O-PITBLAST

O-PITSURFACE USER MANUAL

BLAST DESIGN & OPTIMIZATION PLATFORM

O-Pitblast, S.A.

Rua Professor Manuel Baganha 249,
4350 - 414 Porto, Portugal
T: +351 224 096 803
E: info@o-pitblast.com
W: www.o-pitblast.com

O-Pitblast, S.A.

O-Pitblast, S.A.

Rua Professor Manuel Baganha 249, 4350-414

Porto, Portugal

Phone: +351 910 222 599

E-mail: info@o-pitblast.com

Website: www.o-pitblast.com

Customer Support

O-Pitblast is supported by a team of qualified technicians who are fully mobile and ready to assist you. For inquiries and assistance, please contact us:

General info: info@o-pitblast.com

O-PitSurface License Agreement

1. License

By receiving, opening the file package, and/or using O-PitSurface (Drill & Blast Design supported by O-Pitblast) (hereafter referred to as "O-PitSurface), you agree that this End User License Agreement (EULA) is legally binding and valid contract and agree to be bound by it. You agree to abide by the intellectual property laws and all of the terms and conditions of this Agreement. Unless you have a different license agreement signed by O-Pitblast, S.A..
Your use of O-PitSurface indicates your acceptance of this license agreement and warranty.

Subject to the terms of this Agreement, O-Pitblast, S.A. grants to you a limited, non-exclusive, non transferable license, without right to sub-license, to use O-PitSurface in accordance with this Agreement and any other written agreement with O-Pitblast, S.A..
O-Pitblast, S.A. does not transfer the title of O-PitSurface to you; the license granted to you is not a sale. This agreement is binding legal agreement between O-Pitblast, S.A. and the purchasers or user of O-PitSurface.

If you do not agree to be bound by this agreement, remove O-PitSurface from your computer now and, if applicable, promptly return to O-Pitblast, S.A. by mail any copies of O-PitSurface and related documentation and packaging in you possession.

2. Distribution

O-PitSurface and license herein granted shall not be copied, shared, distributed, re-sold, offered for re-sale, transferred or sub-licensed in whole or in part except that you may make one copy for archive purposes only. For information about redistribution of O-PitSurface contact O-Pitblast, S.A..

3. User Agreement

3.1 Use

Your license to use O-PitSurface **is limited to the number of licenses purchased by you**. You shall not allow other to use, copy or evaluate copie of O-PitSurface.

3.2 Use Restrictions

You shall use O-PitSurface in compliance with all applicable laws and not for any unlawful purpose. Without limiting the foregoing, use, display or distribution of O-PitSurface together with material that is pornographic, racist,

vulgar, obscene, defamatory, libelous, abusive, promoting hatred, discriminating, or displaying prejudice based on religion, ethnic heritage, race, sexual orientation, or age is strictly prohibited.

Each licensed copy of O-PitSurface may be used on one single computer location by one user. Use of O-PitSurface means that you have loaded, installed, or run O-PitSurface on a computer or similar device. If you install O-PitSurface onto a multi-user platform, server, or network, each and every individual user of O-PitSurface must be licensed separately.

You may make one copy of O-PitSurface for backup purposes, providing you with one copy installed on one computer being used by one person. Other users may not use your copy of O-PitSurface. The assignment, sublicense, networking, sale, or distribution of copies of O-PitSurface are strictly forbidden without the prior written consent of O-Pitblast, S.A..

It is a violation of this agreement to assign, sell, share, loan, rent, lease, borrow, network, or transfer the use of O-PitSurface. If any person other than yourself uses O-PitSurface registered in your name, regardless of whether it is at the same time or different times, then this agreement is being violated and you are responsible for that violation!

3.3 Copyright Restriction

This Software contains copyrighted material, trade secrets and other proprietary material. You shall not attempt to, modify, reverse engineer, disassemble or decompile O-PitSurface. Nor can you create any derivative works or other works that are based upon or derived from O-PitSurface in whole or in part.
O-Pitblast, S.A.'s name, logo and graphics file that represents O-PitSurface shall not be used in any way to promote products developed with O-PitSurface. O-Pitblast, S.A. retains sole and exclusive ownership of all right, title and interest in and to O-PitSurface and all Intellectual Property rights relating thereto.
Copyright law and international copyright treaty provisions protect all parts of O-PitSurface, products and services. No program, code, part, image, audio sample, or text may be copied or used in any way by the user except as intended within the bounds of the single user program. All rights not expressly granted hereunder are reserved for O-Pitblast, S.A..

3.4 Limitation of Responsibility

You will indemnify, hold harmless, and defend O-Pitblast, S.A., its employees, agents and distributors against any and all claims, proceedings, demand and costs resulting from or in any way connected with your use of O-Pitblast, S.A.'s Software.
In no event (including, without limitation, in the event of negligence) will O-Pitblast, S.A. , its employees, agents or distributors be liable for any consequential, incidental, indirect, special or punitive damages whatsoever (including, without limitation, damages for loss of profits, loss of use, business interruption, loss of information or data, or pecuniary loss), in connection with or arising out of or related to this Agreement, O-PitSurface or the use or inability to use O-PitSurface or the furnishing, performance or use of any other matters hereunder whether based upon contract, tort or any other theory including negligence.
O-Pitblast, S.A.'s entire liability, without exception, is limited to the customers 'reimbursement of the purchase price of the Software (maximum being the lesser of the amount paid by you and the suggested retail price as listed by O-Pitblast, S.A.) in exchange for the return of the product, all copies, registration papers and manuals, and all materials that constitute a transfer of license from the customer back to O-Pitblast, S.A..

3.5 Warranties

Except as expressly stated in writing, O-Pitblast, S.A. makes no representation or warranties in respect of this Software and expressly excludes all other warranties, expressed or implied, oral, or written, including, without limitation, any implied warranties of merchantable quality or fitness for a particular purpose.

3.6 Governing Law

This Agreement shall be governed by the law of the Portugal applicable therein. You hereby irrevocably attorn and submit to the non-exclusive jurisdiction of the courts of Portugal therefrom. If any provision shall be considered unlawful, void or otherwise unenforceable, then that provision shall be deemed severable from this license and not affect the validity and enforceability of any other provisions.

3.7 Termination

Any failure to comply with the terms and conditions of this Agreement will result in automatic and immediate termination of this license. Upon termination of this license granted herein for any reason, you agree to immediately cease use of O-PitSurface and destroy all copies of O-PitSurface supplied under this Agreement. The financial obligations incurred by you shall survive the expiration or termination of this license.

4. Disclamer of Warranty

This Software and the accompanying files are sold "as is" and without warranties as to performance or merchantability or any other warranties whether express or implied. This Disclaimer concerns all files generated and edited by O-Pitblast as well

5. Consent of use of data

You agree that O-Pitblast, S.A. may collect and use information gathered in any manner as part of the product support services provided to you, if any, related to O-PitSurface . O-Pitblast, S.A. may also use this information to provide notices to you which may be of use or interest to you.

Table of Contents

Table of Figures

1.Introduction

O-PitSurface, is a PC Windows-based application software designed for the planning, control and optimization of rock blasting operations. Developed by O-Pitblast©, is an application that pretends to fulfil all the need of blast engineers in order to optimize, control, reduce costs and increase safety in their blasts.
This platform allows the user to import terrain features, like topography and rock characteristics, and design the best blast for each operation. This is possible due to the artificial intelligence module that identifies potential safety risks and KPI's capable to generate savings. Besides all the operation modules, it has a management section that permits the recording of blast data, generation of blast plans and reports, KPI control graphics, track & trace technology, user control and multiple-projects management.
This software is user-friendly, and this manual will guide the user throughout all the basic features needed to learn and control it.

2.System Requirements (Recommended)

Operating System	Windows 10 or later
Productivity Tools	Adobe PDF
Processor Type	Core i7 Processor or higher
Memory	8 GB RAM or higher
Graphics Card	512 MB Video Memory or higher
Free Hard Drive Space	10 GB
Minimum Resolution	1280 x 720

3.Installing O-PitSurface

To install the O-PitSurface, download the file from: https://www.o-pitblast.com/products/o-pitsurface-drill-blast-design-software and after the download of the file, double click on the O-PitSurface executable (.msi) icon (Figure 1) and follow the onscreen instruction of the Setup program.

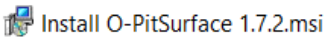


Figure 1 - O-PitSurface Installation icon.

After the welcome window appears (Figure 2), click Next and select the Typical installation method. Previously you must agree with the EULA (End-user license agreement) and select INSTALL to execute the installation of the software (Figure 4).

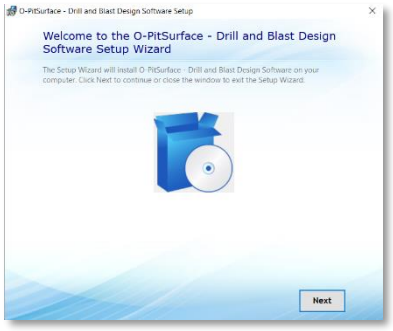


Figure 2 - O-PitSurface Welcome Window.

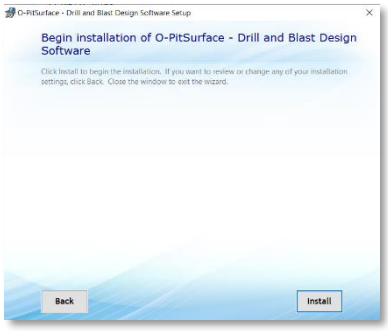


Figure 3 - O-PitSurface Ready to Install.

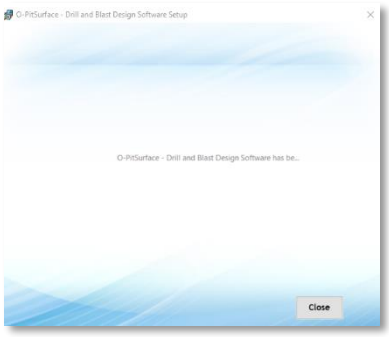


Figure 4 - O-PitSurface Installation Finished.

A desktop icon (Figure 5) is created and you must click on it to execute O-PitSurface.

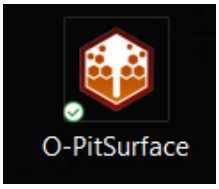


Figure 5 - O-PitSurface Desktop icon.

4.Updates

O-PitSurface update installation is automatic. If an update is available, and the user is connected to internet a pop-up window will appear advising to proceed with the installation of the update.

5. Registering O-PitSurface

When clicking in the O-PitSurface desktop icon a loading screen (Figure 6) and an authentication window (Figure 7) will be available for the user registration. Your login credentials must be given by O-Pitblast Technical Support (support@o-pitblast.com). Introduce your user credentials and confirm.

Figure 6 - O-PitSurface Loading Screen.

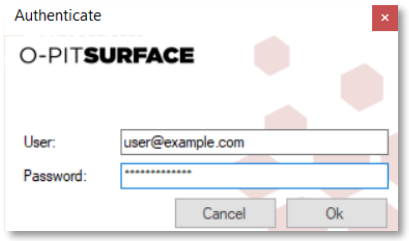


Figure 7 - O-PitSurface User Login Window.

O-PITSURFACE USER MANUAL

6.O-PitSurface Overview

O-PitSurface interface is showed in Figure 8 and it is composed by **5 sectors**:

A. **Main Control Bar**
B. **Toolbox**
C. **Work Environment**
D. **View Pane**
E. **Status**

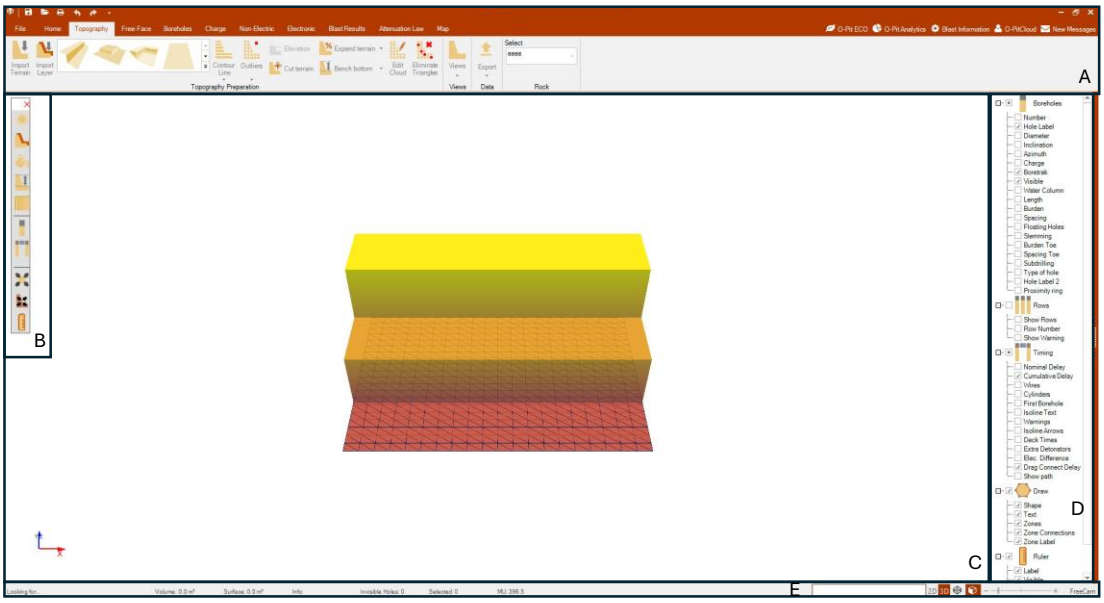


Figure 8 - O-Pitblast Overview.

6.1. Main Control Bar

The **Main Control Bar** serves as the central hub for controlling all software functionalities. Users can perform the following actions:

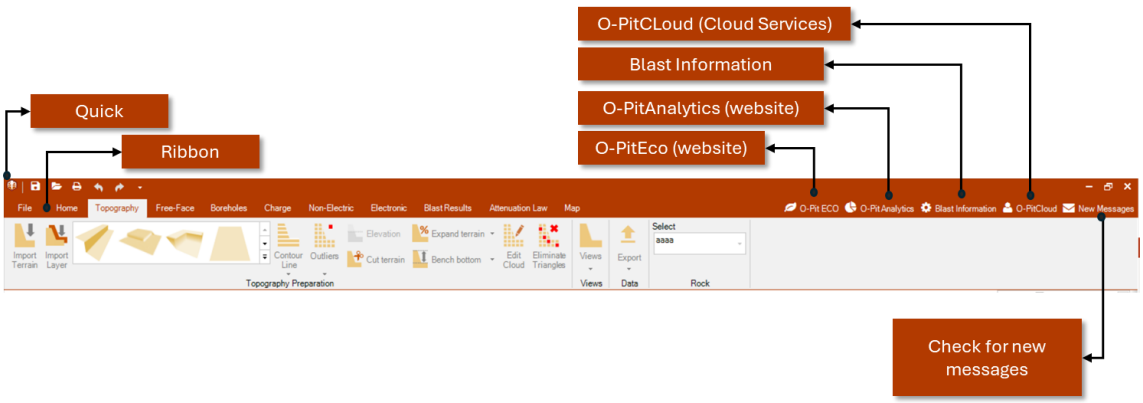


Figure 9 - Main Control Bar.

This figure illustrates the Main Control Bar interface, providing visual guidance on how to access and utilize its functions effectively.

6.2. Quick Access Bar

The **Quick Access Bar** provides the user with several options:

- **Save the actual file**: Save the current file.
- **Open a new file**: Start a new instance of O-Pitblast.
- **Print report**: Print a report from the software.
- **Undo**: Reverse the last action performed.
- **Re-do**: Redo the last action undone.
- **Open toolbox, check for updates and news, tutorials, download the manual and see the list of shortcuts** (Figure 11).

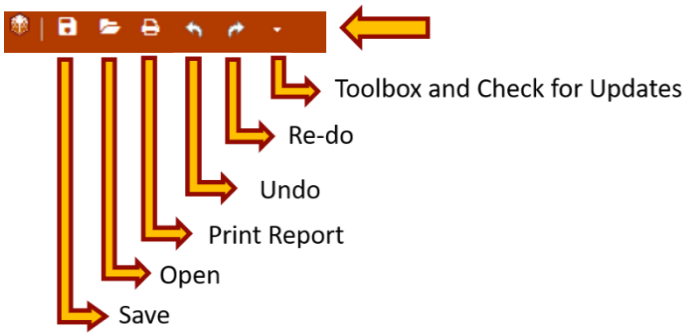


Figure 10 - Quick access bar.

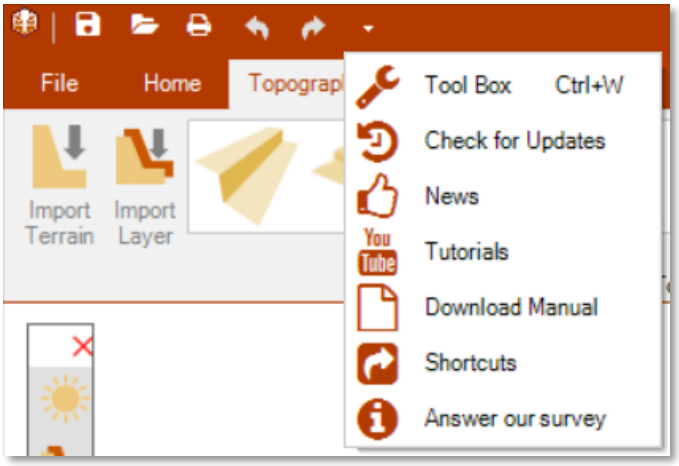


Figure 11 - Options inside of quick access bar.

6.3. Files Tab

On the **Files Tab** (Figure 12) the user can manage the files and project options.

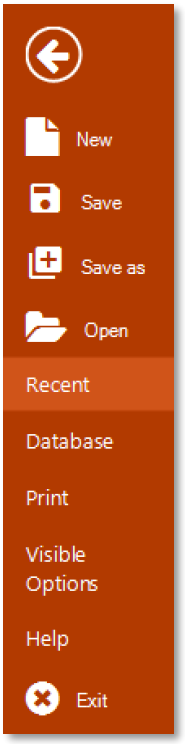


Figure 12 - Files Tab.

6.3.1. Create a New Project

By clicking on the **New Project**, the user opens a new instance of O-PitSurface.

6.3.2. Save and Save as the Current Project

O-PitSurface allows the user to save each project by generating a file with *. opit extension (Figure 13).

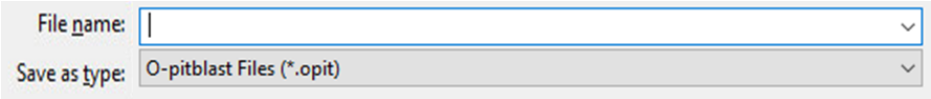


*Figure 13 - Save *.opit File.*

- The **Save** option updates an existing project file.
- The **Save As** option generates a new project file.

6.3.3. Open an Existent File

To open an existing file:

- Double-click the saved file icon (Figure 14) in the Windows File Explorer.
- Alternatively, use the **Open** service in the Files Tab.

Figure 14 - O-Pitblast Files icon.

6.3.4. Open a Recent File

O-PitSurface includes a **Recent Files Tab** (Figure 15) where the software stores up to 20 recently accessed files. This feature allows users to quickly access and open recently used projects without navigating through the file system.

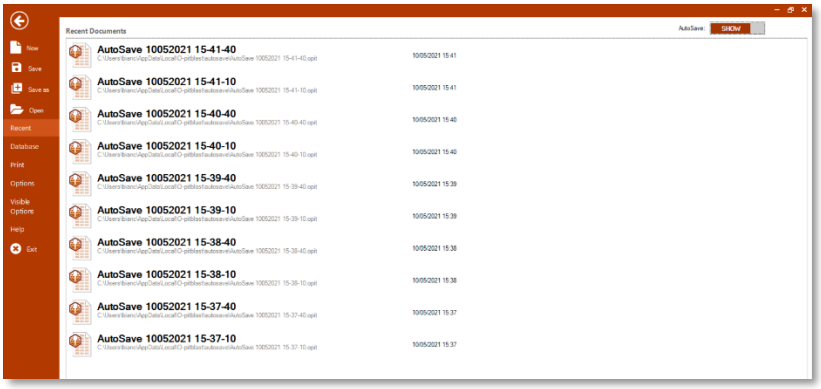


Figure 15 - Recent Files.

Users can select a file from the list, and O-PitSurface will automatically open the selected project.

6.3.5. Database

The **Database** in O-PitSurface allows for the storage of various types of data related to explosives, drilling costs, attenuation laws, rocks, and accessories.

6.3.5.1. Creating Detonators

To create a new detonator:

- Click on the **Add button** ✚
- Enter the following details:
  - Name/Description of the element
  - Type (Dual Detonator, Surface Connector, In-Hole Detonator, Electronic Detonator or Detonating Cord)
  - Surface Delay (ms)
  - In-Hole Delay (ms)
  - Color
  - Length (m)
  - Price
  - Gramature (g/m)
  - Discount (%)
  - Scatter (%)

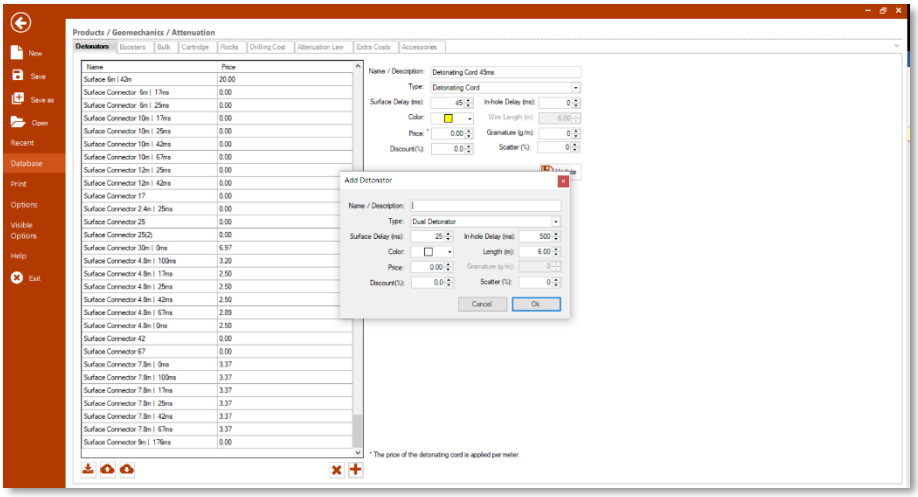


Figure 16 - Detonators Database (Adding detonator).

To delete an element, click on the **Delete Button** ✖

To update characteristics, use **Update Button** 💾.

Import product information using the **Import Button** 📥.

6.3.5.2. Creating Boosters

To create a new booster:

- Click on the **Add button** ✚
- Enter the following details:
  - Name/Description
  - Length (mm)
  - Diameter (mm)
  - Weight (g)
  - Price
  - Discount (%)

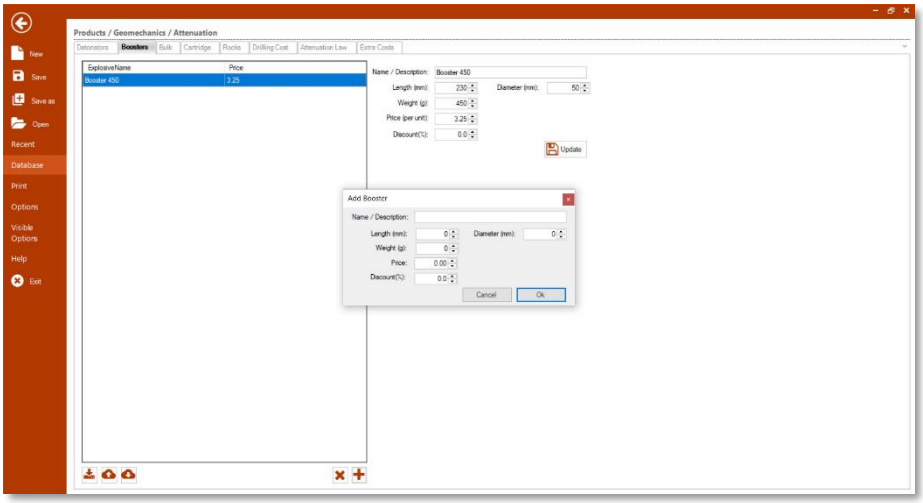


Figure 17 - Booster Database (Adding booster).

To delete an element, click on the **Delete Button**

To update characteristics, use **Update Button**.

Import product information using the **Import Button**.

6.3.5.3. Creating Bulk Explosives

To create a new Bulk explosive:

- Click on the **Add button**
- Enter the following details:
  - Name/Description
  - Density (g/cm^3)
  - RWS (Relative Weight Strength)
  - Price (The user can also choose if he wants per Kg or per Unit by clicking on those options)
  - VoD (Velocity of Detonation) (m/s)
  - Discount (%)
  - Effective Energy (kJ/Kg)

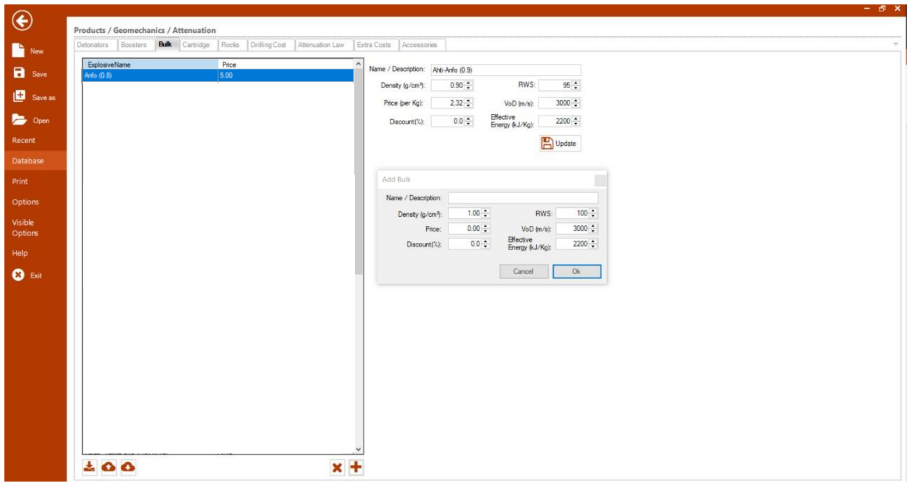


Figure 18 - Bulk Database (Adding bulk explosives).

To delete an element, click on the **Delete Button**

To update characteristics, use **Update Button**.

Import product information using the **Import Button**.

6.3.5.4. Creating Cartridge Explosives

To create a new Cartridge explosive:

- Click on the **Add button**
- Enter the following details:
  - Name/Description
  - Name/Description
  - Length (mm)
  - Diameter (mm)
  - Weight (g)

- RWS (Relative Weight Strength)
- Price (The user can also choose if he wants per Kg or per Unit by clicking on those options)
- Discount (%)
- Density (g/cm^3)
- Effective Energy (kJ/Kg)
- VoD (Velocity of Detonation) (m/s)

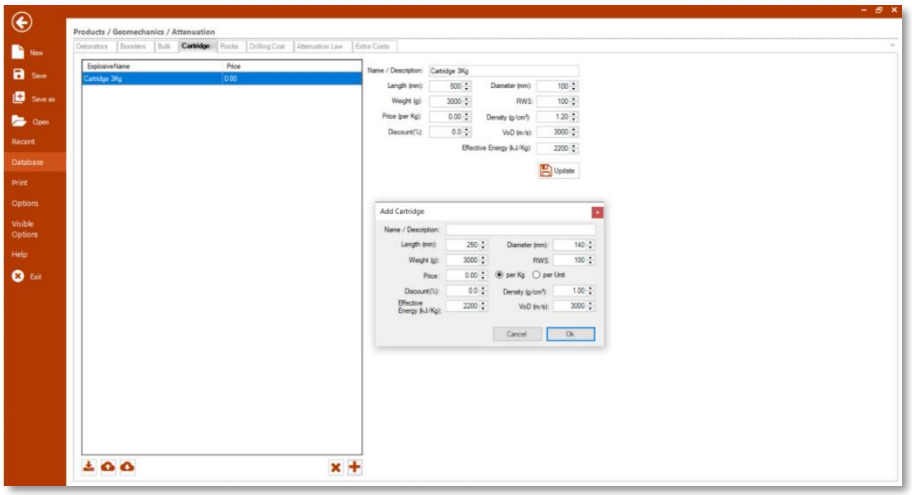


Figure 19 - Cartridge Database (Adding cartridge explosives).

To delete an element, click on the **Delete Button**

To update characteristics, use **Update Button**.

Import product information using the **Import Button**.

6.3.5.5. Creating Rocks

To create a new Rock:

- Click on the **Add button**
- Enter the following details:
  - Name/Description of the element
  - Rock density (g/cm^3)
  - Unc. Compressive Strengh (Mpa)
  - Young's Modulus (Gpa)
  - Rock Factor
  - Dynamic Compressive Strength (MPa)
  - Dynamic Confined Comp. Strength (MPa)
  - Dynamic Tensile Strength (MPa)
  - Poisson´s Ratio

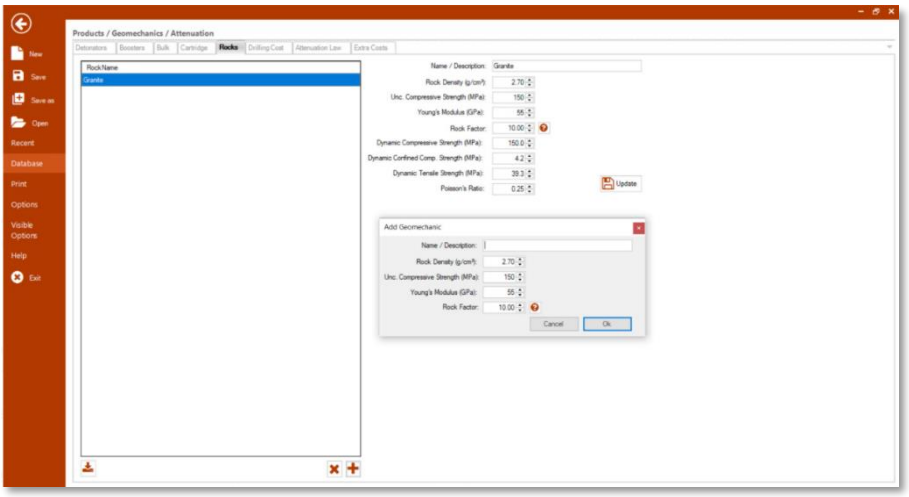


Figure 20 - Rock Database (Adding rock types).

To delete an element, click on the **Delete Button** 

To update characteristics, use **Update Button**  .

Import product information using the **Import Button**  .

The user can change the Rock Factor by click in  and then it will appear the window below:

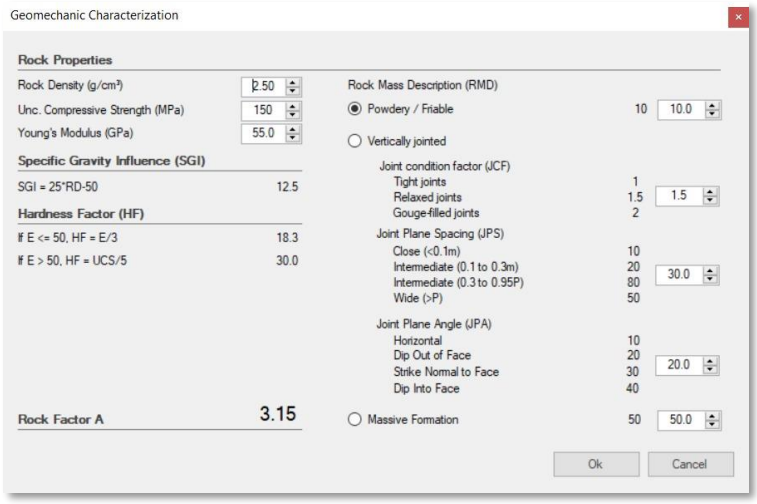


Figure 21 - Geomechanical characterization Window (Adding geomechanical parameters).

6.3.5.6. Creating Drilling Costs

To create a Drilling Cost:

- Click on the **Add button** 
- Enter the following details:
  - Description of the element
  - Diameter (mm)
  - Price per meter

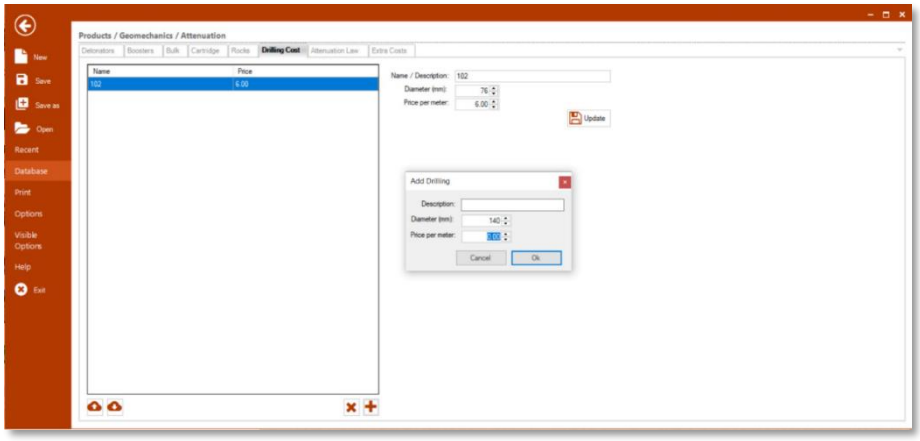


Figure 22 - Drilling Cost Database (Adding drilling costs).

To delete an element, click on the **Delete Button** ✖

To update characteristics, use **Update Button** 💾.

Import product information using the **Import Button** 📥.

6.3.5.7. Creating Attenuation Law

To create an Attenuation Law:

- Click on the **Add button** ✚
- Enter the following details:
  - **Name/Description** of the element
  - K
  - α
  - β

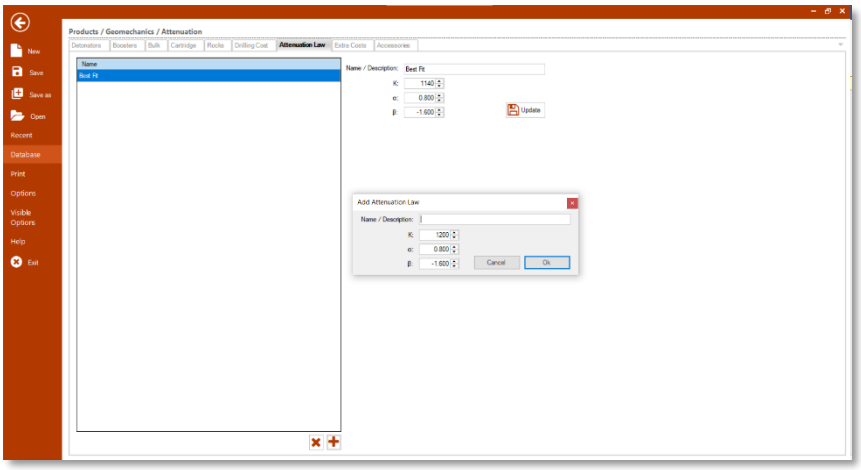


Figure 23 - Attenuation Law Database (Adding attenuation law).

To delete an element, click on the **Delete Button** ✖

To update characteristics, use **Update Button** 💾.

Import product information using the **Import Button** 📥.

6.3.5.8. Creating Extra Costs

To create Extra Costs:

- Click on the **Add button**
- Enter the following details:
  - Name/Description of the element and the
  - Unit Price

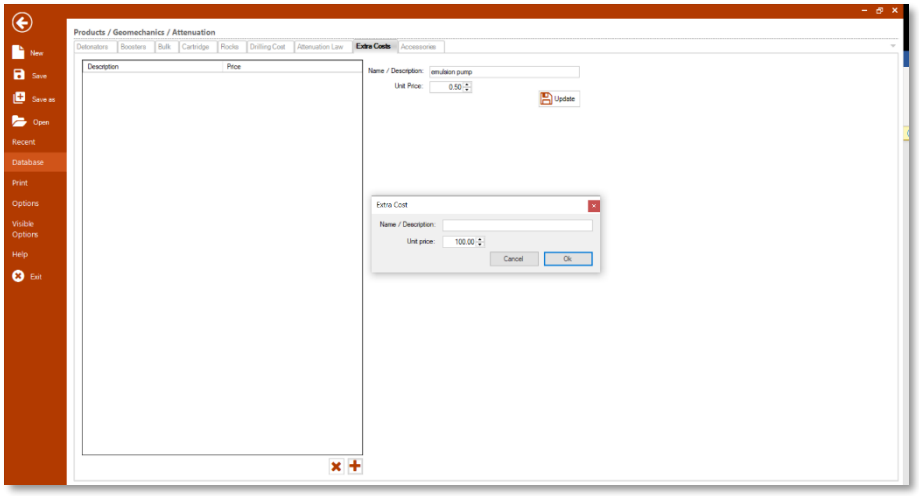


Figure 24 - Extra Costs Database (Adding extra costs).

To delete an element, click on the **Delete Button**

To update characteristics, use **Update Button**.

Import product information using the **Import Button** .

6.3.5.9. Creating Accessories

To create Acessories:

- Click on the **Add button**
- Enter the following details:
  - Name/Description of the element
  - Length (m)
  - Weight (g)
  - Price
  - Discount (%)
  - Null volume (checkbox)

Null Volume: When checked, this option disregards the volume capacity in the borehole.

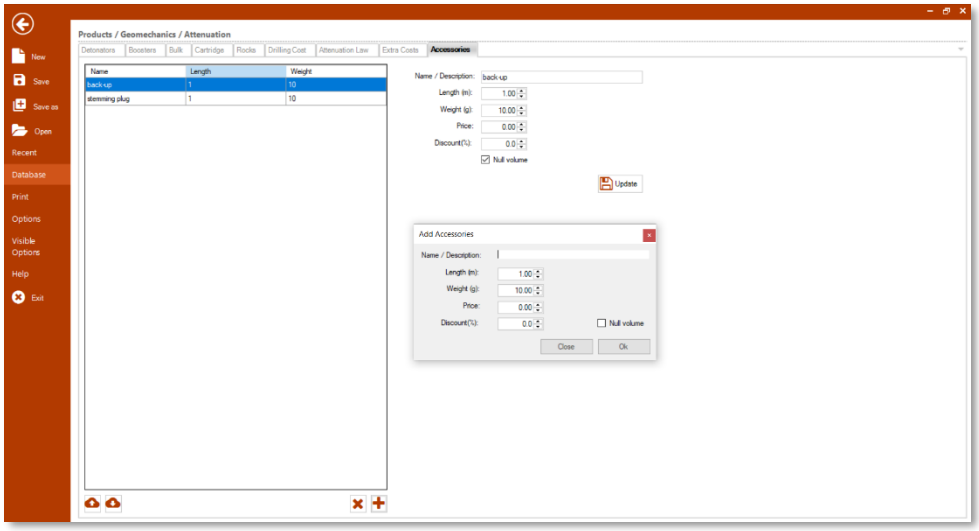


Figure 25 - Accessories Database (Adding accessories).

To delete an element, click on the **Delete Button** 

To update characteristics, use **Update Button**  .

Import product information using the **Import Button**  .

6.3.5.10. Sharing Database Information

6.3.5.10.1. Send to Cloud

On the database, inside of each product, click on the "**Send to cloud**" button (Figure 26). This option sends all product information to O-PitCloud, making it accessible in O-PitApp when creating new products.

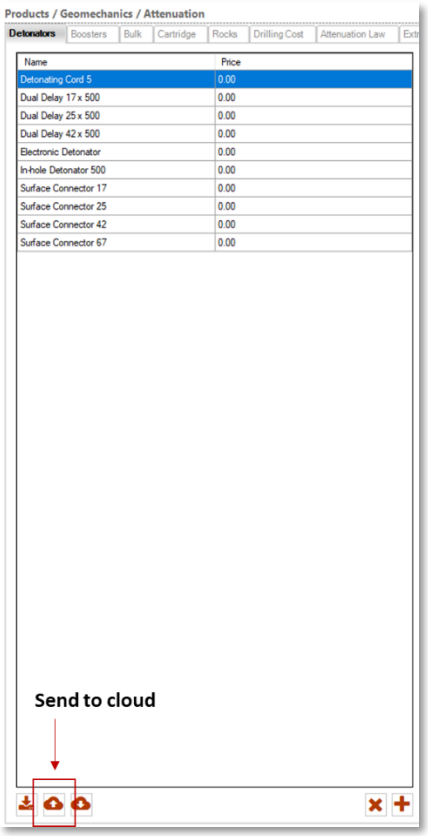


Figure 26 - "Send to Cloud" option.

6.3.5.10.2. Download from Cloud

To download information from other O-PitSurface users' databases:

- Click on **"Download from the Cloud"** (Figure 27).
- Enter the specific code (check section 19.2.9 for code generation details).

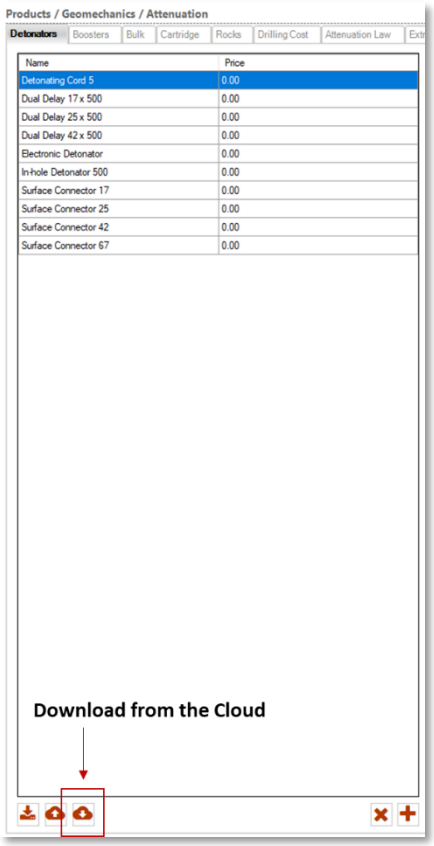


Figure 27 - "Download from Cloud" button.

After entering the code, a list of available information will appear (Figure 28), allowing the user to select and import desired items.

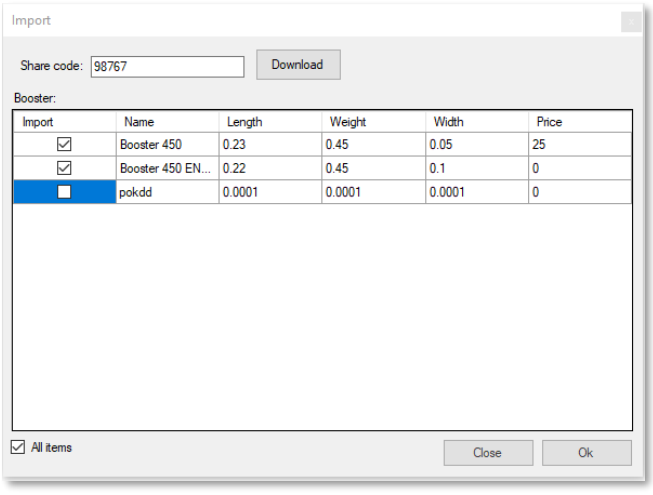


Figure 28 - Window with items for importation (example).

6.3.6. Print the Blast Plan

In the Blast Plan **Print Tab**, users can preview the pages of the blast plan. The final model can be customized by toggling available options.

6.3.6.1. Preview filled PDF

When in the "Print" section, locate the "**Preview and Print**" button at the bottom left. This feature allows users to preview the blast plan report before printing.

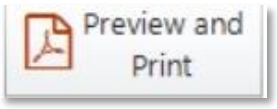


Figure 29 - Preview PDF button.

6.3.6.2. Save to Excel

Also in the "Print" section, find the "**Save to Excel**" button on the left side. This enables users to save the blast report as an Excel file.

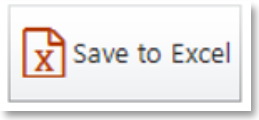


Figure 30 - Preview PDF button.

6.3.6.3. Configure PDF

Clicking this button allows users to configure the report using the General or Drilling tab. In the General tab, adjustments can be made to **colors**, **sizes**, **Connector label sizes, and hole diameter zoom**. In the Drilling tab, users can modify line **colors, opacity, and widths**.

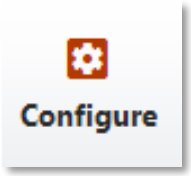


Figure 31 - Configure report button.

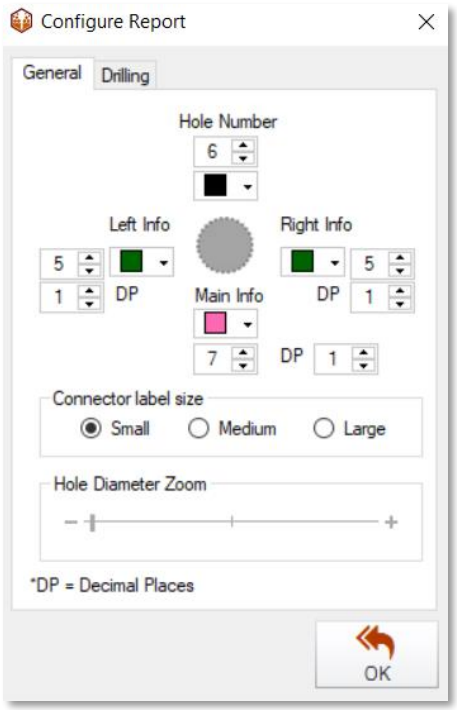


Figure 32 - Configure Report: General tab.

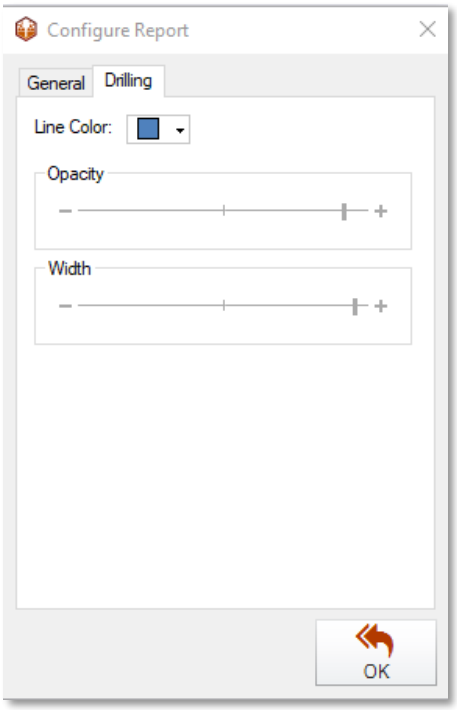


Figure 33 - Configure Report: Drilling tab.

6.3.6.4. Page Options

On the **Size Options** section is possible to select the page size for the general information pages, and for the Plans pages. (Figure 34).

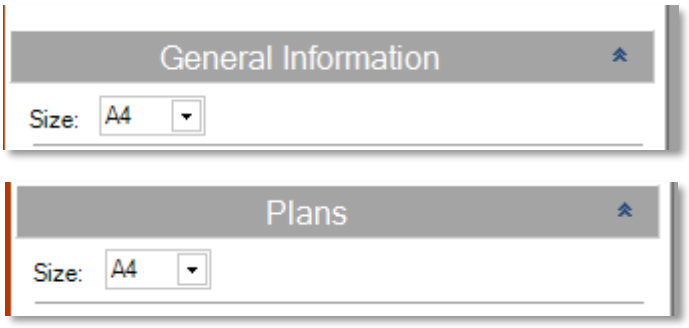


Figure 34 - Printing Blast Plan - Page Options.

Also, in the page options (Figure 35), the user has the possibility to insert a logo for the online report , select logo for report or delete the logo used .

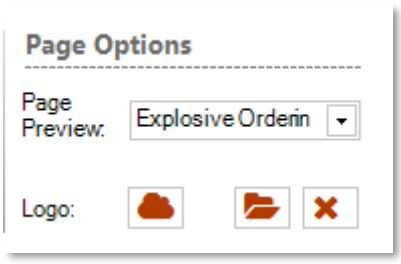


Figure 35 - Page options.

6.3.6.5. General Information

The **General Information** section (Figure 36) allows the selection of **Explosive Ordering**, **Accessories Ordering**, **Blast Resume**, **Comments**, **Charge Rule Design**, **Rows**, **Driller's Report**, **Borehole Information** (Figure 37), **Profile First Row**, **Cost**, **Rows**, **Detonator Profile**, **Fit Booster to BB**. and **Extra Detonators List**, **Map Details** (Figure 38), **Driller's log** (with D.I option – only showing information on the report of holes with deviation data), **Path Logger** (list with Path ID, path order, number of hole associated and delays per detonators), **Fragmentation**, **Histogram** and **Theoretical Bench Height** (this option uses the **Edit Theoretical information** (Figure 36). This last option refers to the theoretical information (Figure 39) that can be added to appear on the theoretical volume calculations (Figure 40).

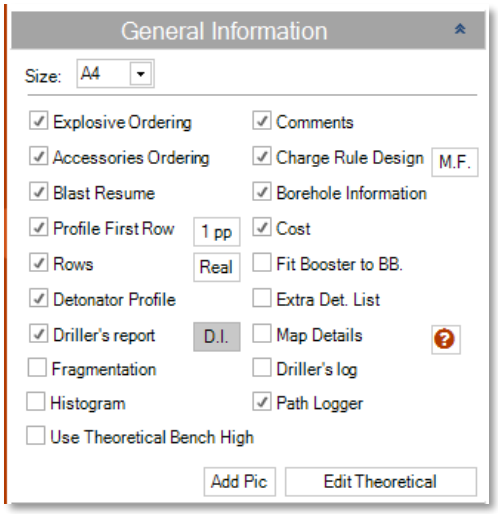
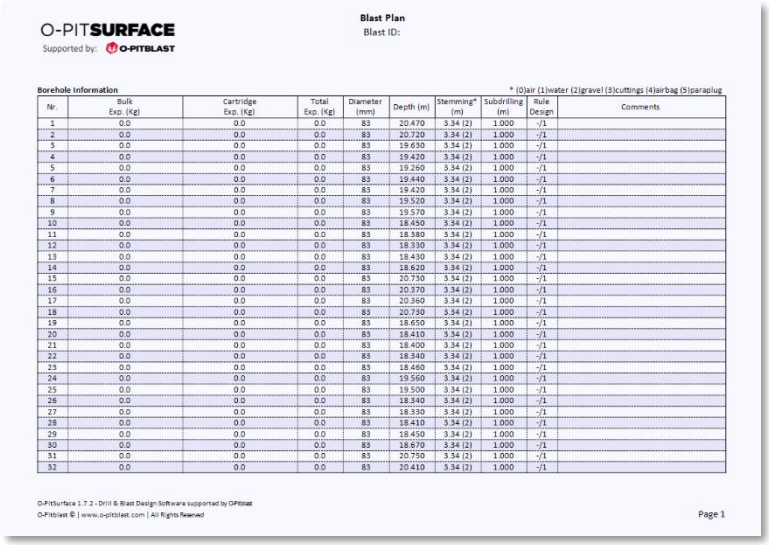


Figure 36 - Printing Blast Plan - General Information.


O-PITSURFACE
Supported by: O-PITBLAST

Blast Plan
Blast ID:

Borehole Information

* (0)air (1)water (2)gravel (3)cuttings (4)airbag (5)paraplug

Nr.	Bulk Exp. (Kg)	Cartridge Exp. (Kg)	Total Exp. (Kg)	Diameter (mm)	Depth (m)	Stemming* (m)	Subdrilling (m)	Rule Design	Comments
1	0.0	0.0	0.0	83	20.470	3.34 (2)	1.000	-/1	
2	0.0	0.0	0.0	83	20.720	3.34 (2)	1.000	-/1	
3	0.0	0.0	0.0	83	19.630	3.34 (2)	1.000	-/1	
4	0.0	0.0	0.0	83	19.420	3.34 (2)	1.000	-/1	
5	0.0	0.0	0.0	83	19.260	3.34 (2)	1.000	-/1	
6	0.0	0.0	0.0	83	19.440	3.34 (2)	1.000	-/1	
7	0.0	0.0	0.0	83	19.420	3.34 (2)	1.000	-/1	
8	0.0	0.0	0.0	83	19.520	3.34 (2)	1.000	-/1	
9	0.0	0.0	0.0	83	19.570	3.34 (2)	1.000	-/1	
10	0.0	0.0	0.0	83	18.450	3.34 (2)	1.000	-/1	
11	0.0	0.0	0.0	83	18.380	3.34 (2)	1.000	-/1	
12	0.0	0.0	0.0	83	18.330	3.34 (2)	1.000	-/1	
13	0.0	0.0	0.0	83	18.430	3.34 (2)	1.000	-/1	
14	0.0	0.0	0.0	83	18.620	3.34 (2)	1.000	-/1	
15	0.0	0.0	0.0	83	20.730	3.34 (2)	1.000	-/1	
16	0.0	0.0	0.0	83	20.370	3.34 (2)	1.000	-/1	
17	0.0	0.0	0.0	83	20.360	3.34 (2)	1.000	-/1	
18	0.0	0.0	0.0	83	20.730	3.34 (2)	1.000	-/1	
19	0.0	0.0	0.0	83	18.650	3.34 (2)	1.000	-/1	
20	0.0	0.0	0.0	83	18.410	3.34 (2)	1.000	-/1	
21	0.0	0.0	0.0	83	18.400	3.34 (2)	1.000	-/1	
22	0.0	0.0	0.0	83	18.340	3.34 (2)	1.000	-/1	
23	0.0	0.0	0.0	83	18.460	3.34 (2)	1.000	-/1	
24	0.0	0.0	0.0	83	19.560	3.34 (2)	1.000	-/1	
25	0.0	0.0	0.0	83	19.500	3.34 (2)	1.000	-/1	
26	0.0	0.0	0.0	83	18.340	3.34 (2)	1.000	-/1	
27	0.0	0.0	0.0	83	18.330	3.34 (2)	1.000	-/1	
28	0.0	0.0	0.0	83	18.410	3.34 (2)	1.000	-/1	
29	0.0	0.0	0.0	83	18.450	3.34 (2)	1.000	-/1	
30	0.0	0.0	0.0	83	18.670	3.34 (2)	1.000	-/1	
31	0.0	0.0	0.0	83	20.750	3.34 (2)	1.000	-/1	
32	0.0	0.0	0.0	83	20.410	3.34 (2)	1.000	-/1	

O-PitSurface 1.7.2 - Drill & Blast Design Software supported by OPitblast
O-Pitblast © | www.o-pitblast.com | All Rights Reserved

Page 1

Figure 37 - Boreholes Info.

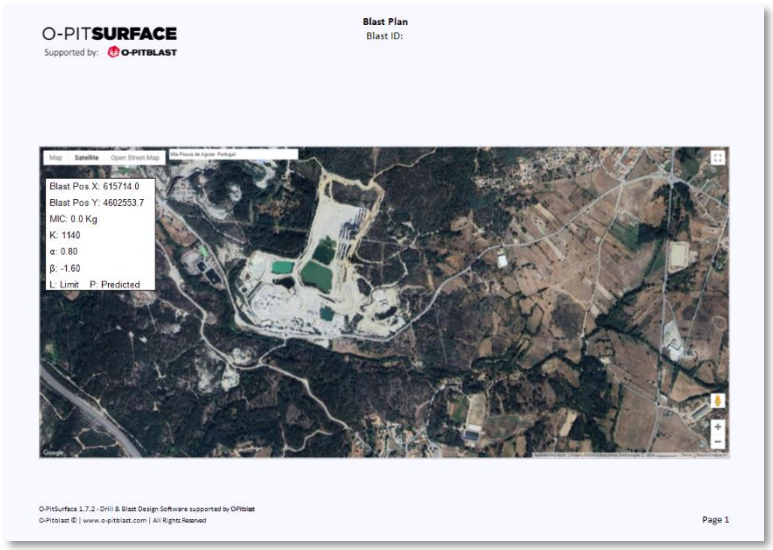


Figure 38 - Map info.

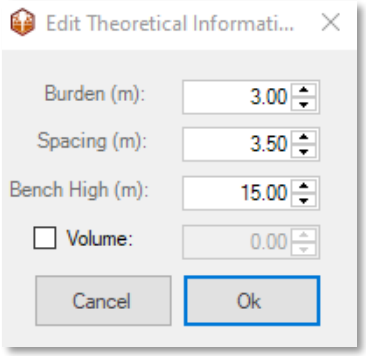


Figure 39 - Edit Theoretical Information.

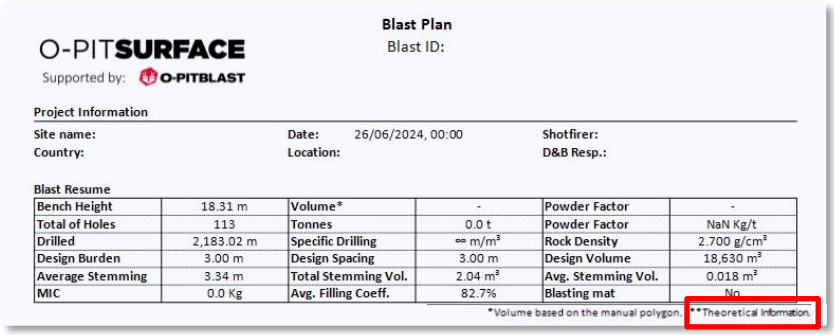
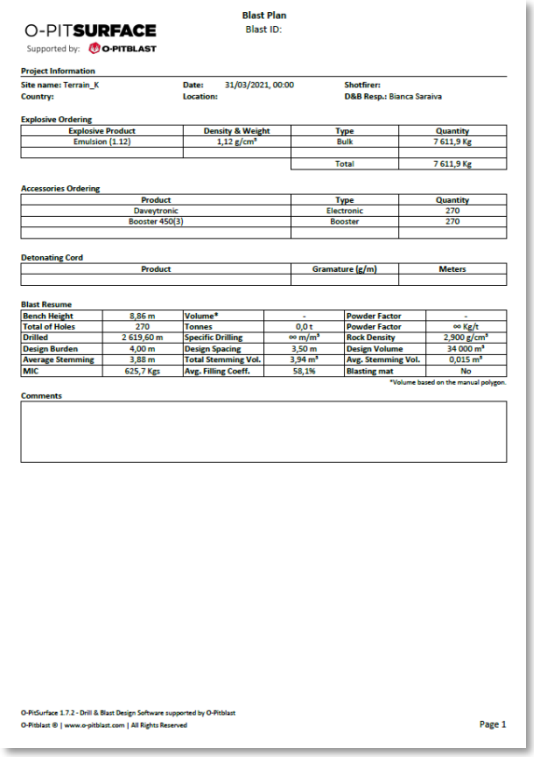


Figure 40 - Theoretical Information that can be added on the blast report.



