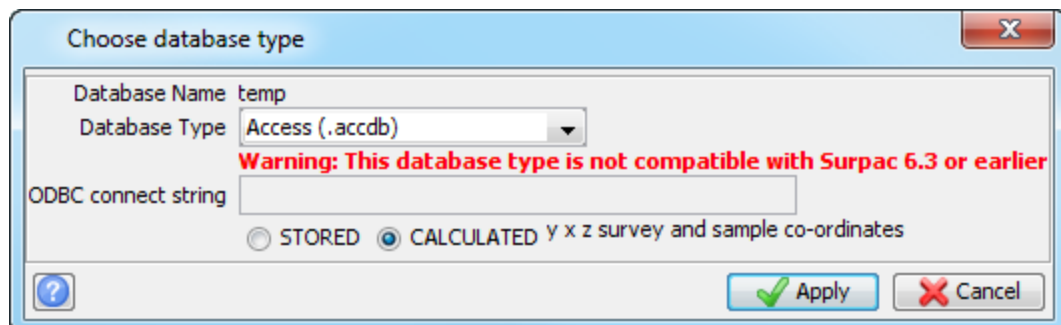
 **Note:** Make sure you are using the blastdesign Database menu, and *not* the Geological Database menu.

4. Enter the information as shown, and click **Apply**.

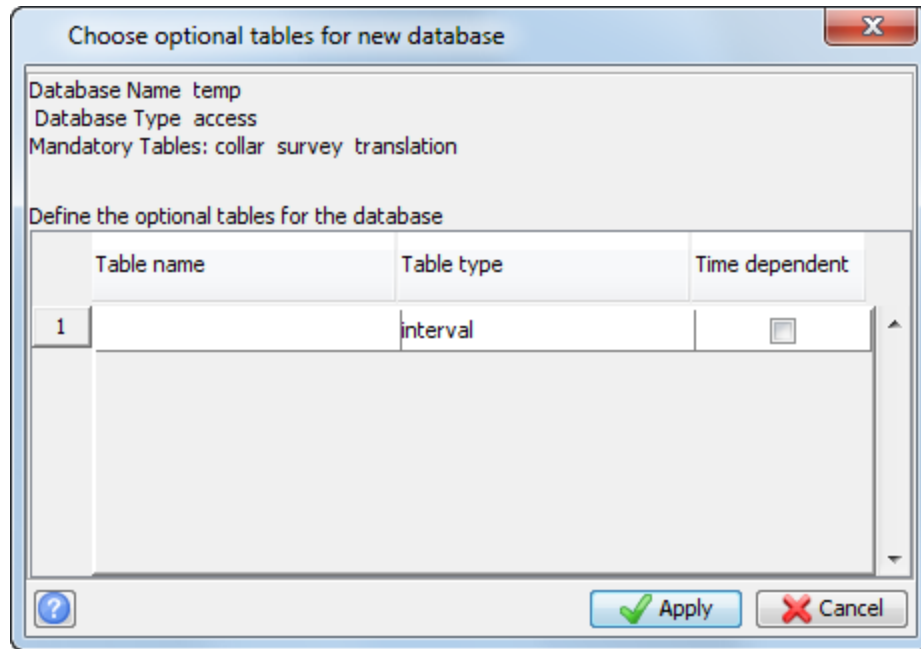


The *Create definition for new database* form appears, showing the name and location of the new database.