Blast Plan
Blast ID:

O-PITSURFACE
Supported by: O-PITBLAST

Project Information

Site name: Terrain_K
Country:
Date: 31/03/2021, 00:00
Location:
Shotfirer:
D&B Resp.: Bianca Saraiva

Explosive Ordering

Explosive Product	Density & Weight	Type	Quantity
Emulsion (1.12)	1,12 g/cm³	Bulk	7 611,9 Kg
		Total	7 611,9 Kg

Accessories Ordering

Product	Type	Quantity
Daveytronic	Electronic	270
Booster 450(3)	Booster	270

Detonating Cord

Product	Gramature (g/m)	Meters

Blast Resume

Bench Height	8,86 m	Volume*	-	Powder Factor	-
Total of Holes	270	Tonnes	0,0 t	Powder Factor	∞ Kg/t
Drilled	2 619,60 m	Specific Drilling	∞ m/m³	Rock Density	2,900 g/cm³
Design Burden	4,00 m	Design Spacing	3,50 m	Design Volume	34 000 m³
Average Stemming	3,88 m	Total Stemming Vol.	3,94 m³	Avg. Stemming Vol.	0,015 m³
MIC	625,7 Kgs	Avg. Filling Coeff.	58,1%	Blasting mat	No

*Volume based on the manual polygon.

Comments

O-PitSurface 1.7.2 - Drill & Blast Design Software supported by O-Pitblast
O-Pitblast © | www.o-pitblast.com | All Rights Reserved
Page 1

Figure 41 - Blast Plan- General Information.

It's important to note that users need to capture a map image (refer to the Map Module) to include this information in the report. Users can also add new pictures to the report by clicking on "**Add Pic**" (Figure 42) in the General Information section.

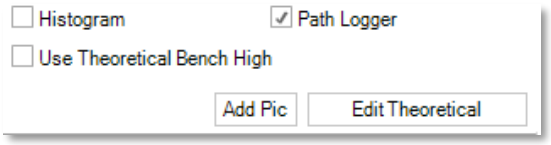


Figure 42 - Add picture option.

Next, users simply need to specify how many additional external pictures they want to include (up to a maximum of 4 photos across 9 pages) and add them using the plus sign (Figure 43).

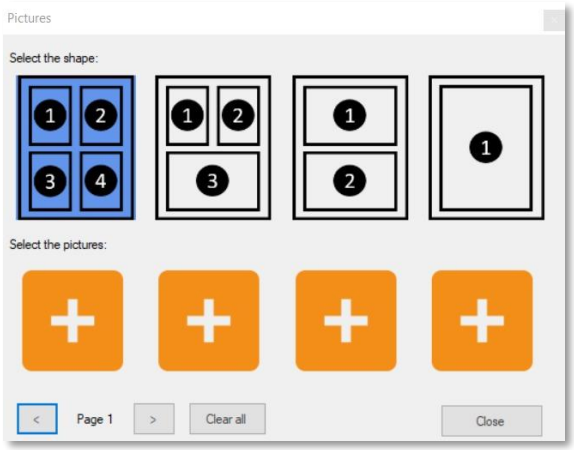


Figure 43 - Add pictures to the report.

6.3.6.6. Plans Information

O-PitSurface generates eight types of plans, **Drill Plan** (Figure 45), **Tie-Up Plan** (Figure 46 e Figure 47), **Offset Plan** (Figure 48), **Charge Plan** (Figure 49), **Electronic Differences Plan**, **Drag Connection Plan** (Figure 50) and **Hole´s Angle Analysis Plan** (Figure 51) that can be managed in the section of Figure 44.

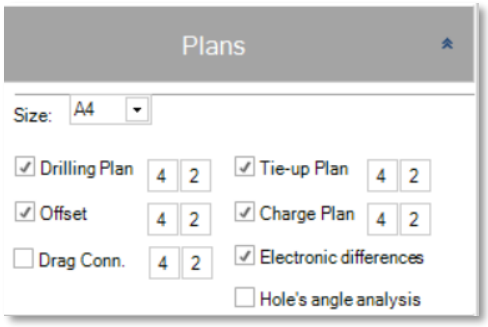


Figure 44 - Printing Plan – Plans.

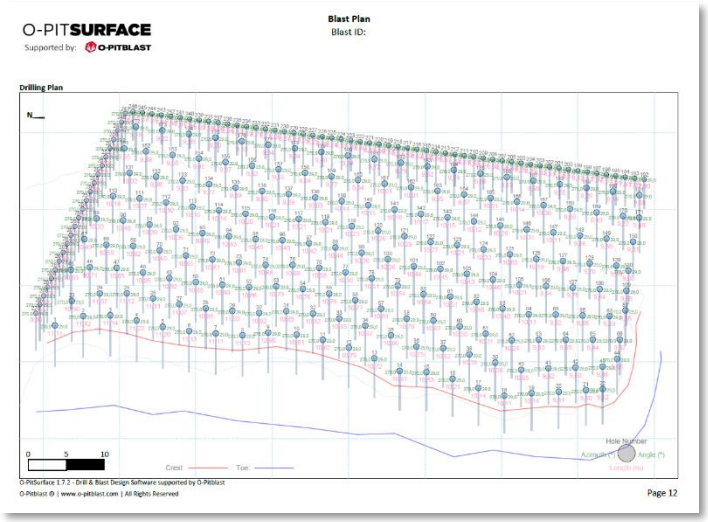


Figure 45 - Drill Plan.

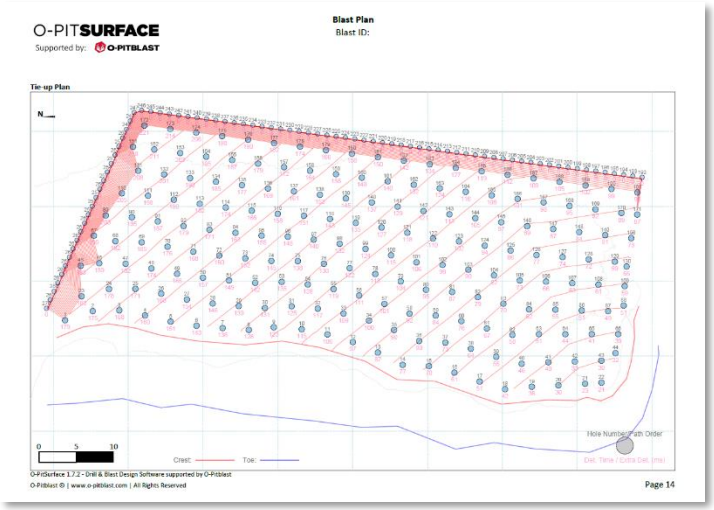


Figure 46 - Tie-Up Plan.

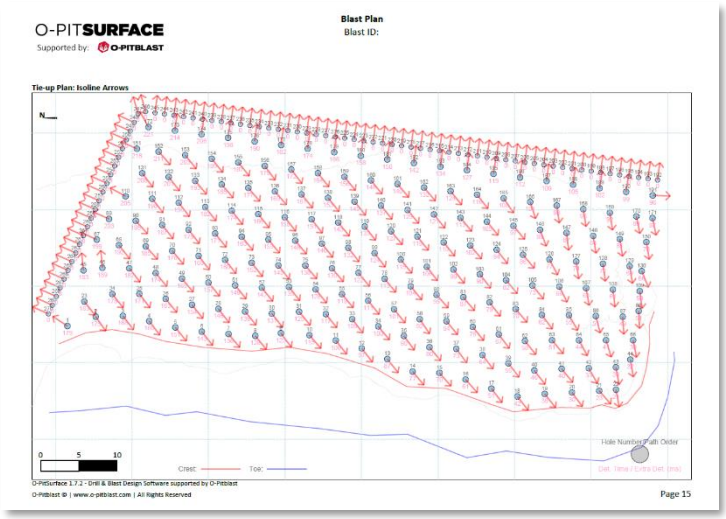


Figure 47 - Tie-Up Plan: Isoline Arrows.

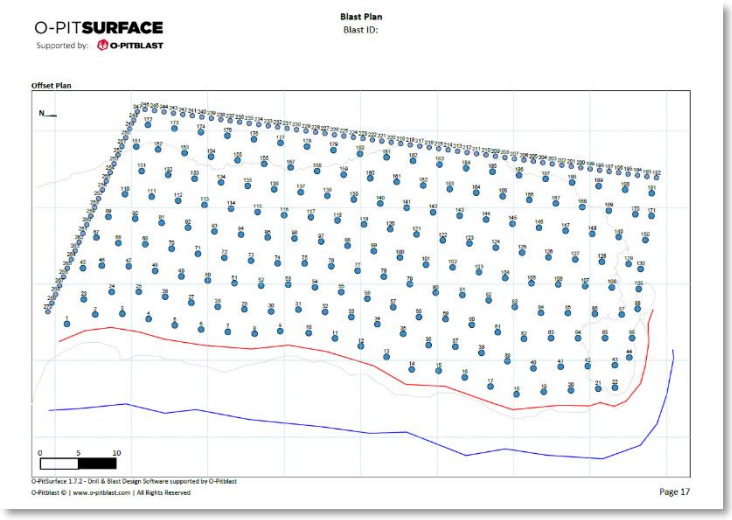


Figure 48 - Offset Plan.

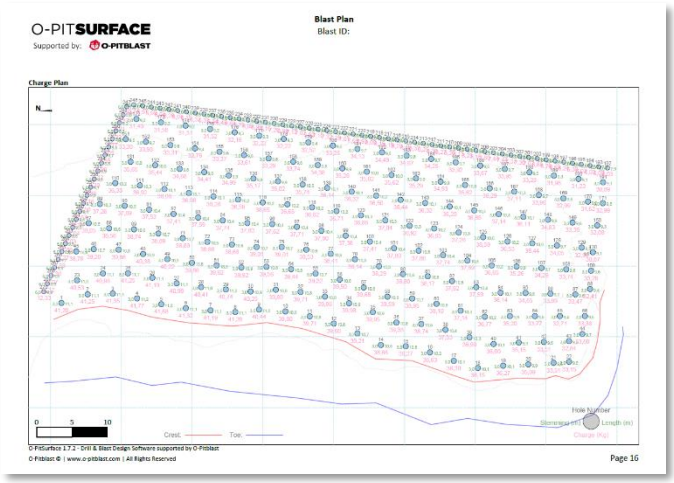


Figure 49 - Charge Plan.

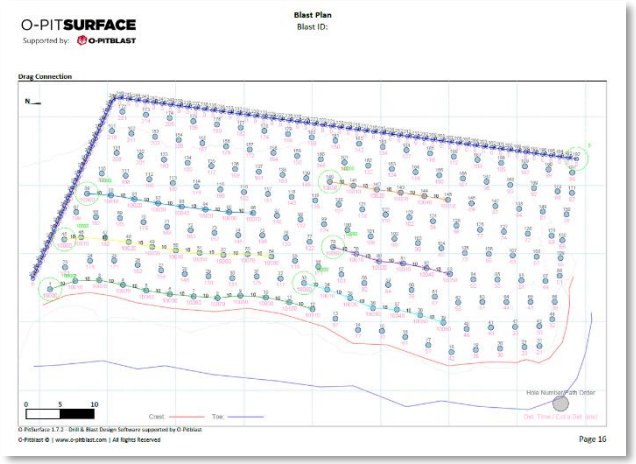


Figure 50 - Drag Connection Plan.

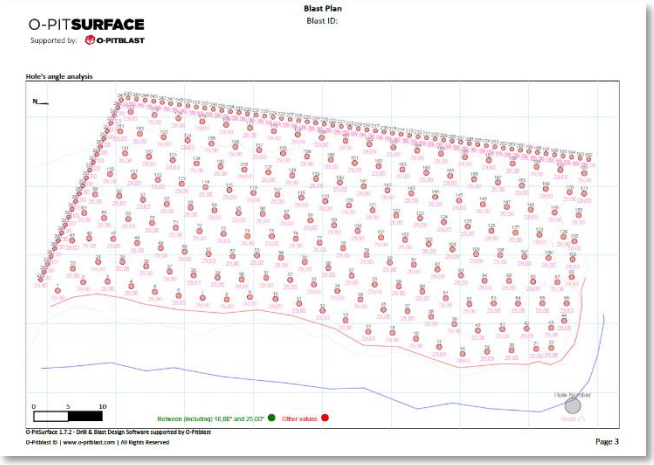


Figure 51 - Hole´s Angle Analysis Plan.

6.3.6.7. Plans Options

The **Plans Options** section permits the selection of some element to be present on plans: **Azimuth and Angle**, **Contour Lines**, **Crest and Toe**, **Grid** (selection of default values), **Time Isolines**, **Isoline Arrows**, **Connector Label**, **Scale**, **Best Fit**, **Show Detonators Time**, **Use Label** (instead of number of hole), **Show Hole ID**, **Extra Detonators Time**, **Stemming/Length on Charge**, **Comments**, **Legend**, **Driller's Report Length** (shows the longitude on driller's report), **Electronic Path**, **Double Tie-Up Report**, **Print Zones** (option to appear zones in the report, for example polygons) and the user can, within the field of the selected zone, choose whether to print the entire zone or a specific zone (polygon). The Print Points (option to appear points in the report, for example points from lines).

The **Best Fit** option generates the best adjustment of the holes, crest, and toe in the printed paper. If the user deselects this option, they can adjust the plan by angle.

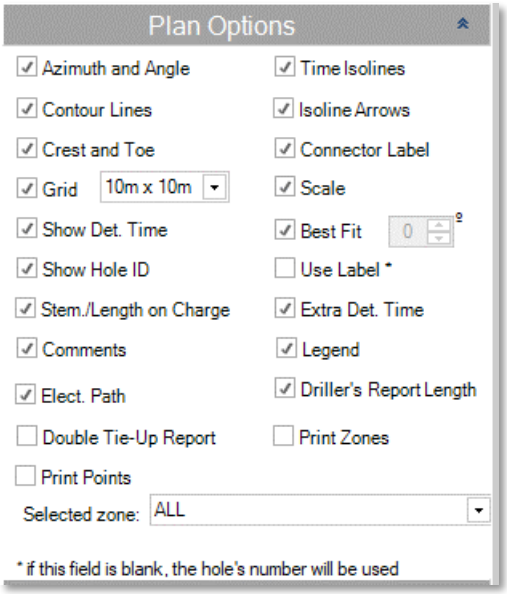


Figure 52 - Printing Plan - Plans Options.

6.3.6.8. Save Configuration

The user can save the configuration that he wants in all report from there. Just need to create a configuration and save it to future refer. It also can delete a configuration.

Figure 53 - Save Configuration. Buttons from left to right: load configuration, delete configuration and save a new configuration.

6.3.7. Options

Here the user has access to general options to change **currency** (Figure 54), **unit system -** Figure 55 **-** (the change it only will be applied when you restart O-Pitblast)**, Language** (Figure 56) , select whether **to show coordinates in feet** (Figure 57)**, terrain detail -** Figure 58 **-** (up to a maximum of 500000 points), **auto save -** Figure 59 - (that allows to automatically save the user work in .opit files - in a defined interval)**, Force Relief Tool** (Figure 60 – tool that is activated when needed), **Use XD Detonators** (Figure 61– option that is activated when needed), **Use DT5 Detonators** (Figure 62– option that is activated when needed), **Volume calculation** (Chapter 6.3.7.1), **Line aspect** (solid line or traditional line - Figure 63 and Figure 64), **High performance** (the change it only will be applied when you restart O-PitSurface)**, Electronic Path** (Figure 66 e Figure 67)**, clearance zone** (Chapter 6.3.7.2), and possibility to see the **initial step by step** (that appears the first time that the user opens O-Pitblast). And in this section, it also possible to select blast simulation –cumulative delay: show nominal (Figure 68). The user can use **Hole´s angle definition** – Figure 69 - to assign steep holes in the Hole´s Angle Analysis Plan, according to the minimum and maximum angle entered. In addition, there is the **PPV isoline limit** which makes it possible to attribute the minimum desired value to appear on the map.

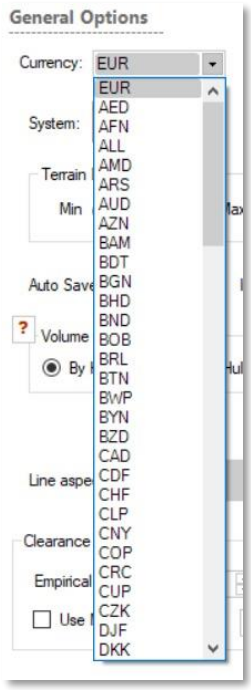


Figure 54 - Change currency.

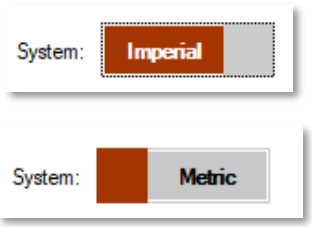


Figure 55 - Change to metric/imperial system.

Figure 56 - Change language.

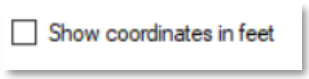


Figure 57 – Show coordinates in feet.

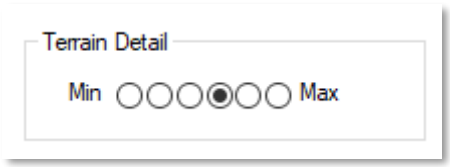
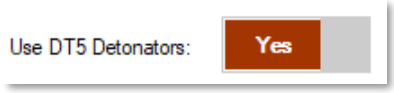


Figure 58 - Change terrain detail.

Figure 59 - Auto Save option.

Figure 60 - Force Relief Tool option.

Figure 61 - Use XD Detonators option.



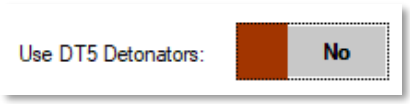


Figure 62 - Use XD Detonators option.

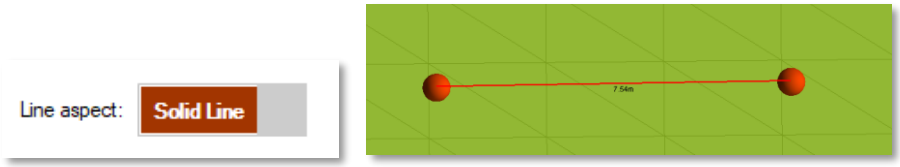


Figure 63 - Solid line.

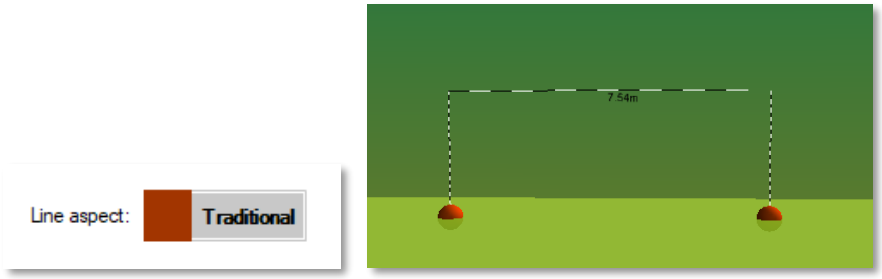


Figure 64 - Traditional line.

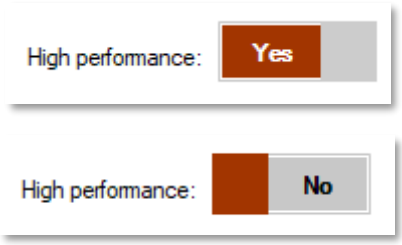


Figure 65 - High Performance option.

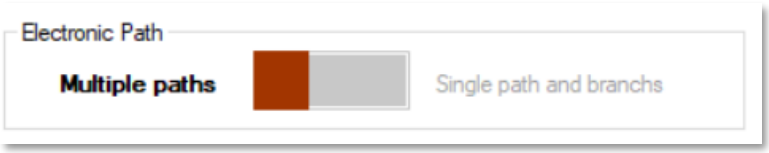


Figure 66 - Change to see Electronic Path as multiple paths.

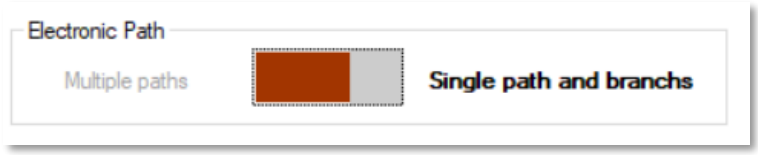


Figure 67 - Change to see Electronic Path as single path and branch.

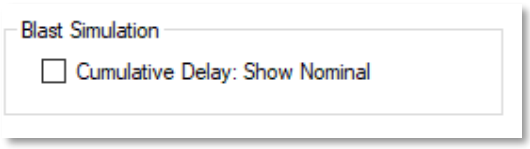


Figure 68 - Select Blast Simulation.

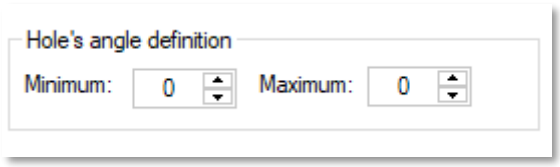


Figure 69 - Hole´s angle definition.

6.3.7.1. Volume Calculation

On the **Options tab**, users can select different methods to calculate the blast volume. These volume calculation methods in O-PitSurface cater to various scenarios encountered in mining and blasting operations. They offer flexibility in incorporating subdrilling data, adjusting calculations based on average burden on the first row, and allowing manual input of theoretical parameters to refine blast volume estimates. Choosing the appropriate method depends on factors such as the terrain complexity, data availability, and desired accuracy of the volume calculation for effective planning and execution of blasting activities.

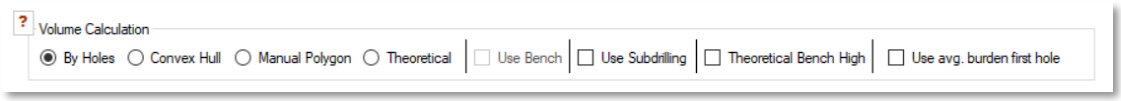


Figure 70 - Options to volume Calculation.

Each option allows the user to **use:**

- **Bench:** This option uses the bench bottom
- **Subdrilling**: Incorporates subdrilling data if available, adjusting the calculated volume based on the depth drilled beyond the bench bottom.
- **Theoretical Bench Height**: Allows consider a theoretical bench height value (inserted manually), which affects the volume calculation by adjusting the top surface level considered for the volume calculation.
- **Average Burden on First Row**: Offers the option to use the average burden (spacing between adjacent boreholes) on the first row of holes to refine the volume calculation.

Below are descriptions of the various volume calculation options.

6.3.7.1.1. By Holes

This method calculates the blast volume by summing up the individual volumes of each borehole.

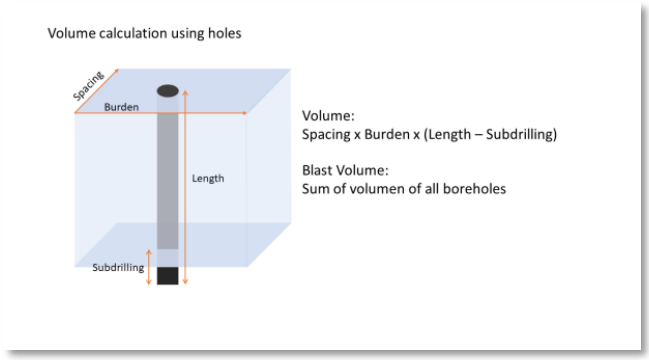


Figure 71 - Volume calculation "By holes".

Use average burden on first row (Figure 72) Offers the option to use the average burden (spacing between adjacent boreholes) on the first row of holes to refine the volume calculation.

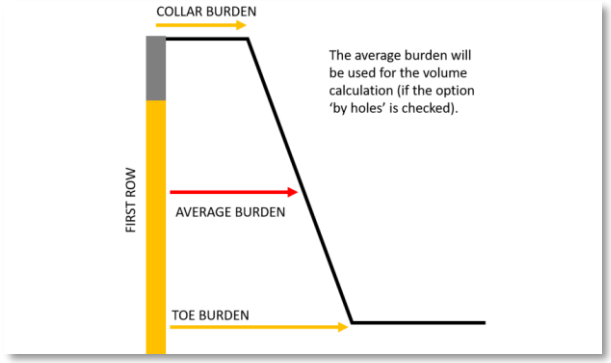


Figure 72 - Collar burden vs average burden.

6.3.7.1.1. Convex Hull

Utilizes the Convex Hull algorithm to determine the blast volume. The Convex Hull is the smallest convex shape that can encompass all borehole collar points.

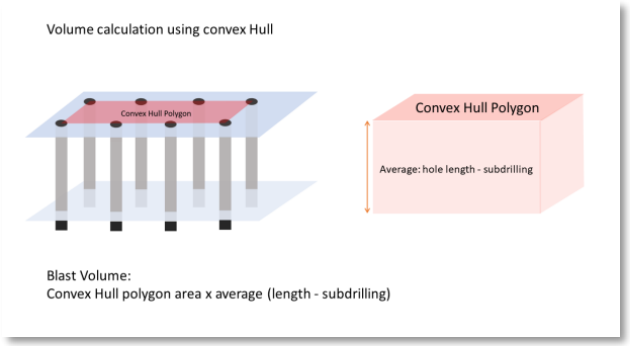


Figure 73 - Volume calculation using "Convex Hull".

Bench Bottom: Recommended. Uses the bench bottom for Convex Hull calculation instead of the average hole length, thereby considering the full depth drilled to the bench bottom for accurate volume determination.

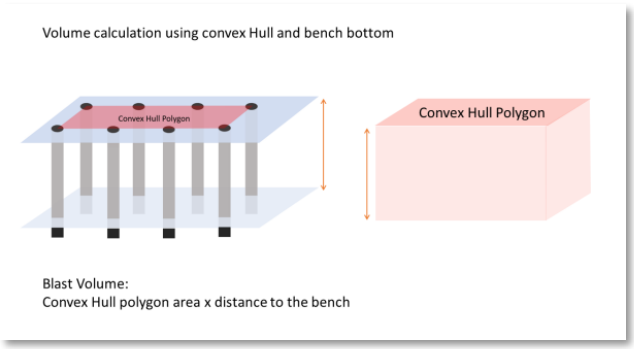


Figure 74 - Volume calculation using convex Hull until bench bottom (instead of holes average length).

6.3.7.1.1. Manual Polygon

On the option “Manual Polygon” (Figure 75), the user needs to design a polygon on the area he wants to be part of the volume calculation, right click over the zone and select the option “set as blast volume”.

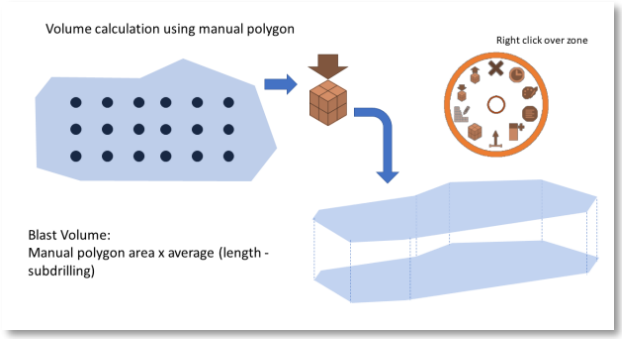


Figure 75 - Volume calculation using manual polygon.

6.3.7.1.1. Theoretical

The **Theoretical volume** is calculated based on a value inputted by the user in the "**Edit Theoretical**" window (Figure 39).

6.3.7.2. Clearance Zone

This option allows the user to define some factors for the clearance zone. The user must define an **empirical constant K**, as higher this constant as harder is the rock, and a safety factor for personal and equipment (Figure 76). And the user must assign values to **Safety Factor** (personnel and equipment).
Like shown in the picture bellow (Figure 77), the software will calculate the fly rock risk based in 3 different types: face burst, cratering and rifling. Then, it will have in account the worst case and will multiple the result for the safety factors. The user can also select whether to separate the fly rock risk calculation for the first line only by all or one of the 3 mechanisms mentioned above, including use crest as a limiter. In addition, for the other rows, it can also be calculated using the 3 types.

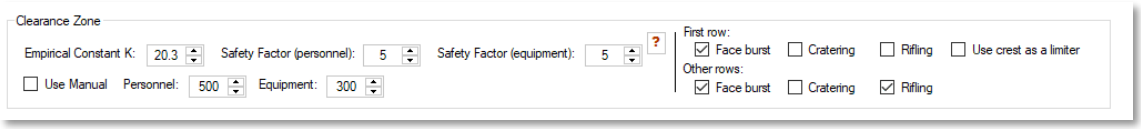


Figure 76 - Calculation of Clearance zone.

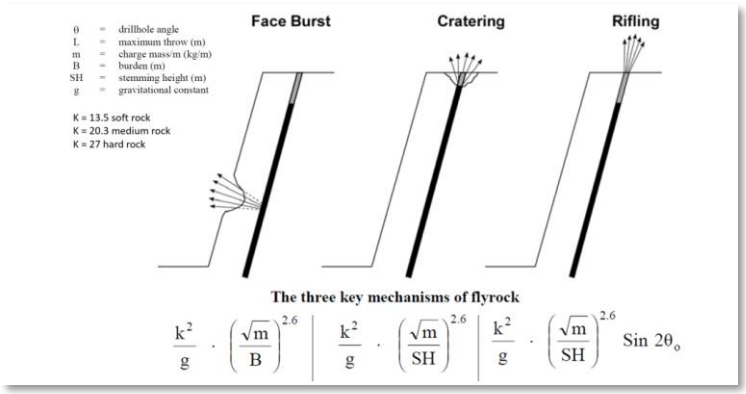


Figure 77 - Face burst, cratering and rifling calculation.

Another way to calculate it, it is to give manual values for the clearance zone (Figure 78).

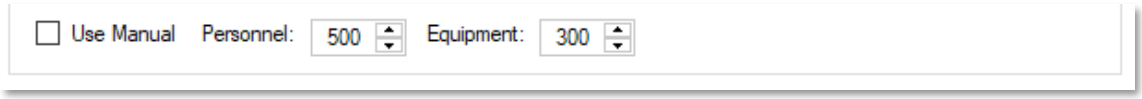


Figure 78 - Manual input for clearance zone.

6.3.8. Visible Options

The visible options allow the user to mark de option that he wants to see in the ribbon. The user can mark and unmark the **Topography** label, **Free-Face** label, **Boreholes** label**, Charge** Label, **Electronic** label, **Non-Electronic** label, **Blast Results** label, **Attenuation Law** label, **Home** label, and **Map** label.

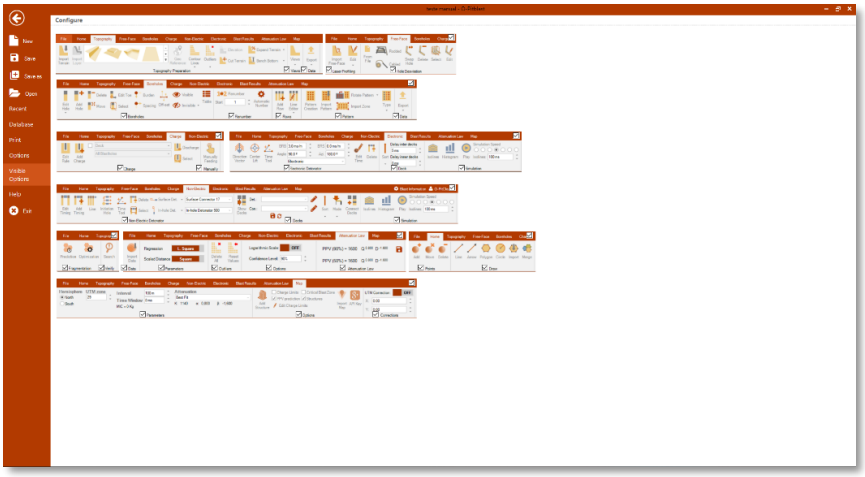


Figure 79 - Visible options tab.

6.3.9. Help

Through the **Help** tab, the O-Pitblast user will have access to **O-Pitblast Website**, to a platform to **Contact** O-Pitblast team, several **Movie Tutorials** and other interest connections.

Figure 80 - Help Tab.

6.3.9.1. Ask for Help

This option (Figure 81) allows the user to open a new ticket where the O-Pitblast file is send to the server with the error reported. Also, the user can add a **tittle** (referring the question/problem), **comments** explaining the problem/question and **pictures** (on the plus sign).

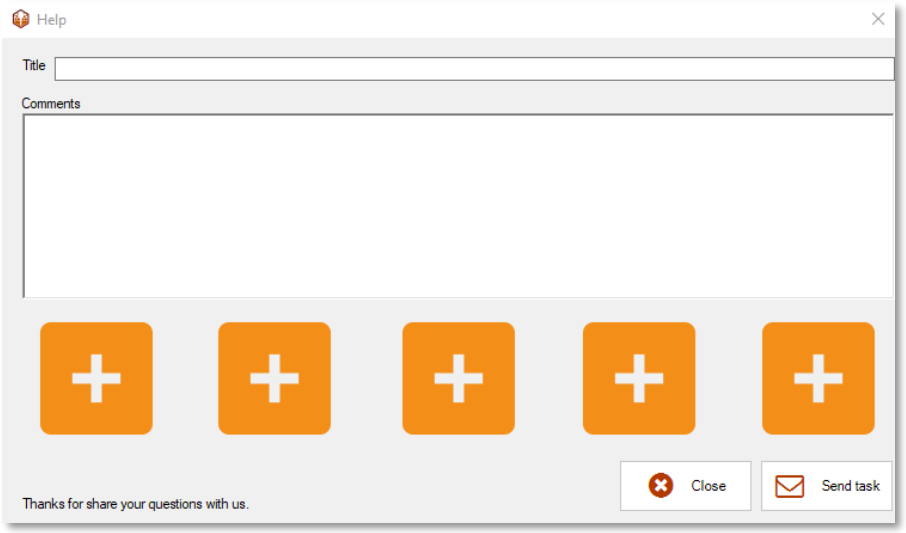


Figure 81 - Ask for help tab.

6.3.10. Exit

By clicking in the **Exit** tab, O-Pitblast will shut down.

6.4. Tool Box

Toolbox centralize all the useful means to control the visual effects of the working environment. It is divided in 7 sub-categories with an extra **Centralize** button to center the terrain in the user screen, an Extra **Size View** and an extra **Ruler** button that will help the user to make measurements on the terrain and check the angles. To all these sub-categories, the actions will only be applied after clicking in the confirmation button **Ok**.

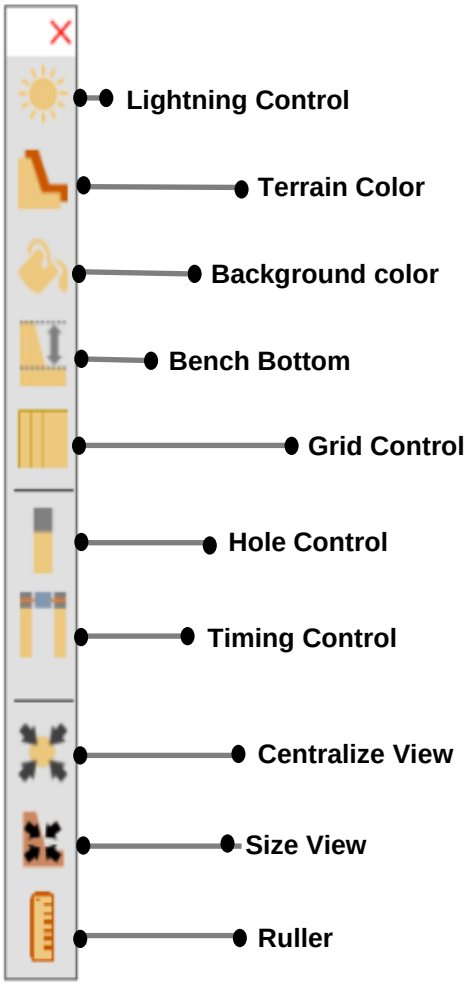


Figure 82 - Tool Box Window.

6.4.1. Lighting Control -

In the **Lighting Control Window** (Figure 83), the user can control the light **Intensity** as also as the incident lighting vector direction (**X** and **Y**).

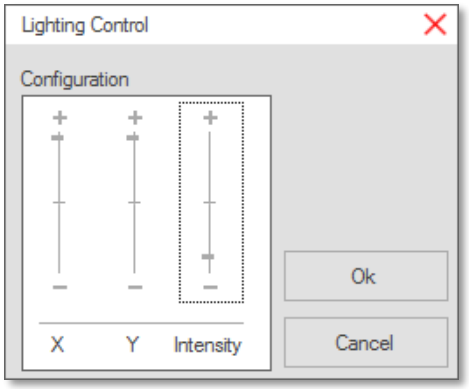


Figure 83 - Lighting Control Window.

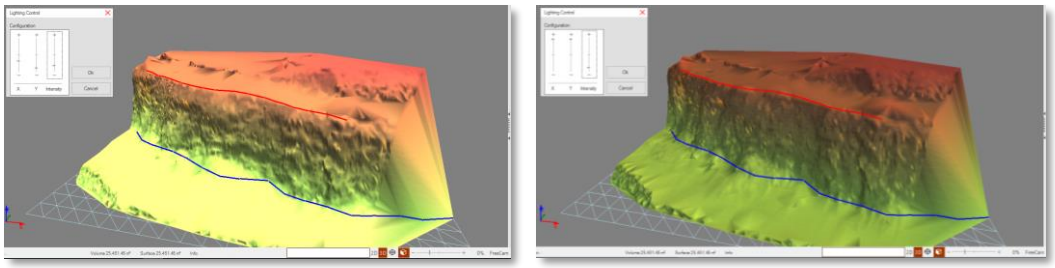


Figure 84 - Lighting Control.

6.4.2. Terrain Color -

To change the terrain visualization characteristics, in the **Terrain Color Window** (Figure 85), the user can modify:

- Main terrain Color or Layer color
- Triangulation type (**Solid** or **Wire**)
- Scan points
- Transparency
- Delete layers

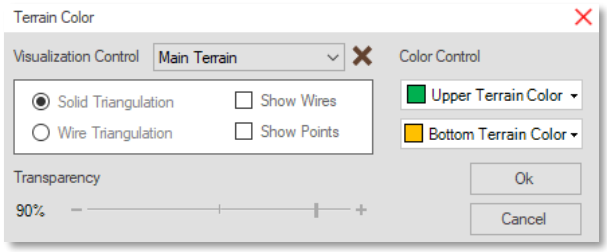


Figure 85 - Terrain Color Window.

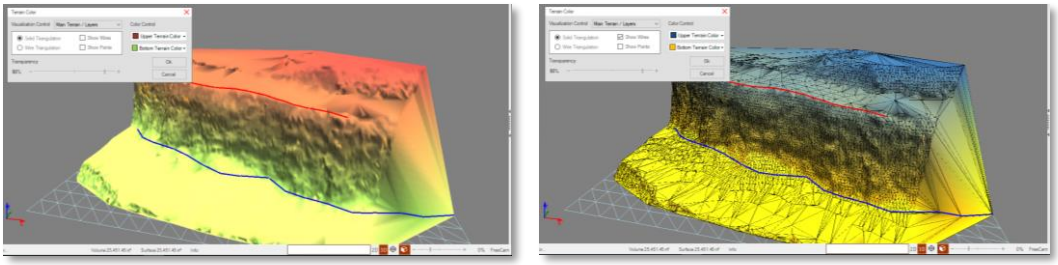


Figure 86 - Terrain Color Edition.

6.4.3. Background Color -

The **Background Color Windows** (Figure 87) allows the user the change the Background color.

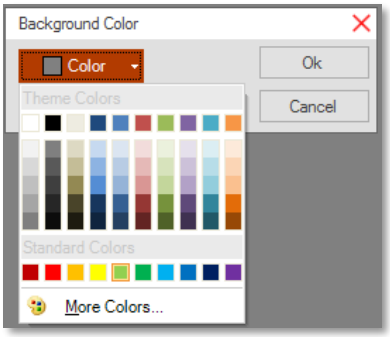


Figure 87 - Background Color Window.

6.4.4. Bench Bottom Control -

In the **Bench Bottom Control Window** (Figure 88), the user can adjust the bench bottom level, inclination, azimuth, color and triangulation type (solid or wire). Also, the user has the option to "**Set layer**" where the user can create new layers of work (Figure 90).

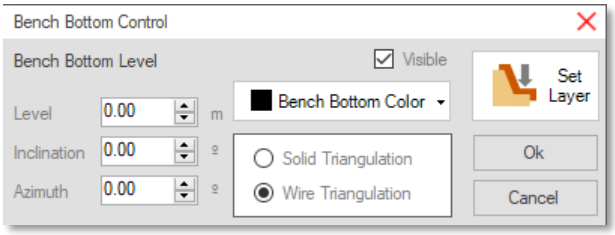


Figure 88 - Bench Bottom Control Window.

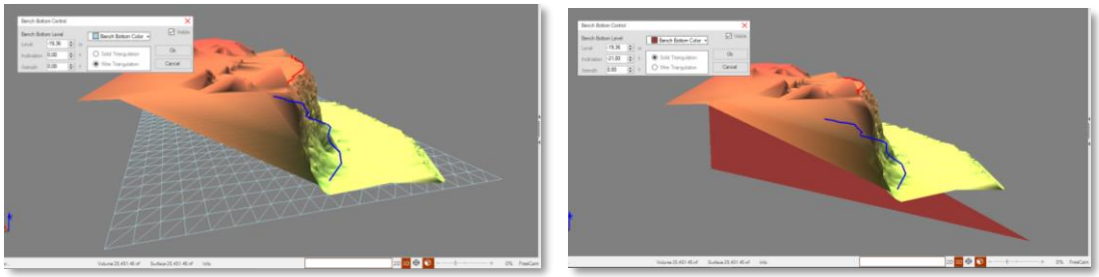


Figure 89 - Bench Bottom Edition.

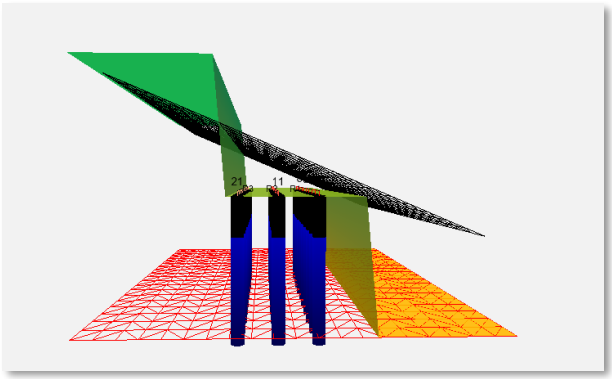


Figure 90 - Two layers of work (red and black).

6.4.5. Grid Control

The **Grid Control** allows the user the change the **grid** (meters), **color** or if is **visible** or not.

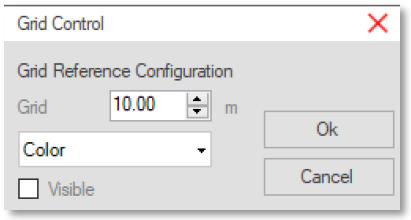


Figure 91 - Grid control.

6.4.6. Hole Control -

The **Hole Control Window** (Figure 92) controls the hole visualization characteristics such as type color, diameter scale.

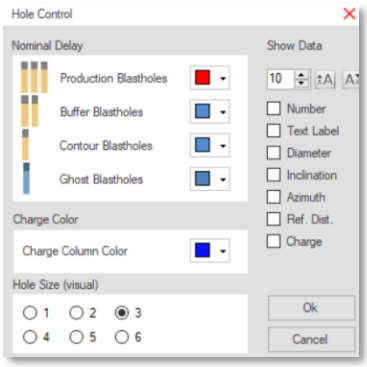


Figure 92 - Hole Control Window.

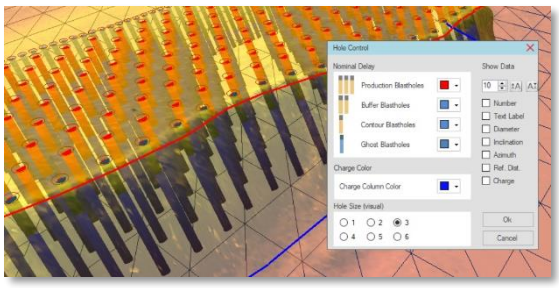


Figure 93 - Holes visualization control.

6.4.7. Timing Control -

In the Timing Control Window (Figure 94), the user can establish the visualization of the nominal times of connectors or/and cumulative blast delays of each hole. Besides that, is possible to control de size of connector cylinders and text sizes.

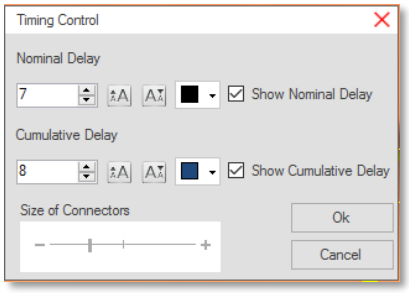


Figure 94 - Timing Control Window.

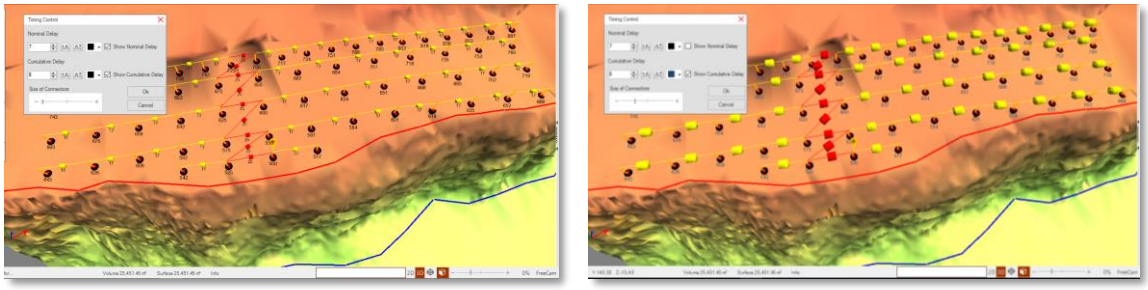


Figure 95 - Editing Connectors.

6.4.8. Ruler -

In the **Ruler** options the user can measure any part of the terrain, such as length of borehole or the burden between two holes. Just click on the ruler option and click in a point on the terrain. Then drag the mouse until the other point (the two points of measure).

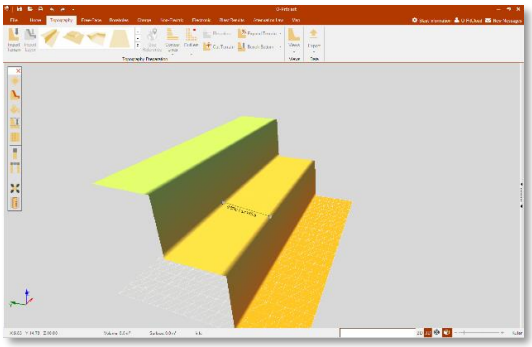


Figure 96 - Ruler tool (measurement view).

One left-click on the measurement and it will appear the angles.

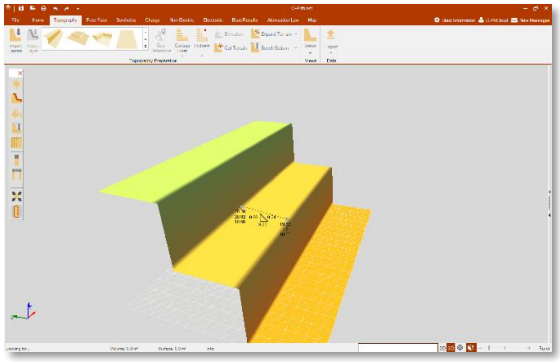


Figure 97 - Ruler tool (angles view).

And finally, two left-clicks and it will pop up a window to create a new label to that measurement. And the user can change the XY size and the azimuth.

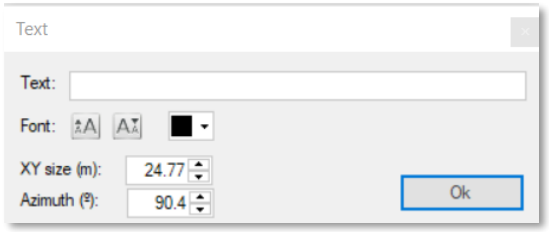


Figure 98 - Label window.

To see the distance between a collar and a bottom (of two different holes), the user needs to click in CRTL + on the sphere above the hole. The same thing to see the distance between two bottoms (Figure 99).

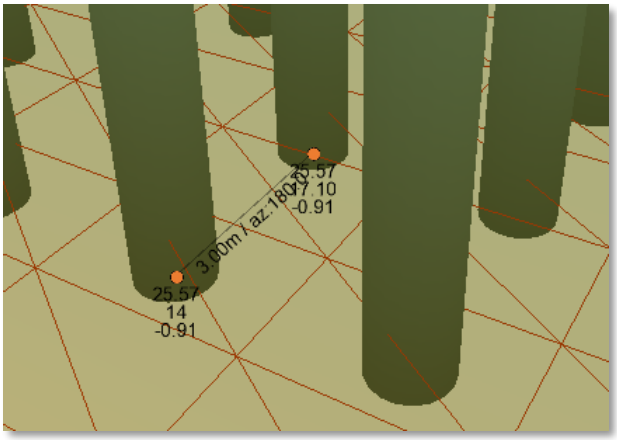


Figure 99 - Distance between two bottoms (CRTL + click on orange spheres).

To delete the ruler, the user must click on CRTL plus the right button over the ruler.

6.5. Work Environment

The work environment is the area where the project terrain will be shown which the user can edit, change and add planning elements. It has three views (2D, 3D: parallel (orthogonal) view and perspective).

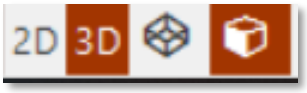
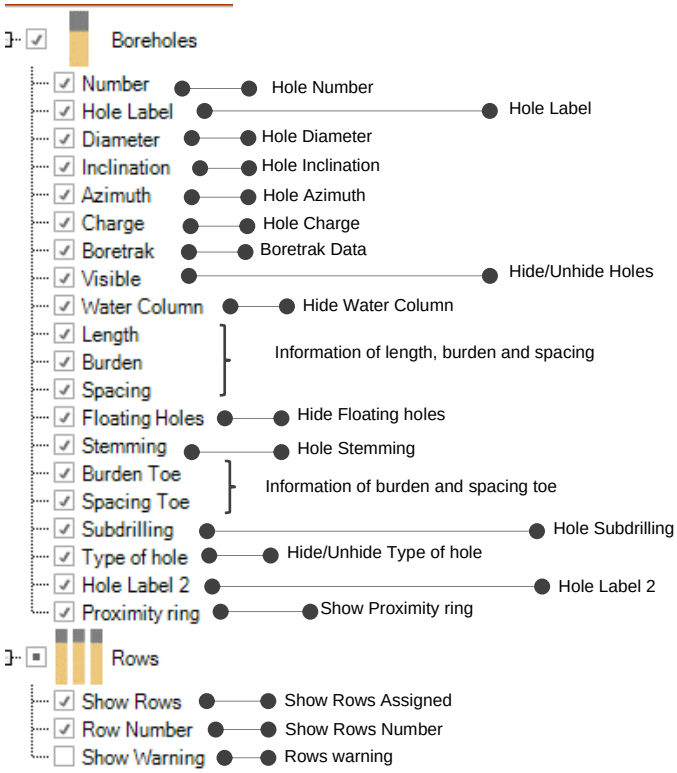


Figure 100 - From the left to the right: 2D view, 3D view, orthogonal view and perspective view.

6.6. View Pane

The view pane allows the user to select several view options.



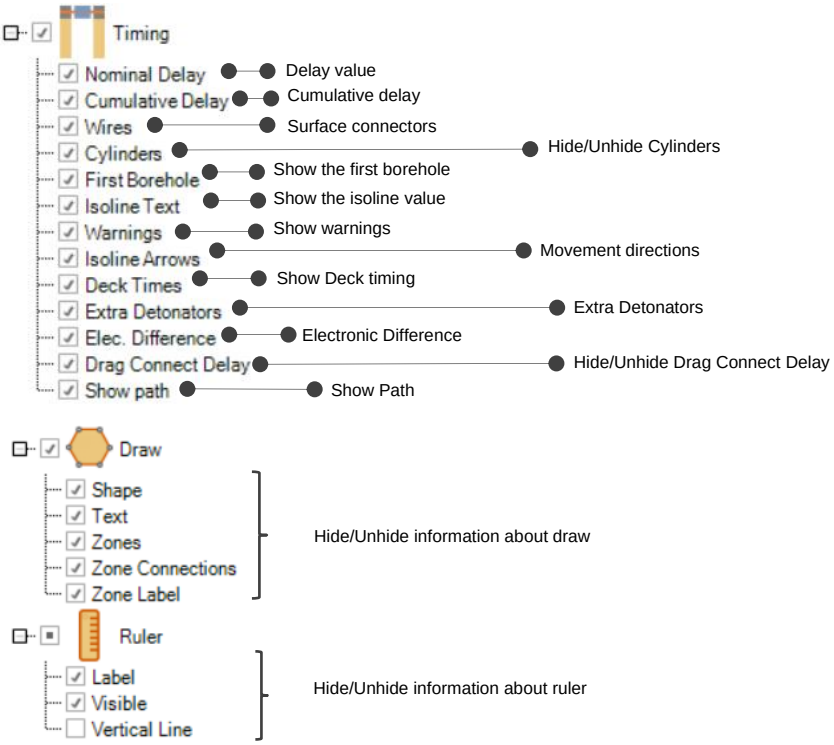


Figure 101 - View Pane.

6.7. Operation Control Tab

In the **Operation Control Tab** (Fig. 1) the user can observe information like:

- Mouse coordinates
- Terrain volume
- Terrain area
- Hided holes
- Status info
- Status bar
- View perspectives
- Control zoom
- Stage info

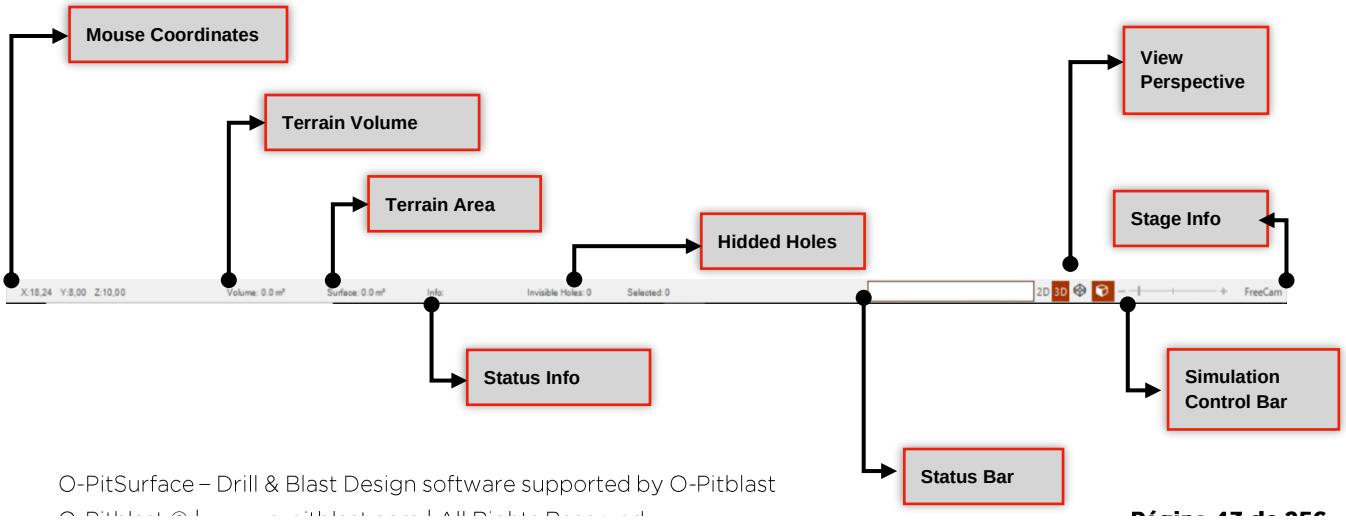


Figure 102 - Operation Control Tab.

Fig. 1 - Operation Control Tab

6.8. Borehole Radial Menu -

The **Borehole Radial Menu** intends to be an easy and useful tool to use key functions. This radial menu appears when pressing the mouse with the right-click button in one hole. Figure 103 displays the main functions available in this menu.

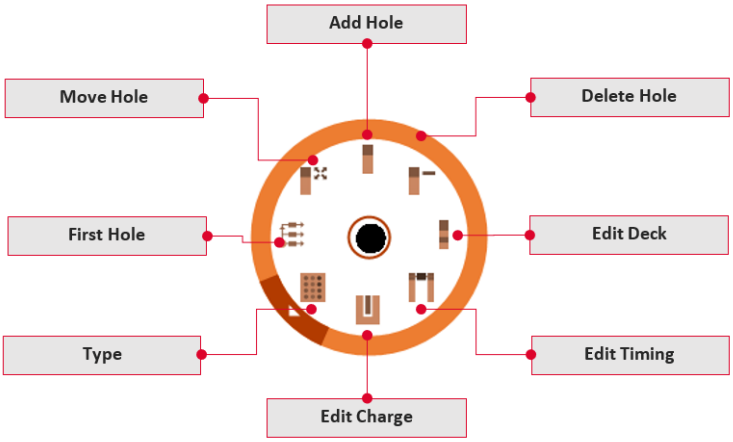


Figure 103 - Borehole Radial Menu.

7.Home

Home module includes tools that allows to add points, polygons, circles, arrows, etc.

Figure 104 - Home module.

Icon		*Description*
	Add point	Add a new point and use it to create lines, arrows, etc.
	Move point	Update the position of a point
	Delete point	Delete all points
	Import point	Import points for your terrain
	Line	Add a new line

	Arrow	Add a new arrow
	Polygon	Create a new polygon
	Circle	Add a new circle
	Import	Import several polygons from an external file
	Merge	Merge zones and create new ones

7.1. Add, Move, Delete and Import Points

The user can add a new point by clicking on the Add symbol and by pressing the left button of the mouse on the terrain.