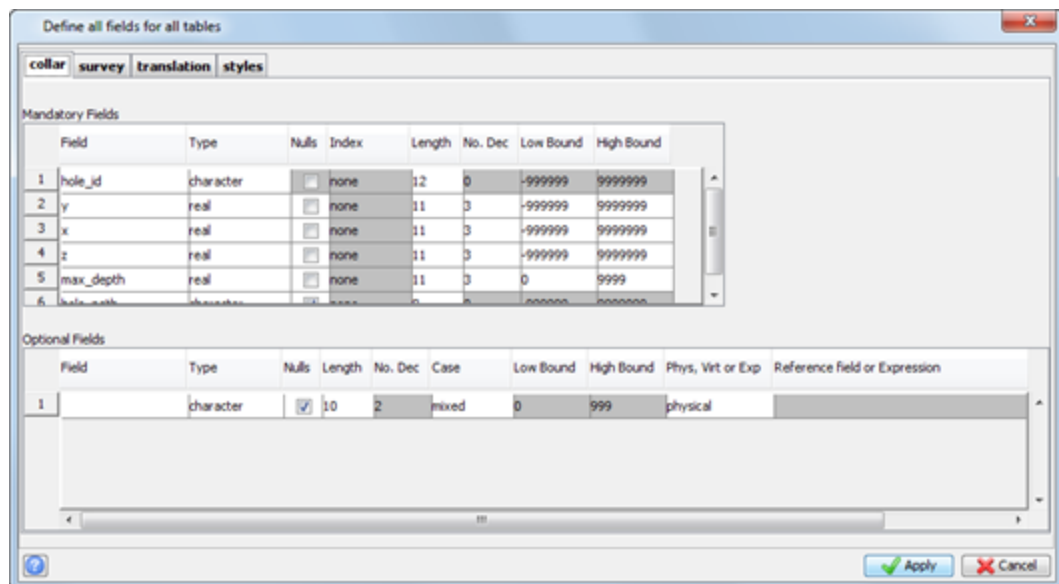
5. Click **Apply**.
6. Enter the information as shown, and click **Apply**.



7. Enter the information as shown, and click **Apply**.



8. Click **Apply**.




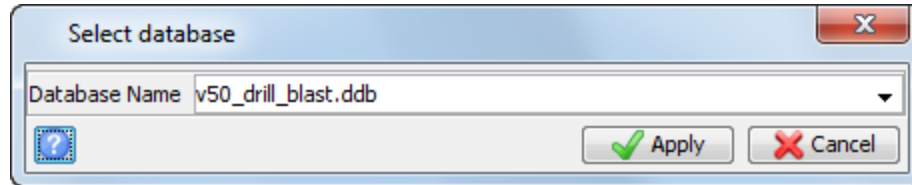
A database is created and the connection to the database is displayed in the Status bar.



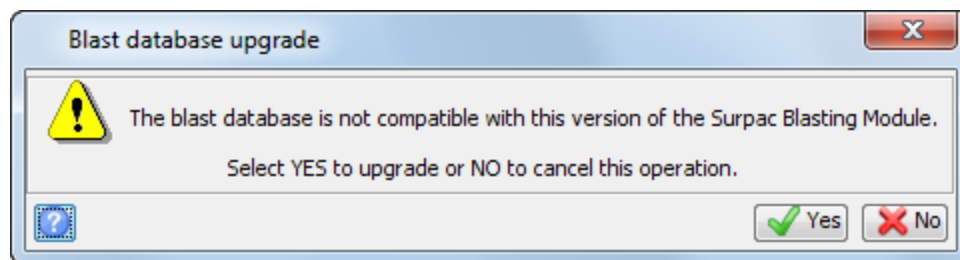
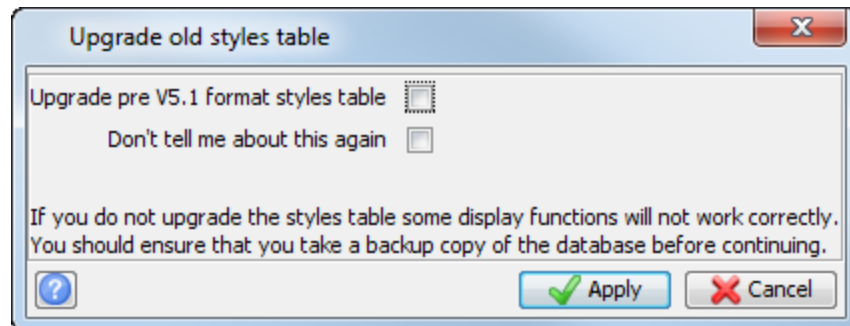
9. Choose **Database > Close database** to disconnect from the database.