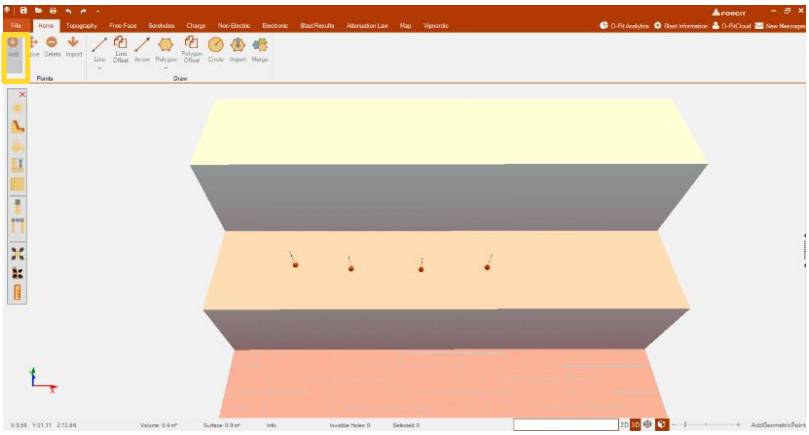


Figure 105 - Add new points.

The user can move a point by clicking on the **Move** button by left clicking on a point and drag it to another place.
The user can delete all points by clicking on the **Delete** button.

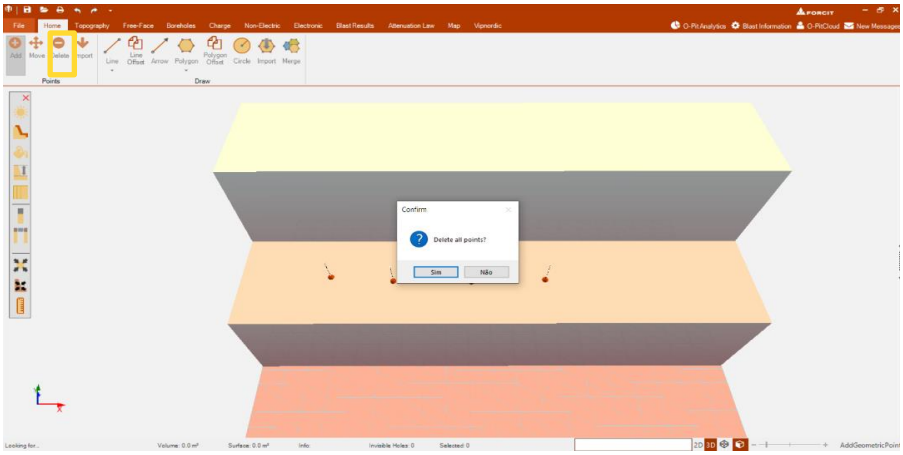


Figure 106 - Delete all points.

Finally, the user can import points by clicking on the **Import** button.

7.1.1. Add, Move and Delete One Point

The user can do the same things just to one point with the singular menu. This menu appears when pressing the mouse with the right-click button in one point. The picture bellow displays the main functions available in this menu.

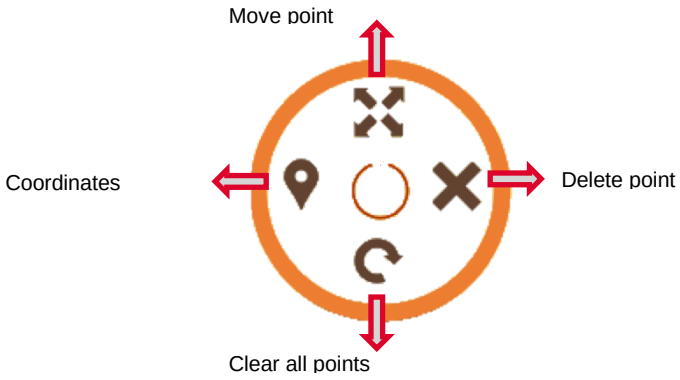


Figure 107 - Menu of a singular point.

The **Coordinates** option opens a window that allows the user to input the coordinates that he wants.

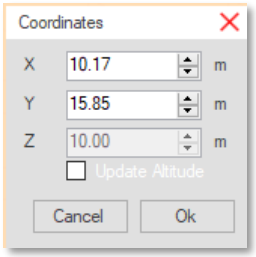


Figure 108 - Coordinates window.

7.2. Create Draw

7.2.1. Create Lines, Arrows Polygon and Circle

The user can create a new line and a new row by clicking on the **Line** button and click in any place of the terrain and drag the mouse (without drop) to another point.

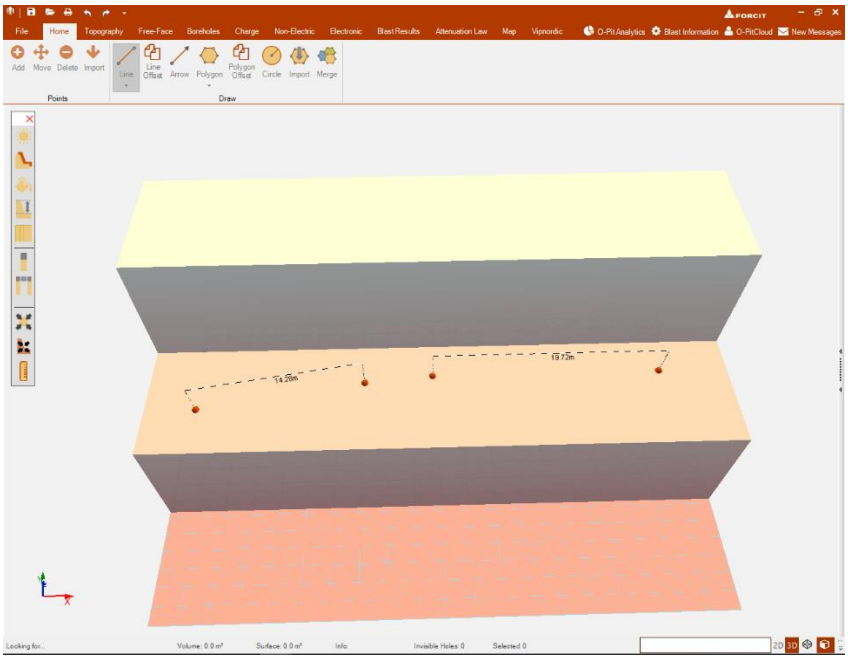


Figure 109 - Create a new line.

Also, inside of the line option (Figure 110), the user has the option to **import a file** with the coordinates of a line, export as an external file .dxf (Figure 110), and to create **a vertical line** that will show him the distance (vertical distance) from that point until the bench bottom - left click on the terrain to mark the point - (Figure 111).

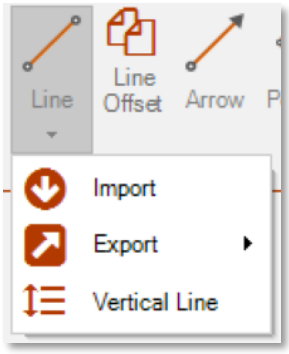


Figure 110 - Option to import line and see a vertical line.

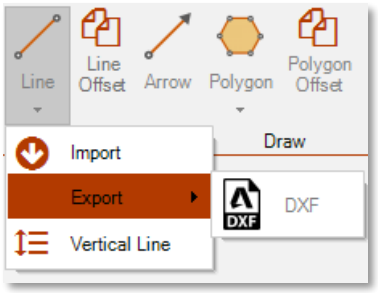


Figure 111 - Option to export line as .dxf.

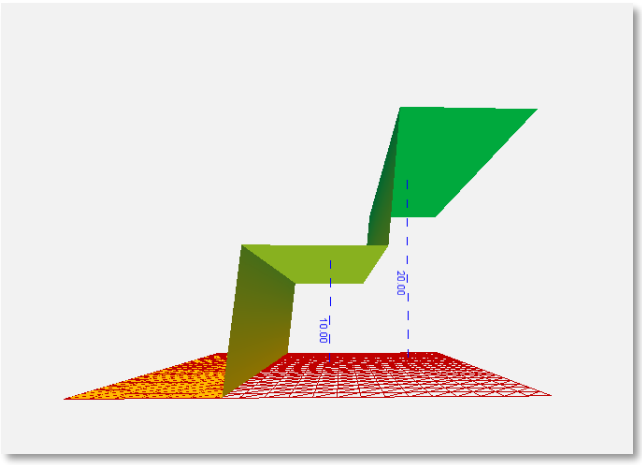


Figure 112 - Vertical line option (left click on the terrain to mark the point).

To create polygon the user must left click on the mouse in the terrain and draw the polygon that he wants.

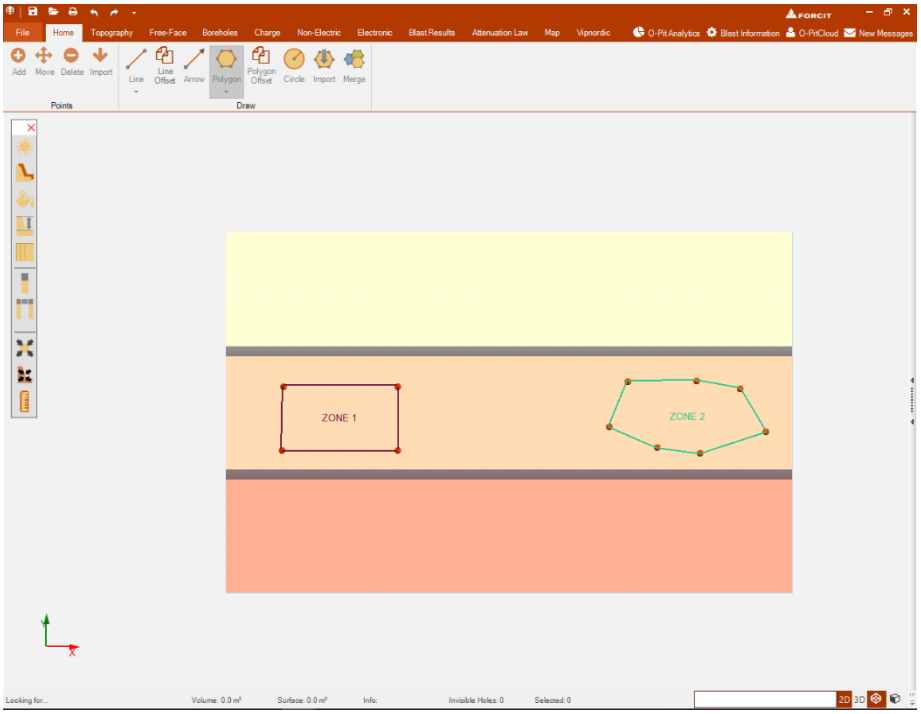


Figure 113 - Create a new polygon.

Also, inside of the polygon icon the user has the option **use crest** (Figure 114). If there is a crest defined the user can use this option. This button will use the crest point the help the user to easily create a new polygon.

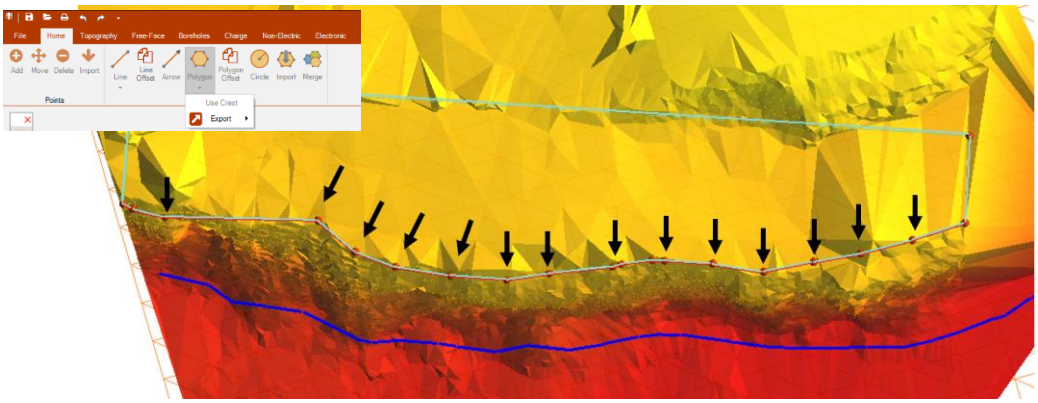


Figure 114 - Use crest option.

And finally, it is possible export the polygon as .dxf file too.
To create circle the user must left click on the mouse in the terrain and draw the circle where he wants.

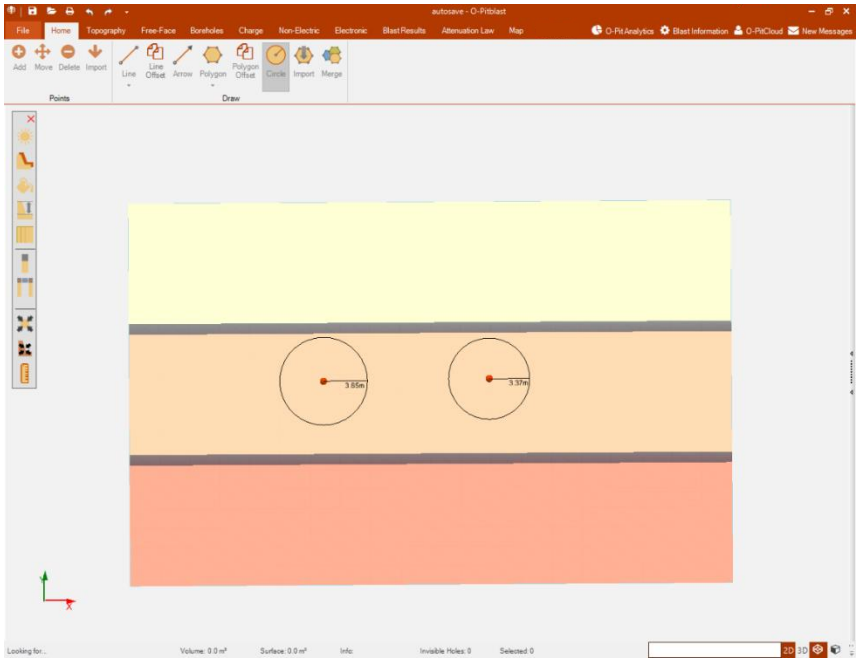


Figure 115 - Create circle.

7.2.2. Line Offset

The user can use the line offset tool to duplicate a previous line created. After clicking on this tool, a pop-up window will appear to insert the desired offset value, and then it is necessary to click on the line.

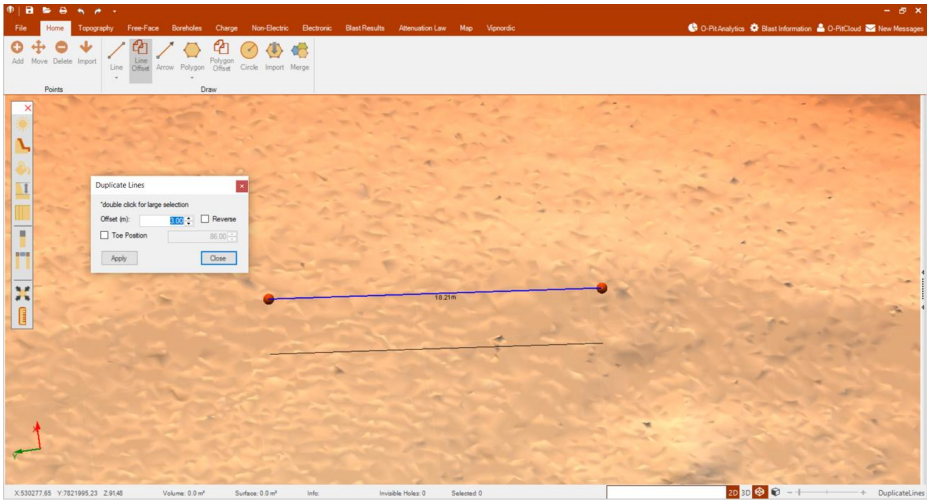


Figure 116 - Line offset option (duplicate lines window).

7.2.3. Polygon Offset

The user can also create a polygon offset using the tool “polygon offset”.

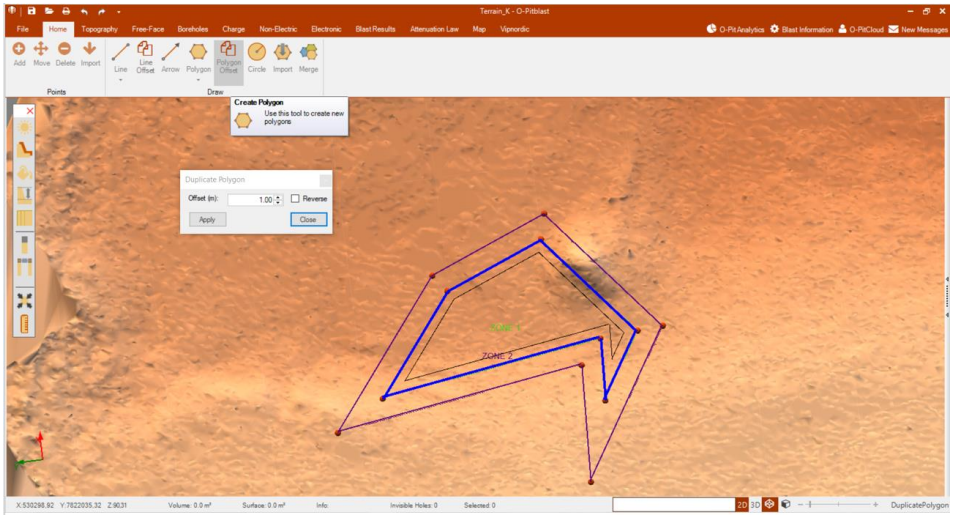


Figure 117 - Polygon offset option (duplicate polygon window).

7.2.4. Import Polygon

To import a polygon the user can click on the button **Import** and upload .dxf .xml .csv files. Also, the user as the option to change the coordinate system of the data (see **Topic 52**).

7.2.5. Merge

The user can merge different polygons to create a new one. First, user clicks on the button **Merge** and it will pop up a window (Figure 118) to choose the zone that the user wants to merge. Then he can delete the selected zones by checking the box that said **Delete selected zones**.

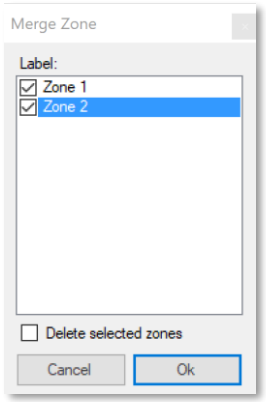


Figure 118 - Merge zones window.

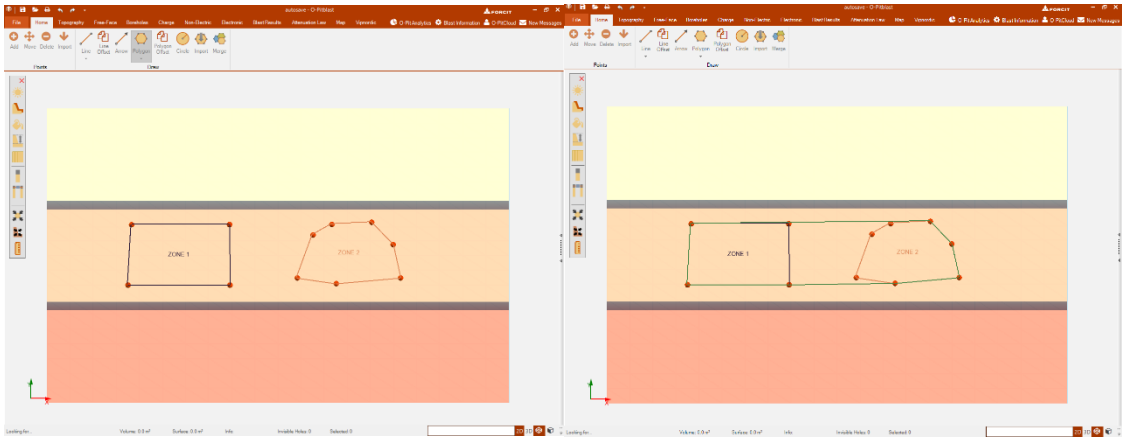


Figure 119 - Left (A): Two separated polygons; Right (B): Merged zone.

7.3. Zone Menu

This module also as another menu, that appear when a polygon is created when the user right-clicks inside of the polygon zone. In the picture bellow we'll see the main options.
Clicking on the **Delete** and **Delete Points** button the user will erase the polygon/points of the polygon. By clicking on the **Add Hole** button will create a pattern (10.10.1) inside of the polygon area. Clicking on **Edit Label** will create a label – the user must insert a name/description for that label. The **Change Polygon Color** button will allow the user to change the polygon color. The button **Export Zones Points** will generate a .csv file with coordinate system of the points of the polygon. The **Show Volume** button will tell the user the volume of the terrain inside of the polygon. Finally, the button **Edit timing** (Figure 120) will let the user to add a translation delay (ms) in the timing of the boreholes (when using electronic detonators). Also, the user as **the Volume Calculation** option, where he can set the zone to be included or excluded on the volume calculations (Chapter 6.3.7.1 and Figure 75).

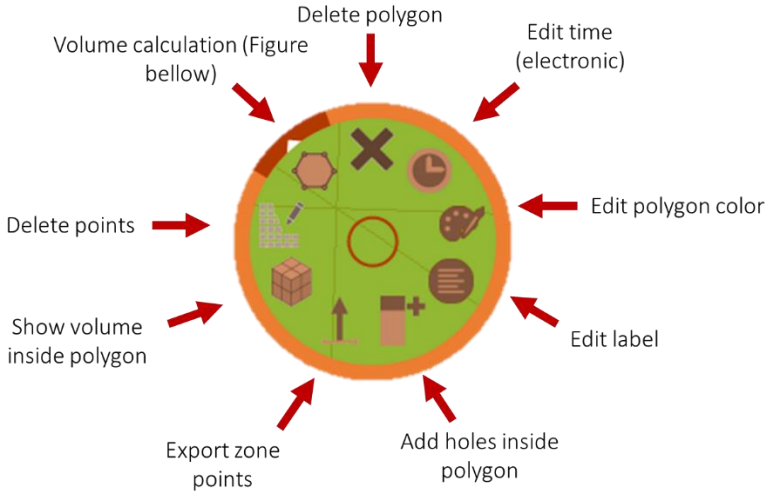


Figure 120 - Zone Menu.

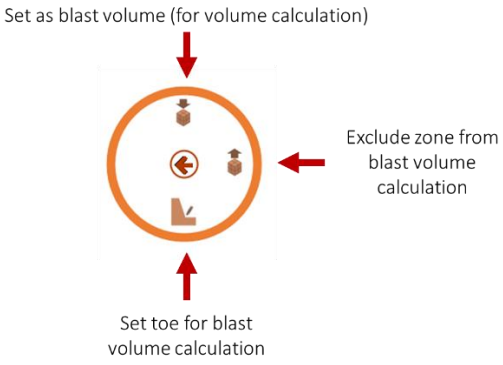


Figure 121 - Blast volume calculation options.

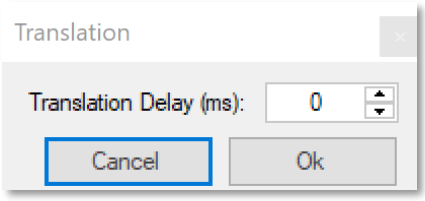


Figure 122 - Add Timing Window.

8.Topography

Topography module includes all the important tools for terrain importation and edition.

Figure 123 - Topography module.

8.1. Topography preparation

Icon		*Description*
	Import Terrain	Import terrain from file (.xyz, .xls .str .csv)
	Import Layer	Import Layer from file. A Layer can be a terrain element, orebody stratum or any geometrical shape.
	Terrain Styles	Create or use a pre-defined topography.
	Contour Lines	View terrain isolines and set the interval (meters). Toggle visibility.
	Outliers	Detect and eliminate outliers such as out-of-range points or dust refraction points from terrain or laser scans.
	Terrain	Eliminate terrain outliers.
	Crest/Toe	Eliminate crest/toe outliers.
	Cut Terrain	Cut a specific area of terrain to define a precise work area.
	Expand Terrain	Expand a determinate work terrain.
	Bench Bottom	Define and control bench bottom.
	Edit Cloud	Eliminate cloud points from the terrain.
	Eliminate Triangles	Remove triangulation triangles from the terrain.
	Views	View crucial terrain points like the free-face and isolines.
	Export	Export terrain and contour data (.csv files).
	Select	Select the type of rock associated with the terrain.

8.1.1. Importing terrain -

To import terrain, click on the **Import Terrain** icon. A selection window will appear, allowing you to choose the terrain file (Figure 123).

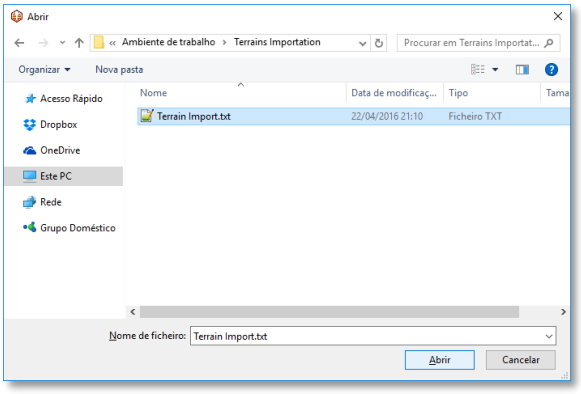


Figure 124 - Import terrain window.

In the selection window, assign the **X**, **Y**, and **Z** values to the North coordinates, East coordinates, and elevation coordinates, respectively (Figure 124) and click **Import coordinates** (Figure 128).

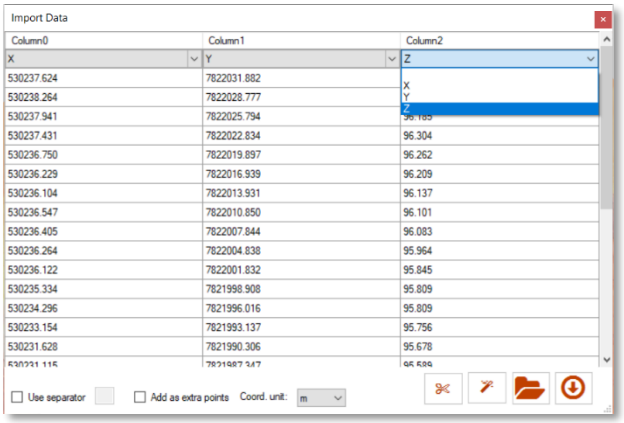


Figure 125 - Correlating XYZ values with North, East and Elevation.

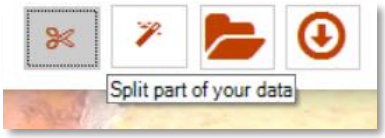


Figure 126 - Split part option.

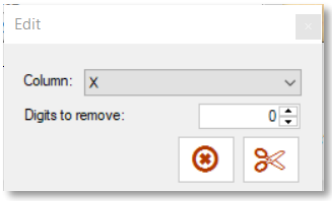


Figure 127 - Split part – Edit window: Curt part of your data.

Figure 128 – Importing the coordinates of the terrain.

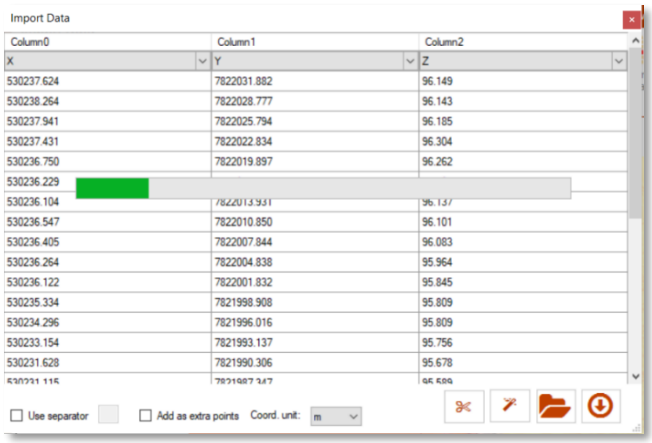


Figure 129 - Loading Terrain.

8.1.2. Coordinate System

This option allows the user to convert the X, Y, and Z values from one coordinate system to another.

First, select the X, Y, and Z values of the raw data (Figure 125).

Then, click on the **Coordinate System** ( ) icon in the import terrain window.

This action will open a new window (Figure 130) where the user must choose from/to which coordinate system that he wants.

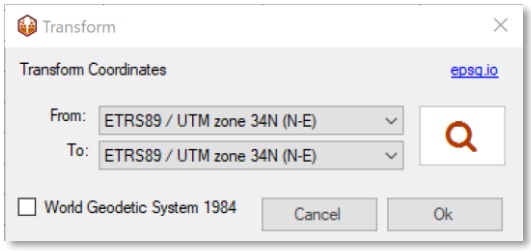


Figure 130 - Choose from/to coordinate system window.

Next, click on the magnifying glass icon (Figure 130) to search for new coordinate systems.

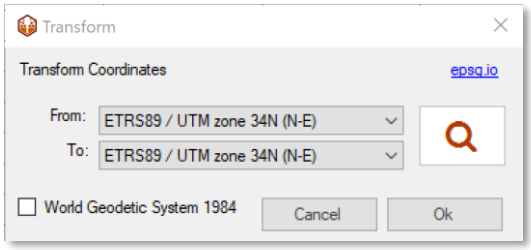


Fig. 2 - Search new coordinate system

This will open a new window (Figure 131) where the user can search for the new coordinate system through:

- ETRS;
- Name;
- UTM ZONE.

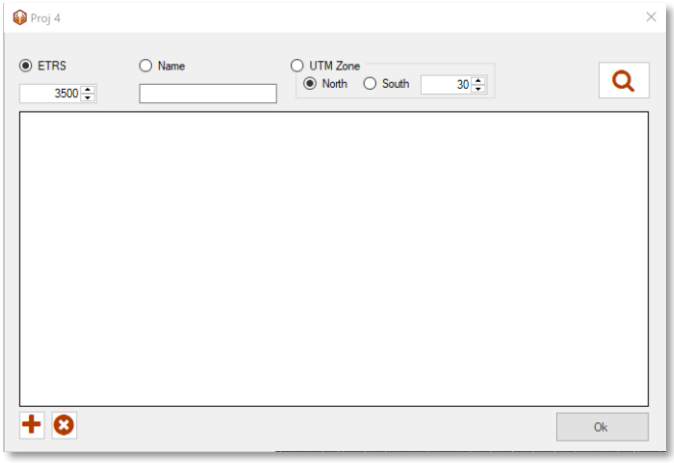


Figure 131 - New coordinate system window.

To check coordinate systems worldwide (EPSG/ESRI), preview locations on a map, and get transformations, visit EPSG.io.

After inputting a parameter in the search method chosen (ETRS, Name or UTM Zone) the user clicks again in the magnifier glass on top right to get the results (Figure 132).

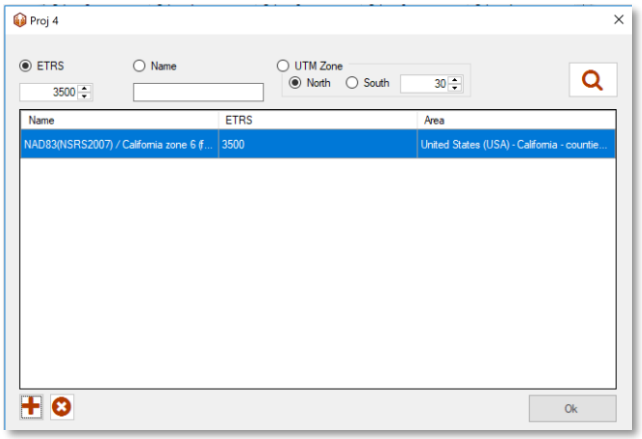


Figure 132 - Search results.

To **add** the pretend system to the main window the user must click on the plus sign ( ) and it will appear a message confirming the action **"Data added successfully".**

Otherwise, if the user pretends to **delete** the coordinates that he previously saved it must click on the cross ( ). This option will open all database previously added and the user can choose which ones he wants to eliminate.
Finally, the user just chooses **from** and **to** (Figure 133) which coordinate system he wants to change and clicks in **OK** button.

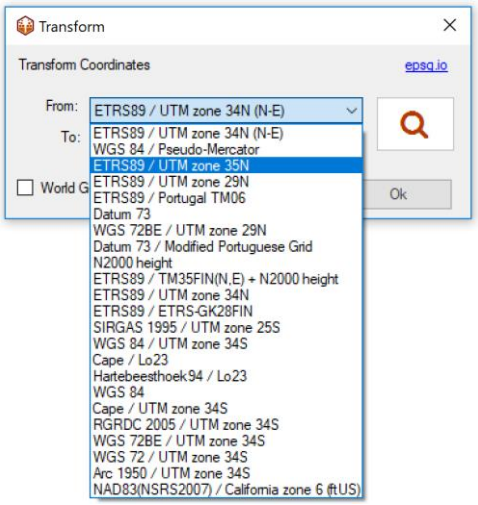


Figure 133 - Coordinate system present in the database.

8.1.3. Import Layer

In this option, the user can import a terrain as a layer (it works as a normal importation). After that it can treat the new layer as a new bench bottom adjusting the pattern until the layer (Figure 134) or, for example, change the layer color (Figure 135).

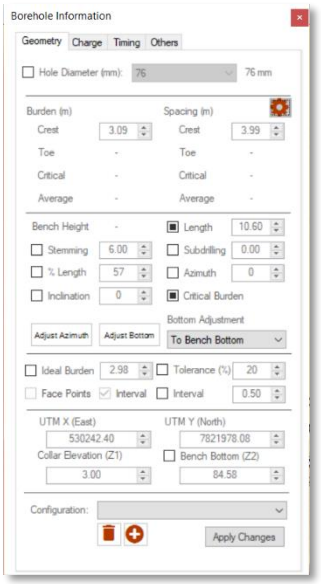


Figure 134 - Adjust hole until layer.

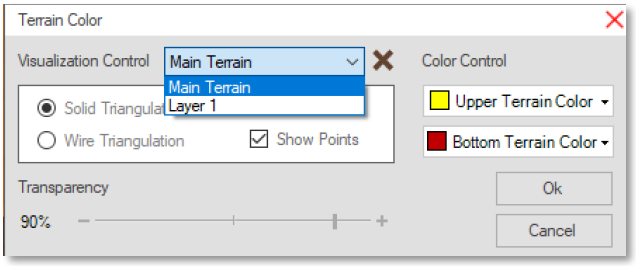


Figure 135 - Change layer color.

8.1.4. Terrain Style -

the user can create a new terrain style or choose from existing ones available in the software. Clicking on '**Create Style**' opens a new window (Figure 136) where user can enter parameters such as like **Longitude, Toe (m), Altitude (m), Angle (°) and Azimuth (°)** to fill in to create a new style.

Figure 136 - Topography's available and Create Style Button.

8.1.5. Contour Lines -

The user can hide/unhide the contour lines of the terrain and choose the isolines interval in meters.

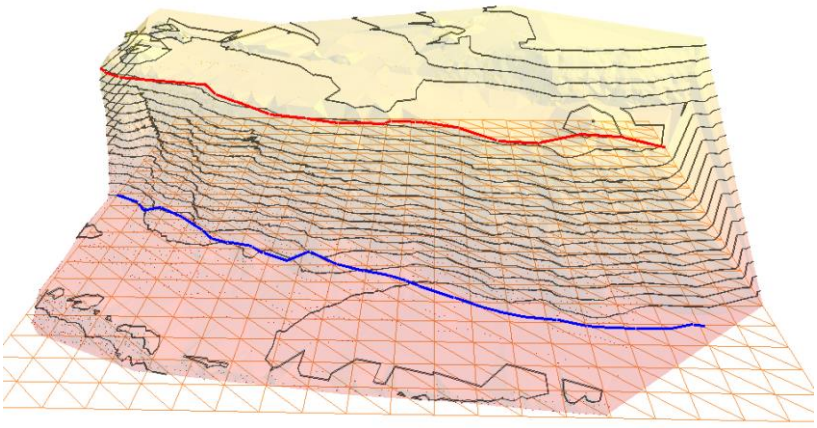


Figure 137 - Isolines visible on the terrain.

8.1.6. Cutting Terrain -

To cut a terrain region the **Cut Terrain** icon allows the user to select a work area and erase the surround zones. The user must click in the terrain to define the cutting borders and press the **Enter** or **Double-Click** to execute the command (Figure 138).

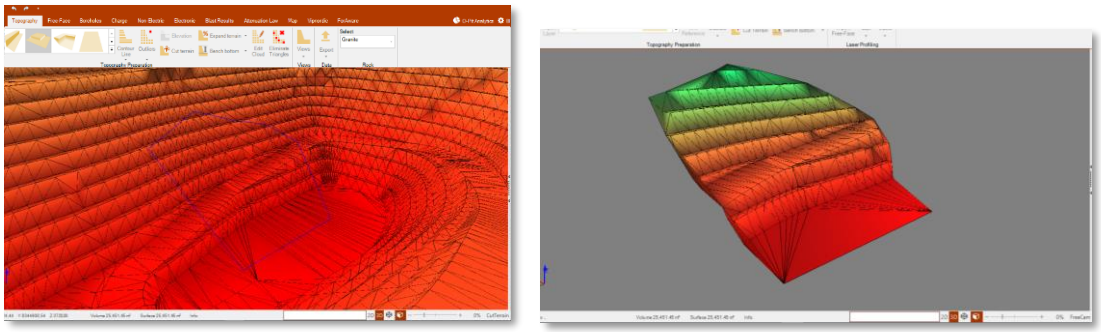


Figure 138 - Area selection and terrain cutting.

8.1.7. Expand Terrain -

The terrain expansion tool generates a new set of points that allows the actual terrain expansion. In Figure 139 it is possible to observe the results of this tool and how it can be applied. The user must select the percentage of terrain expansion and click in **Apply**.

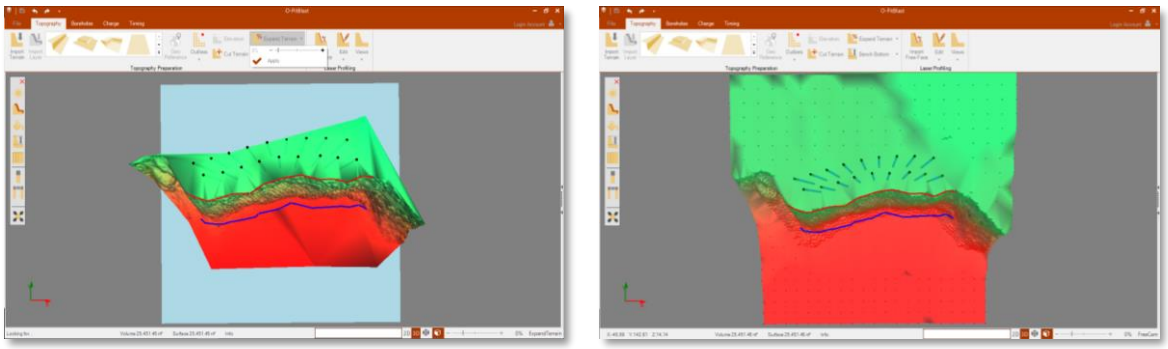


Figure 139 - Expansion terrain tool results.

8.1.8. Bench Bottom -

The Bench Bottom tool permits the adjusting the bench bottom level, inclination, and azimuth (Figure 140).

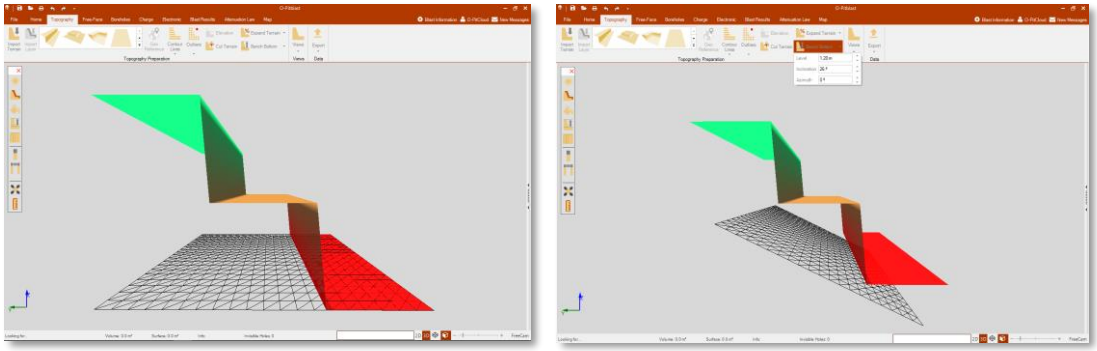


Figure 140 - Bench Bottom Editions.

8.1.9. Edit Cloud

In this option the user can edit cloud points.
First, he needs to check if the points are visible or not. If not, needs to put them visible (Topic 6.4.2).

After clicking on **Edit Cloud** button it will pop a window (Figure 141) explaining how to delete points.

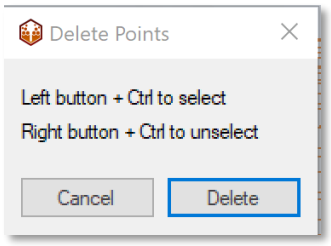


Figure 141 - Delete cloud points window.

The user must click over a point with the left mouse button, press ctrl and drag the mouse on the terrain until all points that he wants to delete are select (Figure 142). After that just click in **delete** the select points.

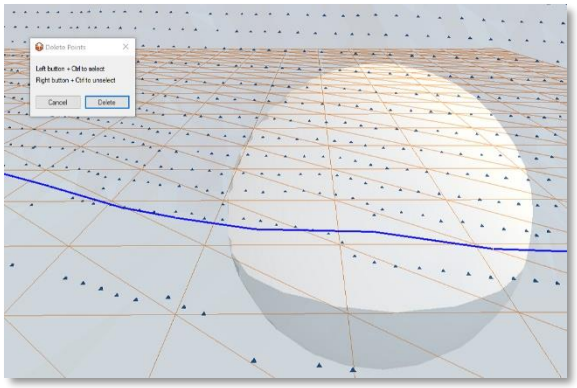


Figure 142 - Area with selected points.

It's important to refer that select points will turn red (Figure 143), before that they are in the terrain color.

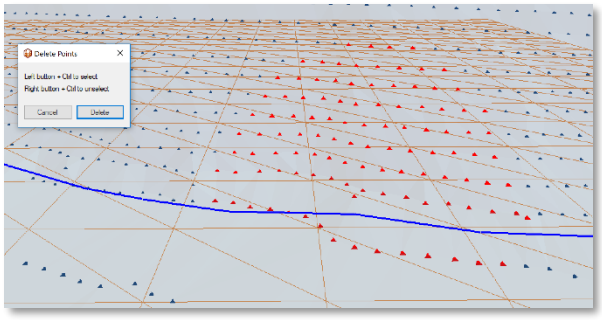


Figure 143 - Red points: selected.

8.1.10. Eliminate Triangles

This option allows the user to eliminate triangles that create the triangulation of the terrain.
After clicking in this tool, it will appear a window (Figure 144) explaining how to use it.

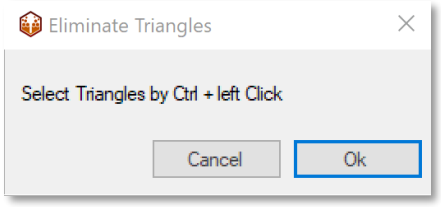


Figure 144 - Eliminate triangles window.

The user can select the triangles by clicking in **left mouse button** and **ctrl**. After that, they will turn red (Figure 145) and if the user clicks in **OK** the triangles will be eliminated.

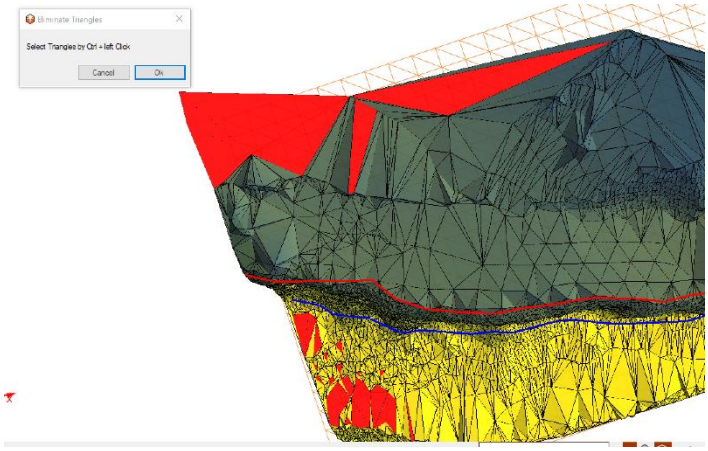


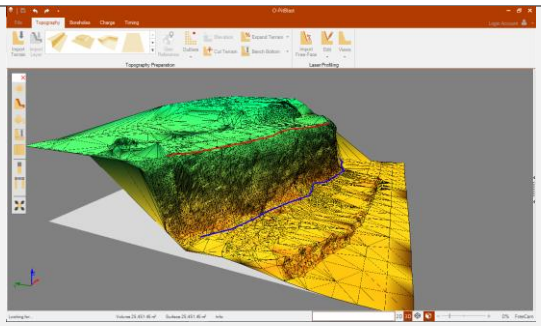
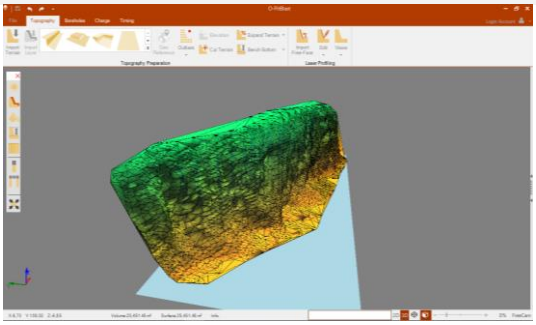
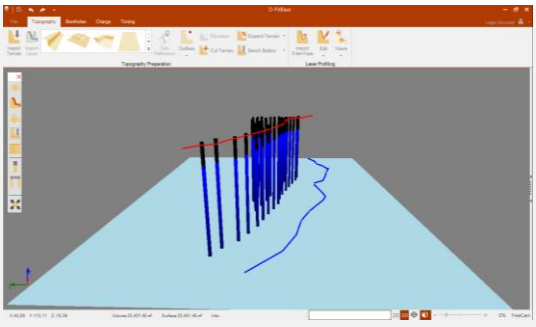
Figure 145 - Selected triangles (in red).

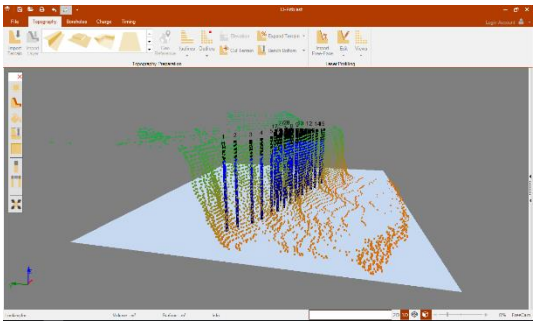
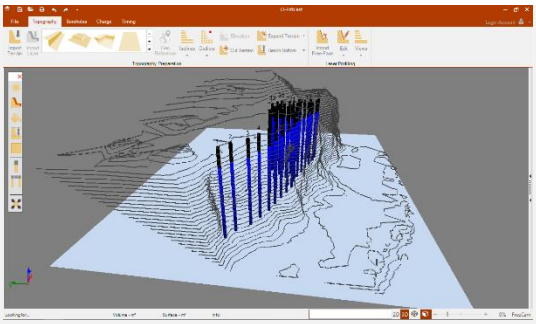
8.1.11. Views

This tool will help the user to see some important aspects of the terrain. The user will be able to see the **Free Face, the Crest and Toe, Dots or Isolines,** as shown above.

View All	View all elements in the project
View Free-Face	View free-face data
View Crest/Toe	View crest and toe reference lines
View Dots	View terrain cloud point
View Isolines	View terrain isolines

TERRAIN VIEWS

View All	
View Free-Face	
View Crest/Toe	

View Dots	
View Isolines	

8.1.12. Select Type of Rock

In this option the user can select the type of rock that it's associated to that terrain (Figure 146).

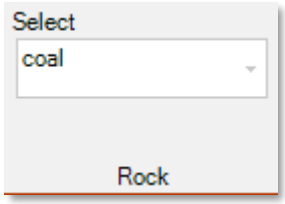


Figure 146 - Selection of the type of rock.

9.Free-face

Free-face module includes all the important tools for the free-face importation and edition, like hole deviation data.

Figure 147 - Free-Face Module.

In the next table the user can see the main options of this module.

ICON		***DESCRIPTION***
	Import Free-Face	Importing free-face data using Renishaw (.FSC) or Quarryman (.CDU) file formats.

	Free Face Edit		Tool for editing free face data.
		Crest Edition	Crest definition tool. Edit previous measures – Add or remove existent points
		Toe Edition	Toe definition tool. Edit previous measures – Add or remove existent points
		Import	Import crest or toe data files.
		Export	Export crest and/or toe (.DXF) file formats.
		Edit Crest/ Toe Altitud	Update the altitude level of crest or toe data.
	From Device		Import the borehole deviation data directly from device.
	From file		Import the borehole deviation data from a local file.
	Rodded		Import the rodded borehole deviation information.
	Cabled		Import the cabled borehole deviation information.
	Swap Hole		Change the borehole deviation information by clicking on the first hole and dragging the mouse to the second hole.
	Delete		Delete selected borehole deviation information. Options include deleting all borehole deviation information or specific selections made by the user.
	Select		Select a group of holes with borehole deviation information. Left-click to define the polygonal selection area around the holes. Right-click to close the polygon and confirm the selection.
	Edit		Adjust the azimuth by dragging an arrow that appears after clicking the Edit button.
	Export RHD		Export borehole deviation data as an RHD file format.

9.1. Importing Free-Face -

In order to import a free face model, the user must select the origin of it (Figure 148) and the correspondent codes. For *.FSC and *.CDU codes the platform has the default values, because of that the importation is automatic. Also, the user can define the bar length used (if it's not on the laser information) and which flied he wants to apply that bar length information.

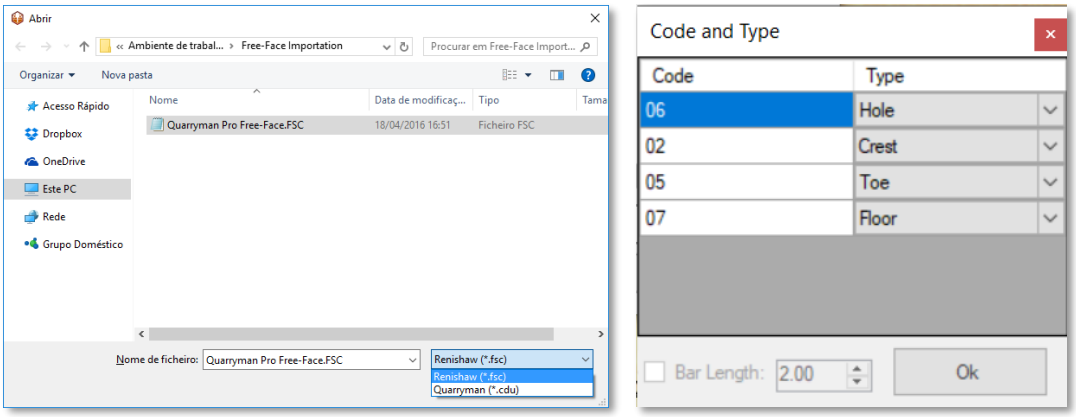


Figure 148 - Importing free face data and code selection.

The Import Data table (Figure 149) shows the raw data divided by codes. With the objective to improve the visualization of pattern holes, O-PitSurface has a **Pattern Definition Algorithm**, which erases outliers point in the pattern area that will decrease the definition of the terrain surface. The user can select or unselect this function by clicking in the checkbox in Import data window. Also, if the user used a bar length on the field and didn't insert the length in the laser can insert now (Figure 148).

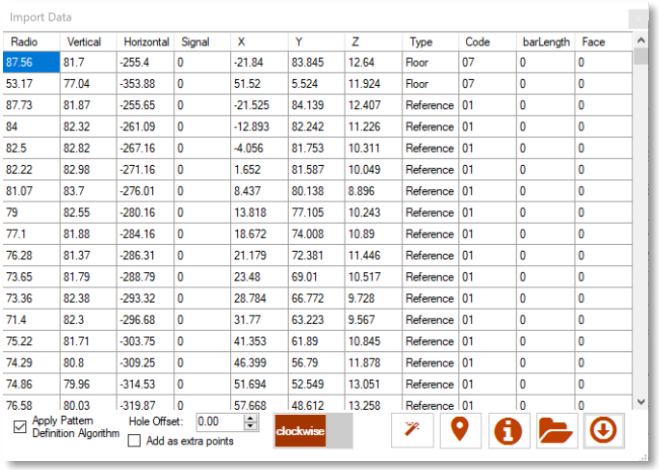


Figure 149 - Import Data - Free Face.

3D Laser user understand that some points obtained by this tool can be out of the free-face range. These outlier points can be generated by:

- Dust
- Obstructing objects
- Wide scan window

O-PitSurface has an automatic detection algorithm for these cases and, when importing a free-face, the following message is presented (Figure 150).

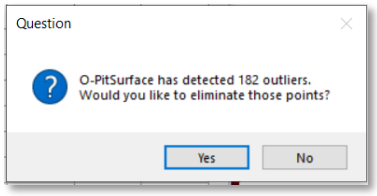


Figure 150 - Outliers detection algorithm.

The result from the use of this tool can be observed in Figure 151.

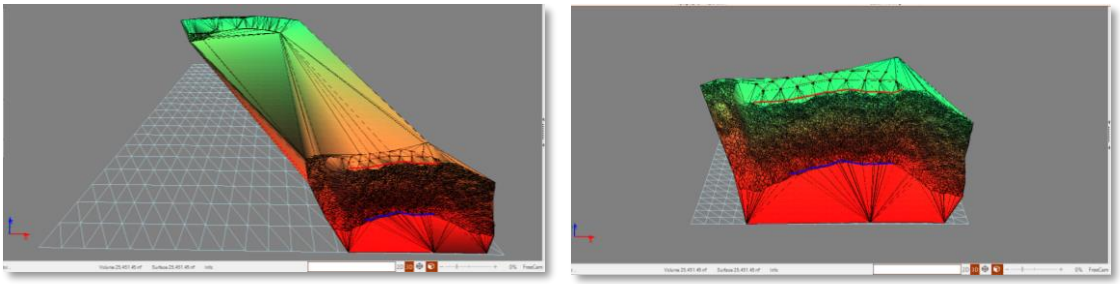


Figure 151 - Outliers detection algorithm results (Left: without outlier detection; Right: With outlier detection).

If the imported data does not include the hole length, the user is prompted to select this value. From Figure 152 is possible to observe that there are two options:

- **Select the bench bottom level and design the hole length until that level.**
- **Select a determinate length value for all the holes.**

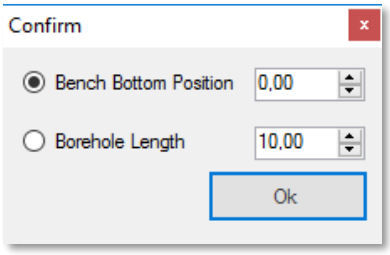


Figure 152 - Borehole length definition.

The results from the borehole length definition can be analysed in Figure 153.

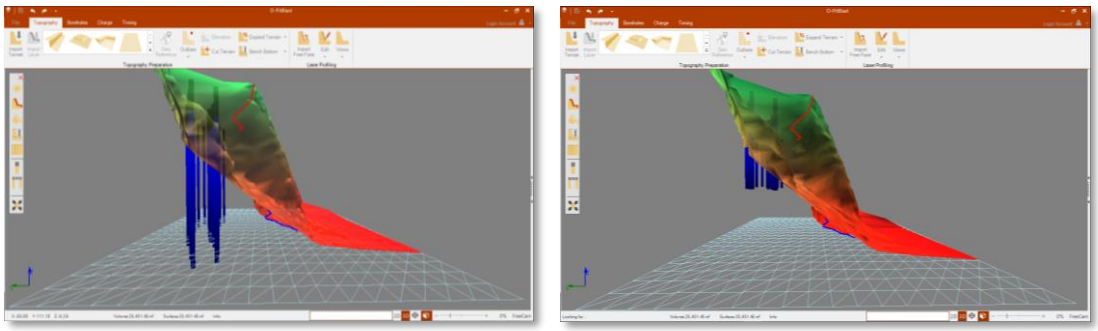


Figure 153 - Borehole length definition (Left: Bench bottom position; Right: Borehole length).

9.1.1. Importing Options

When importing a laser file, the user has some options to optimize the importation (Figure 154).

- Hole Offset
- Add as extra points
- Clockwise
- Coordinate system
- Multiple station
- Georeferentiation of the terrain

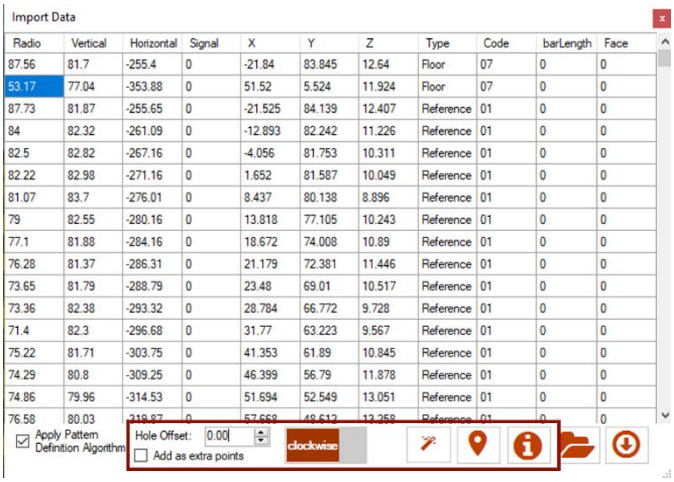


Figure 154 - Importation option.

9.1.1.1. Hole Offset

In field conditions, situations can be challenging. For instance, if an operator cannot reach a hole close to the free face, they can place the laser device aside from the hole (with a specified offset). Later, during importation, they can add this **offset information** using the appropriate tool.

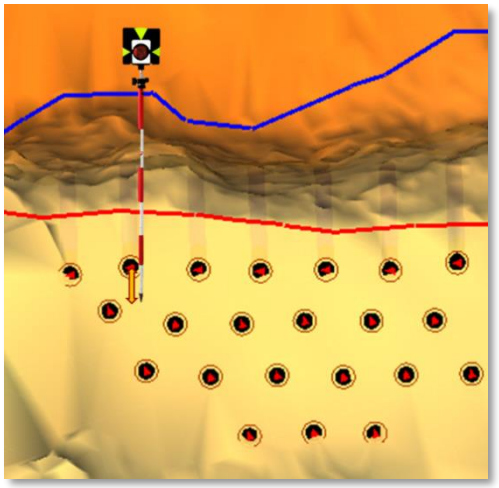


Figure 155 - Example of the laser position (arrow is the offset).