Task: Upgrade a Surpac v5.0 blast database

1. Choose **Database > Upgrade blast database**.
 **Note:** Make sure you are using the blastdesign Database menu and *not* the Geological Database menu.
2. Enter the information as shown, and click **Apply**.




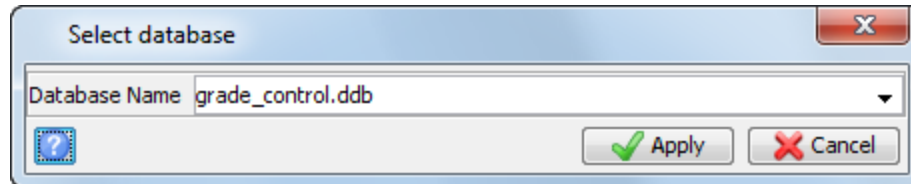
3. Click **Apply** and then **Yes**.



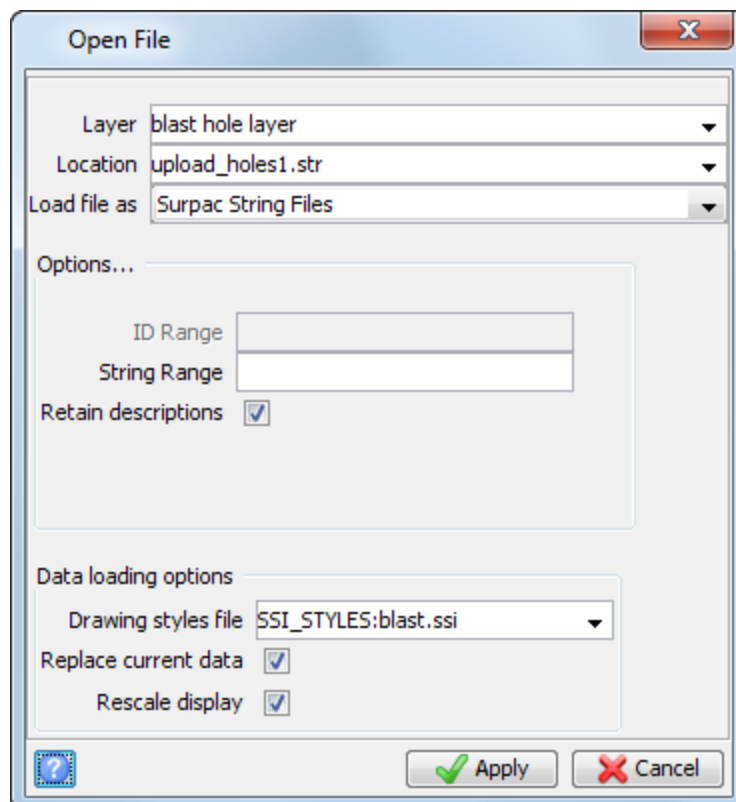
Loading the blast database

Task: Load sample intervals into a database

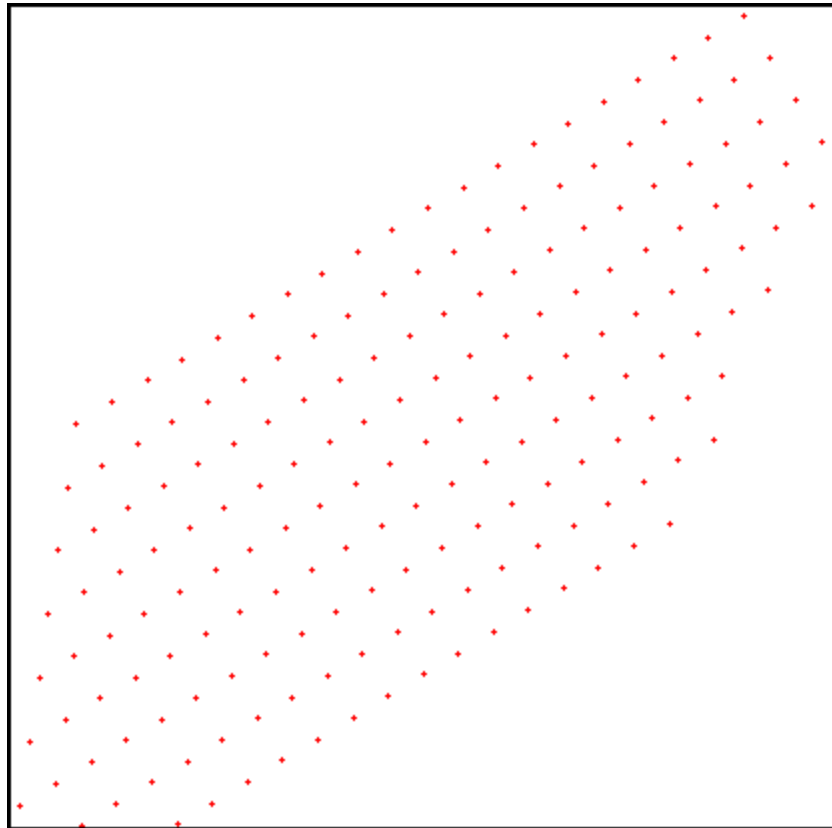
1. Choose **Database > Open database**.
 **Note:** Make sure you are using the blastdesign **Database** menu and *not* the **Geological database** menu.
2. Enter the information as shown, and click **Apply**.



3. Choose **File > Open > String/DTM file**.
4. Enter the information as shown, and click **Apply**.



The blast pattern is displayed.



5. Choose **Database > Upload blast holes into database.**

6. Click the **Sample Data** tab, enter the information as shown, and then click **Apply**.

Load blast holes to database

Duplicate holes in database

Extra holes in database

No extra holes

Duplicate blast holes	
1	1000(BP1)
2	1001(BP1)
3	1002(BP1)
4	1003(BP1)

Overwrite with new blast holes

Charging Data **Sample Data**

Load sample data

Table name

Sample Label

Use %ID% as a place holder for the hole Id

Sample prefix

Sample suffix

Increment start

Increment method continuous reset at each hole

Padding length

Padding character

Sampling Method

Sampling method single sample fixed length varying lengths

Sample length(s)