9.1.1.2. Add as Extra Points

When importing laser information, you can **add** that data to the **actual** one. This will keep the points of the actual one and insert the new points on the terrain.

9.1.1.3. Clockwise

If the user has **Counter Clock** option defined as default on the laser, it can turn it on here. This will define the rotation of the laser counter clock side.

9.1.1.4. Change data coordinate system

Check Topic 8.1.2 to know how to use this option.

9.1.1.5. Multiple Station

In the field sometimes, the operator needs to make multiple scans from different places. If the file that the user is importing was made using multiple stations this option must be selected. After that the user must choose the way that it was made on the field and merge the information (Figure 156):

- GPS information for each laser position and reference;
- Two fixed references for each free face (to see how it was to be made on the field click on question button);
- Based on previous laser position (to see how it was to be made on the field click on question button).

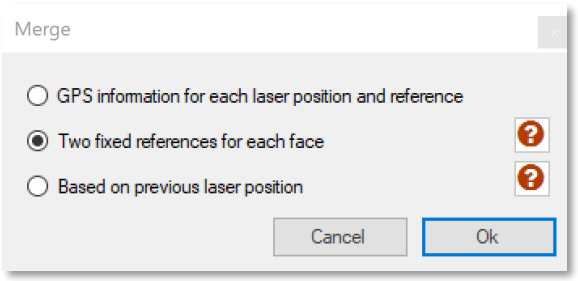


Figure 156 - Merge information tab.

9.1.1.6. General Information

Here the user can import GPS information to georeferenced the terrain (Figure 157). It can put manually, get reference from GPS file, use previous information or use rotation option.

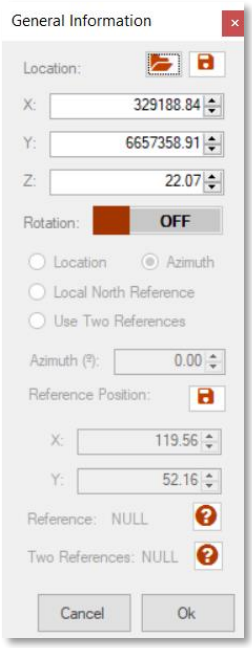


Figure 157 - General information tab.

9.2. Editing Crest/Toe -

With the Crest/Toe tool is possible to create or edit a crest and toe reference lines. When the tool is selected, using the mouse left-click in the crest or toe real points, a new reference line will be generated. To erase existent points is just right-click above them. These reference lines will be used for the calculation of critical profile/burden.

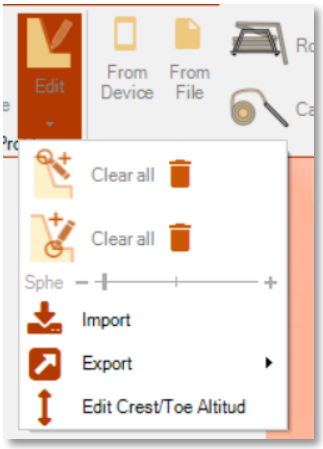


Figure 158 - Crest/Toe tool.

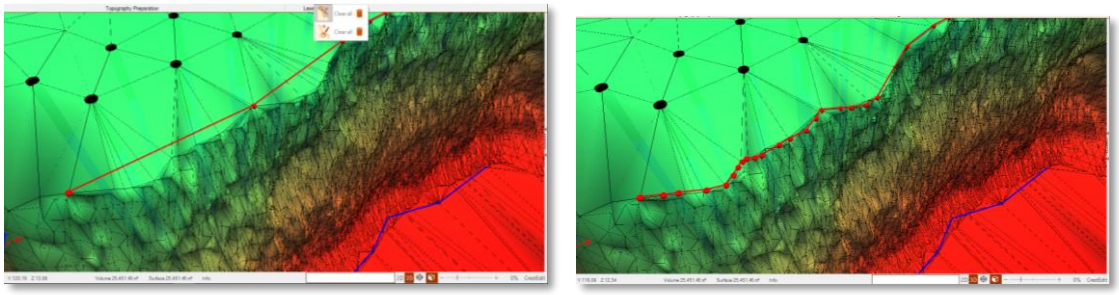


Figure 159 - Crest reference line edition.

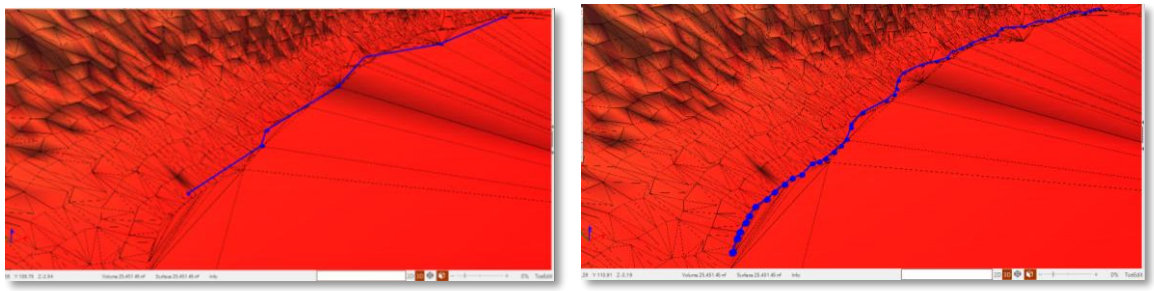


Figure 160 - Toe reference line edition.

9.2.1. Import

The user can import crest and toe directly from file.

9.2.2. Edit Crest/Toe Altitude

In this option the user can change the altitude of crest and toe.
To do this the user must choose between crest and toe, put an altitude (meters) and click in apply.

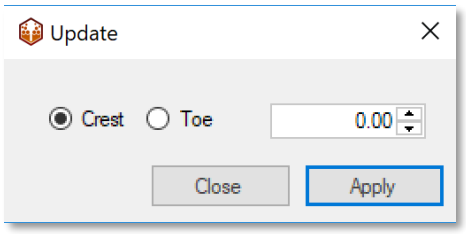


Figure 161 - Update altitude window.

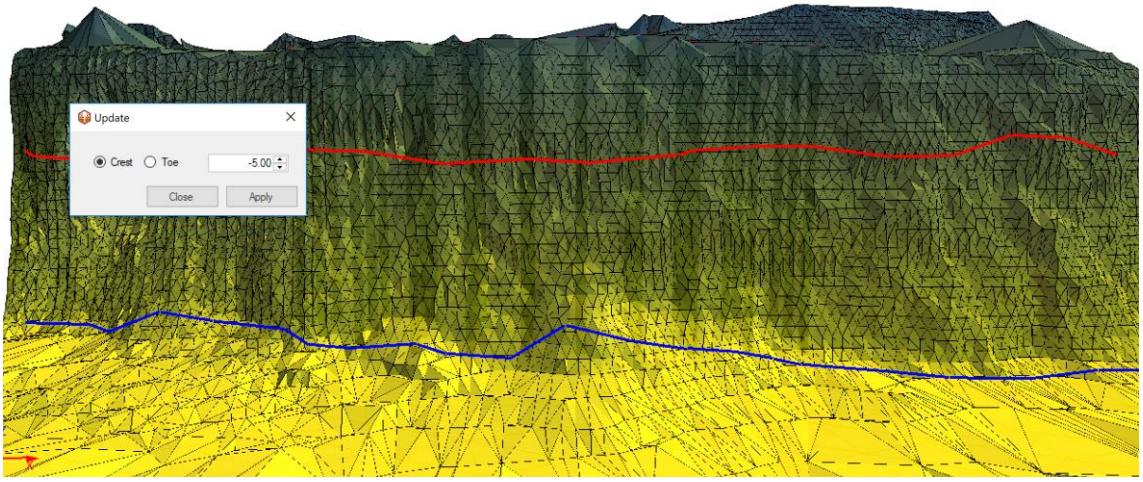


Figure 162 - Example of changed altitude in crest (minus 5 meters from top).

9.3. Borehole Deviation Data

With **Rodded, Cabled, Swap hole, Delete, Select and Edit** the user can import, edit and interact with borehole deviation information.

9.3.1. Rodded

Clicking on Rodded the user can import the borehole deviation information. It will pop a window like the one bellow. The user can import .CDP files to **Probe data** and .cdl files to **CDU Data.**

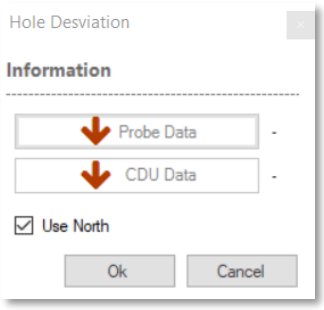


Figure 163 - Import Hole Deviation window (1).

When the user inserts the data, it will appear a message saying, **"Data uploaded successfully"**.

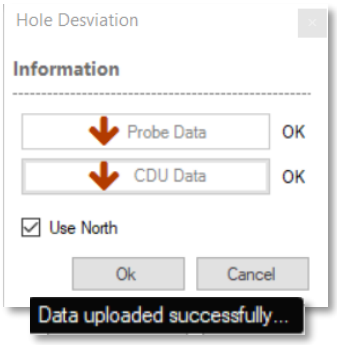


Figure 164 - Message about the deviation data.

Then the user applies the borehole deviation information to the respective holes - Figure 165 and click on the "OK" button.

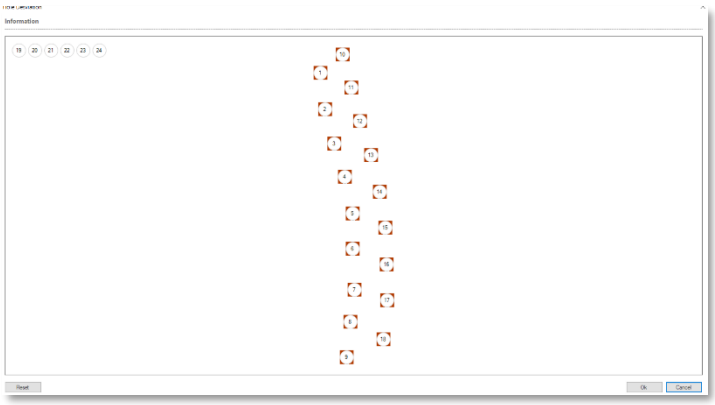


Figure 165 - Import borehole deviation information window (2).

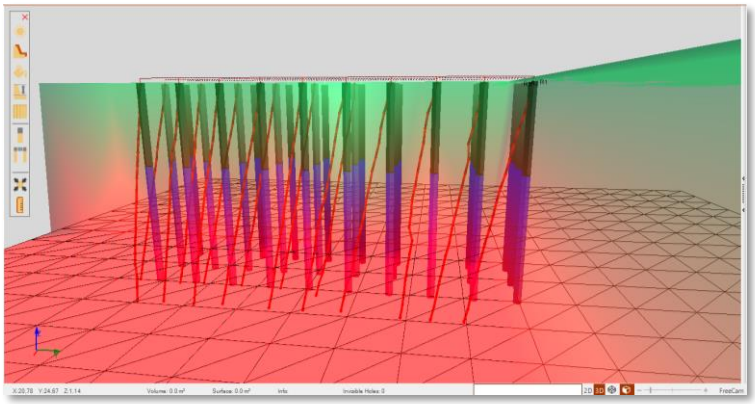


Figure 166 - Borehole deviation information successfully imported.

9.3.2. Cabled

The user can import cabled borehole deviation information. All data files must be .RHD type. When the user inserts the data, it will appear a message saying, "**Data uploaded successfully**".

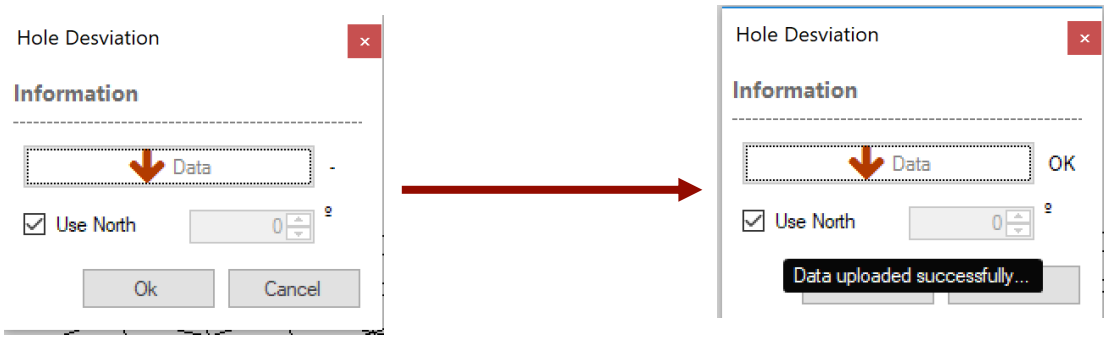


Figure 167 - Import cabled borehole deviation information windows.

Then the user applies the borehole deviation information to the respective holes (like we saw in 9.3.1) and click on the "OK" button.

9.3.3. From Device and From File

In these two options the user can import information directly from a file or by connecting the borehole deviation device directly to the computer.
First the user must connect the device to the computer, then choose the COM PORT associate with it and finally give order to the device to send the data to O-PitSurface (Figure 168).

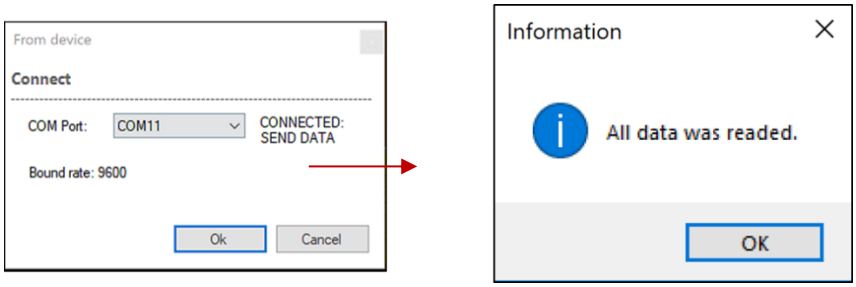


Figure 168 - Sending data from device.

Also, O-PitSurface ask the user if he wants to save a local file from borehole deviation device (Figure 169).

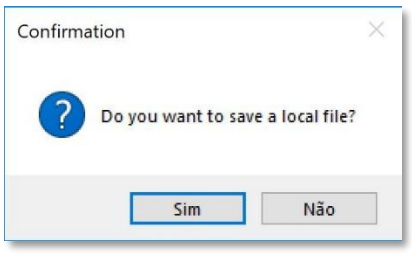


Figure 169 - Save local file.

Then the process is the same explained on the rodded and cabled.

9.3.4. Swap Hole, Delete, Select Edit, Export RHD

In the picture below the user can see the main borehole deviation interaction buttons from Free-Face module.

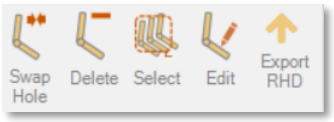


Figure 170 - Other hole deviation buttons.

10. Boreholes

The Boreholes Tab presents all the tools and applications for borehole design and edition.

Figure 171 - Boreholes Module.

10.1. Boreholes Edition

Icon	*Description*	
	Edit Holes	Edit a single hole or a conjunct of holes
	Add Holes	Add holes to an existent terrain
	Delete Holes	Delete a single hole or a conjunct of holes
	Move Holes	Move a single hole or a conjunct of holes
	Edit Toe	Edition of toe position of a single hole or a conjunct of holes
	Edit Collar	Edit of collar position without change the toe position
	Select Holes	Holes selection tool
	Hole shape	Hole not charge
	Hole Shape	Hole charged (no detonator)

10.1.1. Edit Holes -

To edit a hole, the user can either click twice over a determinate hole or recur to **Radial Menu** (Chapter 6.8) and select the edit hole icon. In a single hole edition is possible to analyse and edit several characteristics (Figure 174).
By clicking in **Edit** icon the user will be able to choose wich type of holes he wants to change: **All Blastholes, Production Blastholes, Buffer Blastholes, Contour Blastholes** and **Ghost Blastholes.** The user can also edit the information from the **First Row** of boreholes or the information of a labeled borehole by clicking in **Label**.

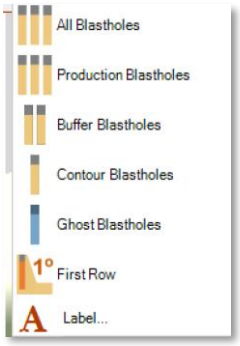


Figure 172 - Types of boreholes that can be edit.

The user can create label, a comment or a water column by double-clicking in the borehole and going to **Others** menu – Figure 173.

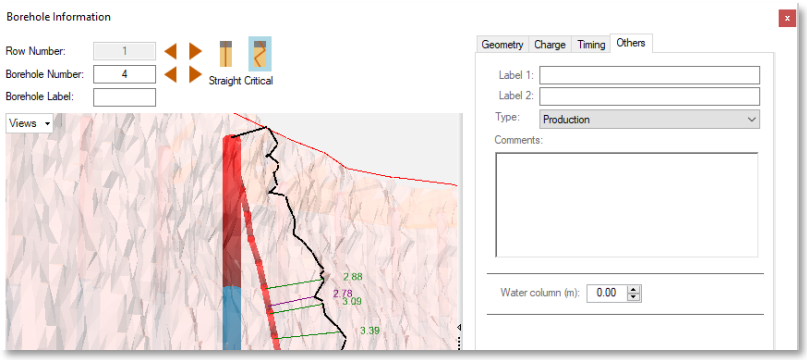


Figure 173 - Others menu: create label (1 and 2), type, comment or water column.

In the case of the selection of more than one hole the **Borehole Information Window** will be presented like the example of Figure 175.

This screen alows the user to control the geometrical characteristics of multiple holes. To change the **Burden** and **Spacing** it is necessary an individual selection, since this option is not available in the multiselection holes edition. In the other hand, if the user pretends to change parameters like **Bench Height**, **Hole Length**, **Stemming**, **Subdrilling**, **Inclination** and **Azimuth** they can be modifiyed by checking the **CheckBox** and clicking in **Apply Changes**. If the checkbox, of any item, presents this shape -▣ - means that there are more than one hole with differente features.

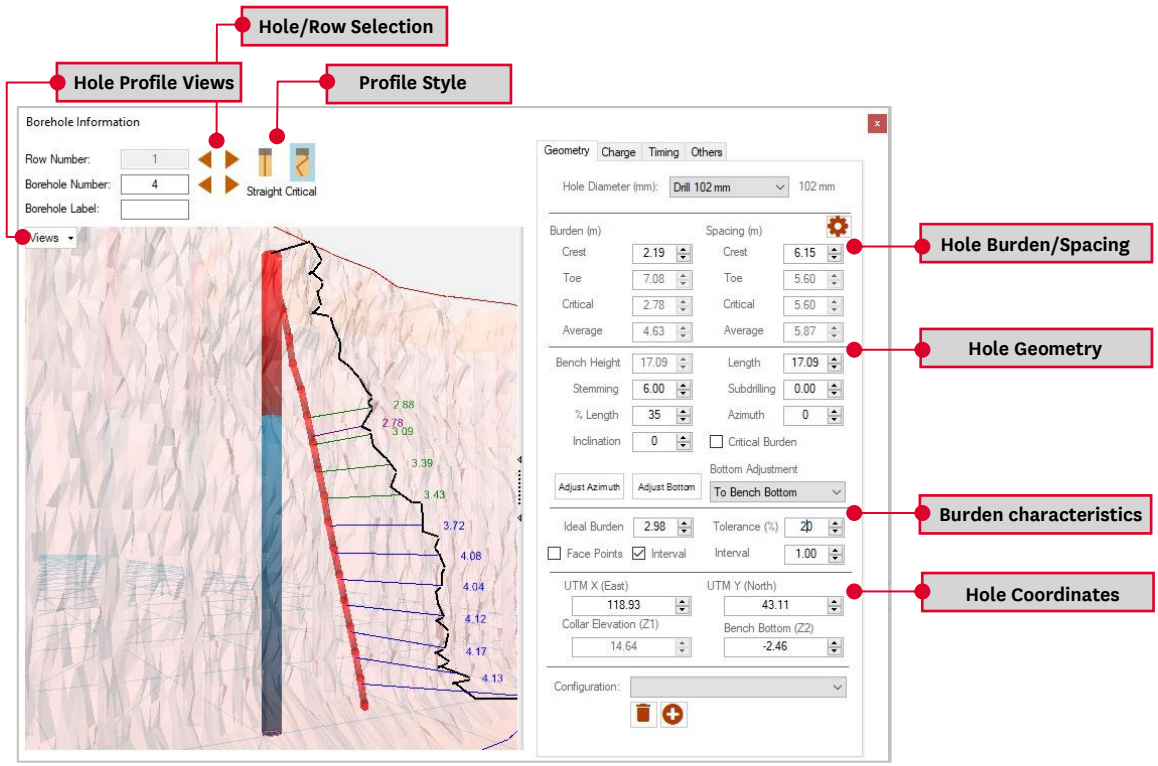


Figure 174 - Borehole Information Window.

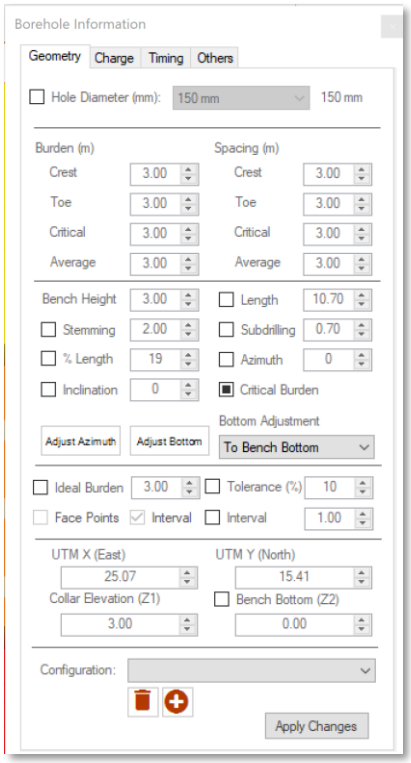


Figure 175 - Borehole Information Window (Several holes selected).

10.1.2. Add Holes -

To add individual holes, the user must select the **Add Hole** icon and then Left-Click in the terrain surface.

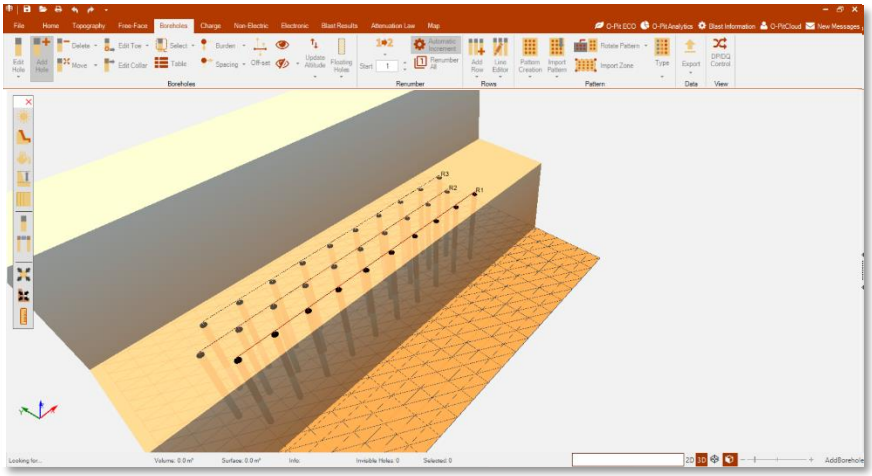


Figure 176 - Add Holes tool.

10.1.2.1. Hole Burden/Spacing

This information is showed if there is a row associated to the holes (Figure 177). O-PitSurface calculates automatically the burden and spacing and, for that, it is necessary the definition of each row in order to identify the closest rows and neighbor holes. You can define your rows like is explained is chapter 10.7.

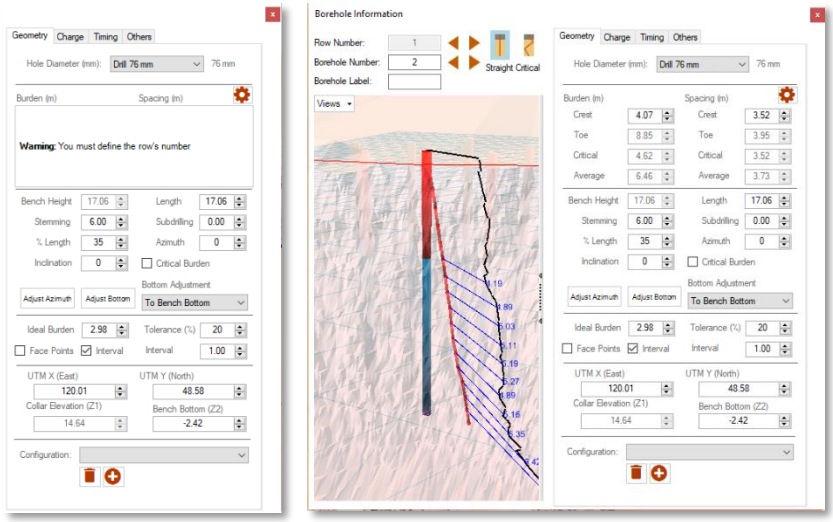


Figure 177 - Burden/Spacing info - Rows definition.

10.1.2.2. Holes Inclination and Bench Bottom Adjustment

To change the inclination of a set of holes the user must select them and click on the **Edit Hole** icon, check the **Inclination** Checkbox and make the desired changes. In the example of Figure 178 is possible to observe that the subdrill of the edited holes was not achieved. To correct this situation, the user must select the **Adjust Bottom** button and click **Apply Changes** (Figure 179). Also, the user can choose until where he wants to adjust holes: bench bottom or layers.

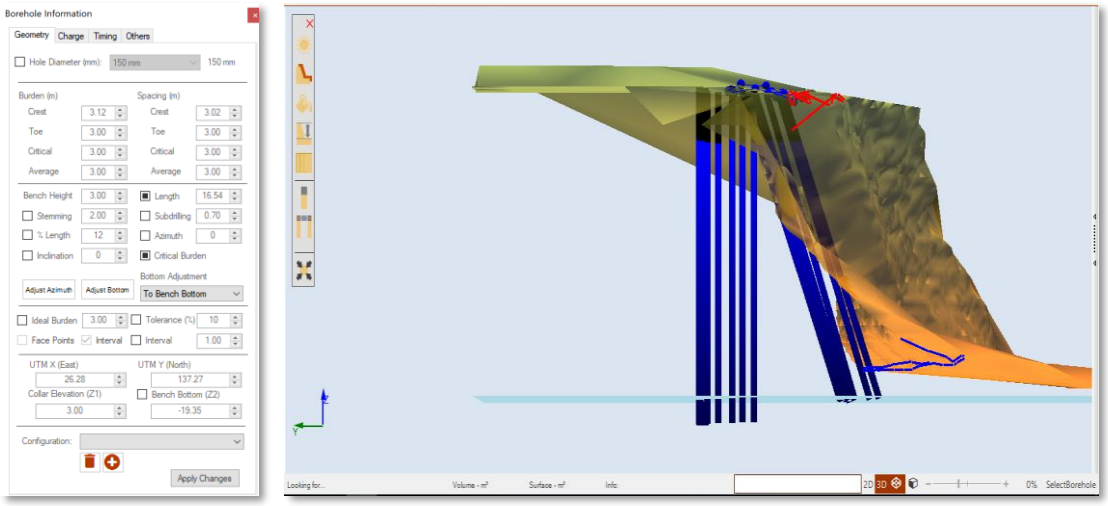


Figure 178 - Changing holes' inclination (no bottom correction).

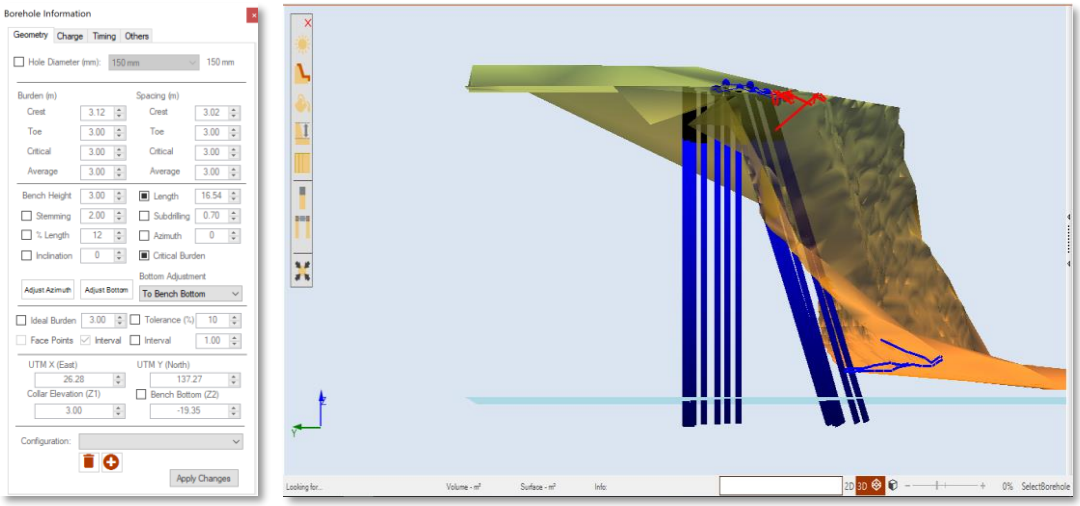


Figure 179 - Changing holes' inclination (with bottom correction).

10.1.2.3. Holes Azimuth

If the azimuth of the holes is not defined, when the user changes the inclination direction can take a wrong value – Figure 180 - A.

To correct this issue, the user can either put the azimuth value manually or, if the crest and toe are defined, select the **Adjust Azimuth** button - Figure 180 – B.

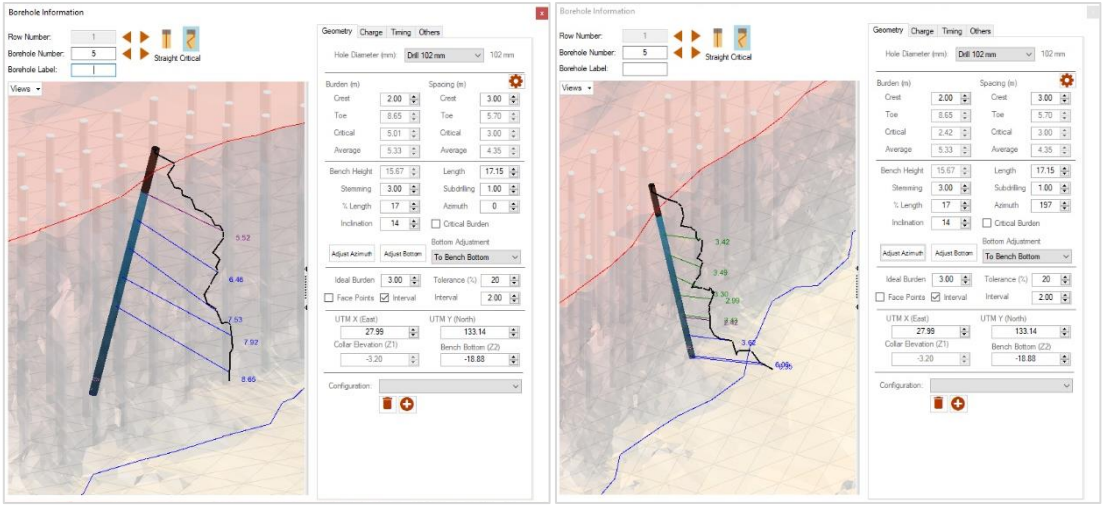


Figure 180 - Adjusting azimuth. A (left): azimuth not adjusted; B (right): azimuth adjusted automatically.

10.1.3. Delete Holes -

The **Delete** holes icon if clicked will erase all the existent holes in the project. To delete individual holes the user must use the **Radial Menu** (Chapter 6.8).
To delete a conjunct of holes is necessary to use the **Select** tool (point: 10.1.6) and click in the **Delete** icon.

10.1.4. Move Holes -

To move individual holes, the **Move** tool must be selected and then, with left-click, drag the hole to the new position (Figure 181).

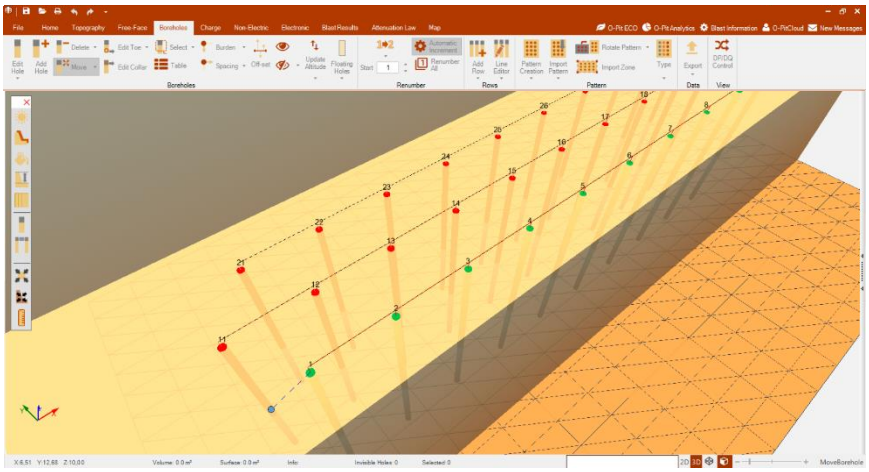


Figure 181 - Moving a single hole.

To move more than one hole is necessarily **select** polygon (point: 10.1.6), left-click in one hole and drag all the holes to their new positions.

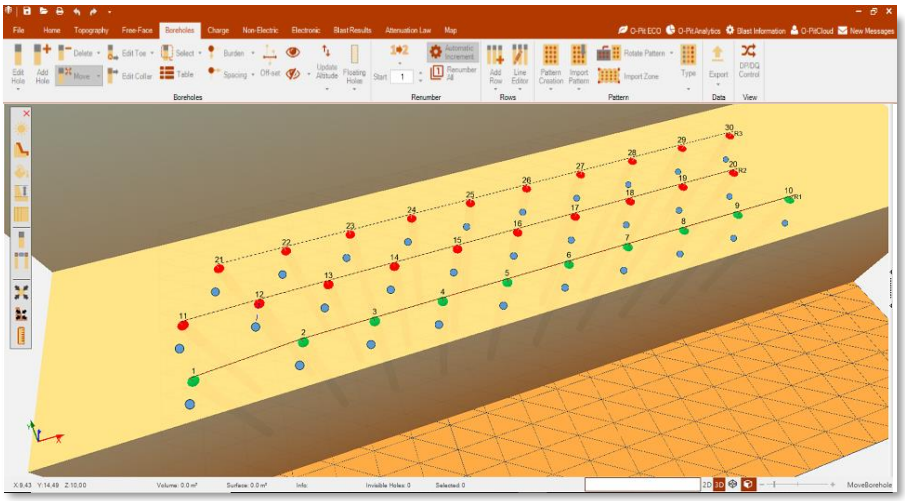


Figure 182 - Moving a conjunct of holes.

The user also has the possibility to move the holes using **move hole over line** or **proximity ring tool** (Figure 183). Once the first option is enabled, it is just necessary left-click in one hole and the dashed lines will appear to move the hole over line (Figure 184).

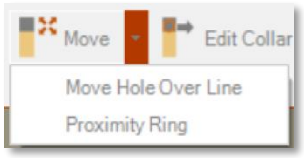


Figure 183 - Tools within Move button.

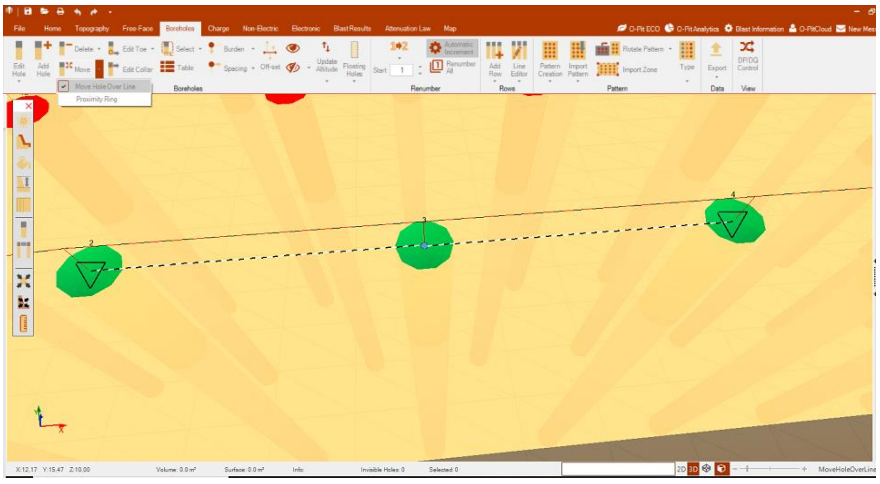


Figure 184 - Move hole over line.

When the user clicks on proximity rings, a pop-up window will appear to select/deselect the desired radius (1, 2 and/or 3) and to assign the desired value for each one.

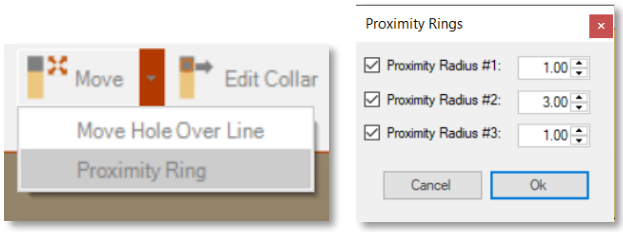


Figure 185 - Proximity ring enabled.

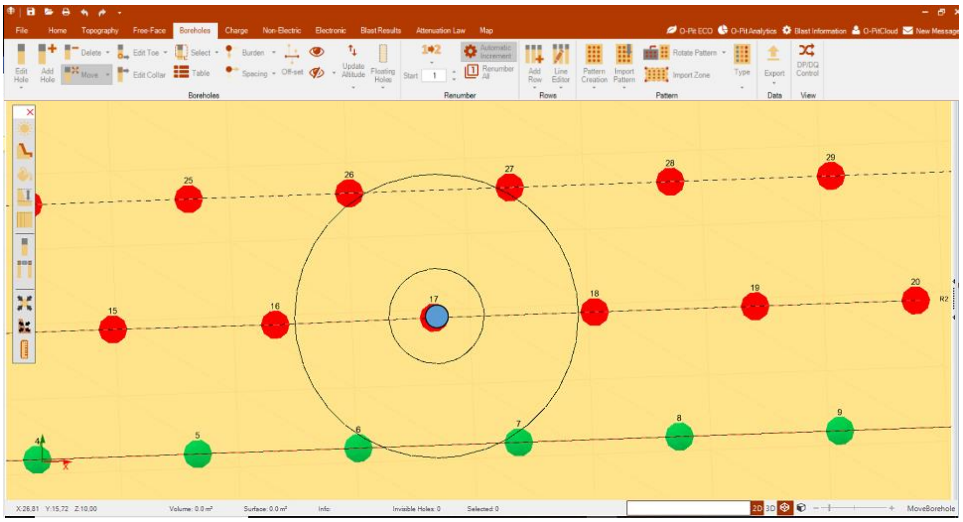


Figure 186 - Move hole using proximity ring.

10.1.5. Edit Toe -

Hole inclination is directly connected with toe position. To change it, the user must click on the **Edit Toe** and orange dots will appear on top of the hole's collars. With the left-click the user must drag these dots in order to positioning the hole's toe (Figure 187).

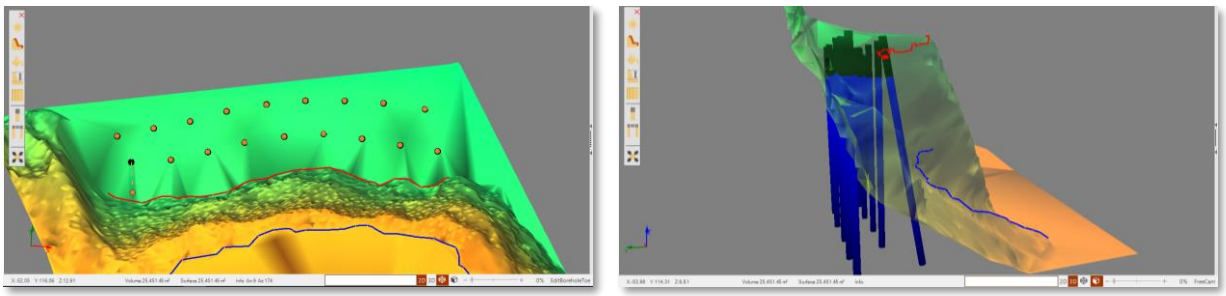


Figure 187 - Toe Edition (Single hole).

For a conjunct of holes, the procedure is to select them (point: 10.1.6) and drag to the desired position.

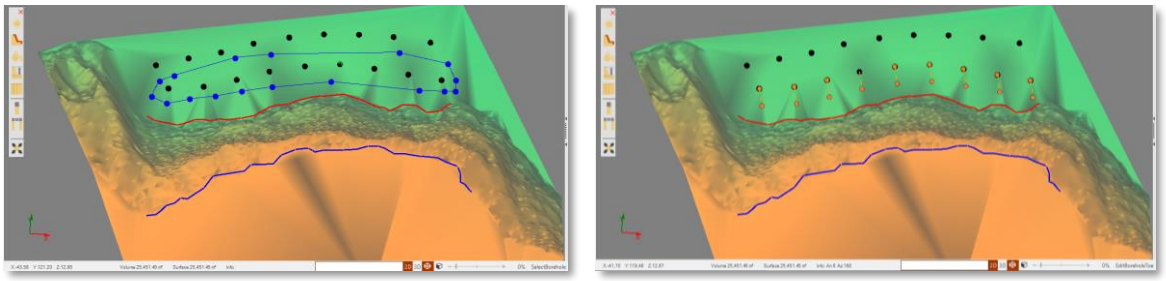


Figure 188 - Selecting a conjunct of holes.

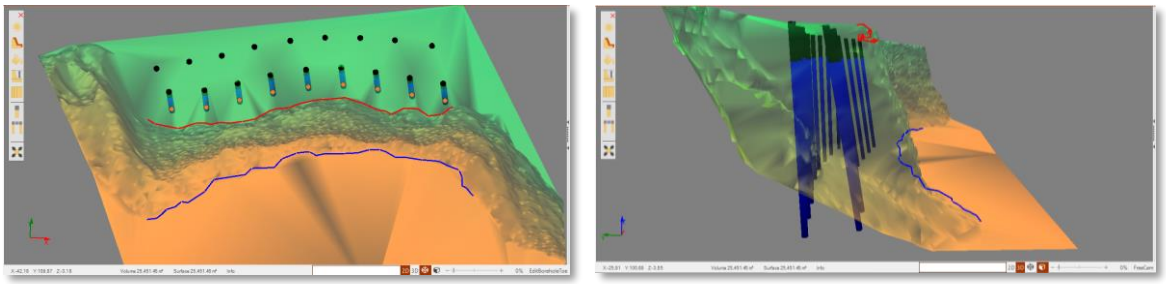


Figure 189 - Dragging a conjunct of holes.

10.1.5.1. Send Toe to the Select Line →

This resource is found within the edit toe tool (Figure 190). It allows the user to adjust holes toe position sending them one by one to the desired line. The first step is to draw a line, where the user wants the new toe position. After that, once this option is enabled it is needed to click in the line and click the desired hole. Then, the holes will extend to the selected line (Figure 191).

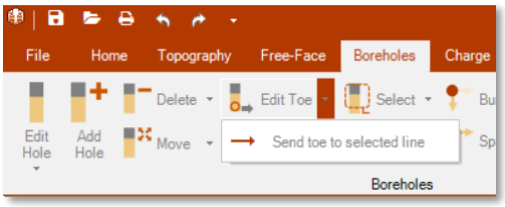


Figure 190 - Send toe to selected line.

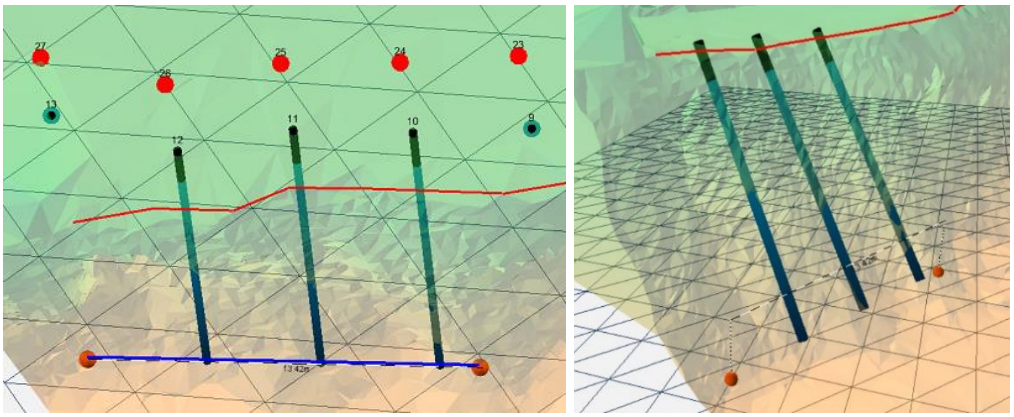


Figure 191 - Send toe to the select line: 1) Line selected in blue; 2) Toe position changed to the new position.

10.1.6. Select Holes -

The **Select** tool allows the selection of a set of holes in order to delete them or change their characteristics. To proceed, the user must left-click in the terrain and build the polygon around a conjunct of holes. To finish the selection is necessary to right-click in order to close the polygon (Figure 192).

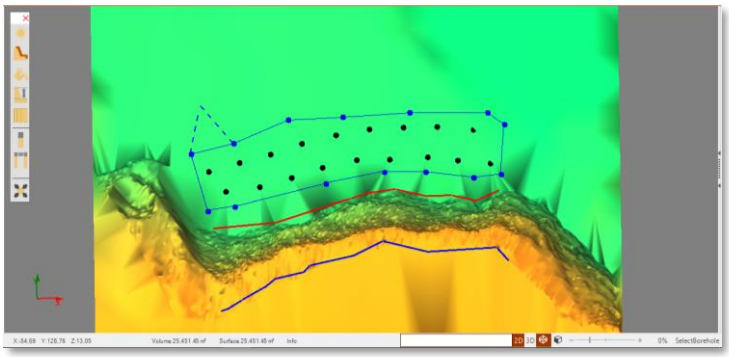


Figure 192 - Holes Selection tool.

Other way to select holes is to press **ctrl** and **left mouse button** over the holes (Figure 193).

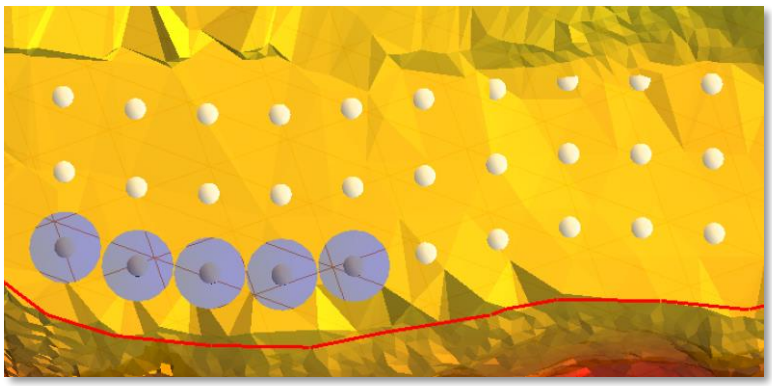


Figure 193 - Holes selection one by one.

To move, delete or add polygon points, the user must left-click on polygon points and use the **Polygon Selection Radial Menu** (Figure 194) to proceed with the desired action.

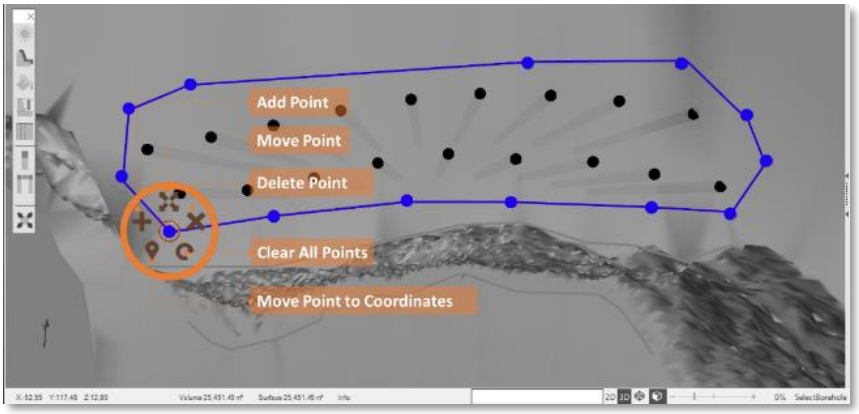


Figure 194 - Polygon Selection Radial Menu.

10.1.6.1. Use Crest

The user can select using crest points – like shown in polygon using crest (chapter 7.2)

10.1.7. Free-Face Profile Control -

O-PitSurface determines the free face profile for all holes. After defining the rows, the user can check each profile on **Edit Hole Window** (Chapter 10.1.1).

10.1.7.1. Straight/Critical Profile Style

This option permits select the views between a straight profile or a critical one (Figure 195). The **Straight View** defines a straight profile in accordance with the free face. In the other hand, the **Critical** profile identifies the line that connects all the critical points along the free face.

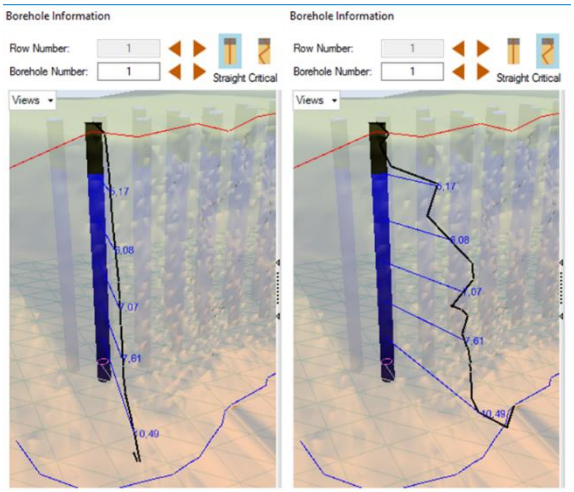


Figure 195 - Profile Style: Straight/Critical.

10.1.7.2. Analyzing Critical Burden

To analyse the critical zones of each hole the user must define the **Ideal Burden,** the **percentage Tolerance,** the **Face Points,** and the visualization **Interval** (Figure 196).

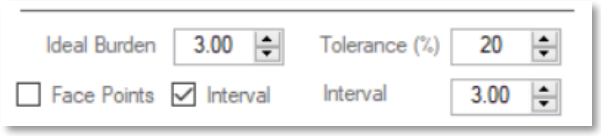


Figure 196 - Critical Burden Definition.

This info is important to identify projections potential risk zones (like the red zones) (Figure 197). To eliminate these risk zones, the user can, in advance, adjust the crest burden or inclination of each hole.

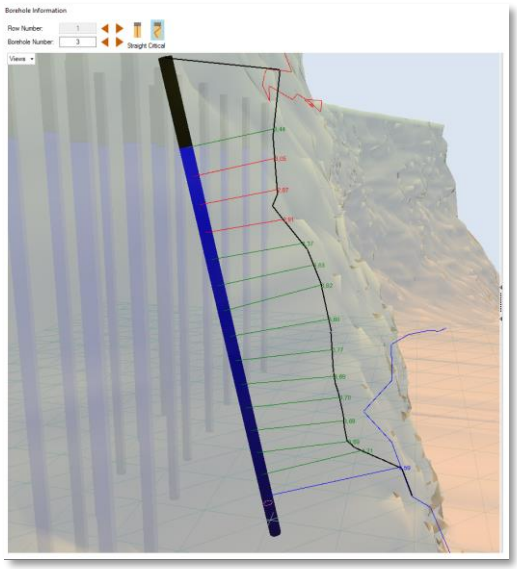


Figure 197 - Projection potential risk zones.

To enhance user experience, it is possible to define 3D limit zones and analyze them with full detail (Figure 198).

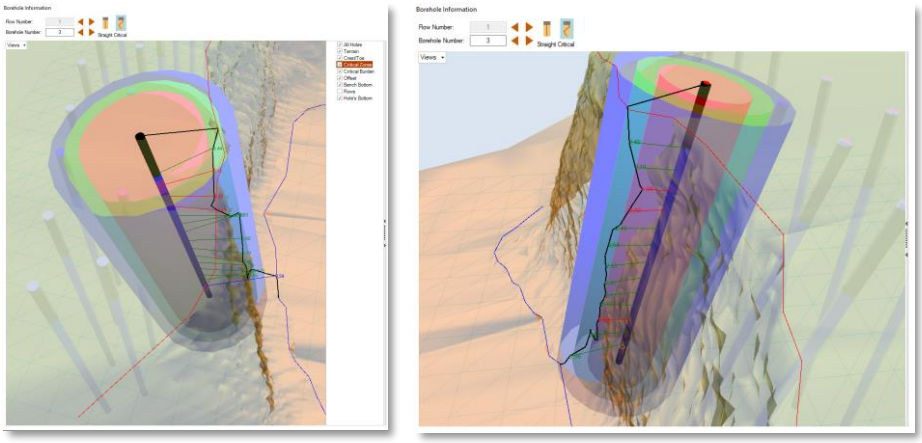


Figure 198 - 3D Burden Limit Zones.

To see the critical profile of the holes that are not in the first row the user must click on critical burden button (Figure 199).

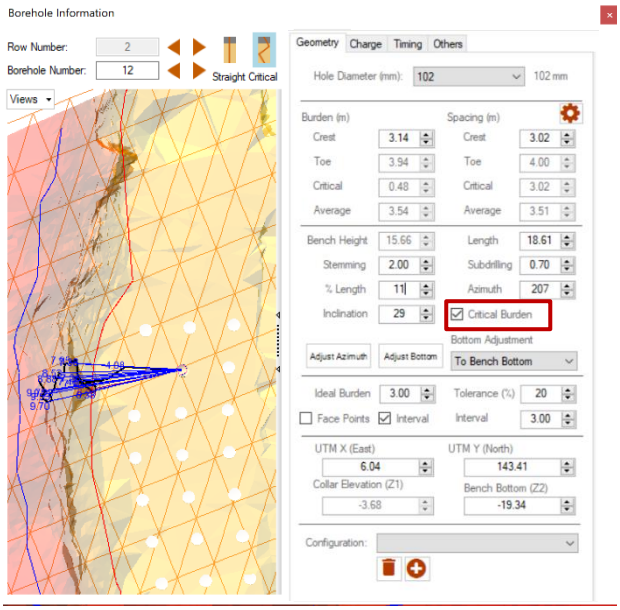


Figure 199 - Critical burden.

10.2. Table

Here the user can see all the information of the holes on a list. Also, he can put visible or invisible the holes on the terrain (one by one) by check or uncheck the option **Visible**.

Boreholes: 30

Number	Label	Burden	Spacing	Stemming	Subdrilling	Diameter	Visible
1		2.715	3.108	0.7	0	150	☑
2		2.943	3.021	0.7	0	150	☑
3		3.1	3.002	0.7	0	150	☑
4		3.138	3.016	0.7	0	150	☑
5		3.18	3.04	0.7	0	150	☑
6		3.2	3.043	0.7	0	150	☑
7		2.984	3.036	0.7	0	150	☑
8		3.014	3.001	0.7	0	150	☑
9		2.998	3.013	0.7	0	150	☑
10		2.937	3.013	0.7	0	150	☑
11		3.137	3.078	0.7	0	150	☑
12		3.145	3.015	0.7	0	150	☑
13		3.289	3.001	0.7	0	150	☑
14		3.309	3.012	0.7	0	150	☑
15		3.236	3.029	0.7	0	150	☑
16		3.16	3.031	0.7	0	150	☑
17		3.094	3.026	0.7	0	150	☑
18		3.064	3.001	0.7	0	150	☑
19		3.071	3.009	0.7	0	150	☑
20		3.101	3.009	0.7	0	150	☑
21		3.145	3.053	0.7	0	150	☑
22		3.183	3.01	0.7	0	150	☑
23		3.3	3.001	0.7	0	150	☑
24		3.314	3.008	0.7	0	150	☑
25		3.249	3.02	0.7	0	150	☑
26		3.173	3.021	0.7	0	150	☑
27		3.102	3.018	0.7	0	150	☑

Figure 200 - List of information of the boreholes.

10.3. Burden and Spacing

By clicking on this option, the user will be able to see the burden and spacing design by the topography and holes pattern (Figure 201 and Figure 202).

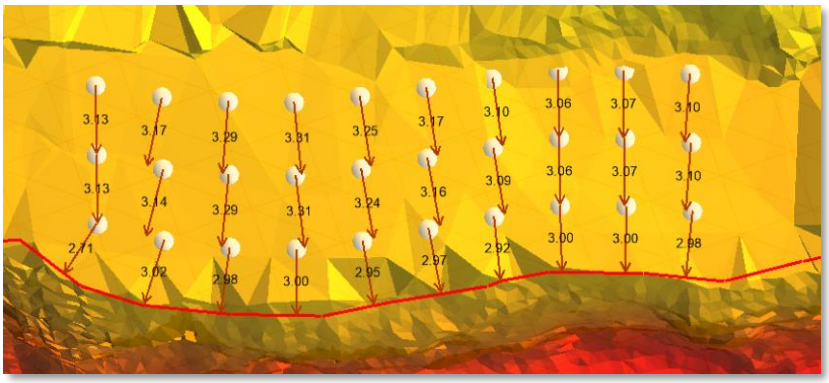


Figure 201 - Burden tool.

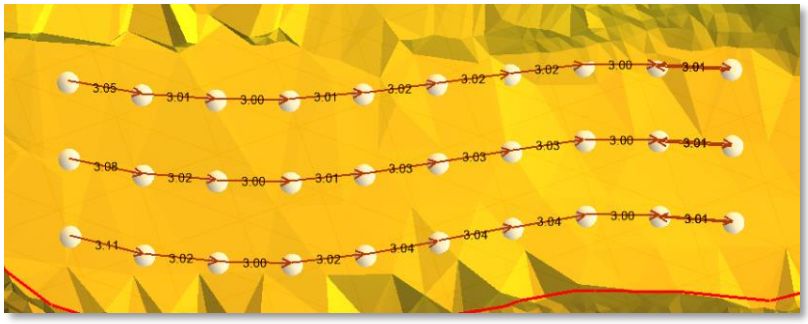


Figure 202 - Spacing tool.

If the user wants to change the burden defined by the software, he needs to click on the arrow present in burden/spacing tool near to holes and drag it to the place he pretends (Figure 203).

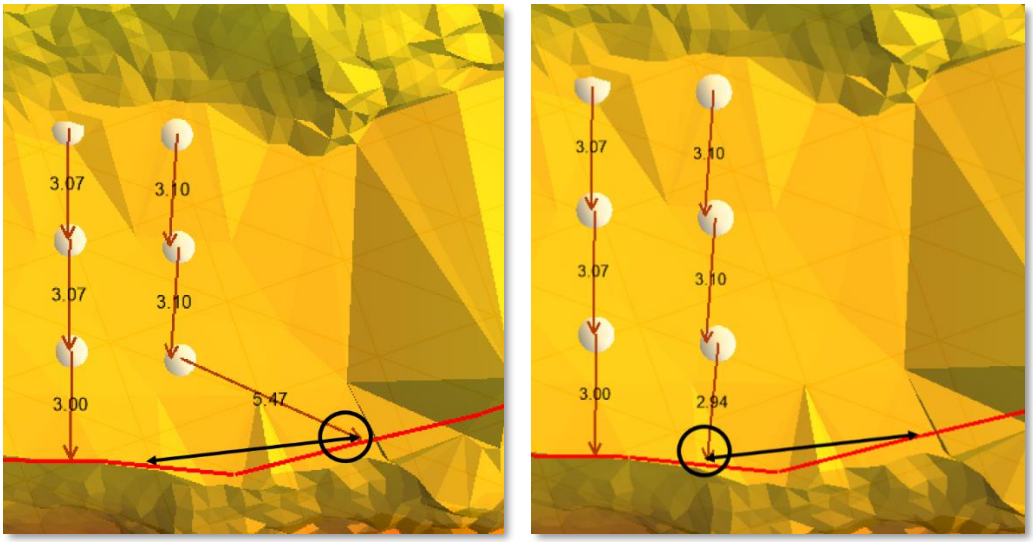


Figure 203 - On the left: first position of the burden; on the right: new burden position.

Another option inside of this tool, is the option to see the radial menu by clicking on the arrow present on burden/spacing option. The user can:

- Reset burden/spacing
- Get coordinates of the position of that burden/spacing
- See the size of burden/spacing

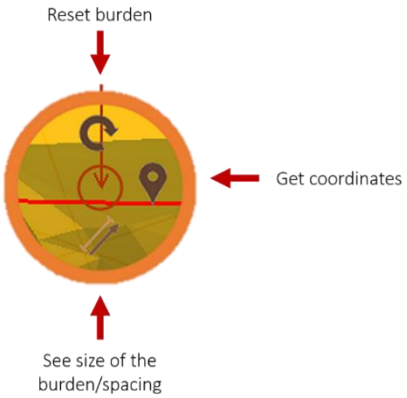


Figure 204 -Radial menu of burden/spacing tool.

10.3.1. Check Minimum Burden and Spacing

With this tool, the user can verify the minimum burden value. If the project is distant, it will approach and highlight the associated hole.

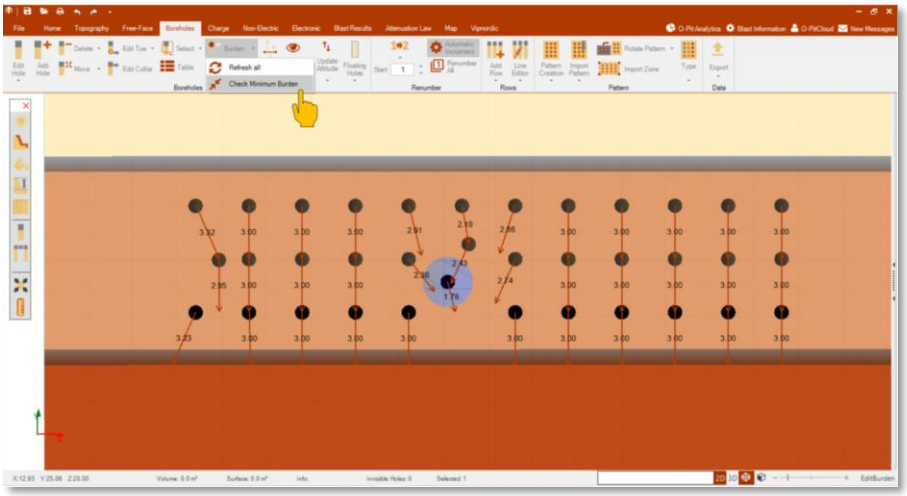


Figure 205 - Check minimum burden tool.

The user can do the same related to spacing using check minimum spacing tool (Figure 206).

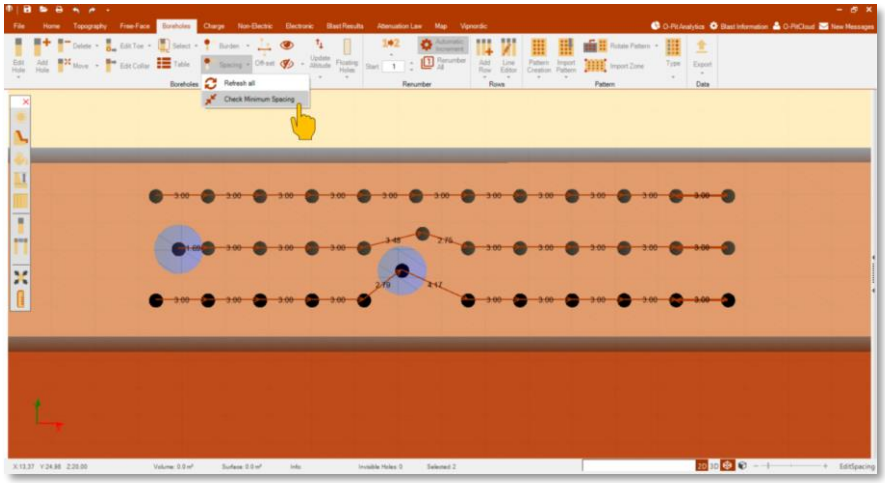


Figure 206 - Check minimum spacing tool.

10.4. Off-Set

The Off-set tool is used to create a reference line to mark the hole in the field. Once selected, an offset window will pop-up (Figure 207). Then, the user must select an arrow ( ) to enable the entry of burden values ( ) – Figure 208.

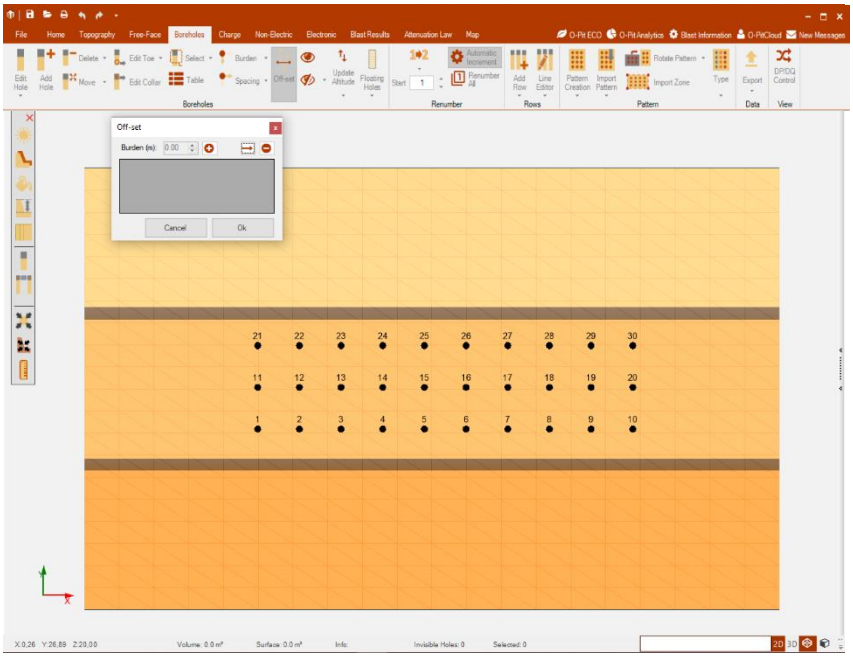


Figure 207 - Off-set tool.

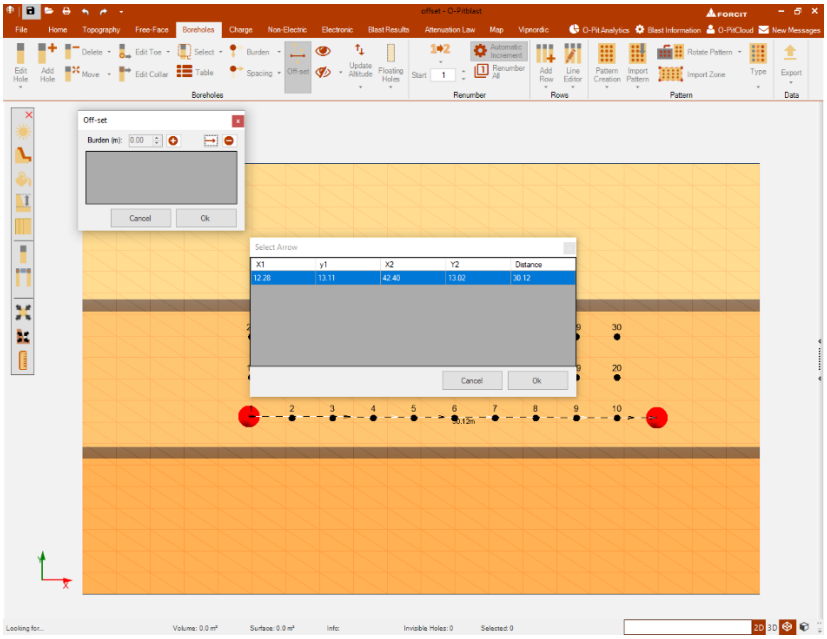


Figure 208 - Off-set tool: select arrow.

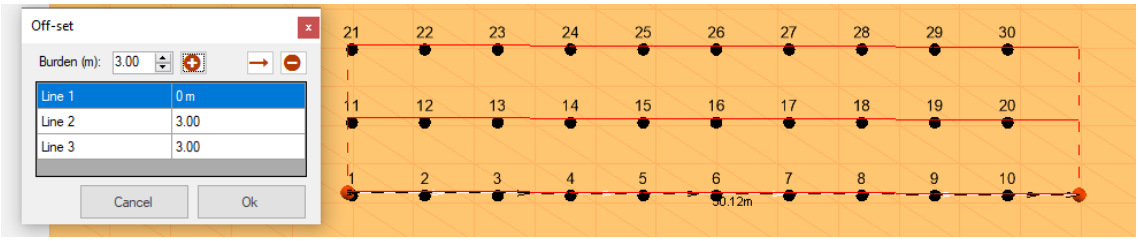


Figure 209 - Example of entered off-set values.

10.5. Visible/Invisible and Renumber

Icon		*Description*
	Visible	All boreholes get visible.
	Invisible	The selected boreholes get invisible.
	With deviation data	The boreholes with boretrak information get invisible.
1➡2	Renumber	By choosing a start point the user can renumber de boreholes that he wants. Edit's hole label
	Automatic Increment	Saves the last number that the user use to renumber the next borehole.
	Renumber all	Renumber automatically all boreholes

10.5.1. Visible or Invisibles Holes

The user can hide the **selected** holes in the terrain by clicking on the **Invisible** button ( ). To put them back **visible** just click on the **Visible** button ( ).

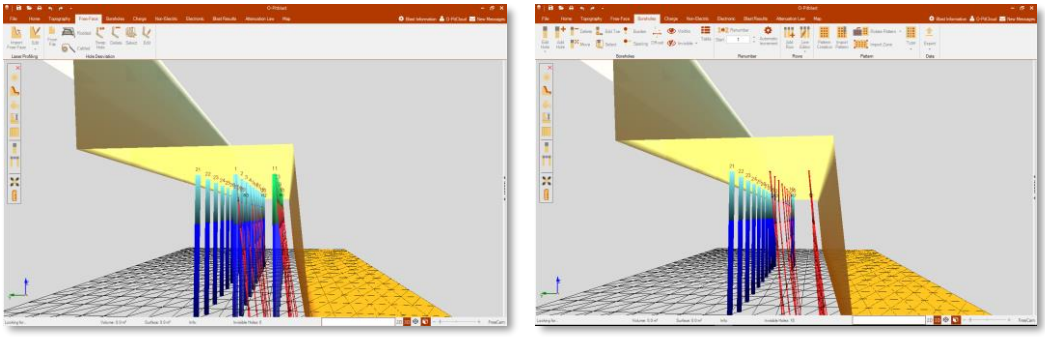


Figure 210 - Left (a): visible boreholes; Right (B): invisible boreholes (with deviation data).

Another option inside of the Invisible button (Figure 211) is to conceal or show with all holes with borehole deviation data.

Figure 211 - Option to hide holes with borehole data.

10.6. Update Altitude

This option allows the user to update the altitude of the boreholes. Clicking in this tool it will appear an option to open a file (**this file must contain hole numbers and new altitude of the hole**). After choosing the file it will pop up a window to connect hole number with altitude (Figure 212). After that the user clicks on the download button and the altitude of the holes will be updated.

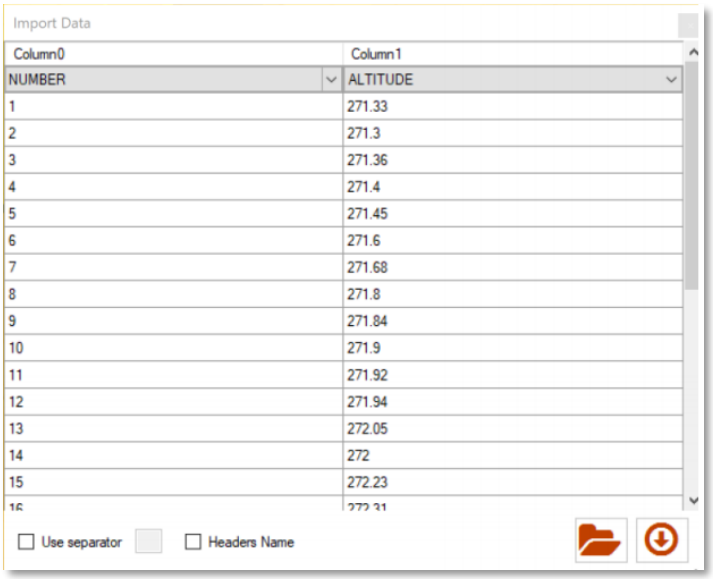


Figure 212 - Update altitude window.

10.7. Floating Holes

In this option the user will be able to import holes from previous blasts. It's important to remember that the user must have terrain and the holes that he's importing must be inside of the coordinates of that terrain.
After clicking on the importation option (Figure 213) and choose X, Y and Z for collar and toe (of the floating holes), the pattern will appear like shown on the pictures (transparent).

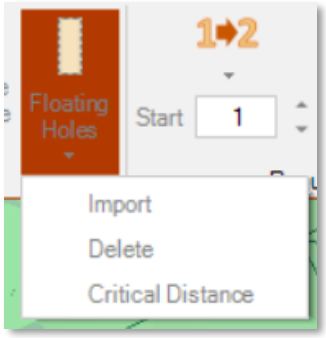


Figure 213 - Importation of floating holes.

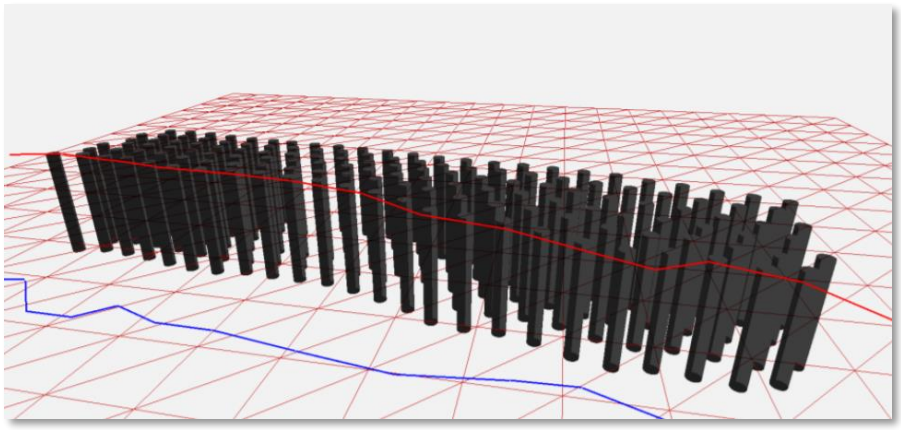


Figure 214 - Example of floating holes.

After that the user can create the new pattern based on the previous position of the previous blast and prevent, for example, deviation of the new holes during the drilling process.
The user can also delete the holes (Figure 213) and create a critical distance (Figure 213). This last option will allow the user to define a critical distance and O-PitSurface will calculate if the new pattern it is too close to the old pattern.

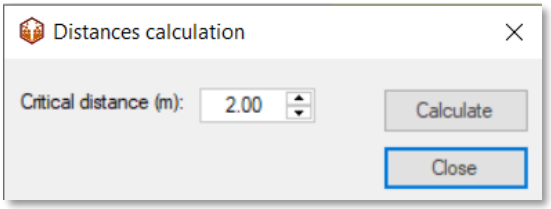


Figure 215 - Option to define the critical distance.

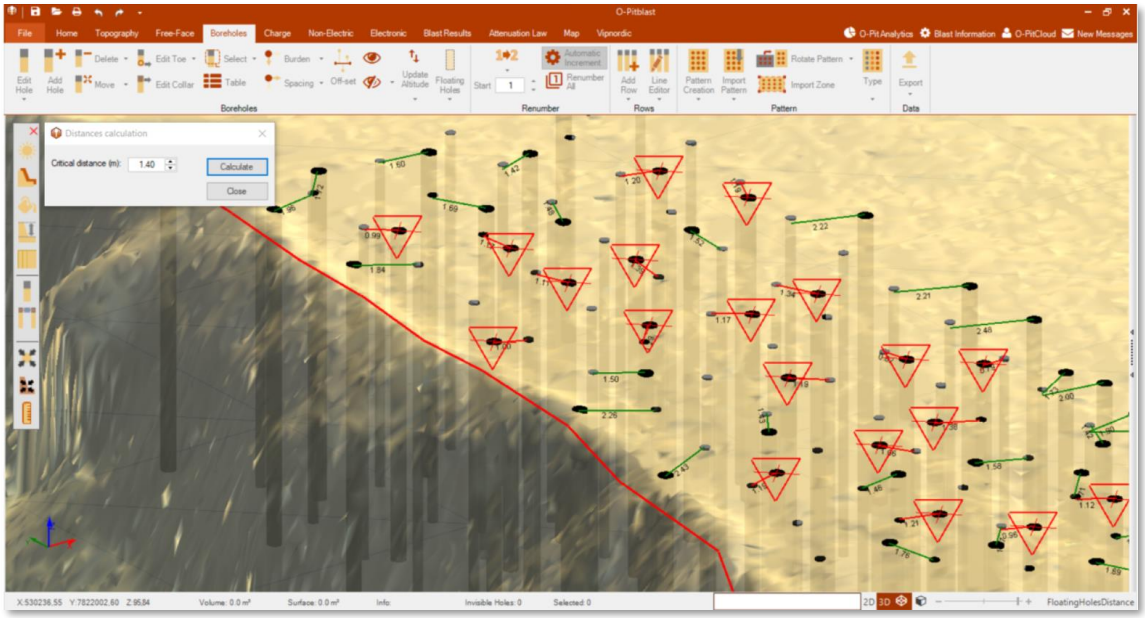


Figure 216 - Critical distance between previous hole (from previous blast) and new hole (for the new blast).

In the case shown in Figure 216, it was defined a critical distance, for example of 1.40 meters between holes. In this case, a green line it is shown when the holes are at a bigger distance than the entered value. If the holes are positioned less than 1.40m apart, warnings will appear in red.

If the user moves each hole, the software will recalculate the critical distance again.

10.8. Renumber

The user has many ways to renumber the holes. First way is clicking on the renumber tool (), choose a start number and start dragging the hole between holes (Figure 218). If the "Automatic Increment" () is **on**, when the user takes the mouse out, the starting point will be automatically update to the next number where the user was. If it is **off**, it will keep the number defined in the start point.

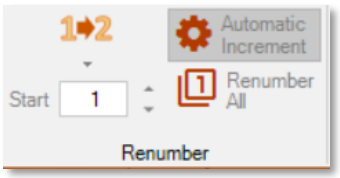


Figure 217 - Renumber tool and start point.

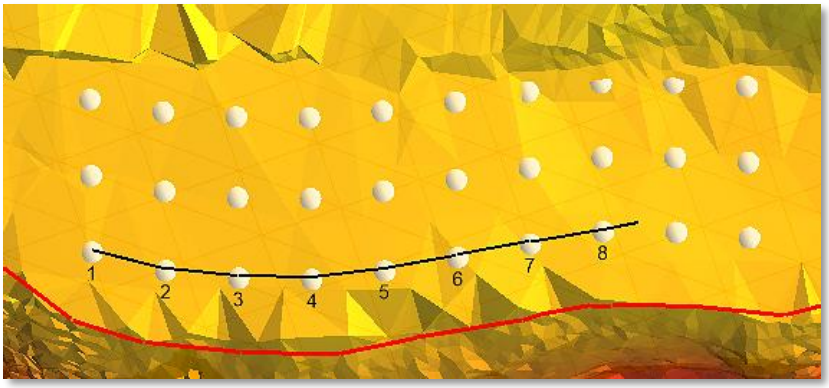


Figure 218 - Renumber tool.

If the user uses the option renumber all ( ) it will automatically update all hole's number.

10.8.1.1. Edit Hole's Label

In this tool the user can create a label hole by hole or automatically.
If the option **one by on**e is checked, the user can choose a **text**, a **number** to attached to the text and if he wants that number to **increase automatically** (if yes must click on" Increased Number").

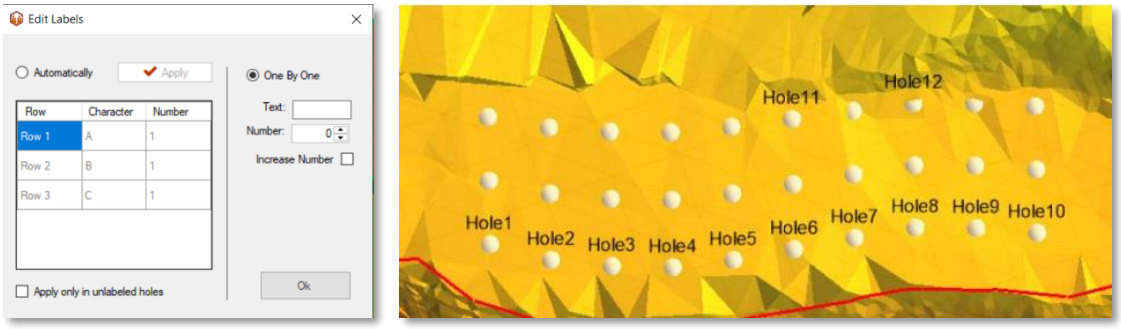


Figure 219 - One by labeling.

If the option **automatically** is checked, the user must define for each row what **text** he wants, the **number** that will start in each hole (of a row) and after that click in **apply**.

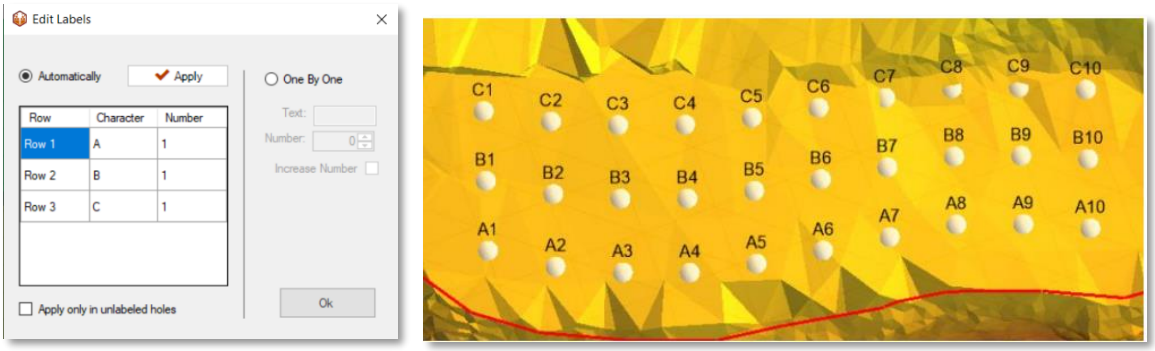


Figure 220 - Automatic labelling.

10.9. Rows: Creation and Edition

Icon		*Description*
	Add row	Create a new row
	One by one	Create a row near to other
	Line Editor	Select holes to define from which row they are.
	Hole by Hole	Define rows by holes individual select
	By line	Define rows by drawing a line over a conjunct of holes
	Clear all	Eliminate all rows

10.9.1. Add Row

When the user clicks on the **Add row** icon ( ) it will pop up a window to define the row number and the spacing between the holes.

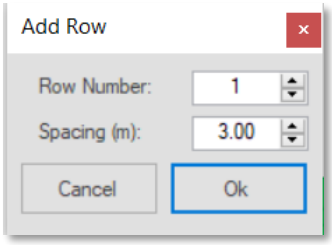


Figure 221 - Add row window.

After defining the parameters, the user must click one time on the field (1) and then drag the mouse until the place where he wants to build the row (2) - Figure 222.

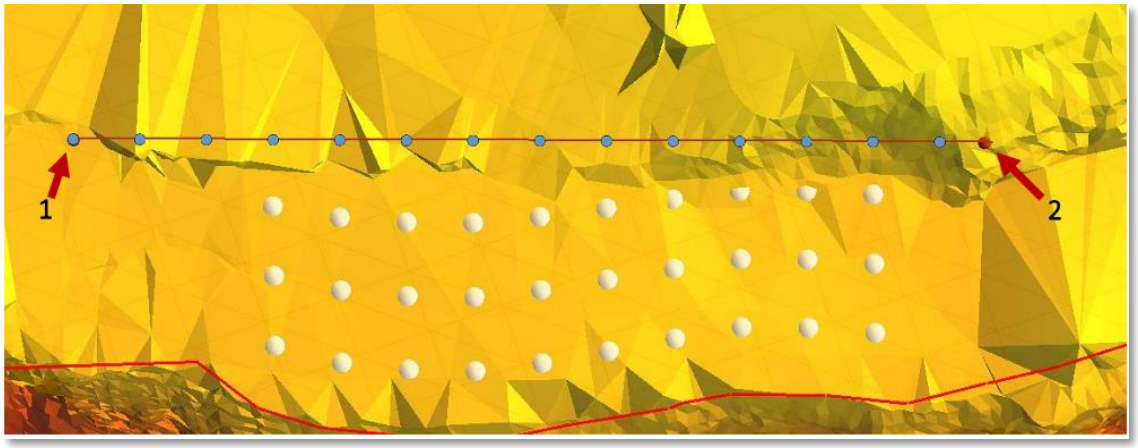


Figure 222 - Creating new row.

On the other hand, if the user wants to create a row near to other it has one option for that. On **create row near to another** () the user it will be forwarded to a window with the option to define **spacing**, **burden**, **after which row,** he wants to put the new one, **the row number** and **type of pattern.**

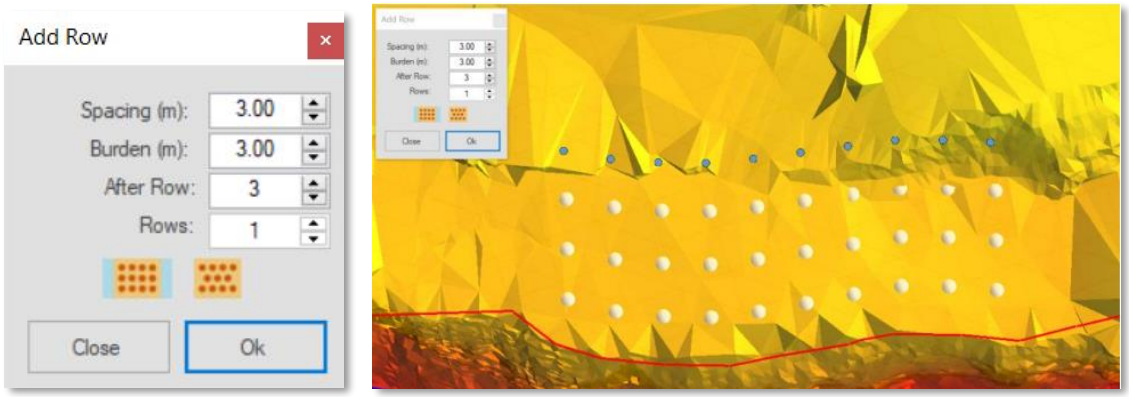


Figure 223 - Create row near to another.

10.9.2. Line Editor

The Line Editor tool permits the attribution of a row ID to each hole. There are two main options:

- **Hole by hole**: The user must define the row number in the **Row Control Box** and drag the mouse over a hole to assign a row ID (Figure 224).
- **By line**: The user must define the row number in the **Row Control Box** and draw a line over a set of holes to assign a row ID (Figure 225).

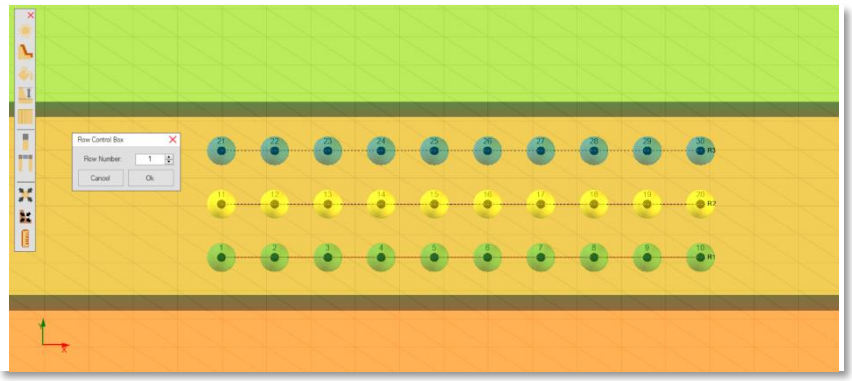


Figure 224 - Line Editor: Hole by hole.

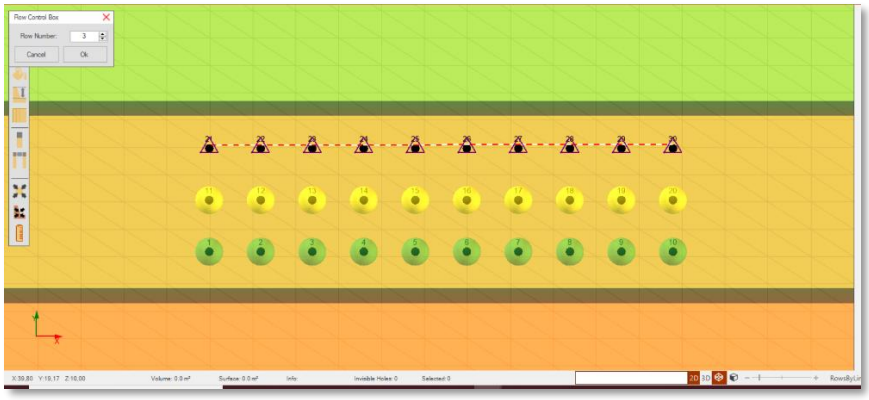


Figure 225 - Line Editor: By Line.

- Purple triangles illustrate that the rows are not assigned.
- To delete the information of the rows the user just must click on **Clear All** button.

10.9.3. Prepare Rows

When the user uses this option, it will pop up a window that works the same way as the **Row Control Box.** If select a row or numerous rows the holes with hole deviation measurements will appear all align on the report (as they were on the same row). To delete the information of these tool just click on reset button.

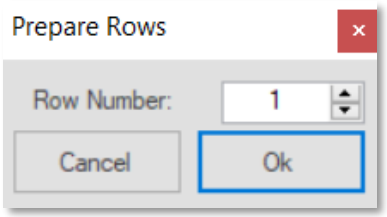


Figure 226 - Prepare rows window.

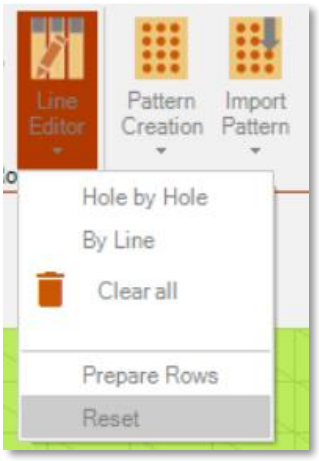


Figure 227 - Reset tool.

10.10. Pattern

Icon		*Description*
	Pattern Creation	Create a pattern over an existent terrain
	From Back	Create a pattern from back based on a line angle, a single point or a line.
	Edit Burden and Spacing	Automatically edit burden and spacing using a previous pattern.
	Along line	Create holes along line.
	Between Line_Crest	Create a pattern between a specific line and the crest.
	Between Line_Crest Polygon	Create a pattern between the crest line and the line at the back of a polygon.
	Import Pattern	Import holes from file.
	Import as Terrain	Create a new terrain from the borehole's collar.
	Import Pattern	Import holes files from various formats such as .TXT, .CSV, .XLSX, .DXF, and more
	Iredes DP/DQ	Import .XML files specifically designed for Drill Plan (DP) and Drill Quality (DQ) control
	From Picture	Import pattern data directly from picture files.
	Rotate Pattern	
	Rotate 90° to the Right	Rotate the entire pattern or a conjunct of selected holes 90° to the right.
	Rotate 90° to the Left	Rotate the entire pattern or a conjunct of selected holes 90° to the left.
	Turn Vertically	Turn the entire pattern or a conjunct of selected holes vertically.

	Turn Horizontally	Turn the entire pattern or a conjunct of selected holes horizontally.
Import Zone		Import blast polygon from file.
Type		
Production Blastholes		Assign the Production Blasthole ID to a hole or a conjunct of holes.
Buffer Blastholes		Assign the Buffer Blasthole ID to a hole or a conjunct of holes.
Contour Blastholes		Assign the Contour Blasthole ID to a hole or a conjunct of holes.
Ghost Blastholes		Assign the Ghost Blasthole ID to a hole or a conjunct of holes.
1st Hole		Assign the 1st hole ID to the holes defined as the first row.
Export		Export your borehole information in .CSV, IRedes, Center of Blast, .DXF or .JSON files.
DP/DQ Control		Manage IRedes data - Drill Plan (DP) and Drill Quality (DQ)

10.10.1. Pattern Creation -

For the **simple pattern creation**, over an existent terrain, the user must select the **Pattern Creation** tool. It is necessary select the pattern characteristics on the **Pattern Window** (Figure 228) and then, left click in the terrain.

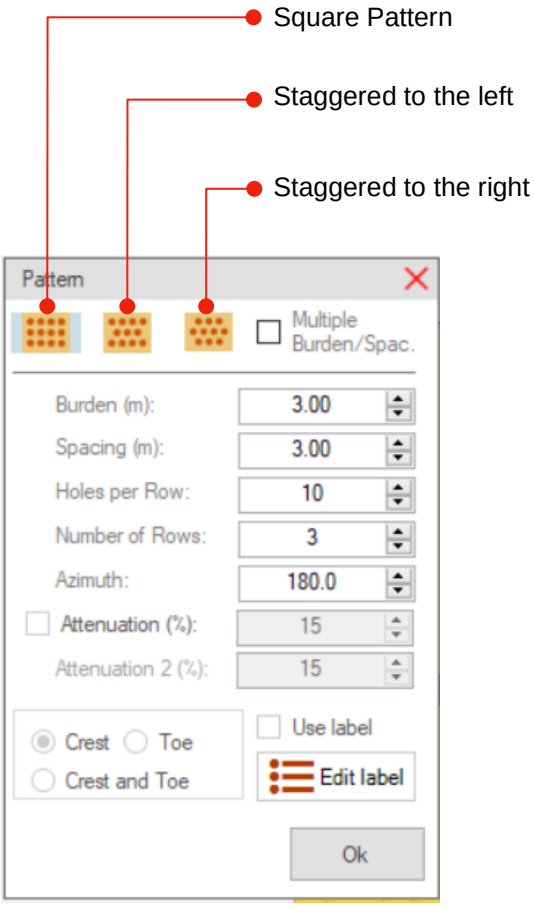


Figure 228 - Pattern Characteristics Window.

The user can **preview** the **position** of the hole in the terrain by **clicking** once on the terrain. They can **adjust** the **characteristics** before **confirming** the final **position** (Figure 229).

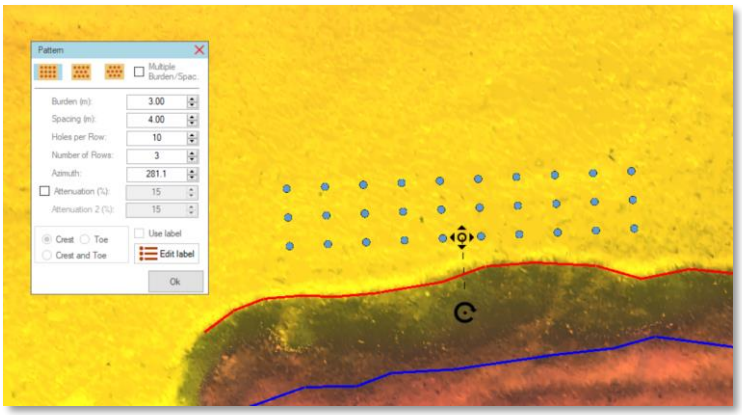


Figure 229 - Changing Pattern Characteristics.

Additionally, the pattern position can be manually adjusted by moving the **Pattern Position Adjustment** icon, and the azimuth can be changed either in the **Pattern Characteristics Window** or by dragging the **Rotating** icon.

The user can check the option **Multiple Burden/Spacing** to creat a pattern with multiples burdens/spacings between rows (Figure 230).

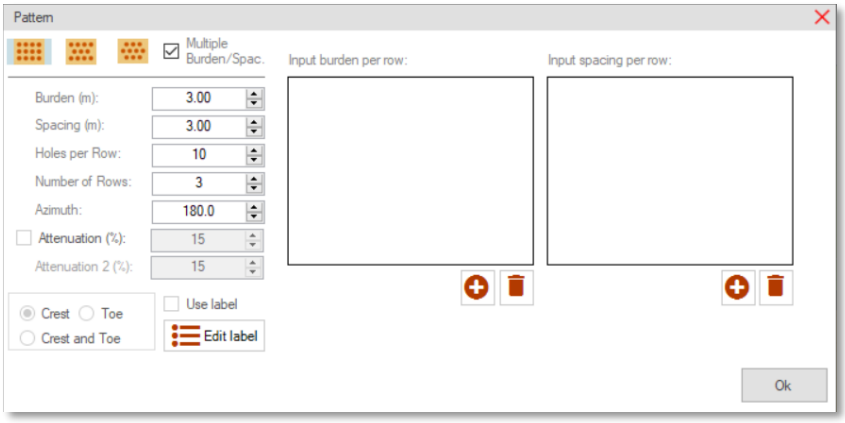


Figure 230 - Multiple burden/spacing per row.

The user clicks on the **Plus** button to add the number the rows that he wants. To delete just click on the **Delete** button. To change the burden just click on the row you want to change and write the number of burdens/spacings.

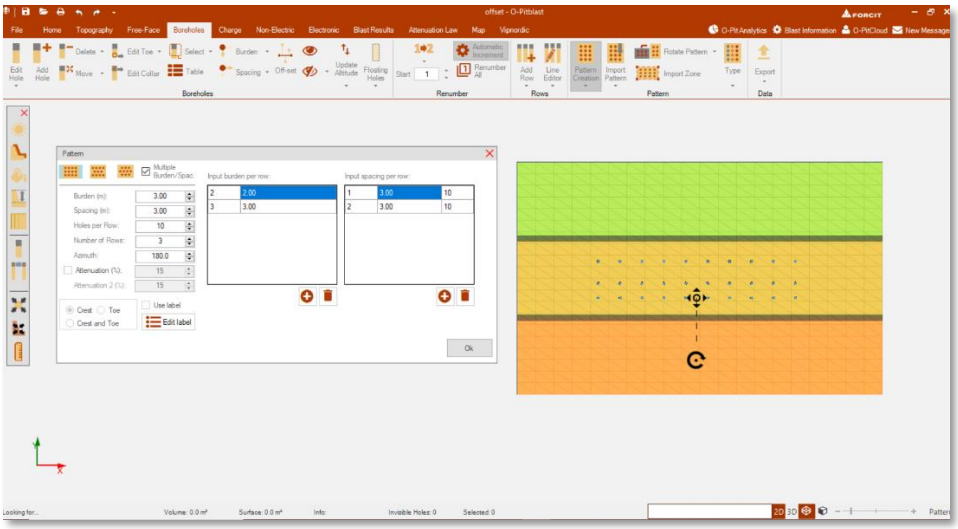


Figure 231 - Editing the burden/spacing per rows.

10.10.2. Attenuated Pattern Adjusted to Crest, to Crest and/or Toe

In this option, the user can attenuate the pattern to the crest, toe, or both, provided these features are defined.

10.10.2.1. Attenuation

If the **Attenuation** option is enabled, the user can apply attenuation to the burden. This value indicates that the burden is attenuated by a specified percentage (e.g., 15%) in each row (Figure 232).

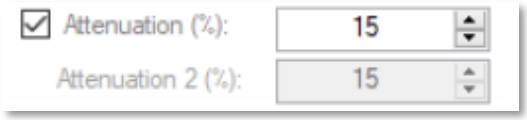


Figure 232 - Pattern Creation - Attenuation option.

For example, if the user wants the last line horizontal, the attenuation between rows must increase (Figure 233).

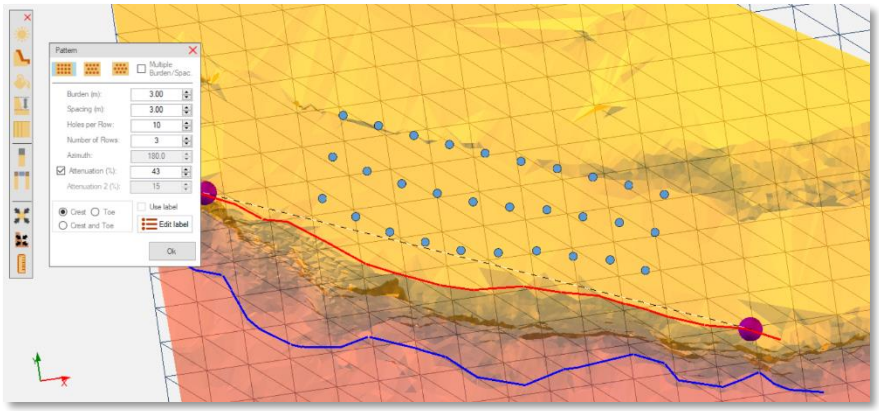


Figure 233 - Last row horizontal.

After that the user has three options. Adjust only to crest (Figure 234), only to toe (Figure 235) or crest and toe (Figure 236).

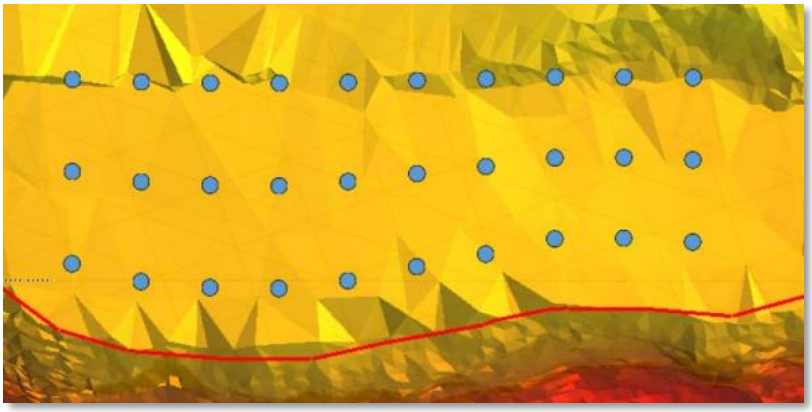


Figure 234 - Adjusted to crest.

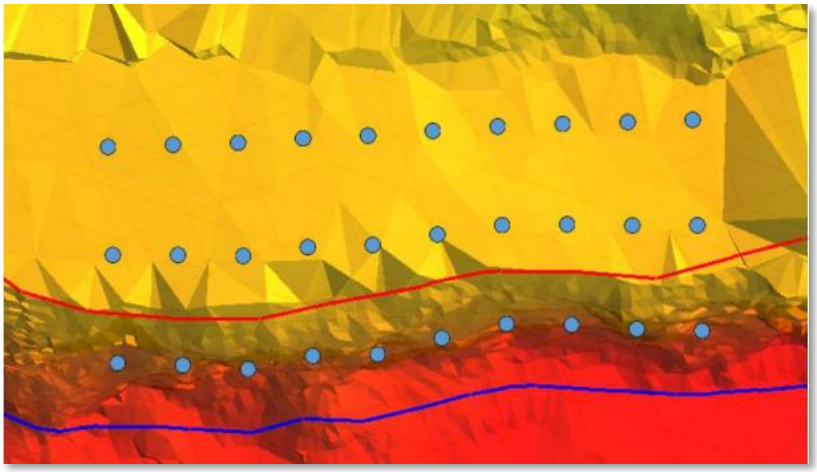


Figure 235 - Adjusted to toe (the blue circles represent the toe of the borehole).

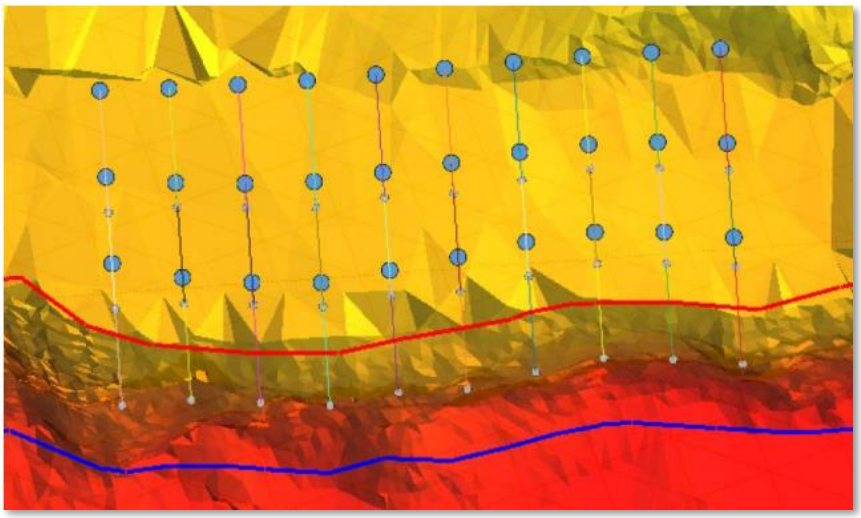


Figure 236 - Adjusted to crest and toe.

If the user clearly sees that the line from one point of the blast to another (on the free face is not well defined can change it) by right-clicking on the purple spheres (Figure 237).

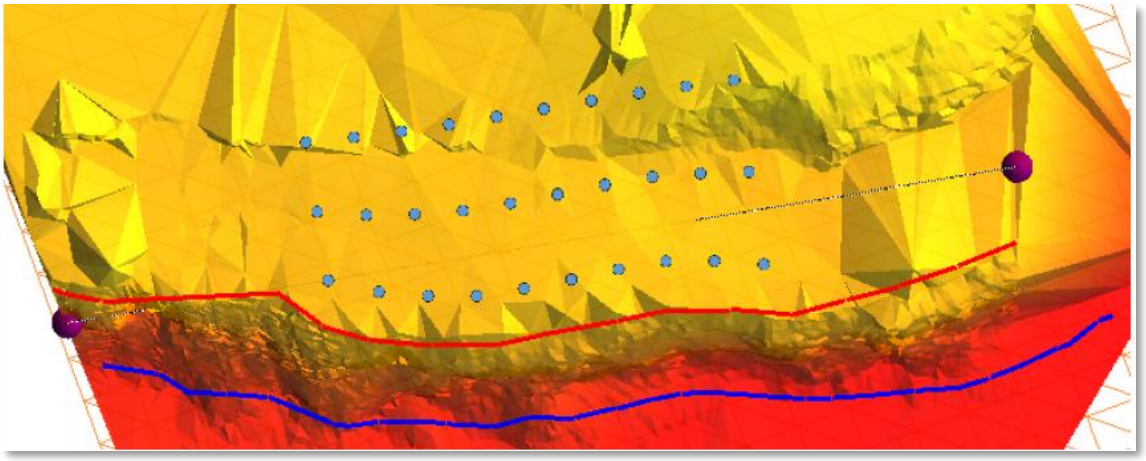


Figure 237 - Purple spheres (on both sides).

It will pop up a radial menu where the user can:

- Move the point
- Eliminate the point
- Clear all points
- See the coordinates of the points

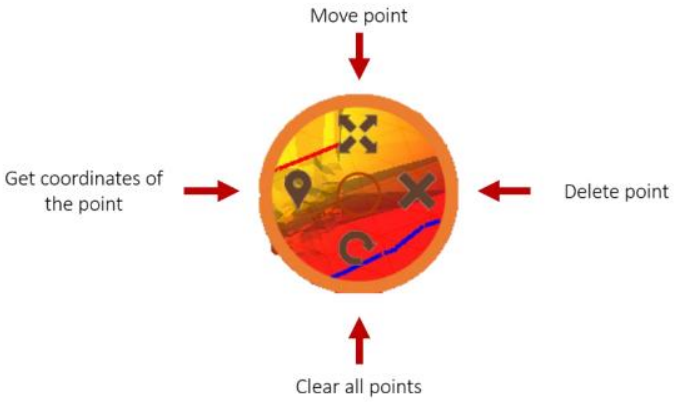


Figure 238 - Radial menu of attenuation points.

10.10.3. Pattern Creation Tools

10.10.3.1. From Back -

The user can create a pattern using from back tool. Once this tool is selected, the following window it will appear:

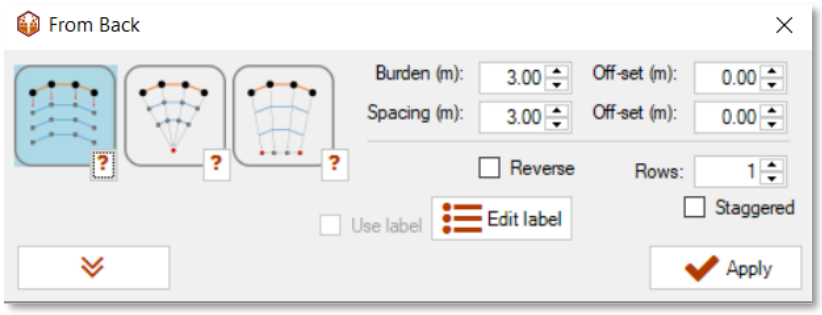


Figure 239 - Editing the burden/spacing per rows.

Basically, first it is needed import/create a back line. Then, it is possible use three mechanisms to create pattern from this resource: based on a line angle; based on a single point; and based on a line.

- Based on a line angle:
  - Select the back lines (left click on them) and choose the angle
  - Choose burden, spacing and number of rows
  - Define the offset (distance of the 1st row from the back line)
  - If needed, the user can choose the burden/spacing per row

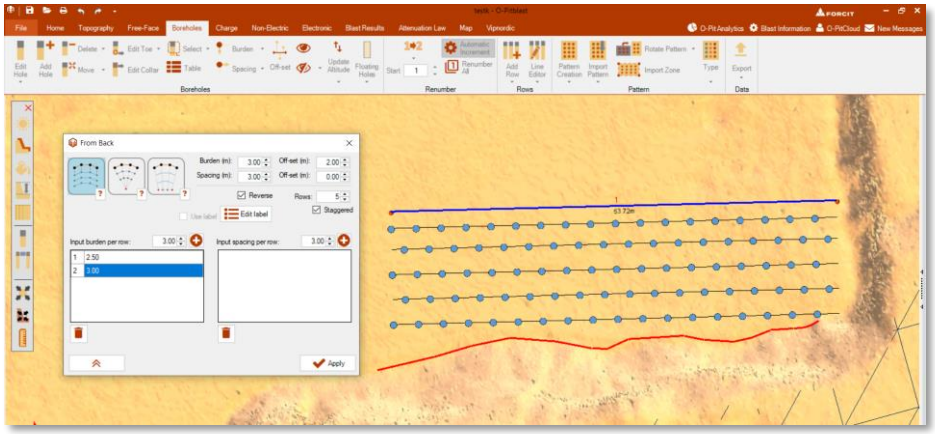


Figure 240 - Pattern creation using from back based on line angle.

- Based on a single point:
  - Select the back lines (left click on them) and then, left click on the terrain to select the point to converge your pattern
  - Choose burden, spacing and number of rows
  - Define the offset (distance of the 1st row from the back line)
  - If needed, the user can choose the burden/spacing per row

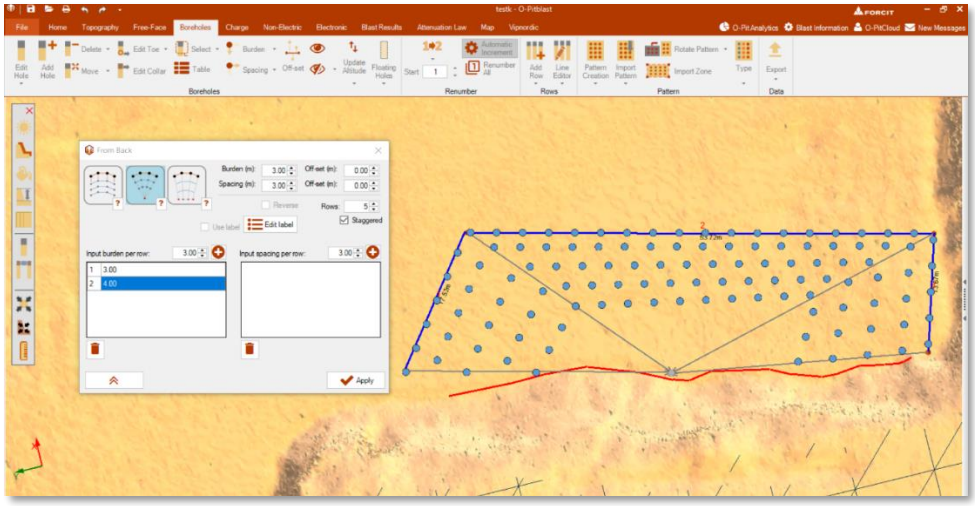


Figure 241 - Pattern creation using from back based on a single point.

- Based on a line:
  - Select the back lines (left click on them). Then, right click on the terrain and drag the mouse to create a line
  - Choose burden, spacing and number of rows
  - Define the offset (distance of the 1st row from the back line)
  - If needed, the user can choose the burden/spacing per row

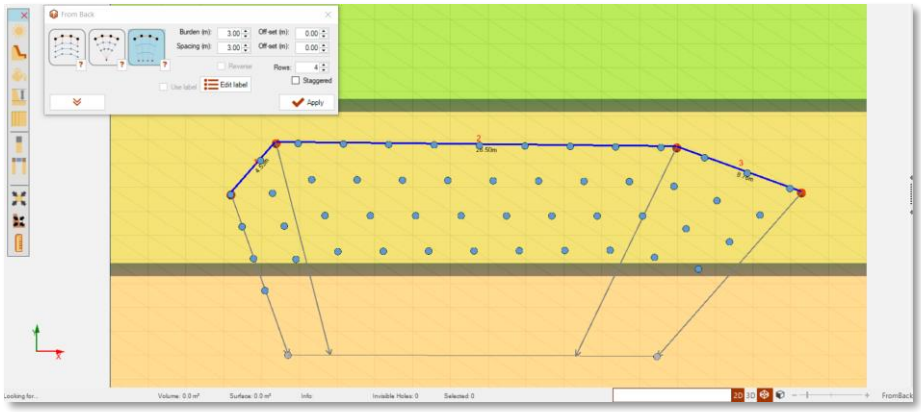


Figure 242 - Pattern creation using from back based on a line.

10.10.3.2. Edit Burden and Spacing -

Edit burden and spacing tool will make it possible to modify a previous pattern. The user can enter with an increment related to burden and/or spacing per row (0.00) inside the edit window.

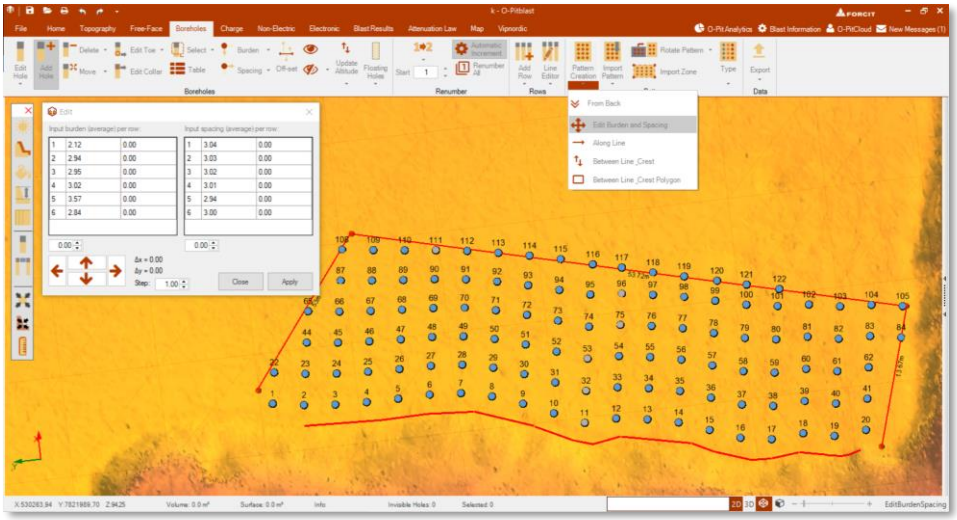


Figure 243 - Edit burden and spacing tool.