blank for hole depth

End sample method

Distance

Sample Id example

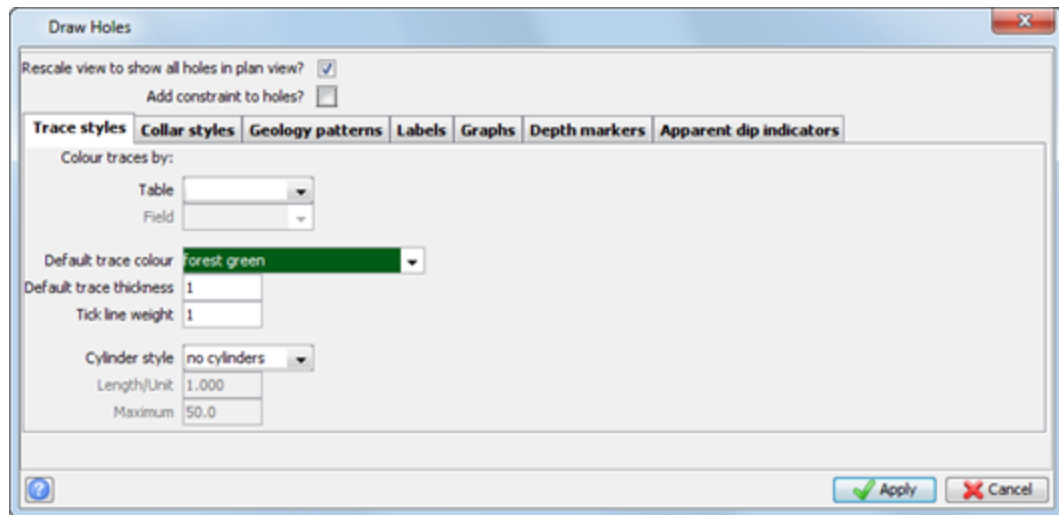
HOLE1-1 HOLE1-2 HOLE1-3 HOLE2-4 HOLE2-5

Database Load Report

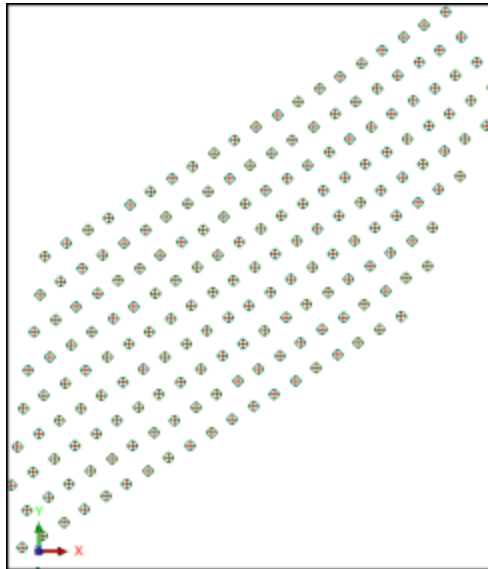
Report file name

Format

7. Enter the information as shown, and click **Apply**.



The holes are displayed.



8. Open **grade_control.not**.
The report is displayed.


```

BLAST HOLE DESIGN - LOAD BLAST HOLES TO DATABASE REPORT

Load commencing on 27-Apr-12
Loading collar table - collar
Loading survey table - survey
Loading charging table - charge
Loading sample table - sample
=====
Ignoring hole depth from      5.00 to      7.20 after sample (721(BP1)-1)
Ignoring hole depth from      5.00 to      7.20 after sample (722(BP1)-2)
Ignoring hole depth from      5.00 to      7.20 after sample (766(BP1)-3)
Ignoring hole depth from      5.00 to      7.20 after sample (767(BP1)-4)
Ignoring hole depth from      5.00 to      7.20 after sample (768(BP1)-5)
Ignoring hole depth from      5.00 to      7.20 after sample (769(BP1)-6)
Ignoring hole depth from      5.00 to      7.20 after sample (770(BP1)-7)
Ignoring hole depth from      5.00 to      7.20 after sample (771(BP1)-8)
Ignoring hole depth from      5.00 to      7.20 after sample (772(BP1)-9)
Ignoring hole depth from      5.00 to      7.20 after sample (773(BP1)-10)
Ignoring hole depth from      5.00 to      7.20 after sample (774(BP1)-11)
Ignoring hole depth from      5.00 to      7.20 after sample (775(BP1)-12)
Ignoring hole depth from      5.00 to      7.20 after sample (776(BP1)-13)
Ignoring hole depth from      5.00 to      7.20 after sample (777(BP1)-14)
Ignoring hole depth from      5.00 to      7.20 after sample (778(BP1)-15)
Ignoring hole depth from      5.00 to      7.20 after sample (779(BP1)-16)
Ignoring hole depth from      5.00 to      7.20 after sample (780(BP1)-17)
Ignoring hole depth from      5.00 to      7.20 after sample (781(BP1)-18)
Ignoring hole depth from      5.00 to      7.20 after sample (782(BP1)-19)
Ignoring hole depth from      5.00 to      7.20 after sample (783(BP1)-20)
Ignoring hole depth from      5.00 to      7.20 after sample (784(BP1)-21)
Ignoring hole depth from      5.00 to      7.20 after sample (811(BP1)-22)
Ignoring hole depth from      5.00 to      7.20 after sample (812(BP1)-23)
Ignoring hole depth from      5.00 to      7.20 after sample (813(BP1)-24)
Ignoring hole depth from      5.00 to      7.20 after sample (814(BP1)-25)
Ignoring hole depth from      5.00 to      7.20 after sample (815(BP1)-26)
Ignoring hole depth from      5.00 to      7.20 after sample (816(BP1)-27)
Ignoring hole depth from      5.00 to      7.20 after sample (817(BP1)-28)

```

This report indicates that the data was loaded successfully, and that any partial sample increments at the end of the hole were disregarded.

 **Note:** To see all of the steps performed in this task, run macro **07_blast_database.tcl**. You need to click **Apply** on any forms presented.