The arrow icons inside this window also enable to move the blast to left, up, down or right. And the step entry means the value to be added to the Δx and Δz increments according to the user clicks on some arrow.

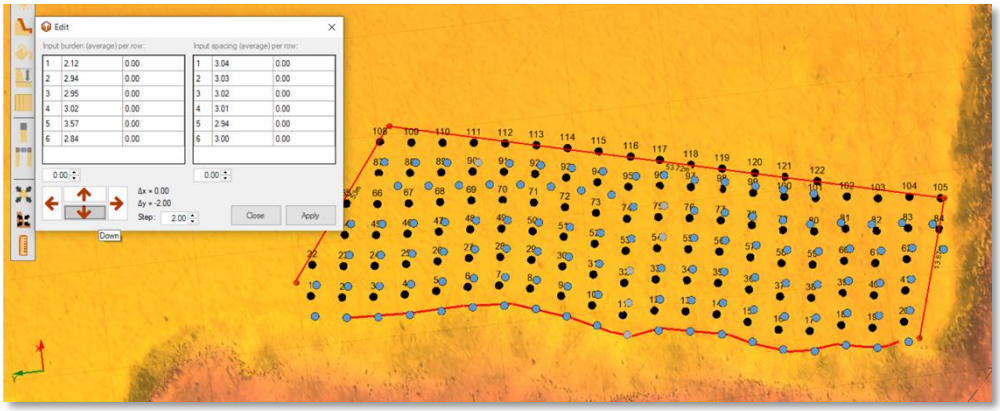


Figure 244 - Edit window: moving down the blast with step of 2 on the y-axis.

10.10.3.3. Along Line - →

The user can create or import a line. Once there is a line, then it is possible to create a pattern using the along line tool. After clicking on this tool, a holes along line window will appear to define spacing and offset as desired. With just one click, the line will be selected and with double-click on the line, the holes will appear according the adjust (Figure 245).

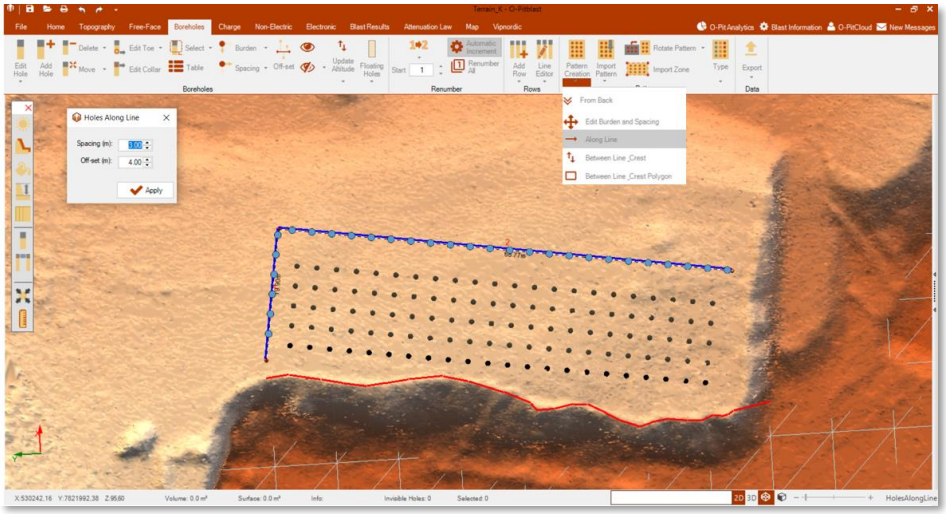


Figure 245 - Pattern creation using along line.

10.10.3.4. Between Line_Crest -

This tool will help the user can create a pattern between one specific line and the crest (Figure 246). First, it is needed to create/import a crest and line. After this button is selected the crest appears automatically enabled and it is only necessary to select the line back for pattern creation. Then the user can choose the geometry and other parameters as illustrated in the picture below and to finish click on the apply button.

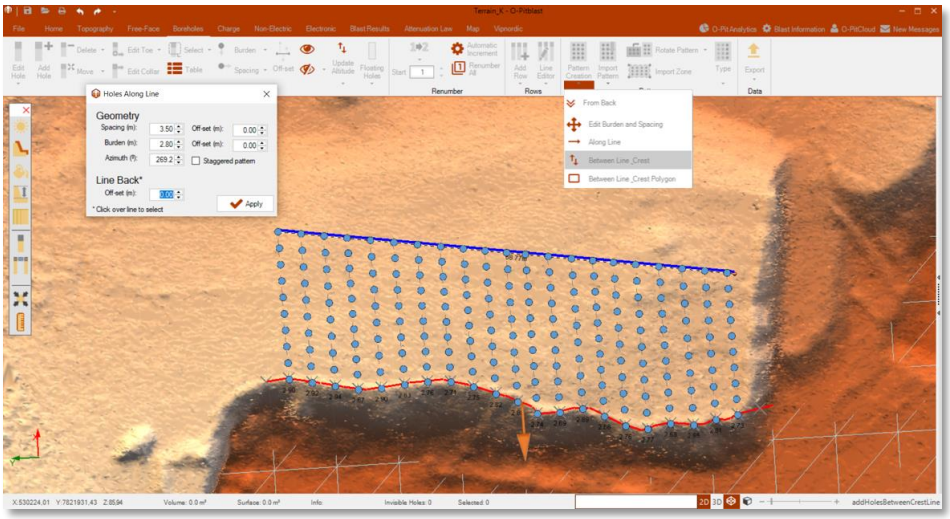


Figure 246 - Pattern creation using between Line_crest.

10.10.3.5. Between Line_Crest Polygon -

To create a pattern through this feature, first of all the user must create or import a polygon. After selected, the polygon selection window will open. Then the user will make the selection of crest line and line back. And can also change geometric properties – spacing, burden, azimuth – give an off-set and select/deselect staggered pattern (Figure 247).

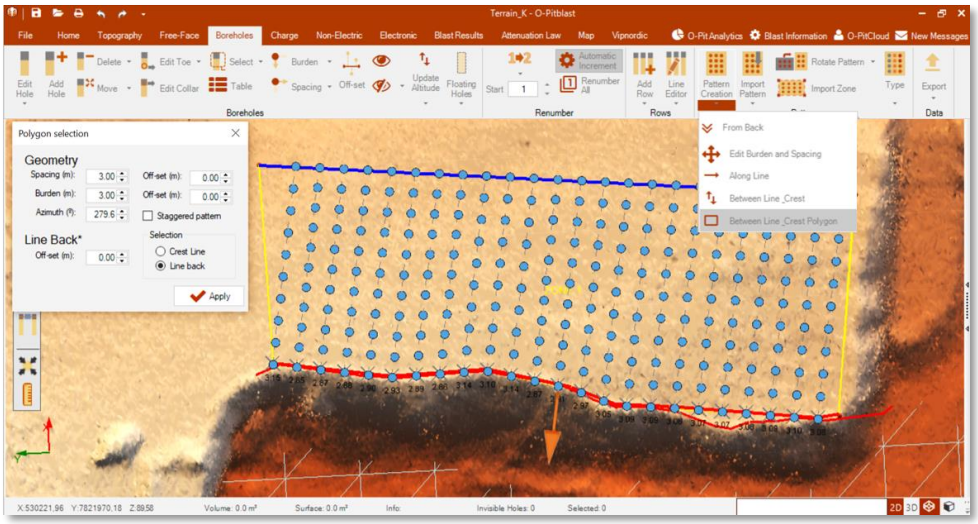


Figure 247 - Pattern creation using between Line_crest polygon.

10.11. Import Pattern

In the Boreholes module, the **Import Pattern** feature allows users to efficiently import patterns using a dropdown menu that presents all import options in a single click (Figure 248). This functionality is designed to simplify the process of pattern importation by offering multiple methods to accommodate different data sources.

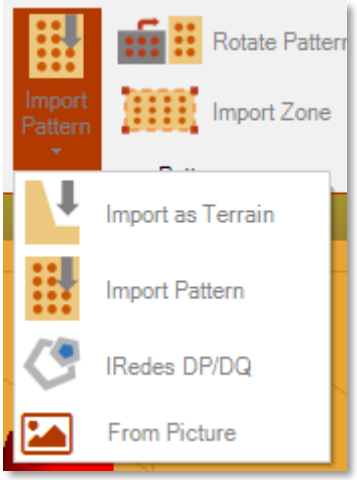


Figure 248 - Import Pattern tools.

10.11.1. Import as Terrain -

The **Import as Terrain** tool facilitates the **creation of terrain from hole's collar coordinates** when users lack existing terrain data. It supports importing patterns from various formats like **.TXT, .CSV, .XLSX, .DXF**, and even **.XML**, the tool

automatically generates terrain from the imported data. When importing in **.XML** format, users need to additionally import the pattern by using the **IRedes DP/DQ option (see section 10.11.3)** to ensure correct pattern importation.

To begin, users must import a list of hole coordinates by clicking the Import as Terrain icon, which opens the importation window (Figure 249). In this window, users define the X, Y, and Z coordinates (Figure 250) and set various parameters if the file contains more information besides the coordinates (Figure 251).

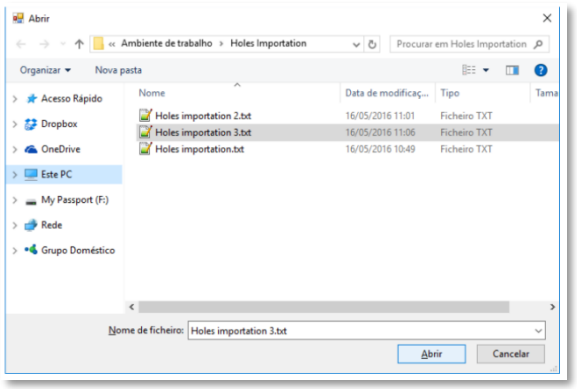


Figure 249 - Selecting hole coordinates file for importation.

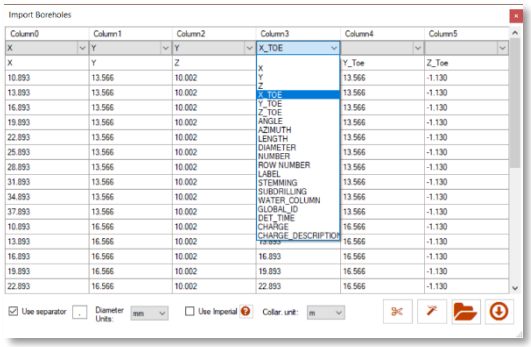


Figure 250 - X, Y and Z coordinates definition.

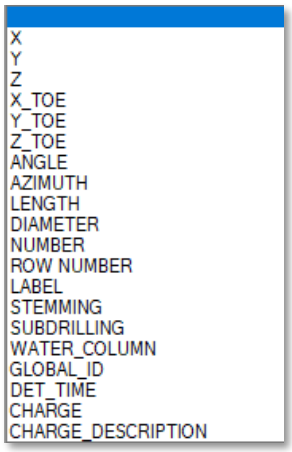


Figure 251 -Parameters to import holes.

When everything is ready the user must click on **Import the coordinates** button (Figure 250). After importing the hole coordinates, users need to define the hole' s length if it wasn't imported automatically. This involves specifying the **Bench Bottom Position** or establishing a **Borehole Length** (Figure 252) to complete the process.

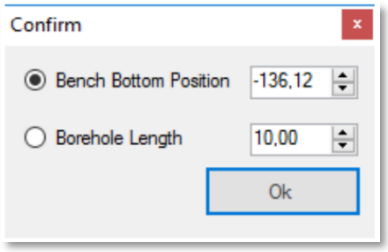


Figure 252 - Borehole length definition.

Additionally, users have the flexibility to adjust diameter units and change the coordinate system as needed (see chapter 8.1.2).

10.11.2. Import Pattern -

The Imported Pattern tool is designed to be used when the user has already imported **a previous terrain that matches the pattern data** being imported. It follows the same behavior as mentioned in 10.11.1. Users must import a list of hole coordinates by clicking the **Import Pattern** option, which opens the importation window (Figure 249). In this window, users define the X, Y, and Z coordinates (Figure 250) and set various parameters if the file contains more information besides the coordinates (Figure 251).

When everything is ready the user must click on **Import the coordinates** button (Figure 250). After importing the hole coordinates, users need to define the hole' s length if it wasn't imported automatically. This involves specifying the **Bench Bottom Position** or establishing a **Borehole Length** (Figure 252) to complete the process.

If there is a mismatch between the imported terrain and the pattern data, a warning message will appear (Figure 253).

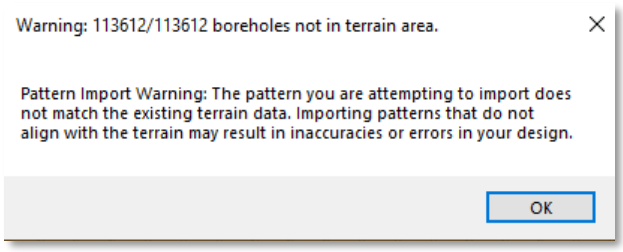


Figure 253 - Warning message: Imported Pattern boreholes not in terrain area.

10.11.3. IRedes DP/DQ -

This feature allows users to import specialized **IRedes files in .XML** format, specifically designed for **Drill Plan (DP) and Drill Quality (DQ) control**, enabling simultaneous importation of both DP and DQ data in a single operation.

To import patterns using the **IRedes DP/DQ option**, users follow these steps:

1. **Import as Terrain (if necessary):** If a terrain area hasn't been imported previously, users must first use the Import as Terrain feature (refer to 10.11.1) to create the topography from the same file format (.XML). This establishes the necessary terrain data for accurate pattern importation.

2. **Import Pattern Using IRedes DP/DQ:** If the terrain area has already been imported and matches the XML file, users can directly import the pattern using the IRedes DP/DQ option. This feature ensures that drill plan (DP) and drill quality (DQ) data are correctly integrated and analyzed within the system.

Once this tool is selected, a window will open and then the user is obligated to import the external file. Users must import a list of hole coordinates by clicking the **IRedes DP/DQ** option, which opens the importation window. In this window, users define the X, Y, and Z coordinates (Figure 254) and parameters (Figure 255).

Once everything is set up, the user needs to click on the "**Import Coordinates**" button (Figure 250) to automatically import the borehole coordinates. Once imported DP and/or DQ holes, the DP/DQ Control window is automatically displayed (check **section 10.14**).

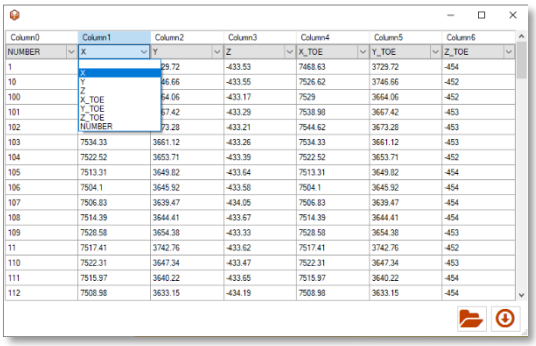


Figure 254 - X, Y and Z coordinates definition.

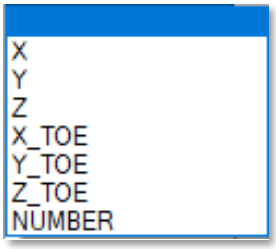


Figure 255 -Parameters to import holes from IRedes data.

10.11.4. From Picture

The user also has the option to **Import Pattern From Picture**. Once this tool is selected, a window will open and then the user is obligated to import the external file.

After the importation, the user can centralize ( ) the picture and zoom it or zoom out by scrolling the mouse or using the buttons (,). With the right click the user can mark the holes in the picture and them they will appear as blue points. There is the clear holes button ( ) to delete all these points. And to delete just one of them it is necessary to right-click again in each point.

When set scale is enabled, the user can draw a line between two points and enter with the respective scale (m) and hole length (m) values to generate the pattern (Figure 256).

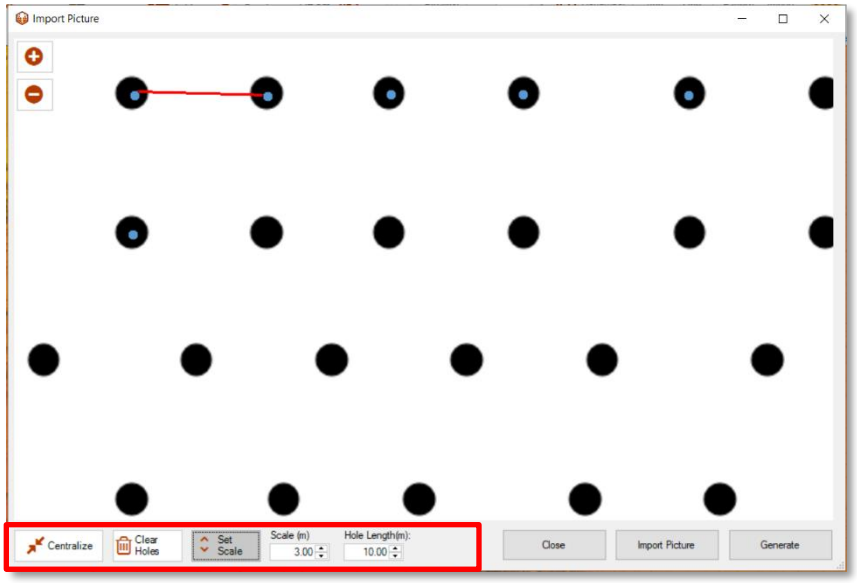
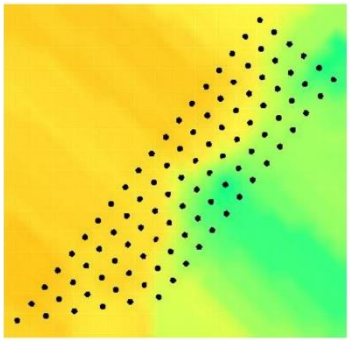


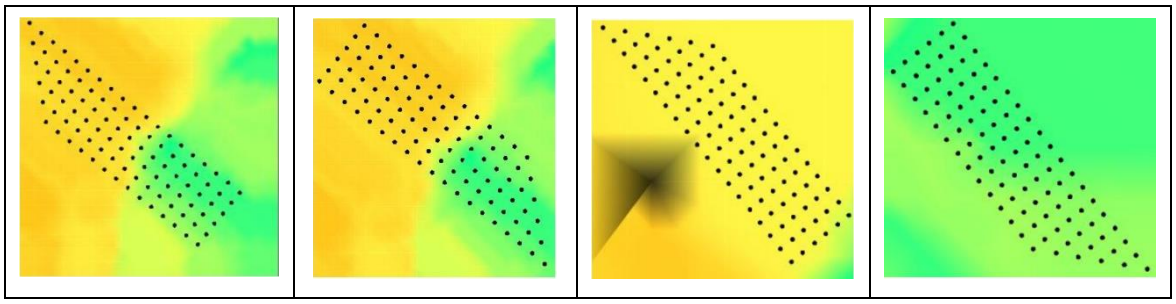
Figure 256 - Import picture window and its features.

10.12. Rotate Pattern -

The **Rotate Pattern** tool allow the user to rotate each pattern in the following ways:

- Rotate 90° to the right
- Rotate 90° to the left
- Turn vertically
- Turn horizontally

Original Pattern			
			
Rotate 90° to the right	**Rotate 90° to the left**	**Turn vertically**	**Turn horizontally**



To use this tool is necessary to have one point into consideration: if the transformed holes are positioned out of the existent terrain they will not be moved. For that the user must expand the terrain previously to the pattern transformation.

10.12.1. Import Zone -

To import a blast polygon, the user must select the **Import Zone** icon, selecting the polygon file and define the X and Y coordinates (Figure 257).

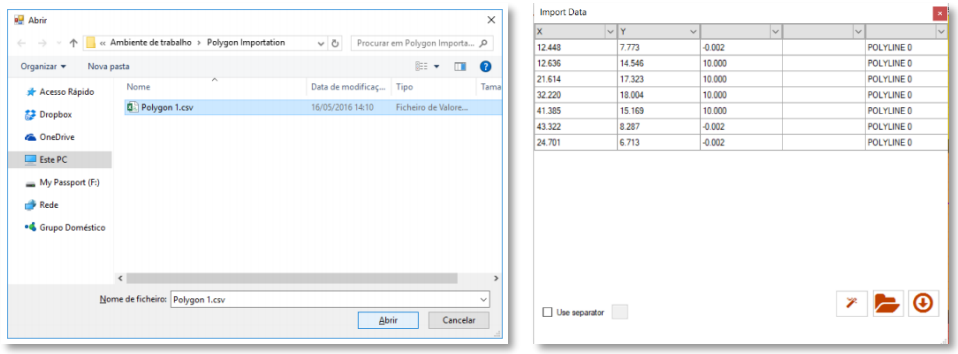


Figure 257 - Polygon importation (file selection).

After import the polygon, the user can generate holes inside the polygon by the **Radial Menu** (Chapter: 6.8) or any other tool as desired.

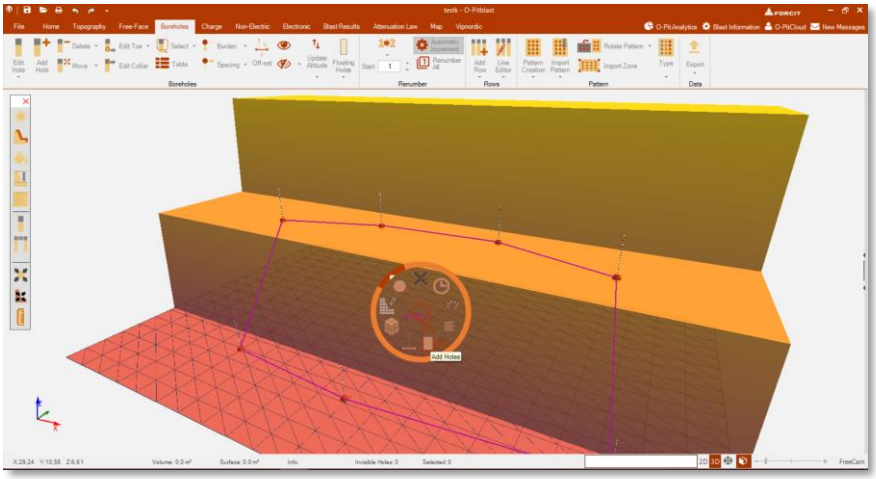


Figure 258 - Edition of polygon pattern.

10.12.2. Type -

To define the **hole type ID for a group of holes**, the user must select the desired holes and then, in the Type expansion tab, choose the appropriate color for each selection (Figure 259).

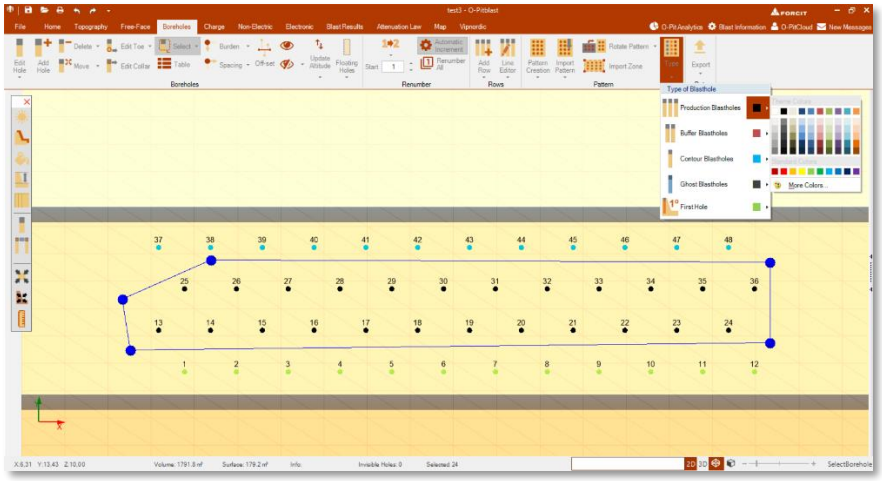


Figure 259 - Hole type selection.

To edit the Type ID of an individual hole, the user can utilize the Radial Menu. Note: Ghost holes will be displayed differently, as shown in the picture below.

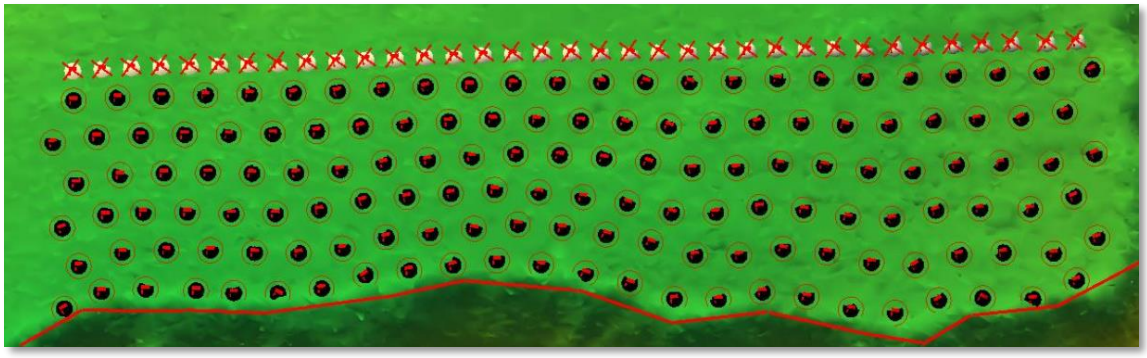


Figure 260 - Ghost holes (with a cross on top of the holes).

10.13. Export Pattern

The user can export the pattern in various formats, including **.CSV, IREDES, .DXF and .JSON** (Figure 261).
When exporting in .CSV or .DXF format, the user has the option to choose between various fields to be included in the export (Figure 262).
P.S: When exporting in .CSV, the "Use Toe Real Position" checkbox is presented in the window. This can be selected if boreholes were measured in the field and this deviation information has been imported into O-PitSurface.

Additionally, there is an option to export the coordinates by using the "Center of Blast" feature to change the coordinate system. This option is used when the user wants to change or transform the coordinate system (Figure 263) and it will export in .TXT.

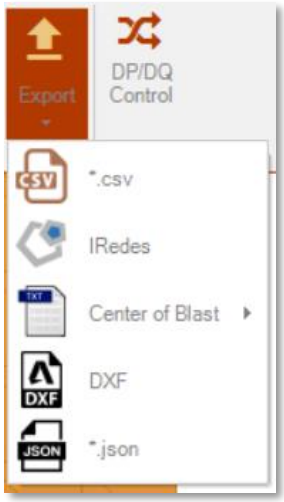


Figure 261 - Export pattern options.

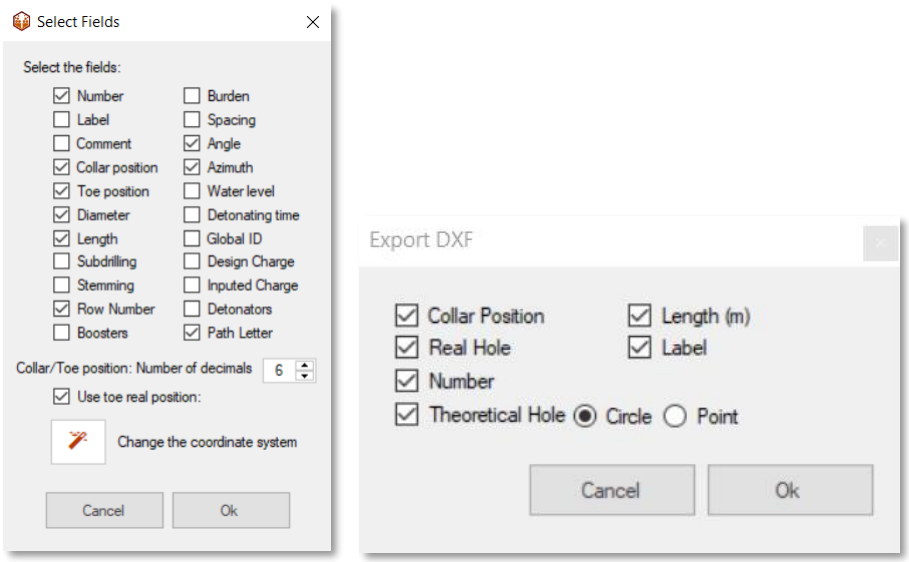


Figure 262 - .CSV and .DXF fields to export.

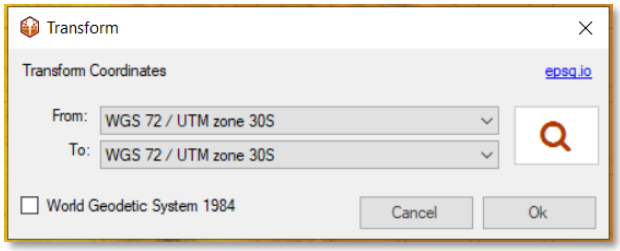


Figure 263 - Transform hole coordinates system.

10.14. DP/DQ Control

DP/DQ Control is a specialized feature for managing IRedes data, specifically Drill Plan (DP) and Drill Quality (DQ). Clicking on this feature opens a dedicated window where users can easily view and manage their DP and DQ data. The window includes a toggle button for navigation: simple arrows allow users to move hole by hole, while double arrows enable quick movement to the first or last hole. This functionality is activated upon importing IRedes data such as DP or DQ (Check section 10.11.3).

Figure 264 - DP/DQ Control window.

10.15. DP/DQ Analysis -

The **DP/DQ Analysis** Tool allows for comprehensive analysis of IRedes data, specifically Drill Plan (DP) and Drill Quality (DQ). This tool provides users with the ability to track and visualize information on planned versus real coordinates using the **Bullseye** section. Additionally, users can compare drilled depths to planned depths in the **Depth Control** section and gain insights into the distribution of hole position and length errors through **Histogram section**.

P.S: This functionality is only available for users who have purchased the MWD Module.

10.15.1. Bullseye

In the **Bullseye** section (Figure 265), users can analyze the errors associated with drilling by comparing the drill plan and drill quality files from the IREDES format. This section allows for the assessment of drilling errors either from the collar or toe of the holes, with the option to include or exclude the Z coordinate in a 2D graph. Users can define a target to determine if the drilling performed falls within the permitted error range. Additionally, the Bullseye section provides insights into the average drilling error and the percentage of holes that are within the acceptable error limit.

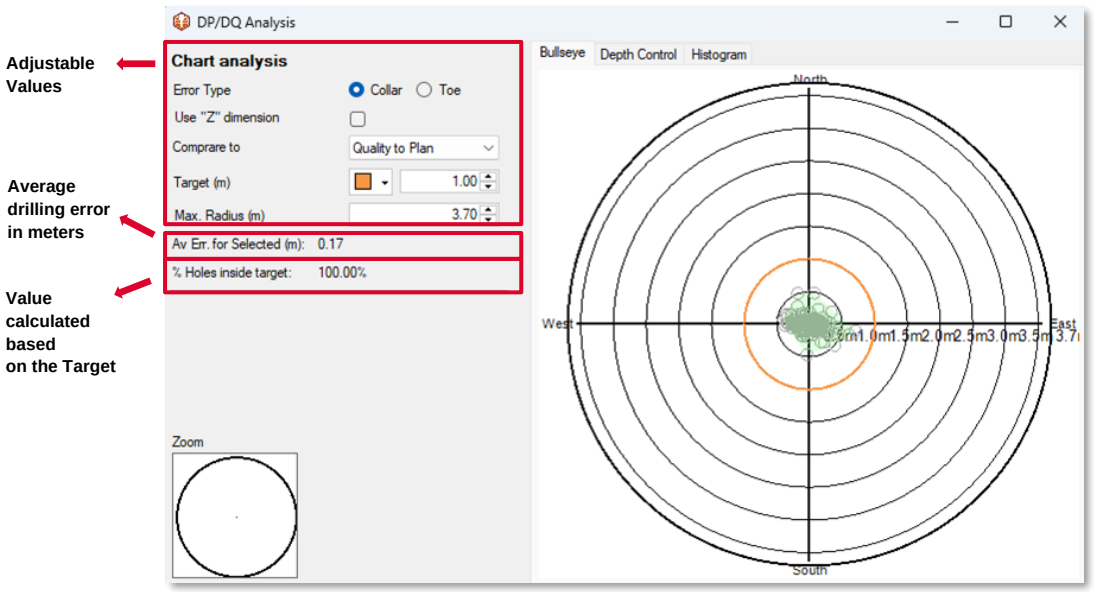


Figure 265 - DP/DQ Analysis - Bullseye Graph.

When hovering the mouse cursor over any circle (Figure 265), displays detailed information about the hole, including the drilling distance in meters (Figure 266).

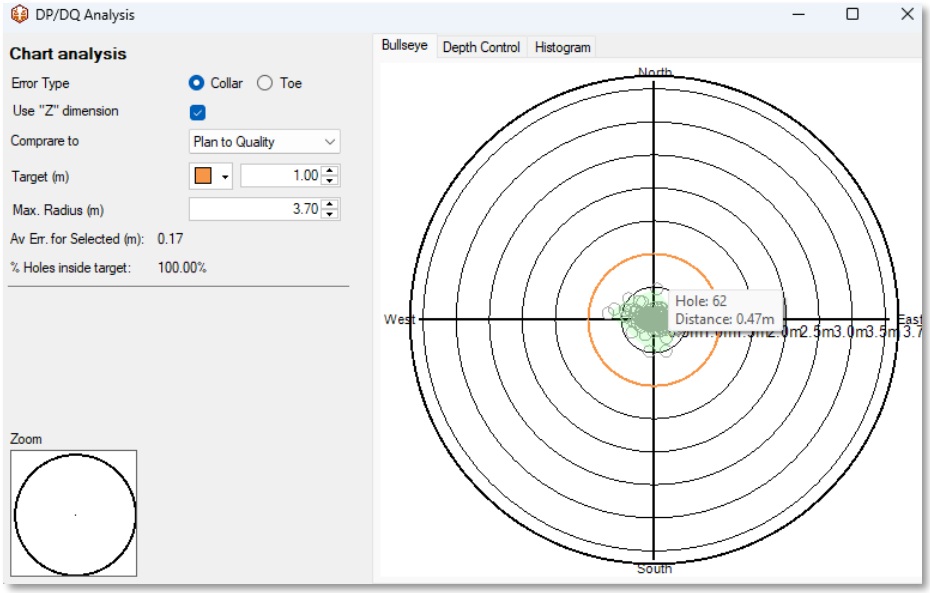


Figure 266 - DP/DQ Analysis - Bullseye Graph - Information displayed on mouse hover.

10.15.2. Depth Control

In the Depth Control section (Figure 267), users can compare the actual drilling depth with the planned depth. By using the target parameter, users can accurately identify and analyze the differences between planned and actual drillings, allowing for a detailed assessment of drilling errors.

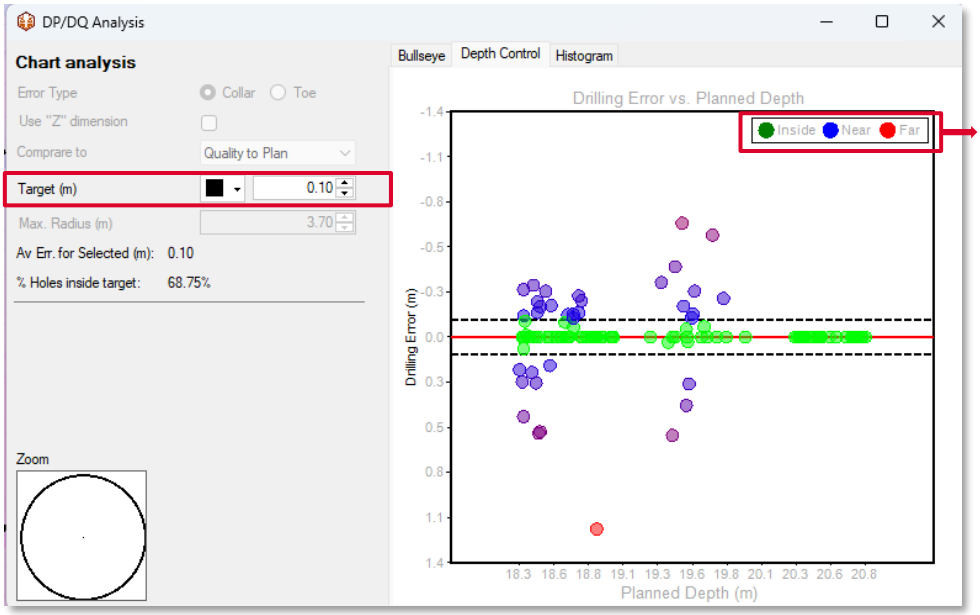


Figure 267 - DP/DQ Analysis - Depth Control Graph.

When hovering the mouse cursor over any circle (Figure 268), displays detailed information about the hole, including the planned depth, drilled depth and DQ/DP difference.

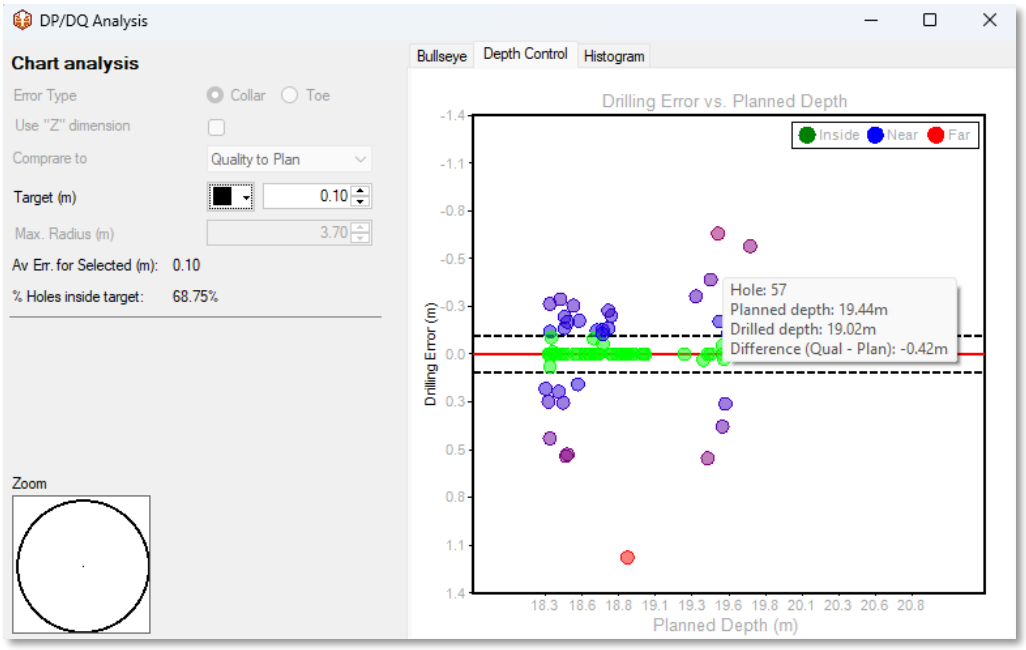


Figure 268 - DP/DQ Analysis - Depth Control Graph - Information displayed on mouse hover.

10.15.3. Histogram

In the Histogram section (Figure 269) the user can analyze the distribution of a set data by choosing between analyzing Bullseye data or depth control data.

Bullseye Data Analysis (Figure 269)**:**

- Assesses drilling errors from either the collar or toe of the holes (as detailed in 10.15.1),
- Option to include or exclude the Z coordinate in a 2D graph.
- Organizes data by deviation.

Depth Control Data Analysis:

- Organizes data by depth difference.

For both types of analysis, users can customize the data displayed on the graph by editing the column bars and setting the intervals into:

- **Automatic Interval**: Automatically sets the intervals.
- **Series Width**: Defines the width of each interval (bin) to be analyzed.

- **Number of Bins**: Specifies the number of bins, determining the granularity of the data distribution. Each bin counts the number of holes that fall within that range.

This customization allows users to identify how many holes have similar deviations or depth differences within a given range.

Additionally, users can edit excess values:

- **Positive/Negative Excess**: Checkboxes allow for grouping values greater than, less than, or equal to the chosen value.

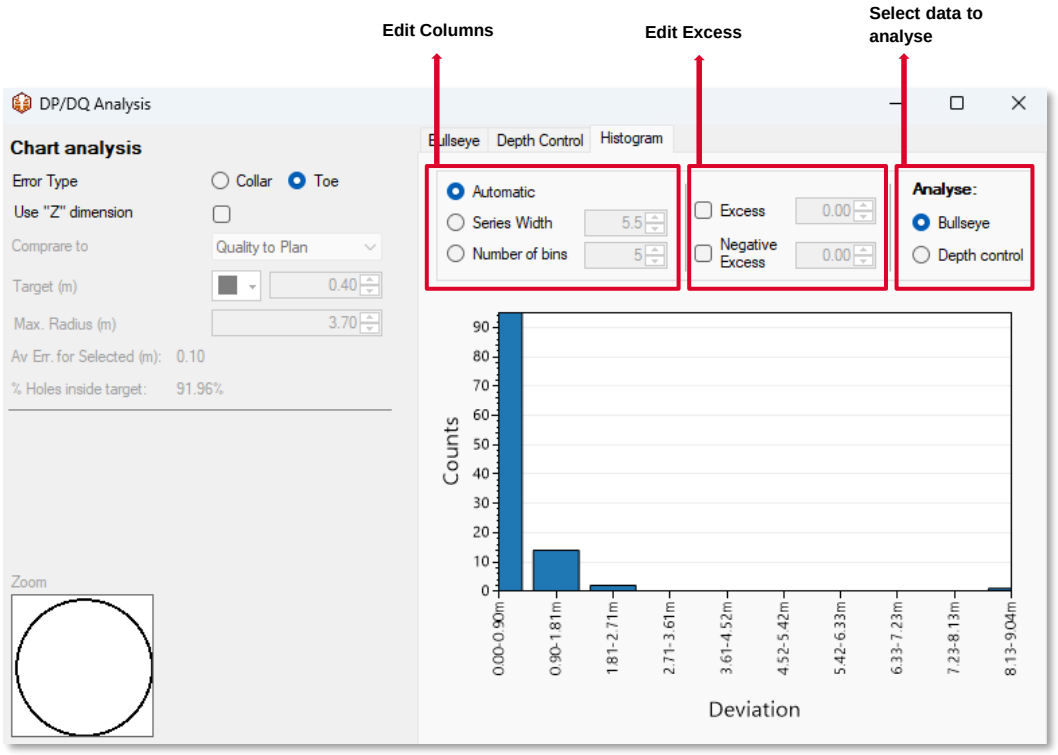


Figure 269 - DP/DQ Analysis - Histogram Graph: Analyse by Bullseye.

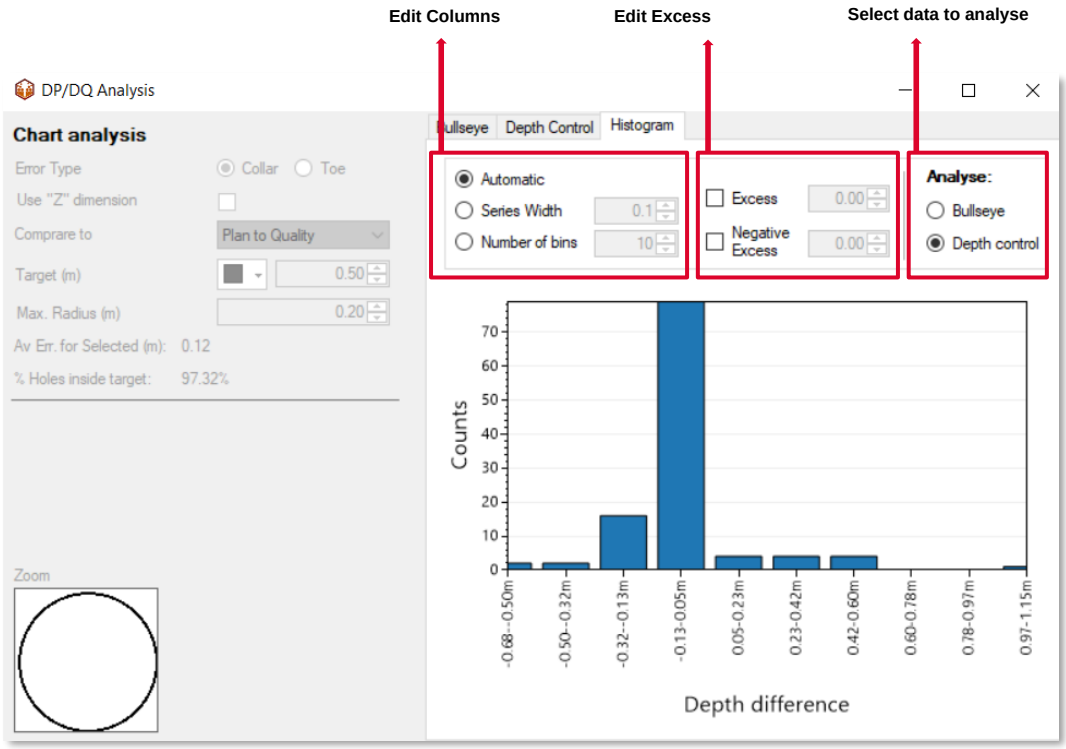


Figure 270 - DP/DQ Analysis - Histogram Graph: Analyse by Depth Control.

11. Charge

On this module the user has multiple options to help him charging the holes in different ways.

Figure 271 - Charge Module.

Icon		***Description***
	Edit Rule	Edit charge rules
	Select by Length	Select charge rule by Length
	Add Charge	Add charge
	Discharge	Unload holes
	Select	Select holes

	Import charge	Import a local file with charge information
	By powder factor	Charge your holes by defining a limit of powder factor
	Manually feeding	Use total charge information to load the holes
	Complete charge	Distribute charge by the unloaded boreholes
	Extra Charge	Add more charge to the blast

11.1. Add Charge -

In the charge edition panel, the user will be able to define the charge of individual or a conjunct of holes. When the holes are charged, a red circle will appear around the holes. Through the **Radial Menu** the user can access to the charge tab of each hole and apply the desired charge by adding elements in the **Quantity of Elements** option (Figure 272).

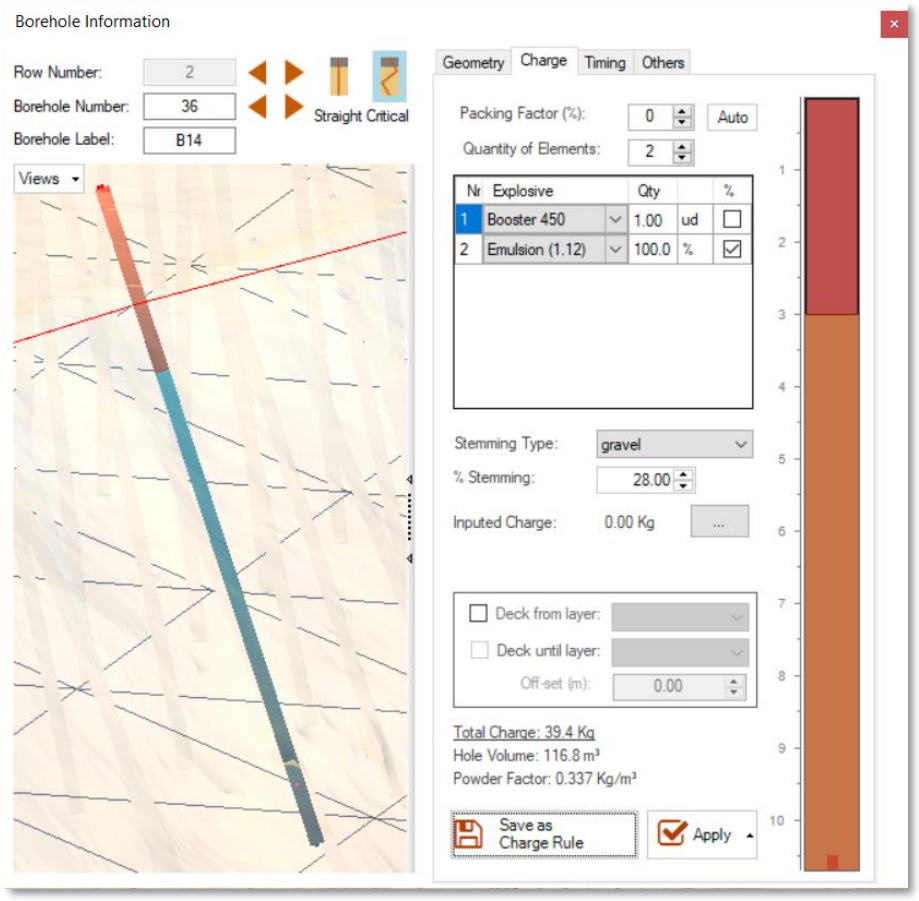


Figure 272 - Charge Tab Window.

In this tab above, the user can also **select stemming type** (air, water, gravel, cuttings, airbag, paraplug) and attribute percentage to it in this tab. And **introduce an inputted charge**: kg for explosives and units for boosters and accessories. This last information it will appear on the comments of the blast report (borehole information).

P.S: In the case of some holes having their charges modified on the field, when updating holes through the server (O-PitCloud), the new information related to their charges will appear within the inputted charge field (Figure 273).

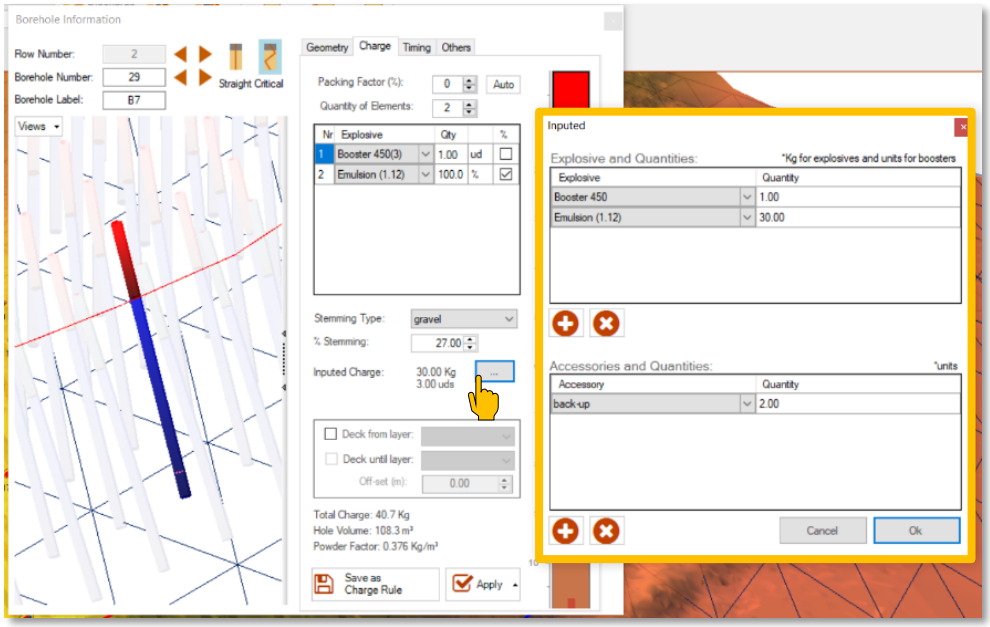


Figure 273 - Inputted charge with the information updated.

11.1.1. Add Primer (Booster)

To add a primer (booster) the user must select it from the dropdown list of the added element and introduce the quantity of the components. The percentage (%) is not available for this element.

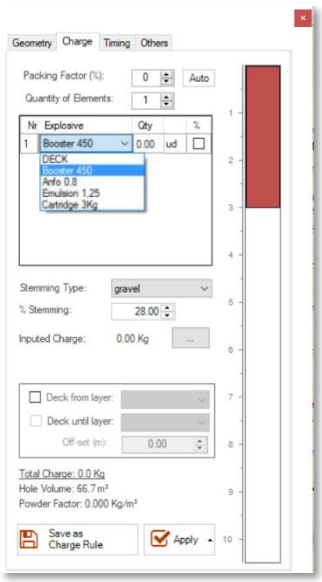


Figure 274 - Adding primer.

11.1.2. Add Column Charge

To add the column charge, the user must add another element and select from the dropdown menu the desired component. There are two options to add cartridges or bulk explosives:

- by percentage: the user selects the hole percentage to be filled by the product (Figure 275 A)
- by meters: the user selects the meters to be completed by using the product (Figure 275 B)

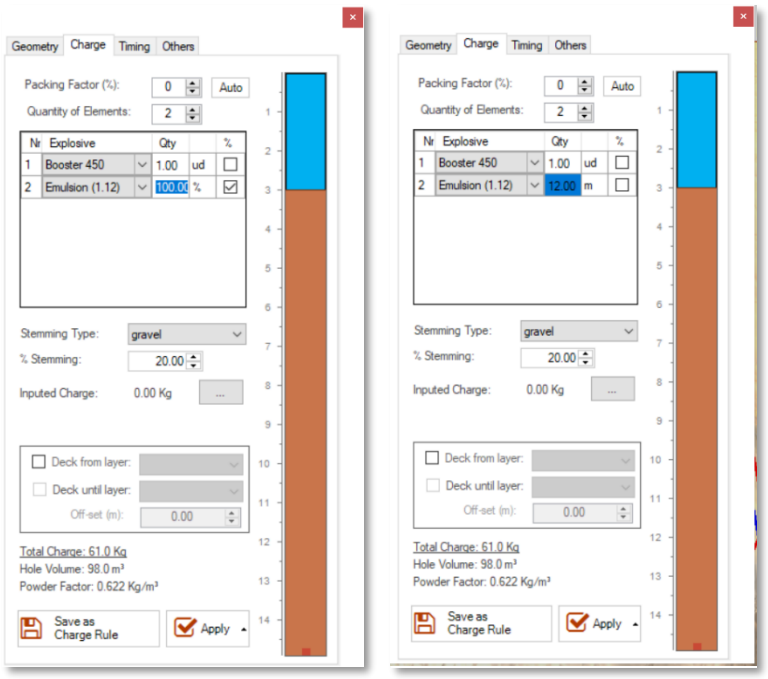


Figure 275 - Left (A): Adding column charge by percentage; Right(B): Adding column charge by meters.

11.1.3. Add Cartridges

The addition of more than one product must follow an order, this means, that the first element to be added will be plotted in the bottom of the hole and the following ones above each other's.

To add a cartridge, the user can also select by quantity or percentage. Nevertheless, in this case the charge model will present the number of cartridges to be loaded (Figure 276). After creating the charge column, the user can apply a **packing factor** to all boreholes (on the top of the page) and define the percentage that he wants.

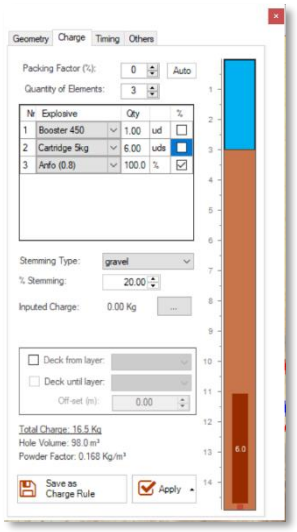


Figure 276 - Add Cartridges and packing factor.

11.1.4. Apply Charge Rule

The user can mark the option **Apply** and choose which holes he wants to apply the charge rule.

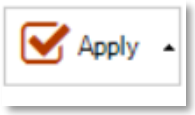


Figure 277 - Apply button.

To enable the option to apply a saved rule to a set of holes, the user must check the Checkbox on the Charge Tab (Figure 278).

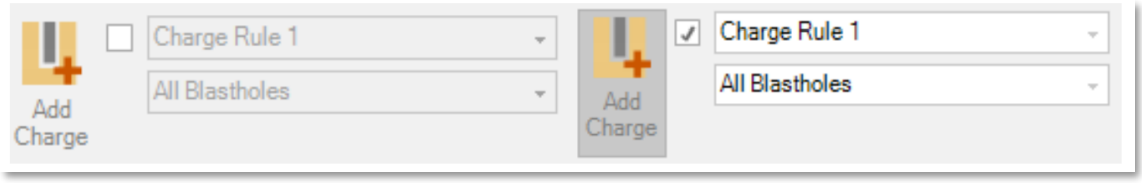


Figure 278 - Applying Charge Rule.

The user must select the charge and the selection to apply the rule and click in the **Add Charge** icon (Figure 279).

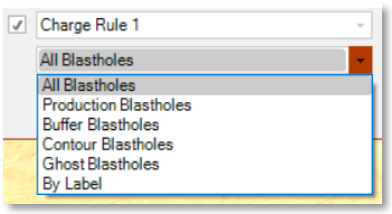


Figure 279 - Apply Charge rule to a type of holes.

11.2. Edit Charge Rule -

To create a rule, the user must define it by selecting the elements on the **Borehole Information Window**. With the charge defined, the user must click on the **Save Charge Rule** button and generate a new charge rule - Figure 280.
To edit a current rule, the user must click on the **Edit Rule** icon, select the rule to be update, change its parameters and click in the update icon - - Figure 281.

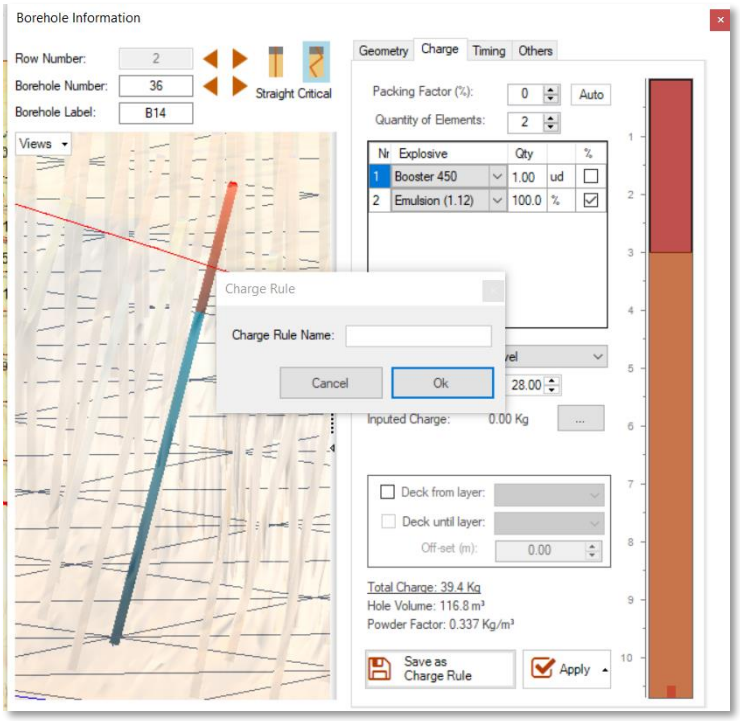


Figure 280 - Create Charge Rule.

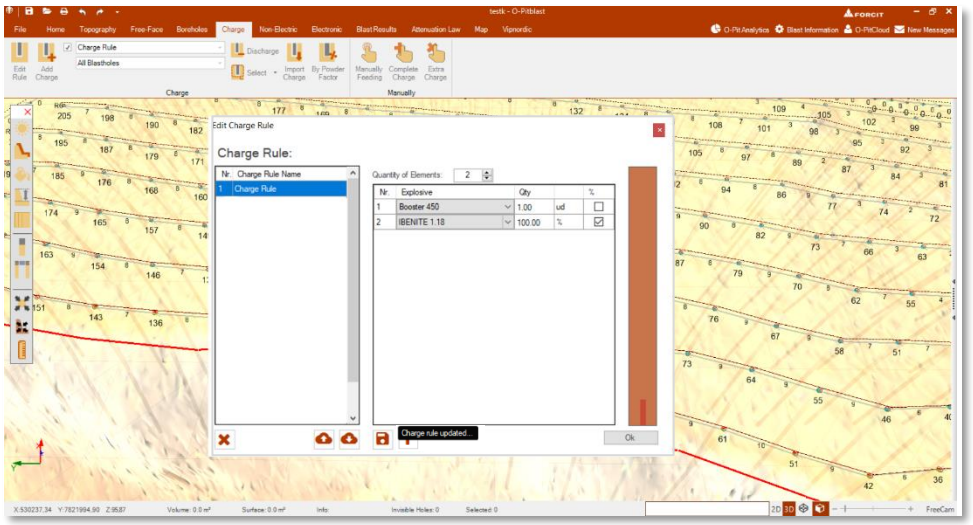


Figure 281 - Edit Charge Rule Window.

11.2.1. Discharge -

When clicked, the **Discharge** option removes all charges from either selected holes or the entire set of holes.

11.2.2. Select -

The **Selection** tool allows the user to select a set of holes and apply or erase a charge rule (Figure 282). The user can also use the crest to select, like shown on the polygon (chapter 7.2).

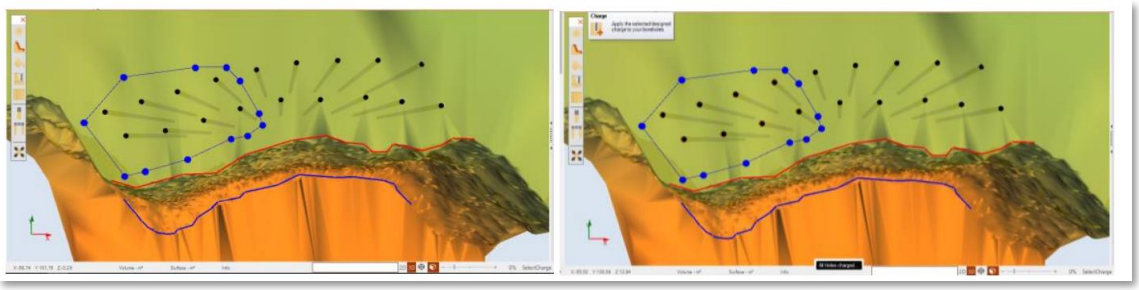


Figure 282 - Applying charge rule to a selection of holes.

11.3. Select by Length -

The user has the possibility to assign the specific charge rule based on different length ranges (Figure 283).

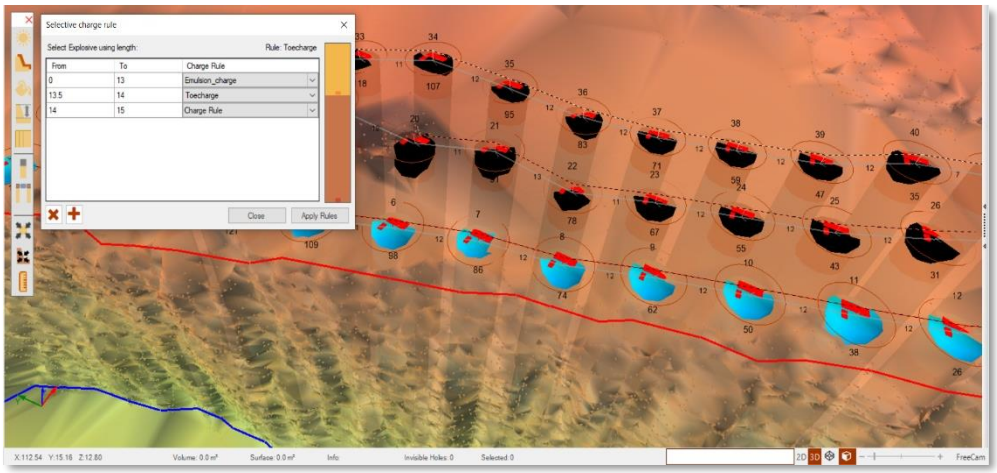


Figure 283 - Applying different charge rule using length as parameter.

11.4. Import Charge

In this option the user can import a local file with boreholes charge information. First, it will open a window to connect the information to the hole number and the respective charge (Figure 284). Then the user has to select the type of explosive and then, select the holes that wants to be charged with that explosive (Figure 285).

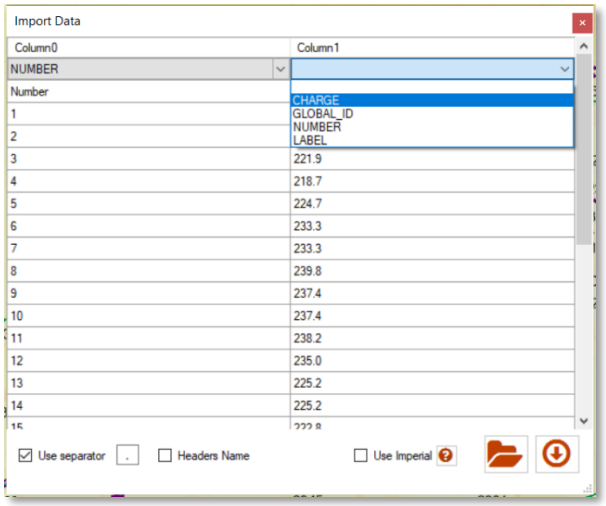


Figure 284 - Import data (charge) window.

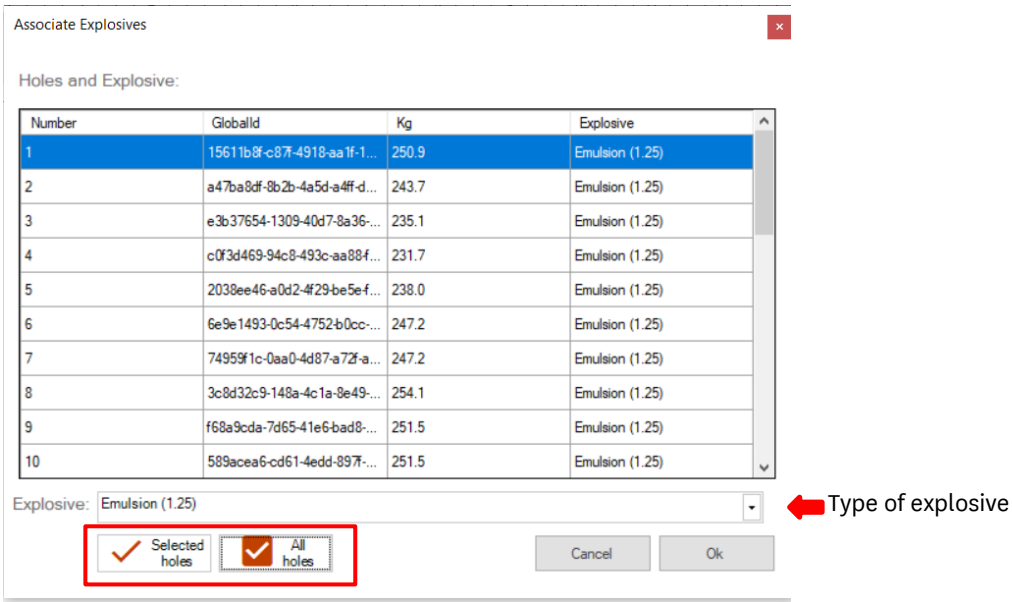


Figure 285 - Choose type of explosive and associate to boreholes.

11.5. By Powder Factor

The user can charge the holes up to a limit of powder factor. First, needs to choose the type of explosive that he wants to charge the holes. Then needs to define the limit of powder factor to be apply **to every hole**. Finally clicks on **Apply changes**. All holes will be charge **only until the limit** of powder factor (considering the borehole length of each hole).

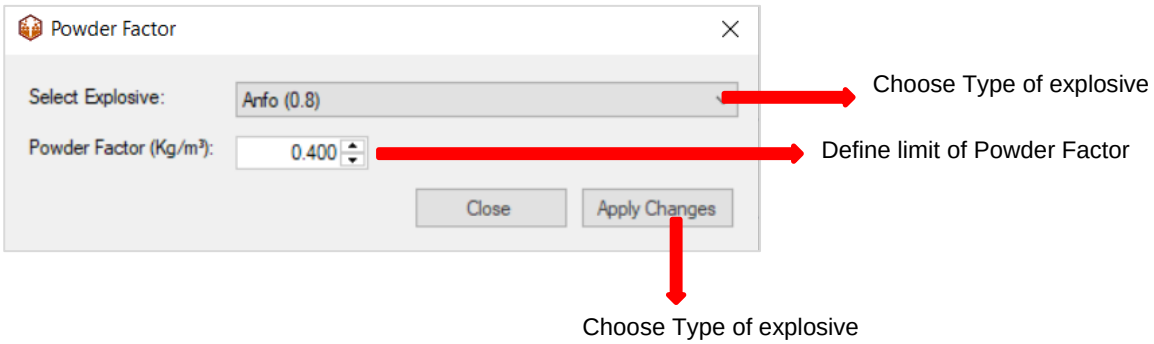


Figure 286 – By powder factor window.

11.6. Manually Feeding -

The user can charge the holes manually.
First, he needs to add (✚) the number of products that he wants to use. To delete must click on the cross (✖).

After that, the user chooses the **total quantity** of explosive that he wants to use, and it will automatically have the kg that will be distributed **per hole in average**. To complete the action, just needs to click on **Apply.**

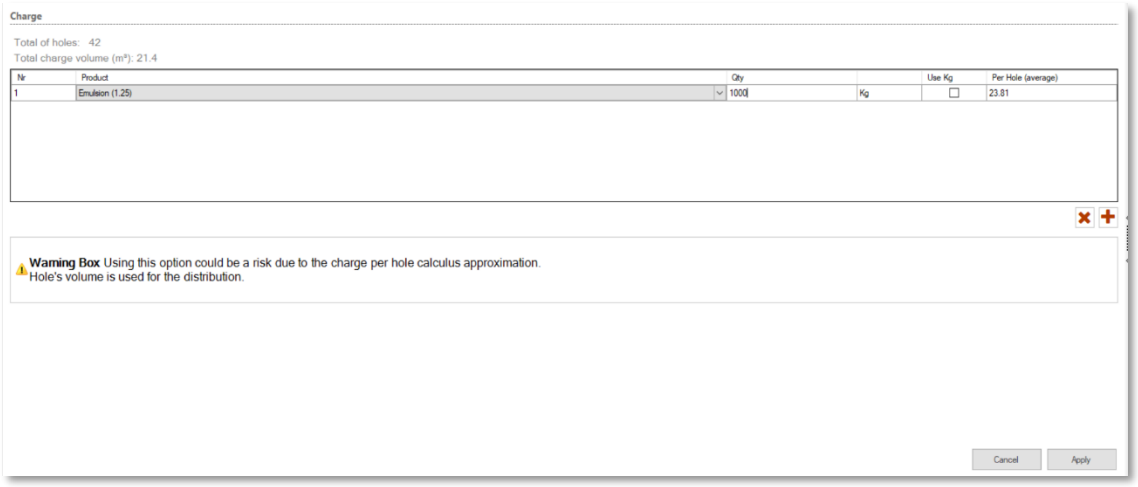


Figure 287 - Manually charge window.

*This information will also appear in the inputted charge window.

11.7. Complete Charge

If in the end the user has some left boreholes that need to be charged with a certain quantity of explosive, he can use this option.
It will open a window equal to **Manually Feeding** but it will open apply the explosive to hole not charged yet (topic 11.6 to know how to use this window).

11.8. Extra Charge

If the user wants to order extra charge to the supplier, just need to add it here. It only appears the extra charge on the report (this charge will not charge the holes) as extra charge.
To use it, the user must add (+) the how many types of explosives he wants to order, the type and associate a quantity (Figure 288).
To delete needs to click in the button.

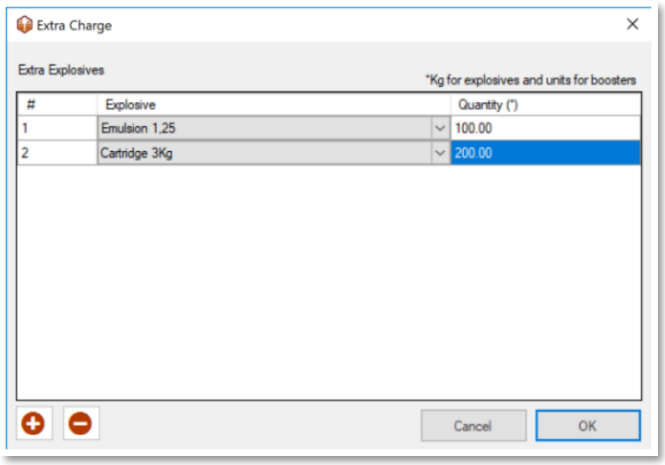


Figure 288 - Extra charge window.

12. Non-Electronic

This tab will allow the user to add, edit and delete timing to the boreholes with non-electronic detonators.

Figure 289 - Non-electric detonators Module.

Icon		Description
	Add Timing	Add a single connection
	Line	Connect holes by drawing a line over them
	Edit Timing	Edit In-hole delay
	Initiation Hole	Select the Initiation point
	Time Tool	Make connections by giving a chosen interval between the holes
	Delete	Delete connection
	Select	Select a conjunct of connections
	Surface Detonator	Surface detonator delay selection

In-hole Detonator	In-hole detonator delay Selection
Dual Detonator	Dual detonator delay selection
Extra Initiation System	Add more extra detonators
Hole Shape	Hole not loaded with dual detonator
Hole Shape	Hole with deck and dual detonator
Hole Shape	Hole not loaded with In-hole detonator
Hole Shape	Hole with deck and in-hole detonator
Tie-up Warning	Hole not connected/without detonator
Tie-up Warning	Extra Dual Detonator inside a hole
Tie-up Warning	In-hole and Dual Detonator inside a hole
Isolines	Show time isolines
Histogram	Show histogram
Play	Play blasting simulation
Pause	Pause the blasting simulation

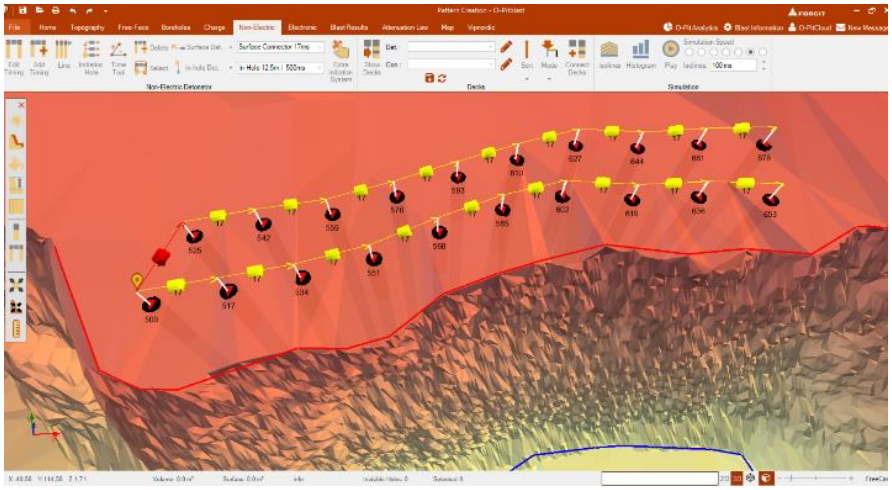


Figure 290 - Non-Electric connections.

12.1. Non-electric detonators

12.1.1. Add Timing -

To add a connection, the user must select the surface detonator, in-hole detonator or dual detonator to be used on it. Then, with the **Add Timing** icon selected, is just draw a line between two holes to connect them (Figure 291).

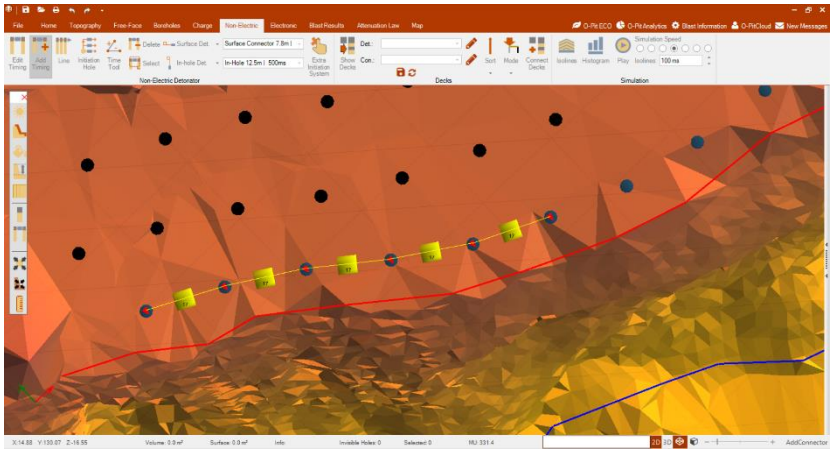


Figure 291 - Single hole connection.

12.1.2. Line -

The **Line** enables the user to draw a line connecting a series of holes automatically. To enhance the influence area of each hole, users can increase the hole diameter scale in the **Toolbox** (Chapter: 6.4). This adjustment facilitates easier and more effective line connections.

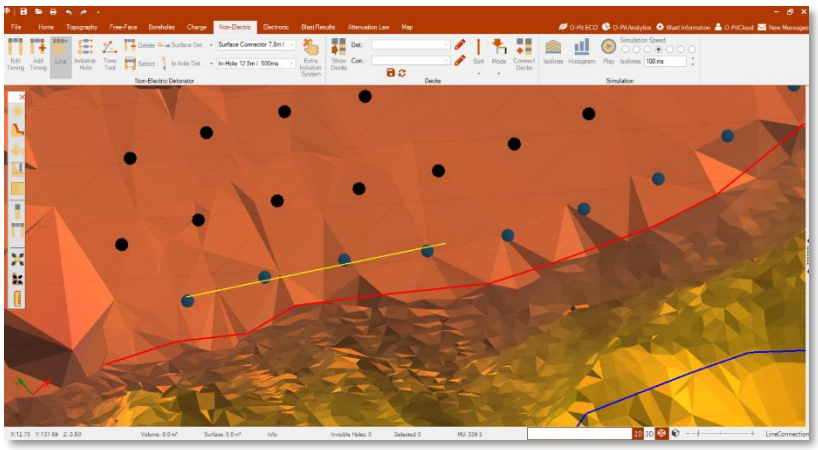


Figure 292 - Line connection.

12.1.3. Edit Timing -

The **Edit Timing** tool allows the user to modify the In-Hole detonator for individual holes or a group of holes (Figure 293). This feature can be accessed by the **Radial Menu** (Chapter: 6.8) or by the **Timing Tab**.

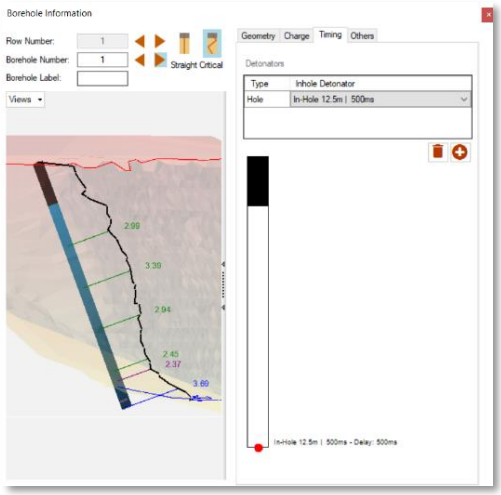


Figure 293 - Editing In-Hole detonator.

12.1.4. Initiation Hole –

To define the initiation hole, the user must select the **Initiation Hole** icon and left click on the desired hole. The initiation hole will be marked with the symbol and it is possible to mark several initial holes.

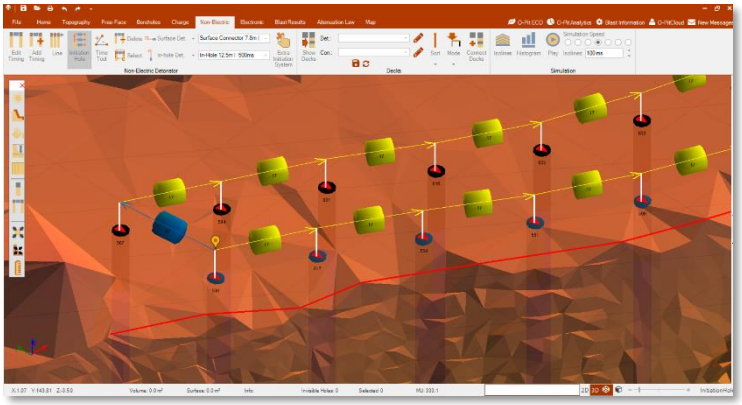


Figure 294 - Initial hole.

12.1.5. Time Tool -

The **Time Tool** allows users to create connections with specified intervals between holes. To use this tool, user must input the number of **Jump Holes** in the tab that will pop-up and click in the hole he wants/or make line.

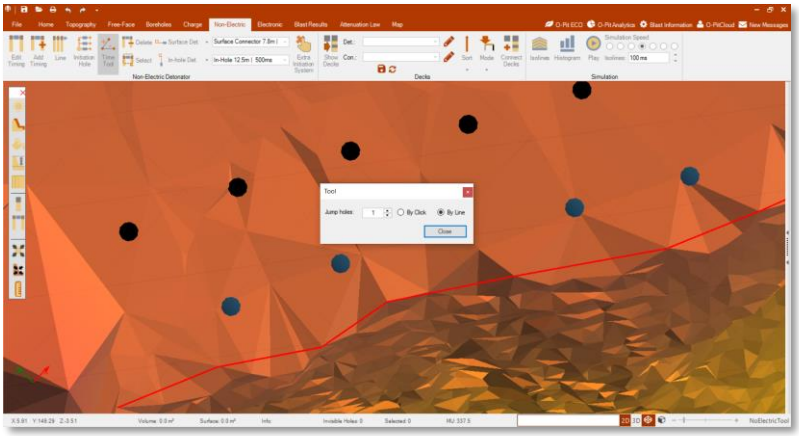


Figure 295 - Time Tool window.

12.1.6. Delete Connections –

Clicking in the **Delete Connections** icon, a prompt-message will appear confirming to delete all connections.

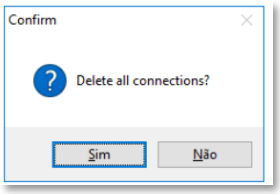


Figure 296 - Confirm window to delete all connections.

To delete a single connector, right-click on the connector's cylinder.

To delete multiple connections, create a selection area (Point: 12.1.7) and click on **Delete Connection** icon (Figure 297). Note: the detonator cylinder must be inside the selected area.

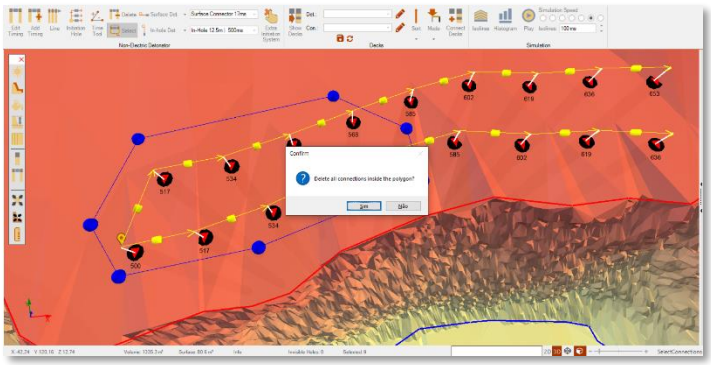


Figure 297 - Delete a conjunct of connections.

12.1.7. Select Connections –

The **Select** tool allows the selection of a set of connections to delete them or changer their characteristics. To proceed, the user must left click in the terrain and build the polygon around a conjunct of connections (the cylinder must be inside the polygon boundaries) (Figure 298). To finish the selection is necessary to right click to close the polygon.

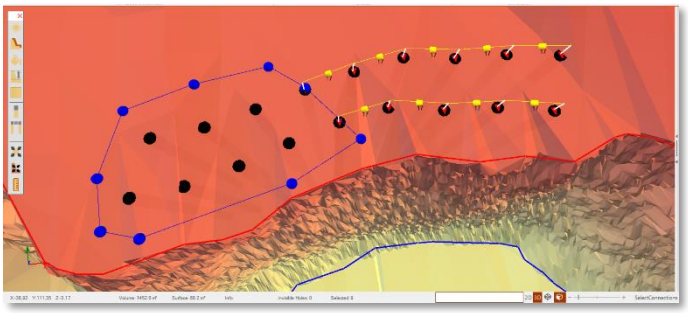


Figure 298 - Selecting detonators.

12.1.8. Surface & In-Holes Detonators –

Surface detonators are use in the connections of down-lines in each hole. To design a time sequencing recurring a surface connector and in-hole detonators it is necessary to select each item from the validation boxes in the **Boreholes Tab**.

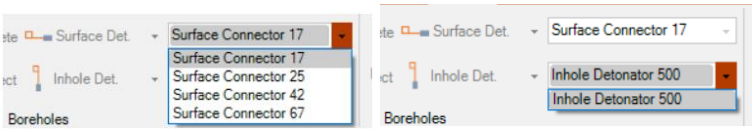


Figure 299 - Selecting Surface Connector and In-hole detonator.

Two holes connected with a surface delay and in-holes detonators present the scheme shown in the picture below.

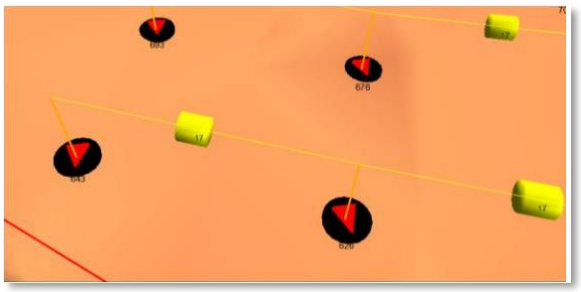


Figure 300 - Surface delays and in-hole detonator visual feedback.

12.1.9. Dual Detonators -

The application of **Dual Detonators does not require the use of in-hole delays**, so the option to select in-hole delays is disabled (Figure 301).

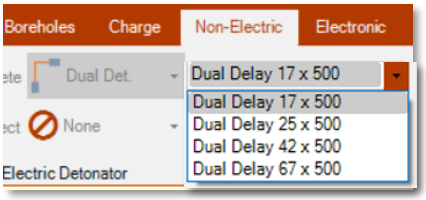


Figure 301 - Dual Detonator Selection.

The visual feedback for dual detonators is presented in Figure 302.

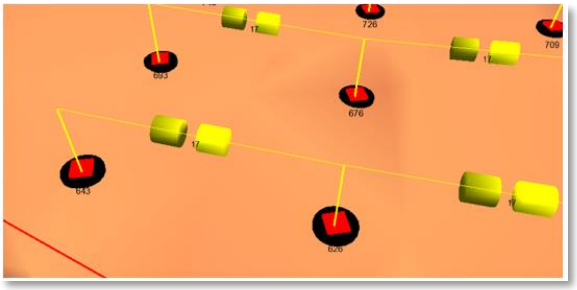
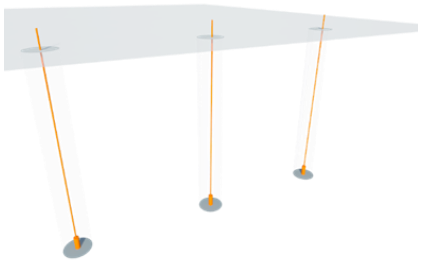
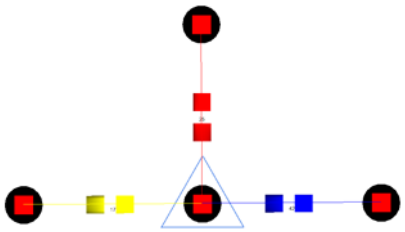
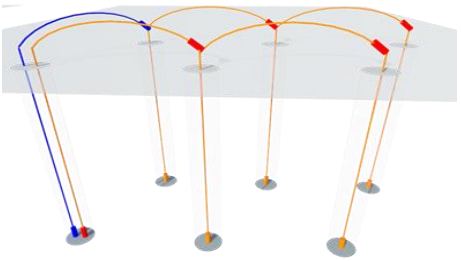
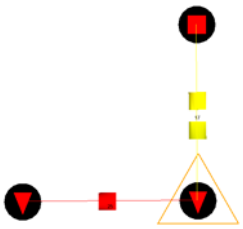
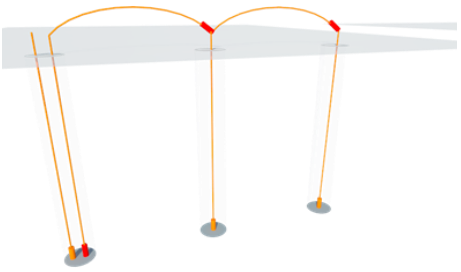


Figure 302 - Dual Connectors visual feedback.

12.1.10. Tie-Up Warnings -

O-PitSurface offers multiple **warning signs to alert the blast engineer to potential tie-up errors**. These visual feedback mechanisms are designed to highlight mistakes and ensure correct tie-up procedures (Tab. 1).

Tab. 1 – Tie-Up Warnings

Warning Sign	O-Pitblast	Example	Description
			Hole not connected/without detonator
			Extra Dual Detonator inside a hole
			In-hole and Dual Detonator inside a hole

12.1.11. Extra Initiation System -

The **Extra Initiation System** option allows users to add additional detonators to their initiation system. Once selected, a window will appear to input details for these extra detonators (Figure 303).

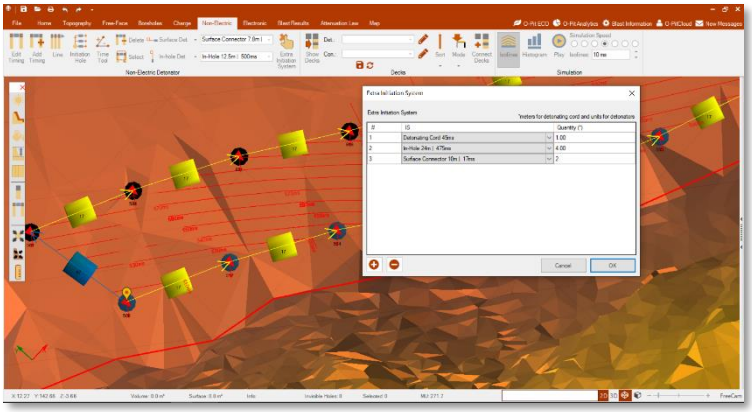
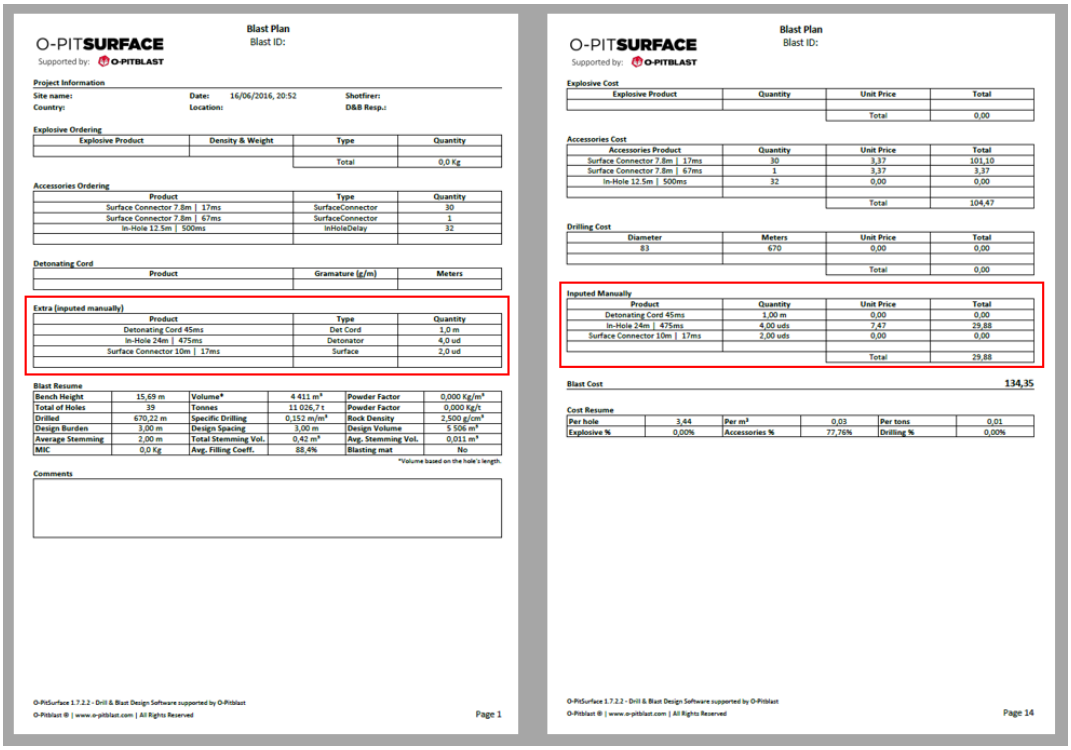


Figure 303 - Extra Initiation System window.

All entered information will be included in the blast report (Figure 304).



Blast Plan
Blast ID:

O-PITSURFACE
Supported by: O-PITBLAST

Project Information

Site name: | Date: 16/06/2016, 20:52 | Shotfirer:
Country: | Location: | D&B Resp.:

Explosive Ordering

Explosive Product	Density & Weight	Type	Quantity
		Total	0,0 Kg

Accessories Ordering

Product	Type	Quantity
Surface Connector 7.8m | 17ms	SurfaceConnector	30
Surface Connector 7.8m | 67ms	SurfaceConnector	1
In-Hole 12.5m | 500ms	InHoleDelay	32

Detonating Cord

Product	Gramature (g/m)	Meters

Extra (inputed manually)

Product	Type	Quantity
Detonating Cord 45ms	Det Cord	1,0 m
In-Hole 24m | 475ms	Detonator	4,0 ud
Surface Connector 10m | 17ms	Surface	2,0 ud

Blast Resume

Bench Height	15,69 m	Volume*	4 411 m³	Powder Factor	0,000 Kg/m³
Total of Holes	39	Tonnes	11 026,7 t	Powder Factor	0,000 Kg/t
Drilled	670,22 m	Specific Drilling	0,152 m/m³	Rock Density	2,500 g/cm³
Design Burden	3,00 m	Design Spacing	3,00 m	Design Volume	5 506 m³
Average Stemming	2,00 m	Total Stemming Vol.	0,42 m³	Avg. Stemming Vol.	0,011 m³
MIC	0,0 Kg	Avg. Filling Coeff.	88,4%	Blasting mat	No

*Volume based on the hole's length.

Comments

O-PitSurface 1.7.2.2 - Drill & Blast Design Software supported by O-Pitblast
O-Pitblast © | www.o-pitblast.com | All Rights Reserved

Page 1

Blast Plan
Blast ID:

O-PITSURFACE
Supported by: O-PITBLAST

Explosive Cost

Explosive Product	Quantity	Unit Price	Total
		Total	0,00

Accessories Cost

Accessories Product	Quantity	Unit Price	Total
Surface Connector 7.8m | 17ms	30	3,37	101,10
Surface Connector 7.8m | 67ms	1	3,37	3,37
In-Hole 12.5m | 500ms	32	0,00	0,00
		Total	104,47

Drilling Cost

Diameter	Meters	Unit Price	Total
83	670	0,00	0,00
		Total	0,00

Inputed Manually

Product	Quantity	Unit Price	Total
Detonating Cord 45ms	1,00 m	0,00	0,00
In-Hole 24m | 475ms	4,00 uds	7,47	29,88
Surface Connector 10m | 17ms	2,00 uds	0,00	0,00
		Total	29,88

Blast Cost 134,35

Cost Resume

Per hole	3,44	Per m³	0,03	Per tons	0,01
Explosive %	0,00%	Accessories %	77,76%	Drilling %	0,00%

O-PitSurface 1.7.2.2 - Drill & Blast Design Software supported by O-Pitblast
O-Pitblast © | www.o-pitblast.com | All Rights Reserved

Page 14

Figure 304 - Extra initiation system info in the report - Explosive Ordering and Cost.

12.2. Decks

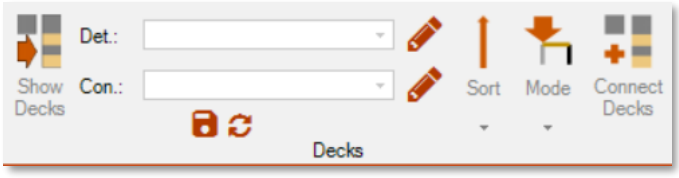


Figure 305 - Decks options.

This option allows the user to add timing to holes with decks. First, the user must choose the decks that he wants to use by clicking on the pencil ( ). The user chooses the detonators that he wants to use on decks and add them by click on the arrow ( ).

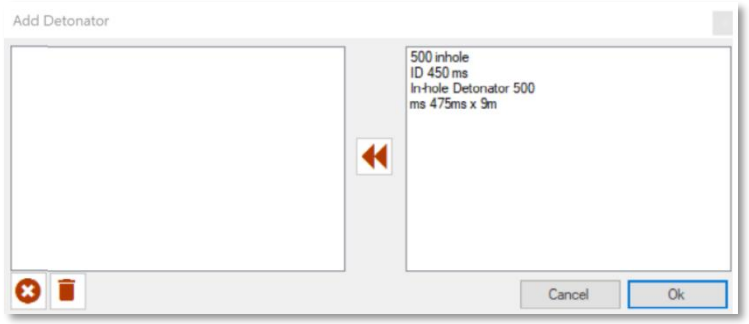


Figure 306 - Add detonator window.

After choosing the time for the decks, **the user must define if wants to connect from the bottom or from the top** ( ). Then chooses the **Mode** to connect decks: surface in-hole, dual in-hole or in-hole connection (Figure 307).

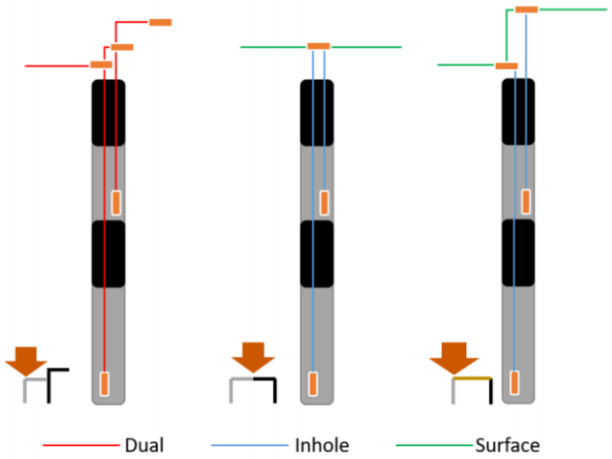


Figure 307 - Type of deck connections.

After those steps, the user clicks on connect decks button ( ) and left click on the holes he wants to connect.

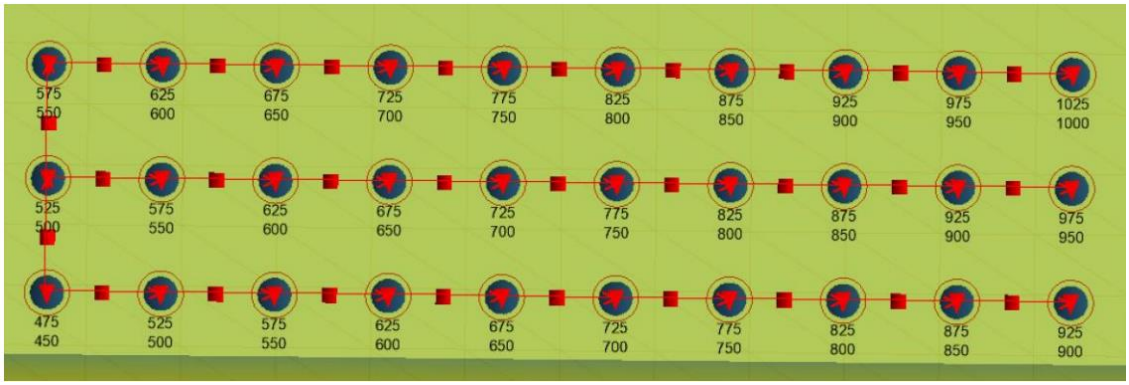


Figure 308 - One deck per hole (decks with connector of 450ms).

If the user clicks on **Show Decks** will see how many decks every hole has and the timing.

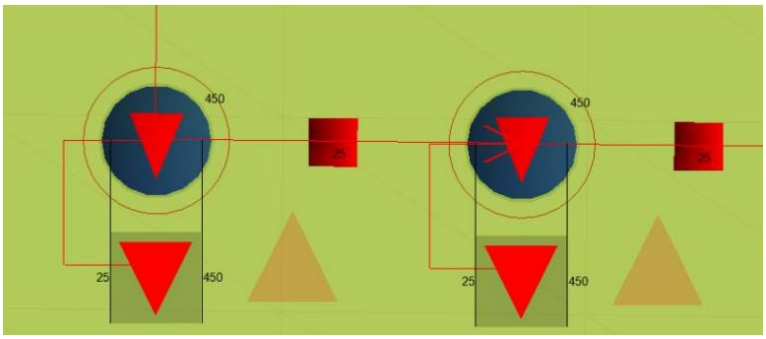


Figure 309 - Show decks option.

P.S: A green hole warning (triangle shape - △) means presence of decks.

12.3. Simulation

12.3.1. Isolines -

After defining the **Initiation hole** (Chapter: 12.1.4) and activating the **Isolines** icon the user will be able to observe the time isolines (Figure 310).

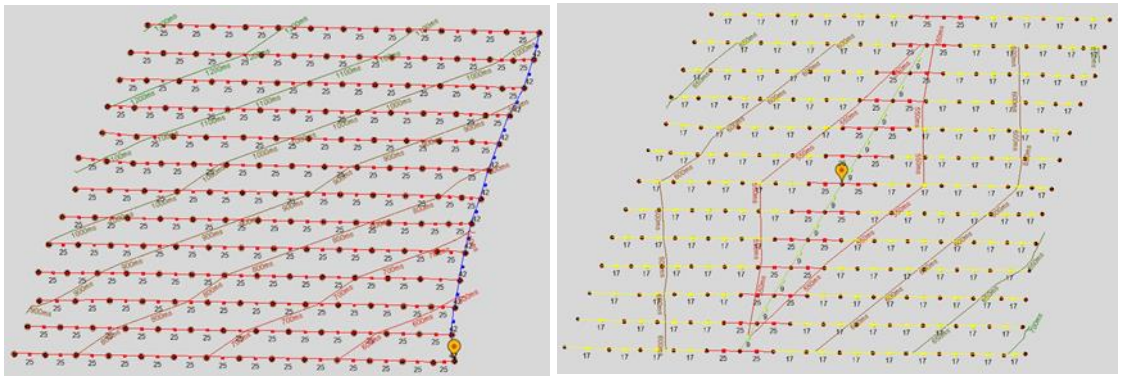


Figure 310 - Time Isolines.

To change the time isoline's interval, in the **simulation** section, the user must adjust the box presented in the Figure 311.

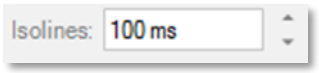


Figure 311 - Adjust Isoline's Interval.

12.3.2. Histogram -

The Histogram gives a graphic feedback of the behaviour of the tie-up applied to the project. Analysing the blast histogram is possible to identify the number of holes initiated at the same time and the maximum instantaneous charge (MIC) (Figure 312). For the last one, the user must check the **Use Charge** checkbox.

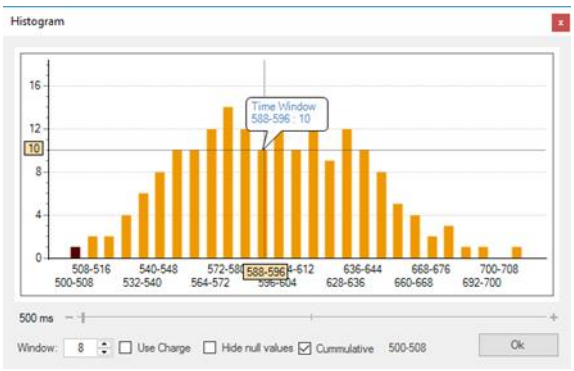


Figure 312 - Histogram - Number of Holes per Delay.

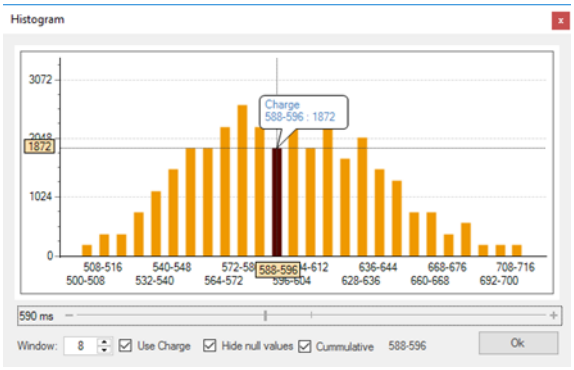
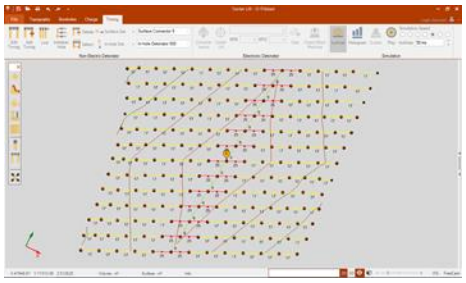
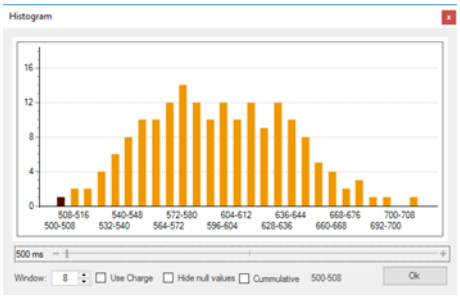
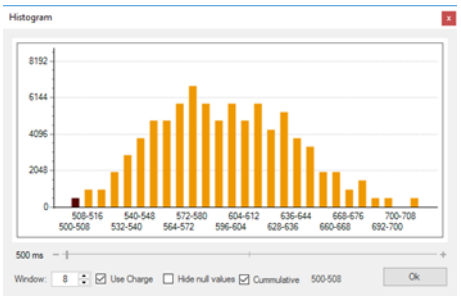
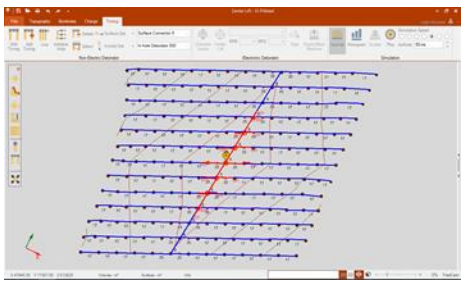
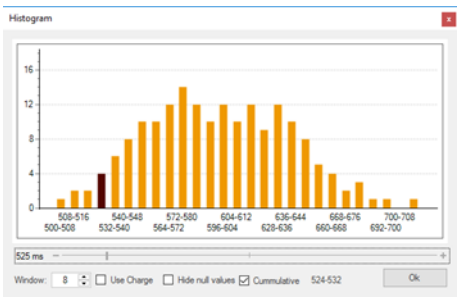
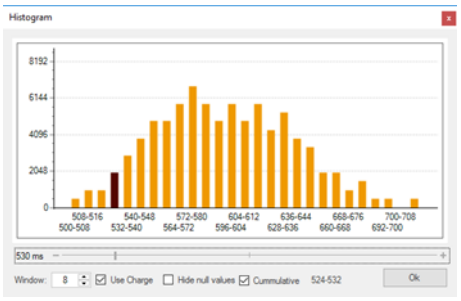


Figure 313 - Histogram - Charge per Delay.

Tab. 2 - Simulation

Simulation	Histogram – Nº Holes/Delay	Histogram – Charge/Delay
		
		

12.3.3. Play -

The **Play** button will start the blasting simulation. During the simulation, user can press the play/pause button to freeze the image and evaluate possible issues from the time design.
By the Simulation Speed buttons, it is possible to adjust the simulation velocity (Figure 314).

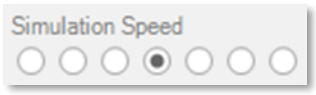
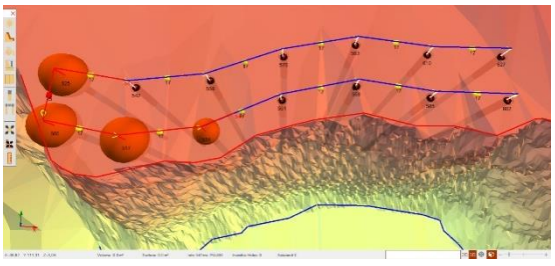
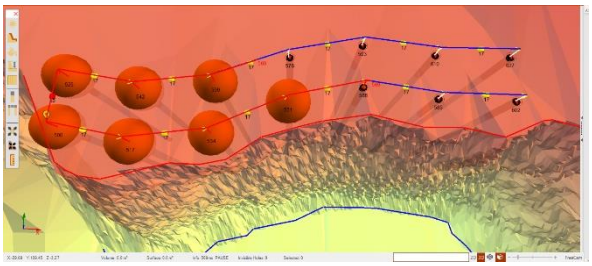
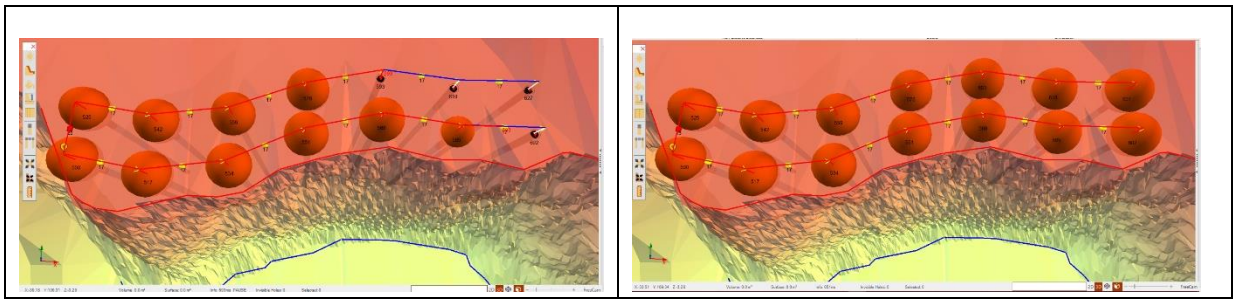


Figure 314 - Simulation Speed Adjustment.

Tab. 3 - Blasting Simulation

Blasting Simulation	
	



12.4. Add Extra Detonators

The user can add extra detonators in one (or more) holes. Just needs to left click twice in one hole and open the timing tab.
He clicks on plus sign (⊕) to add extra detonators and left clicks along the hole to position them. To delete just clicks inn the garbage sign (🗑).

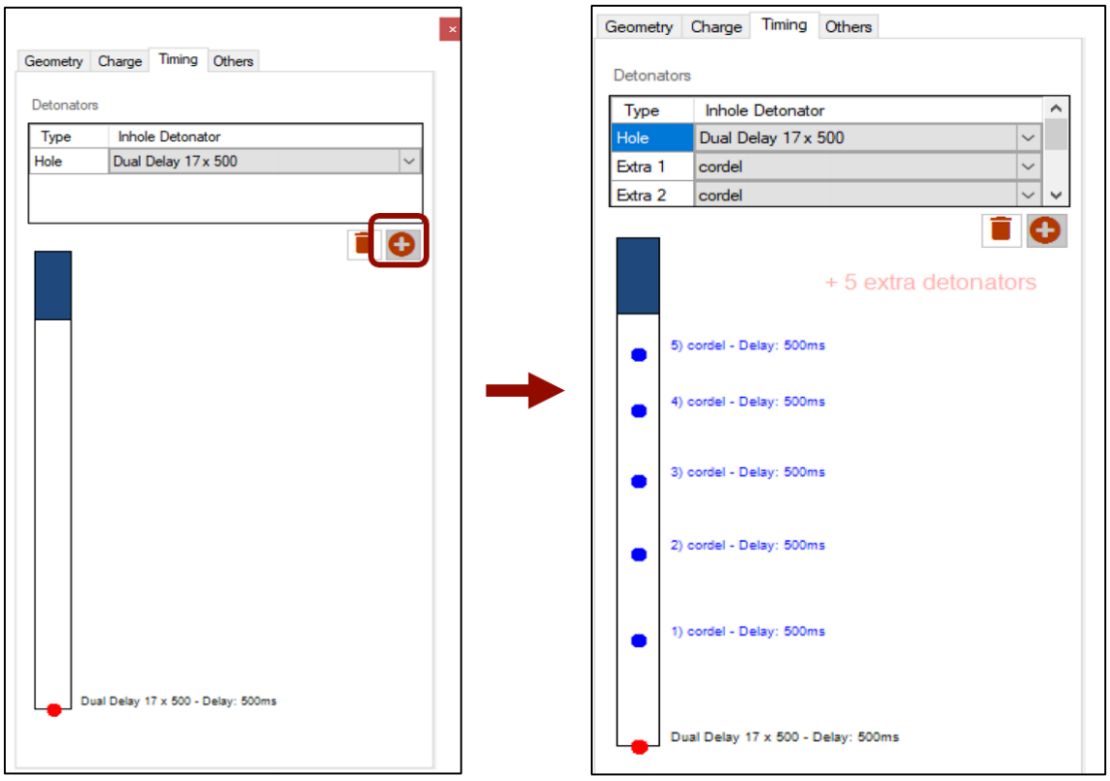


Figure 315 - Adding extra detonators.

13. Electronic Detonators

This tab will allow the user to add, edit and delete timing to the boreholes with electronic detonators.

Figure 316 - Electronic Detonators Module.

Icon		Description
	Direction Vector	Make connection with the possibly to define the direction of the blasting
	Center Lift	Make a center lift blasting
	Multiple Directions	Define multiple directional connections
	Time Tool	Make Inter-Rows and Inter-Holes connections
	By Click	Connect by clicking
	Drag and Connect	Connect by dragging
	Edit Time	Change time connections individually (hole by hole)
	Select	Select a conjunct of connections
	Delete	Delete connection
	Path	Prepare the connections path
	Associate Branches	
	Export Blast Machine	Export the paths to one or more PU's
	Compare Data	Compare timing data between PU and O-PitSurface
	Check	Check connections
	Extra Initiation System	Add more extra detonators
	Isolines	Show time isolines
	Histogram	Show histogram
	Play	Play blasting simulation
	Pause	Pause the blasting simulation

13.1. Direction Vector

To use this button the user must have boreholes. Then the user must select the direction that he wants for the blast.

Is possible to change the **Burden Relief Burden (BRB), Burden Relief Spacing (BRS), Angle** and **Azimuth** of the vector that the user wants for the blast.

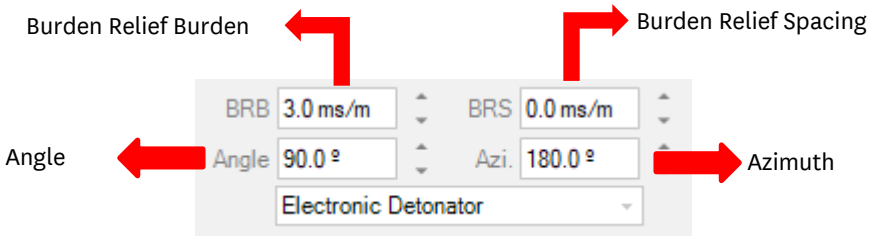


Figure 317 - Parameters that change the direction vector.

The user can move the arrow or point it to anyplace he wants.

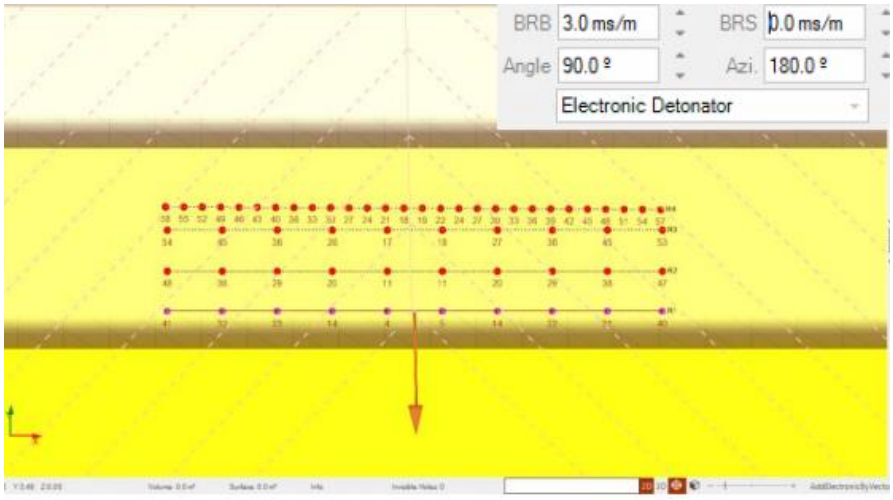


Figure 318 - Direction Vector window.

13.1.1. PolyLine Tool

Inside of this option, the user has "**Polyline tool**" (Figure 319).

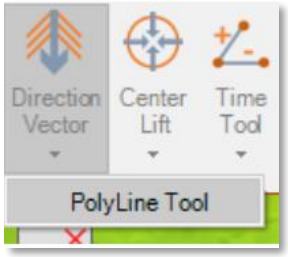


Figure 319 - PolyLine tool.

On this section, the user will be able to create a polyline in the position of the terrain here he wants to direct the blast (Figure 320).

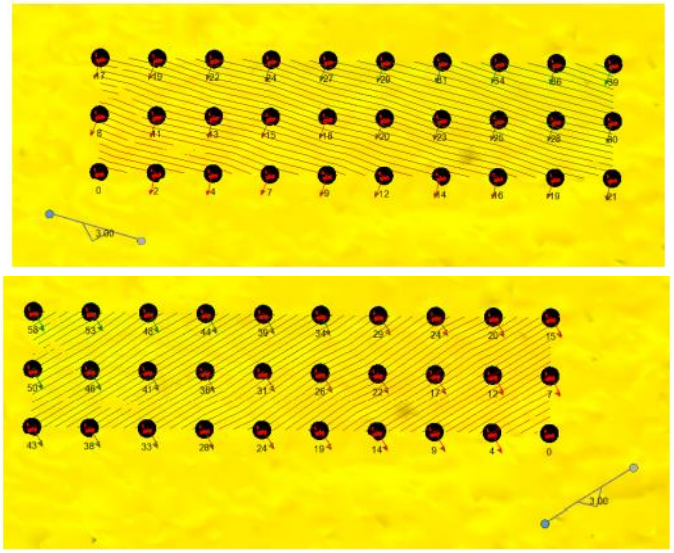


Figure 320 - Two example of blast direction, depending on the polyline position.

To change the BRB, the user must click CTRL plus left-click over the tool or scrolling the mouse over it, and then a pop-up window (Figure 321) will appear with the possibility to change the BRB and to define the starting time, for the first borehole.

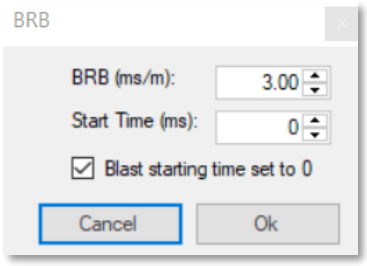


Figure 321 - Window to change BRB and starting time.

To move the tool, the user must click in CTRL + left click and drag for another position.
To delete the polyline the user must click in CRTL + right click (over the polyline).

13.2. Center Lift -

The user can simulate a center lift blasting by click on the **Center Lift** button. It will appear a blue circle that can be moved around the blasting area, to create the condition that the user wants.

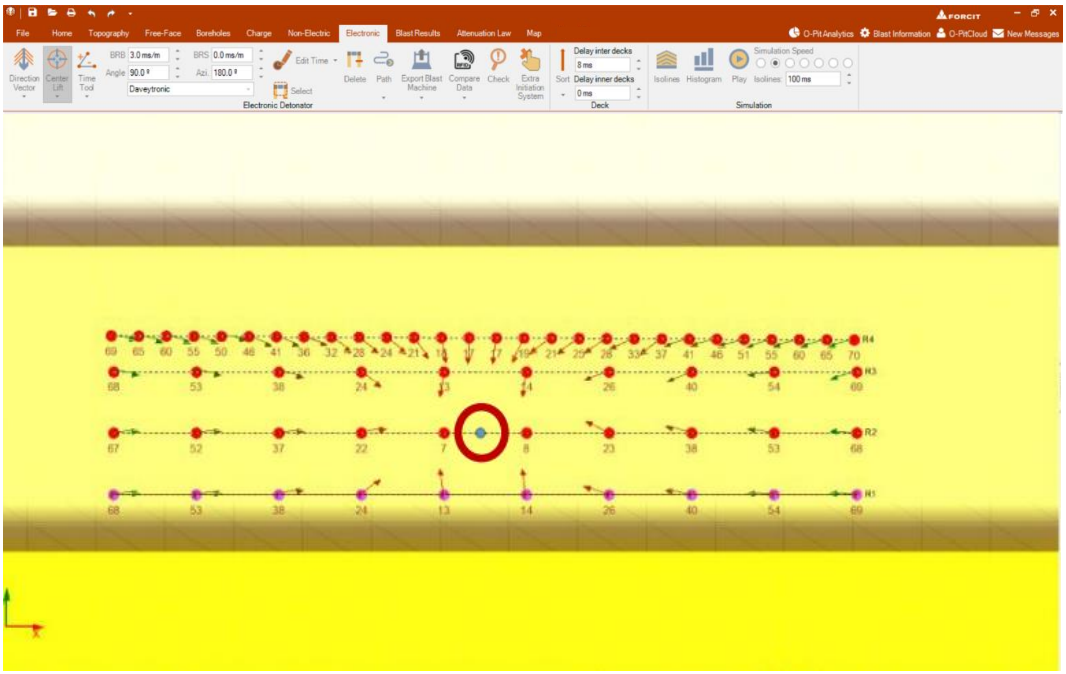


Figure 322 - Center lift tool.

Inside of this option the user can use the tool **multiple directions.** The user draws the direction arrows from the center lift point and choose which BRB will be associate to that arrow (they are referenced by color). To **move** the center lift, the user must use **crtl** and with **left button of mouse** drag the point.

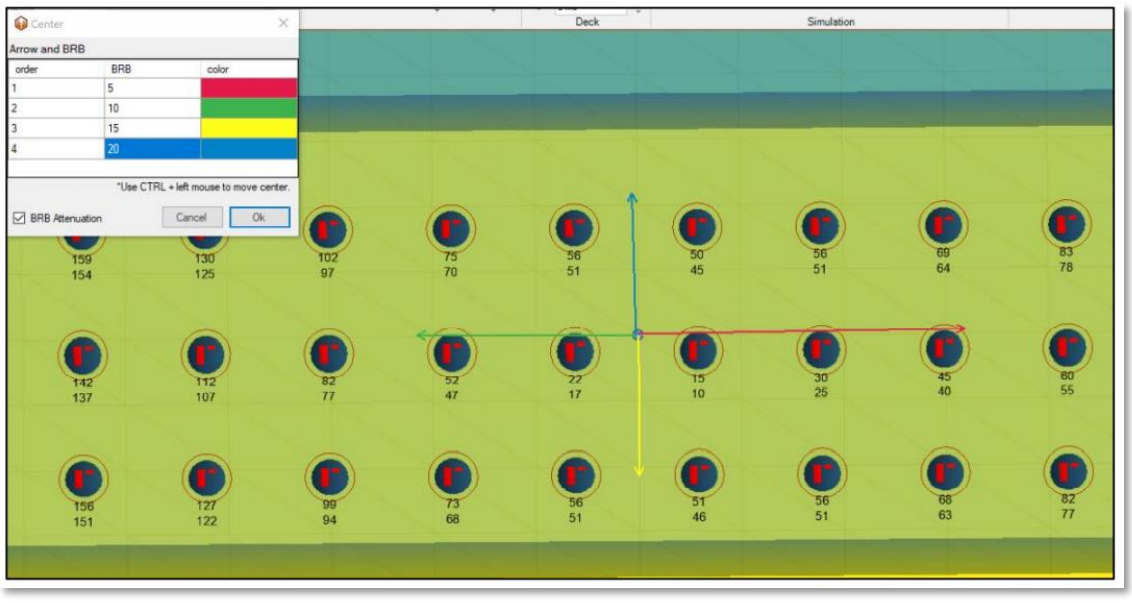


Figure 323 – Center Lift: Multiple Directions.

13.3. Time Tool -

With this tool the user can create different times between rows and holes. It will pop-up a window that allows the user to choose the time that he wants for each (**Inter-Rows** or **Inter-Holes**) and see which holes are not connected.

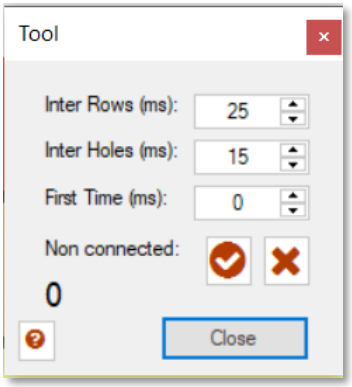


Figure 324 - Time tool window.

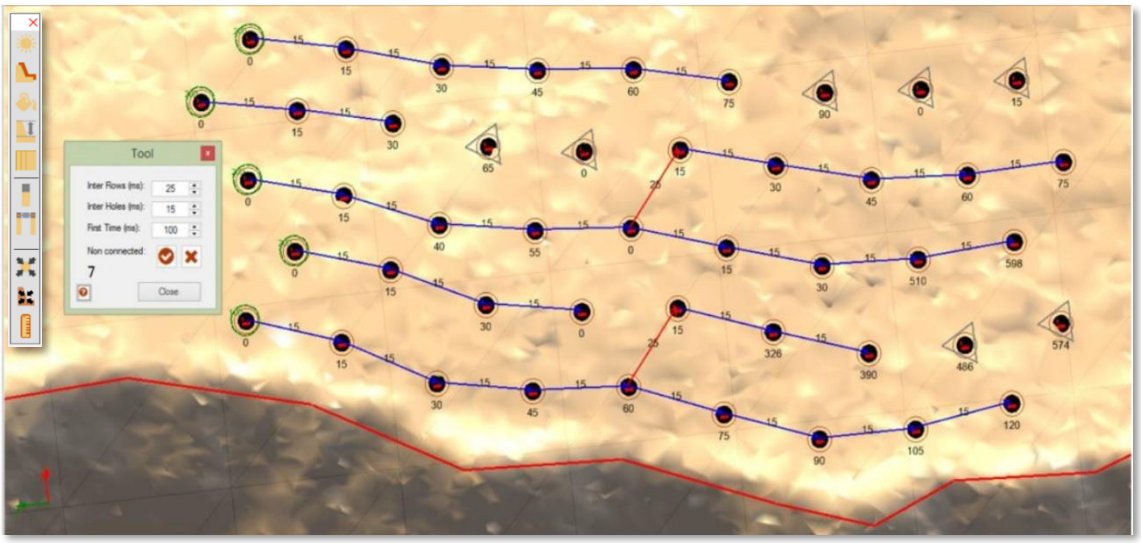


Figure 325 - Timing between Rows and holes.

To use the **Time Tool**, the user needs to:

1. **Define whether to connect inter-rows or inter-holes**.
2. **Choose the time interval**.
3. **Start dragging the mouse** to create the connection between rows/holes.
4. Optionally, **define the first time** (for the first borehole).

To delete a connection, the user must **right-click on the first borehole** they intend to keep. The connections and all information **after that borehole will be deleted**.

13.3.1. By click and Drag and Connect Tool

Below the Time Tool option, the user has access to the folllowing different tools: **By Click, Drag and Connect** and **Old Time Tool**.

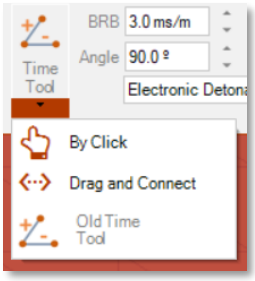


Figure 326 - By click and Drag and Connect tool.

By Click

In this mode, the user simply needs to left-click over the holes to apply a time to them. The user can set the initial time (the first click will apply this time) and then a time step. This step will be added with each subsequent click. For example, if the user sets 100ms as the initial time and 10ms as the step, the first hole clicked will have 100ms, the second 110ms, the third 120ms, and so on.

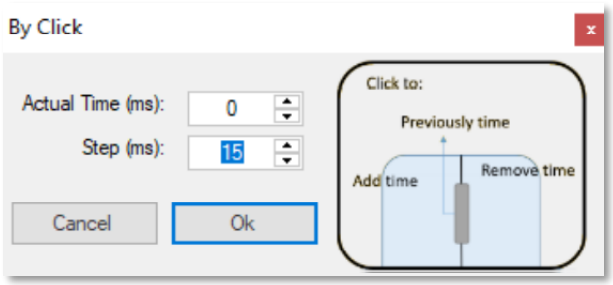


Figure 327 - By click tool.

To **remove** a time from a hole, the user needs to **right click** over the hole.

Drag and Connect

In this mode, the user creates a drag flow by dragging the mouse over the holes. The user can enter the delay and starter time (Figure 328). For example, if the starter time is set to 1000ms and the delay to 10ms, dragging the mouse will increment the time by 10ms for each subsequent hole (Figure 329).

- The user can display hole information in terms of numbers or labels.
- The window also counts how many holes are not connected.
- The user can apply ( ) or clear all connections ( ).

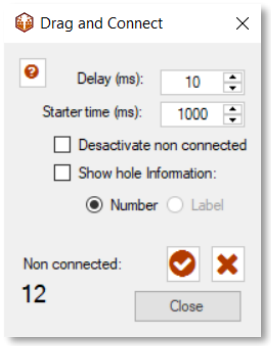


Figure 328 - Drag and Connect window.

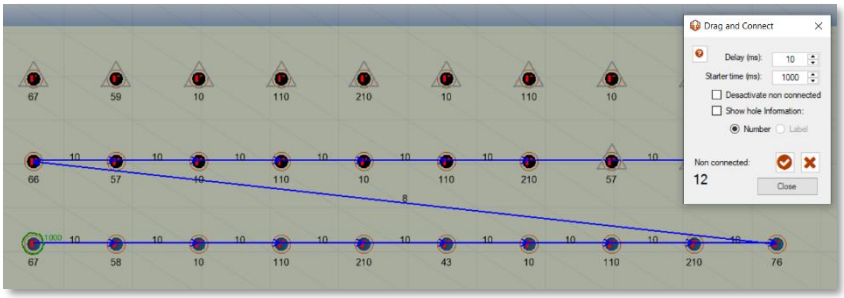


Figure 329 - Drag and Connect Flow between holes.

Fig. 3 - Select node option

When selecting show hole information, the numbers will appear in red.
To delete the connection the user just needs to right click over the hole where the connect that he wants to delete starts.

13.3.2. Old Time Tool

With this tool the user can create different times between rows and lines like section 13.3. It will pop-up a window that allows the user to choose the time that he wants and change the time Inter-Rows or Inter-Holes.

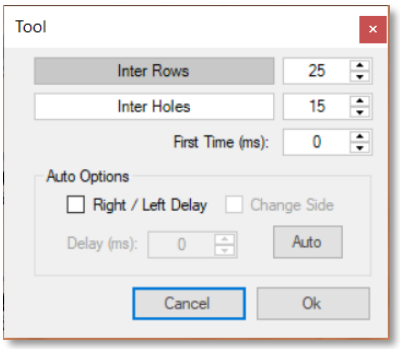


Figure 330 - Old time tool tab.

Clicking on Auto button, the connection will be made automatically in inter-holes.

13.4. Edit Time -

This tool allows the user to change the timing individually (hole by hole). By clicking the **Edit Time** button, a window will appear displaying information for each hole, including its label (if any) and detonating time.

In this window, the user can:

- Edit the timing for the desired hole.
- Verify holes connected by the drag tool.
- Verify boreholes without a detonator.

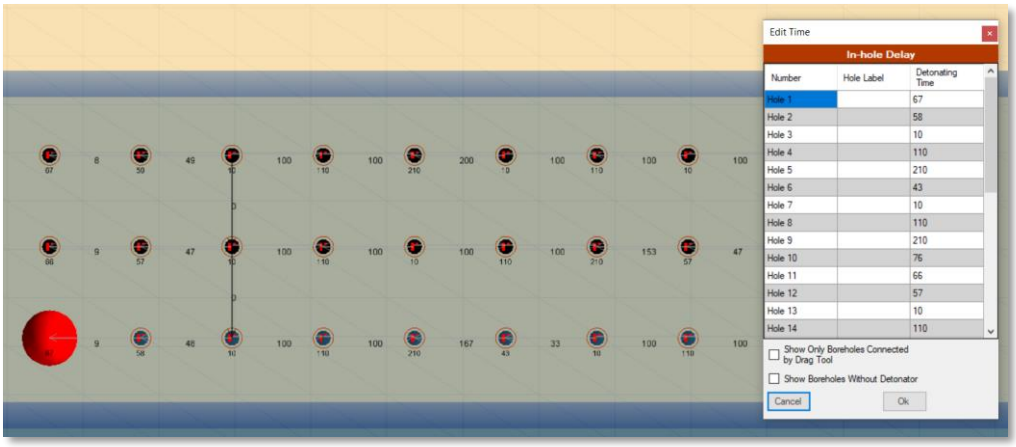


Figure 331 - Edit Time window.

If a borehole contains one or more decks, it will also display each deck's information, such as Deck 1, Deck 2, etc., along with their respective detonating times.

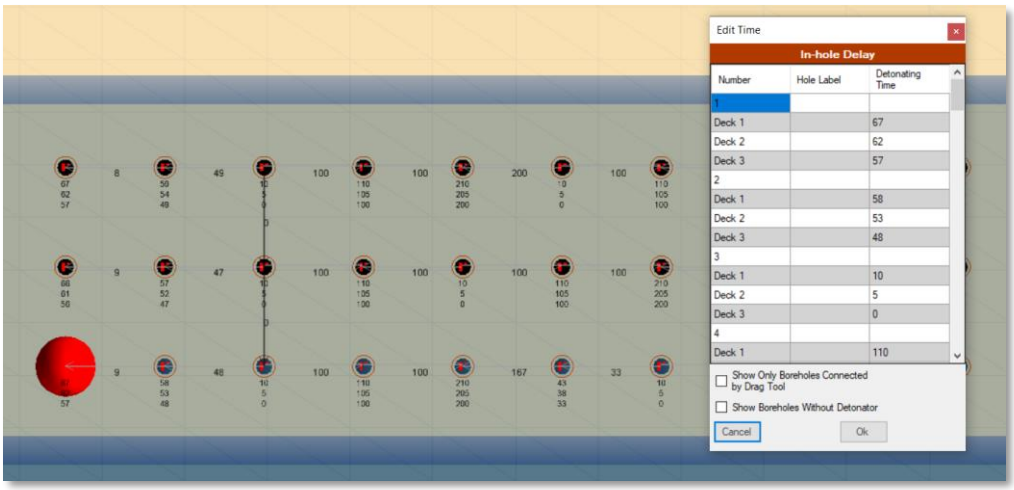


Figure 332 - Edit Time window displaying deck info.

13.4.1. Translate

Below the option Edit time the user has the option to add a delay to the global pattern. For example, if the user wants to start the blast at the second 1000ms, just needs to click on the '**Translate time**' function and define the translation time as 1000ms. It will be added a 1000ms delay to each hole.

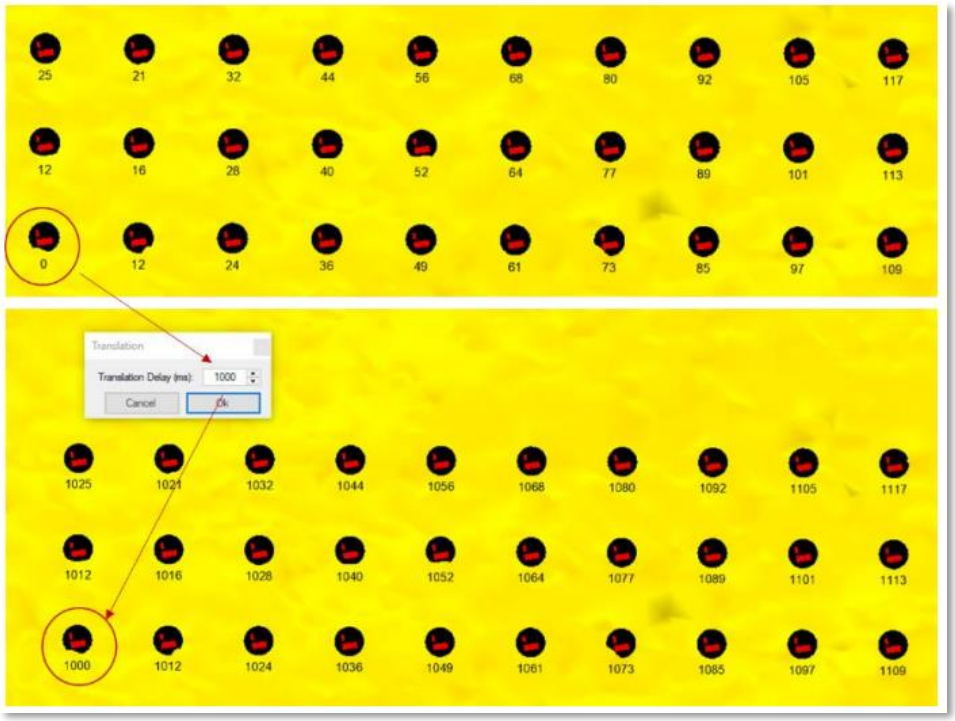


Figure 333 - Translate (delay) option.

13.5. Delete Connections -

By clicking on the **Delete** button the user will delete all connections.
To delete a single connector, the user can right-click above the connector's cylinder.
To delete a conjunct of connections the user must create a selection area (Point: 12.1.7) and click on **Delete Connection** icon. Note: the detonator cylinder must be inside the selected area.

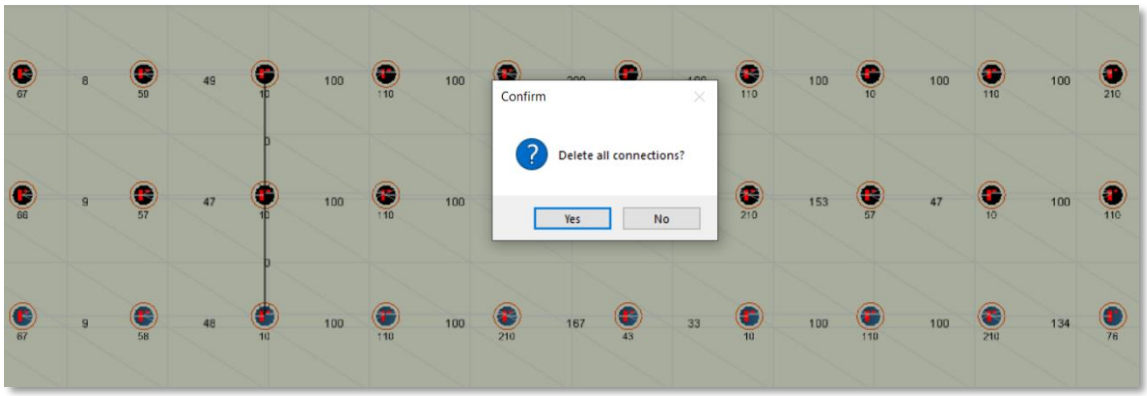


Figure 334 - Delete all connections.

13.6. Path

This option allows the user to prepare the path that will be followed by the PU. The pattern can consist of multiple paths or just one. **It is crucial to ensure that ALL holes have timing associated with them**; otherwise, it won't be possible to export to the blast machine.

To create the path, the user clicks on **Path** button and start dragging the mouse pointer from the starting hole towards the next and keep doing between holes to define the desired path sequence. **For a quick connection**, simply click the middle mouse button (Figure 335). Pressing the shift key while dragging skips holes.

In the options (refer to Chapter 6.3.7- Figure 66 and Figure 67), the user can switch the view to see the Electronic Path as a **single path with branches or as multiple paths** (Figure 336).

Figure 335 - Single Path (quick way).

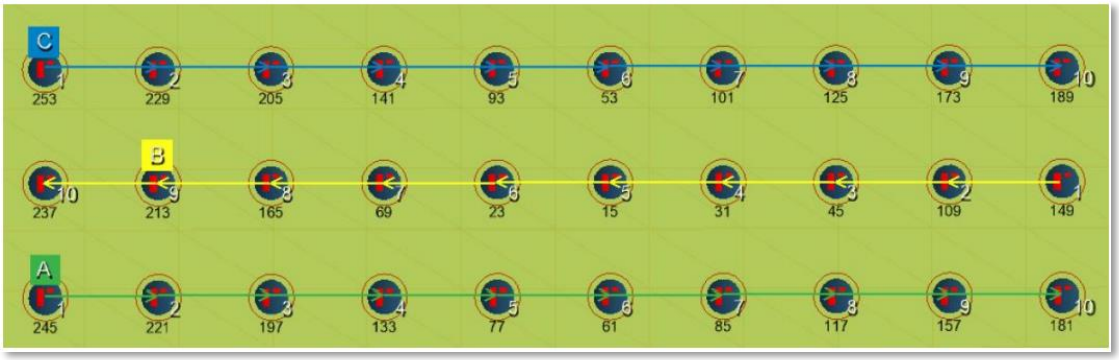


Figure 336 - Multiple paths.

To delete a path, right-click on the first borehole you intend to keep. The path and all information after that borehole will be deleted.

13.6.1. Associate branches

For users of the Austin Powder Electronic System (see Section 13.9), this feature is used to associate branches. Ensure that a polygon is included in the blast design; otherwise, selecting this feature will display the message: "**You don't have any polygon**" (Figure 337), and for this reason no branches can be associated."

The **Associate Branches** window recognizes the total number of holes and those with paths when selecting the number of branches. For each branch, specify its order, the number of holes, and the number of detonators. Only one zone/polygon can be selected at a time, and the same zone cannot be chosen twice. Additionally, only one path is allowed for this operation.

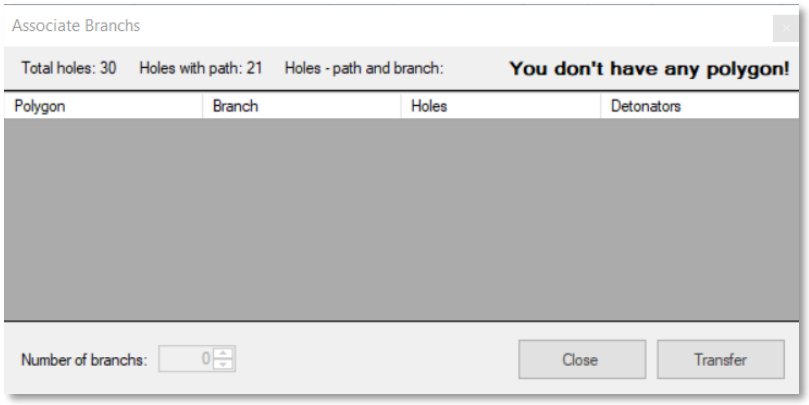


Figure 337 - Associate branches window when user does not have any polygon.

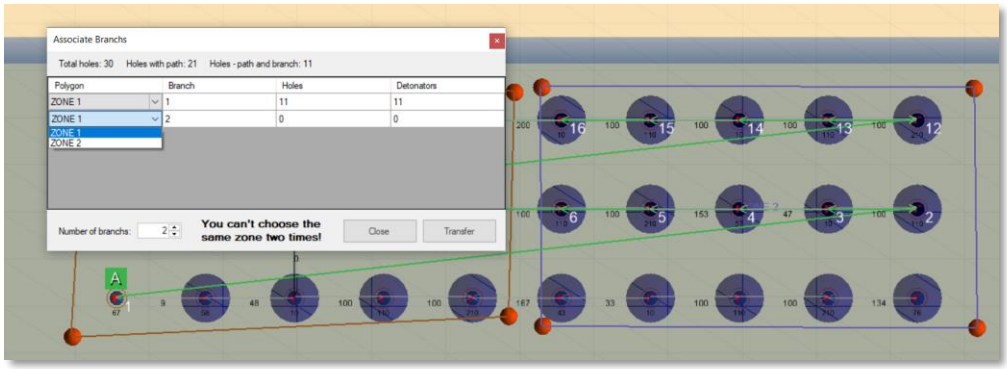


Figure 338 - Associate branches window when user has polygon.

13.7. Isolines, Histogram, Play and Pause

All this button works the same way as the Non-Electric module. The user can check how this Simulation buttons works on Chapter 12.3. The only exception is that the user can **Fix** the blasting time automatically.
Holes Blasting at the same time can be fixed on the option fix inside of the **Histogram**. The user chooses the interval in milliseconds that wants to work (by clicking on the plus sign).

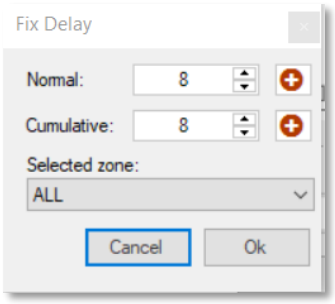


Figure 339 - Fix delay option.

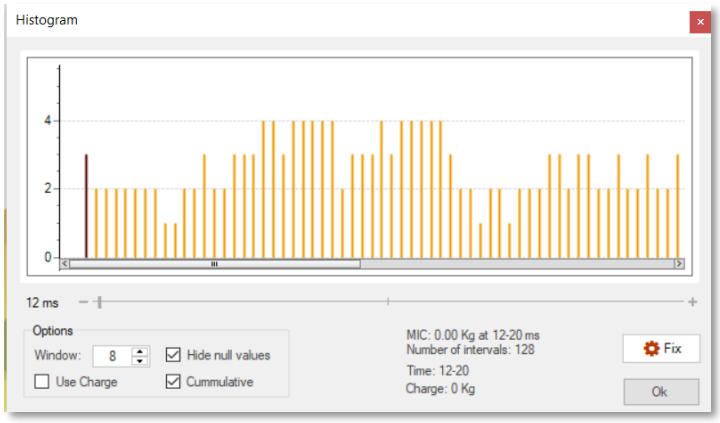


Figure 340 - Holes blasting at the same time (before fix tool).

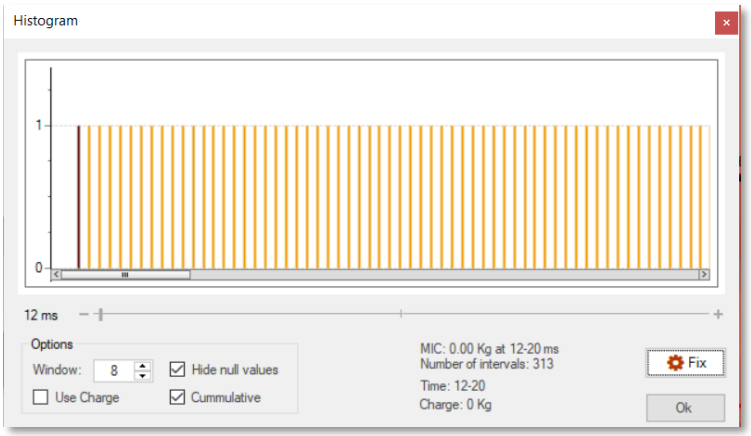


Figure 341 - Holes not blasting at the same time (after fix tool).

13.8. Decks

In these options, if there is a deck, the user needs to choose the delay inter decks, the delay inner decks nd whether the detonation will start from the bottom or top (Figure 342).

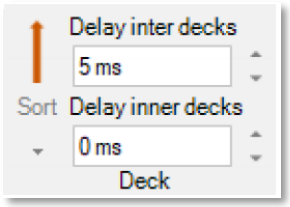


Figure 342 - Decks options.

13.9. Export Blast Machine -

O-PitSurface integrates with various electronic systems, allowing users to export timing information. Supported systems include Davey Bickford, Hanwha, and Austin Powder.

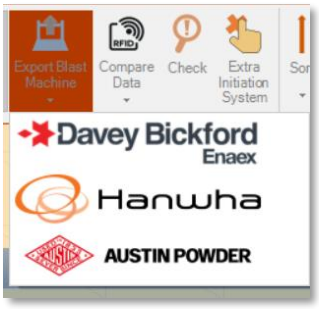


Figure 343 - Supported Electronic Systems for Export.

13.9.1. Davey Bickford (Blast Machine)

This option allows the user to export paths to one or more PU's and save the blast plan with the path as .BPD files.
Once clicked, the **Operator Credentials** window will appear (Figure 344), where they must enter their name. After submitting the credentials, the **Export** window will prompt for further actions.

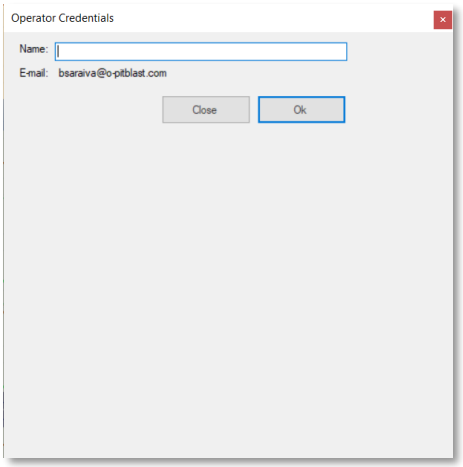


Figure 344 - Davey Bickford (Export Machine) - Operator Credentials window.

In the **Export** window, the user can modify the **Display Name**, **Full Name**, **Site**, **Location** and add **comments**. The user can also check whether the information about Use XD and/or DT5 detonators is activates or not (check Options section - Figure 61, Figure 62).

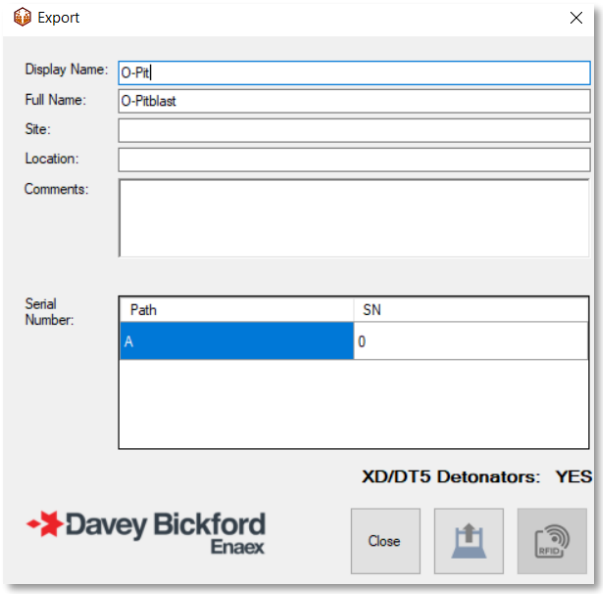


Figure 345 - Export to blast machine window.

Inside of this window, the user can click on button to save a local file (.BPD).

To export to blast machine, the user needs to follow these steps:

1. **Connect the PU to computer via RFID reader;**
2. **Open the Export window**, and the software will recognize the PU number, then the user can associate it to a path (Figure 346);
3. **Repeat steps 1 and 2 for each additional PU**;
4. Once all paths are associated with their respective PUs, the user will see every path associated with a PU (Figure 347);
5. After that, click on RFID ( ) button. A window will appear, asking if the user wants to load the path to the PU (Figure 348);
6. The exportation is complete (Figure 349).

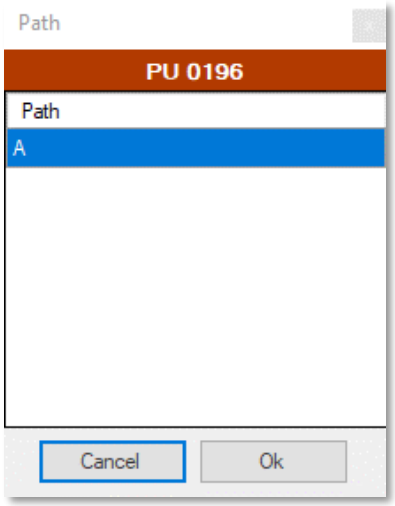


Figure 346 - Connect path to PU.

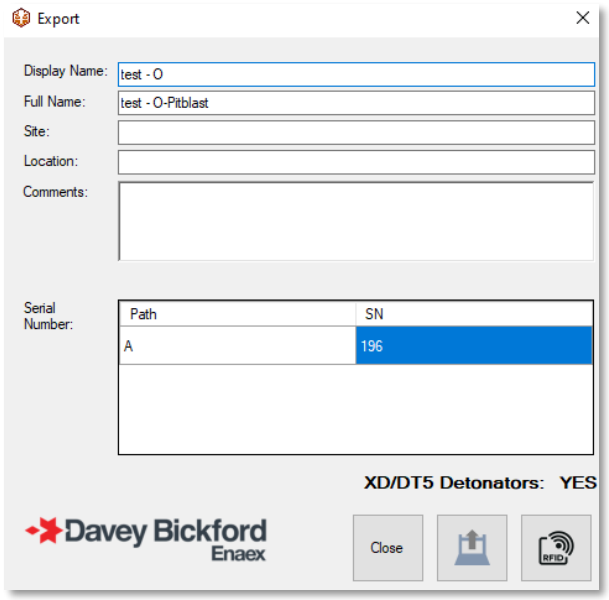


Figure 347 – Confirmation Path-PU: Path associated to the PU SN.

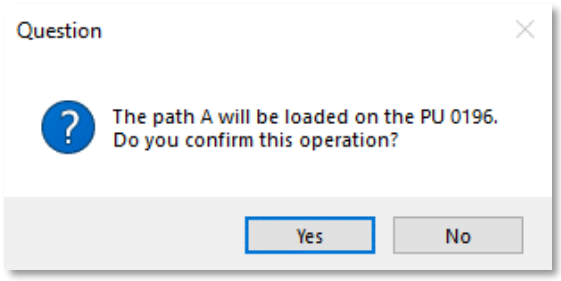


Figure 348 - Confirmation message to exportation.

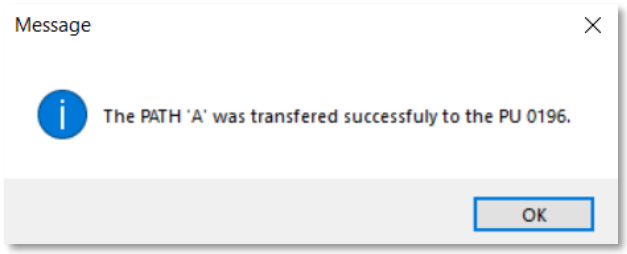


Figure 349 - Message of successful exportation.

13.9.2. Hanwha (Blast Machine)

This option allows the user to export paths to one or more devices and save it as .HSD files.

In the **Austin Powder** window, the user can modify the **Blast Name**, select the device, and choose the data in terms of paths. By clicking the **Transfer** button, the data will be saved to the device, and a confirmation message will be displayed.

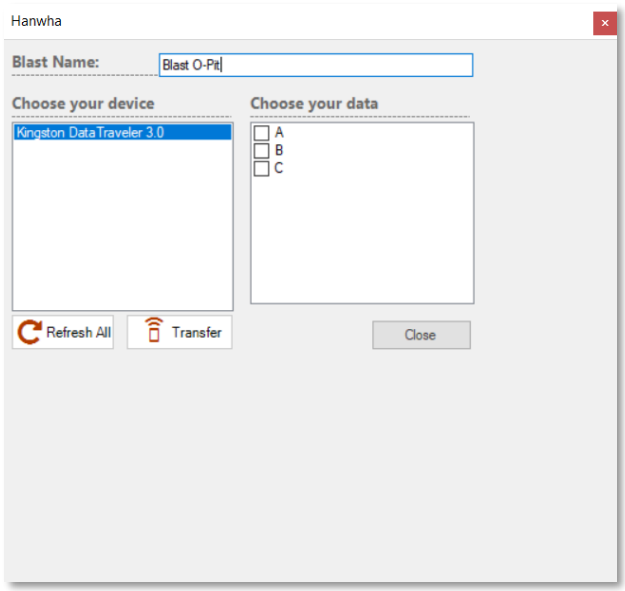


Figure 350 - Hanwha window.

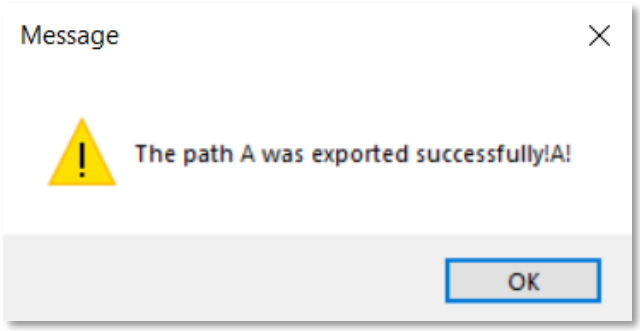


Figure 351 - Message of successful exportation.

13.9.3. Austin Powder (Blast Machine)

13.10. Compare Data

Similar to the **Export Blast Machine** functionality, the **Compare Data** feature in O-PitSurface integrates with various electronic systems, allowing users to compare timing information. This option allows the user to:

- Transfer the timing data from the PU to O-PitSurface.
- Transfer the timing data from O-PitSurface to the PU and update the timing in the PU.

13.10.1. Davey Bickford (Blast Machine)

With the Davey Bickford system, this can be done using an RFID reader (check 13.10.1.1) or by importing a file if an RFID connection is not used (13.10.1.2).

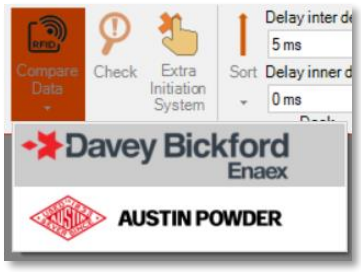


Figure 352 - Supported Electronic System to Compare Data.

13.10.1.1. With RFID reader

PU to computer

1. Inside of the PU, user has the existing timing information
2. Click on the button **"PU to computer"** to transfer the timing data from the PU to O-PitSurface (Figure 355).

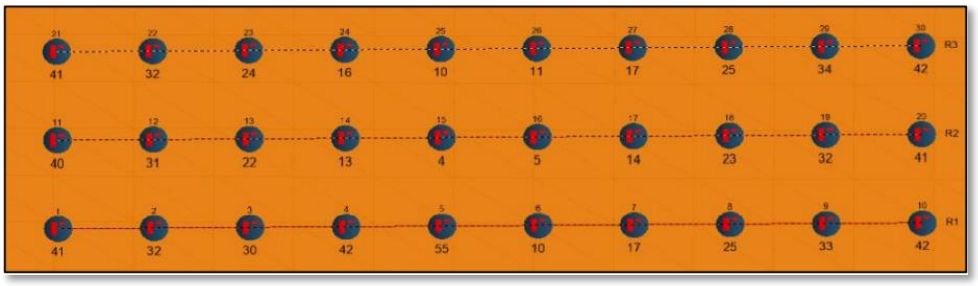


Figure 353 - Timing Programmed inside the PU.

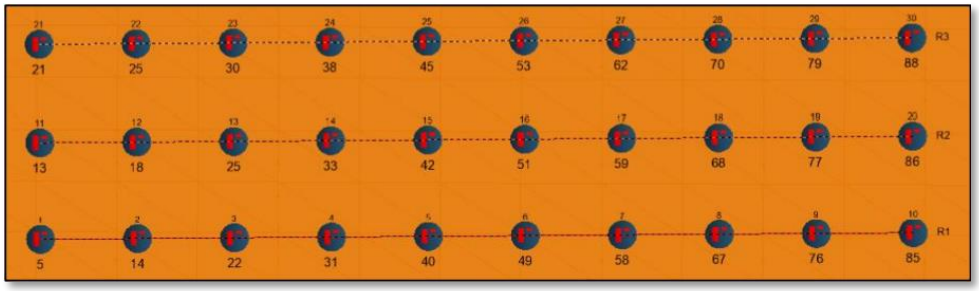


Figure 354 - Timing on O-PitSurface to transfer to the PU.

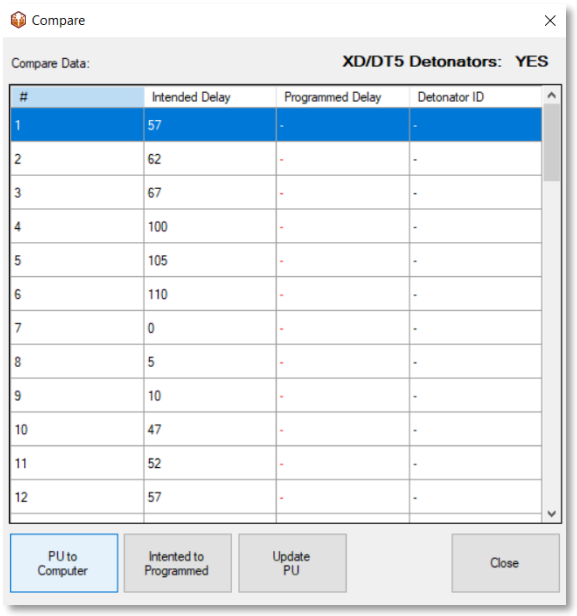


Figure 355 - Compare window: PU to Computer option.

Update timing in the PU after it's programmed

1. Click on the button "**Intended to programmed**" (Figure 356).
2. Click on the button "**Update PU**" (a confirmation window will appear, Figure 357).
3. A confirmation message will be displayed (Figure 358).

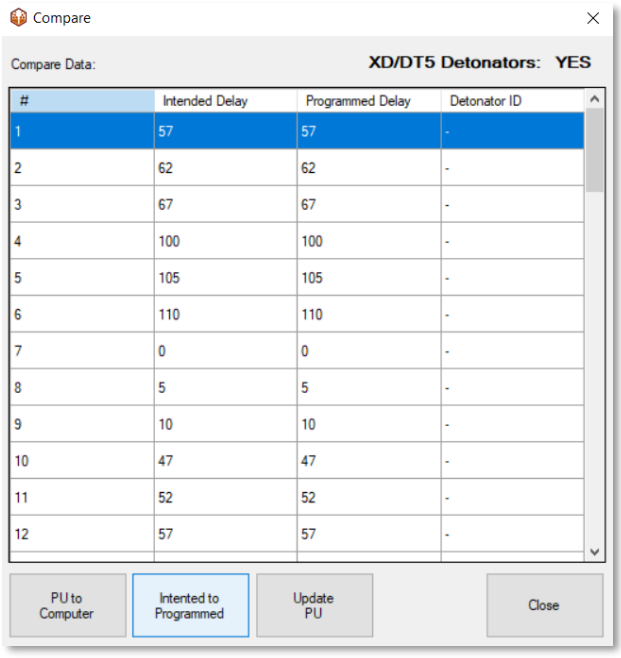


Figure 356 - Intended Delay to be Programmed.

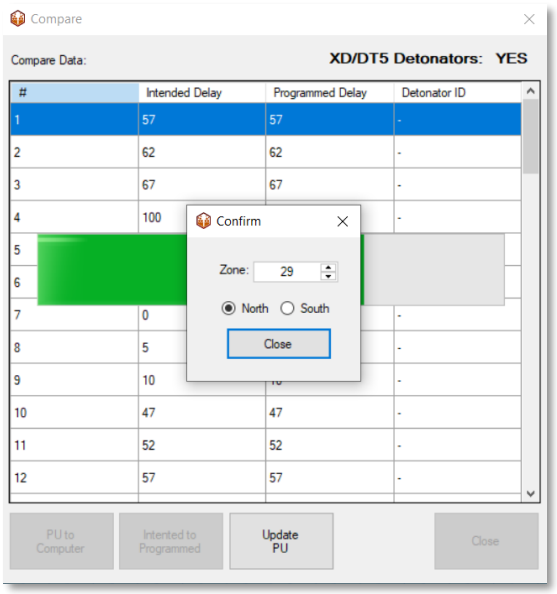


Figure 357 - Update PU: Zone Confirmation.

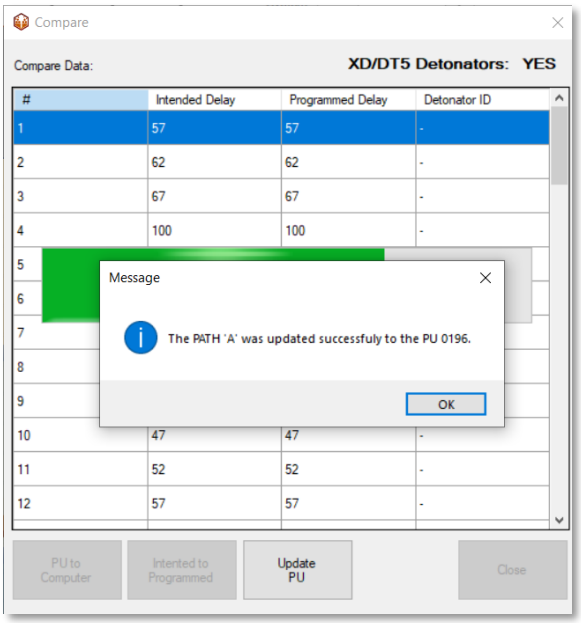


Figure 358 - Update to PU: Message of successful update.

13.10.1.2. Without RFID reader

When a RFID reader is not connected to the computer, clicking on Davey Bickford option (Figure 352) will display the following message:

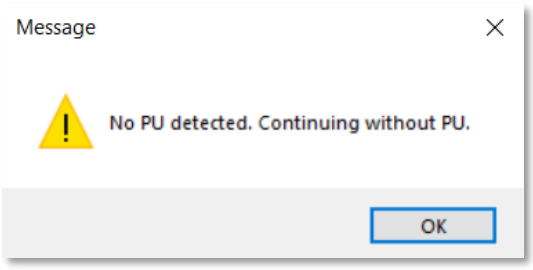


Figure 359 - Message No PU detected.

To proceed:

- Click **OK** on the message. This will open a dialog window where user can select the .XML file from your local machine to import.
- **Import one file at a time**. For additional PU data, repeat this process for each file.
- After selecting the file, a **Select Path** (Figure 360) window will appear, allowing user to associate the imported data with the respective path present in O-PitSurface.
- If the selected data does not match the number of detonators in the associated path, the software will display a warning message (Figure 361). In this case, the data can only be opened in view mode.

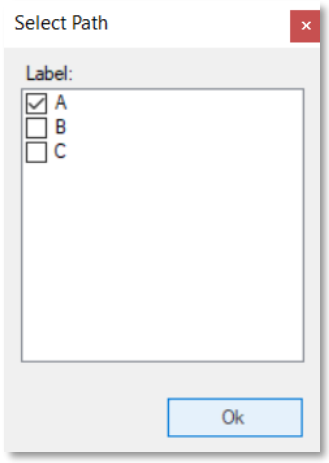


Figure 360 - Select Path window.

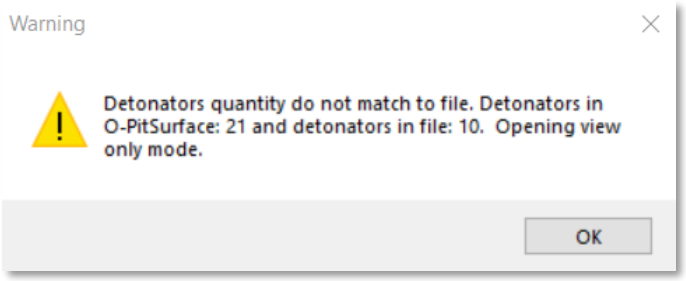


Figure 361 - Warning message when detonators quantity does not match to file.

When the imported file matches, the **Compare Window** will appear. This window allows you to:

- **Update timing information** from the PU to the computer using the **PU to Computer** button.
- **Update timing in the PU** after it's programmed using the **Intended to be Programmed** button.

- Instead of an **Update PU** button, an **Export File** button will be displayed (Figure 362). Clicking on the **Export File** button will prompt a save dialog where you can save the data as an .XML file. A confirmation window will then be displayed to confirm the successful export.

This functionality facilitates comparing and managing timing data without needing an RFID reader.

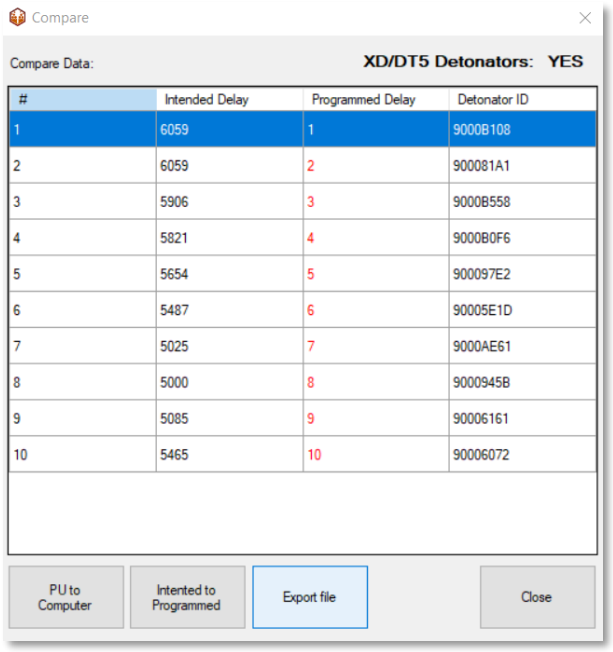


Figure 362 - Compare Data window displaying Export file option.

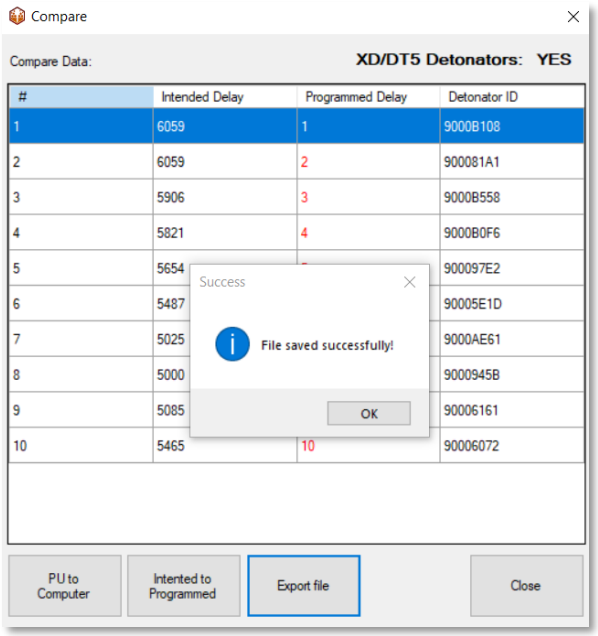


Figure 363 - Compare Data: Message of export confirmation.

13.11. Check

The **Check** feature allows users to identify boreholes that are not connected within their path. To perform this check, simply click the **Check** button.

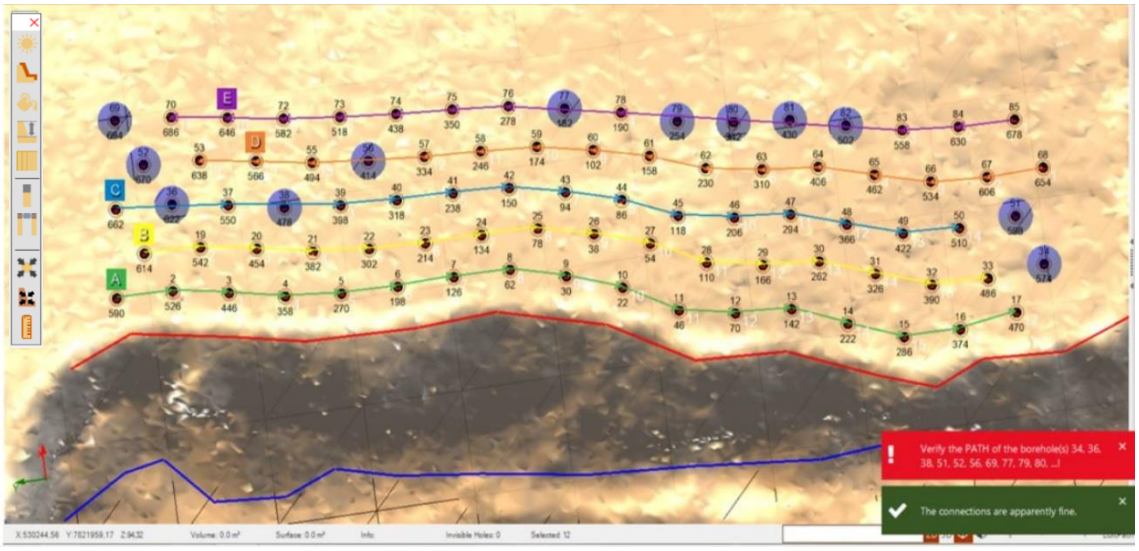


Figure 364 - Check tool.

13.12. Extra Initiation System

The **Extra Initiation System** option allows users to add additional detonators to their initiation system. Upon selecting this option, a window will appear where you can enter details for the extra detonators (Figure 365).

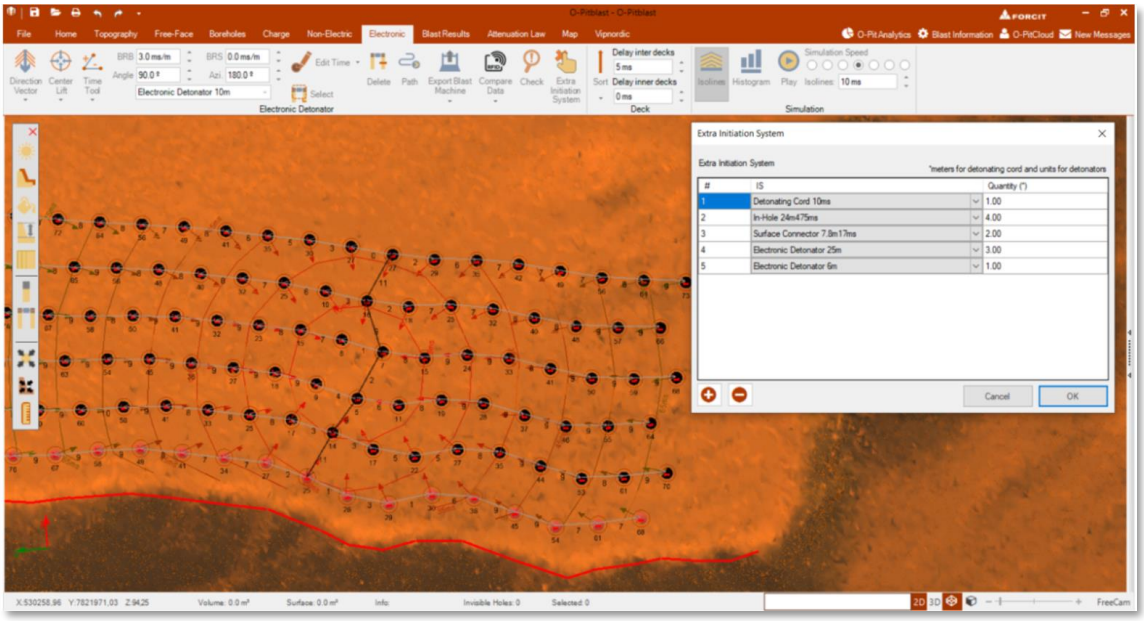


Figure 365 - Extra initiation system.

As detailed in the section 12.1.11, all the information entered using this option will be included in the blast report.

14. Blast Results

The Blast Results Tab presents all the tools and applications for prediction and optimization of fragmentation. Also shows the costs of the selected blast.

Figure 366 - Blast Results module.

14.1. Prediction

Clicking on the **Prediction** button, opens a window that displays all adjustable parameters and the current fragmentation results for the selected curve. User can change the **Rock Type** (as described in Chapter 6.3.5.5) and modify the following parameters: **RWS, Density (g/cm³), Inputted charge (Kg), Burden (m), Spacing (m), Diameter (mm), Drill Accuracy Standard Deviation (m), Stemming, Subdrilling(m)** and **Length (m).**

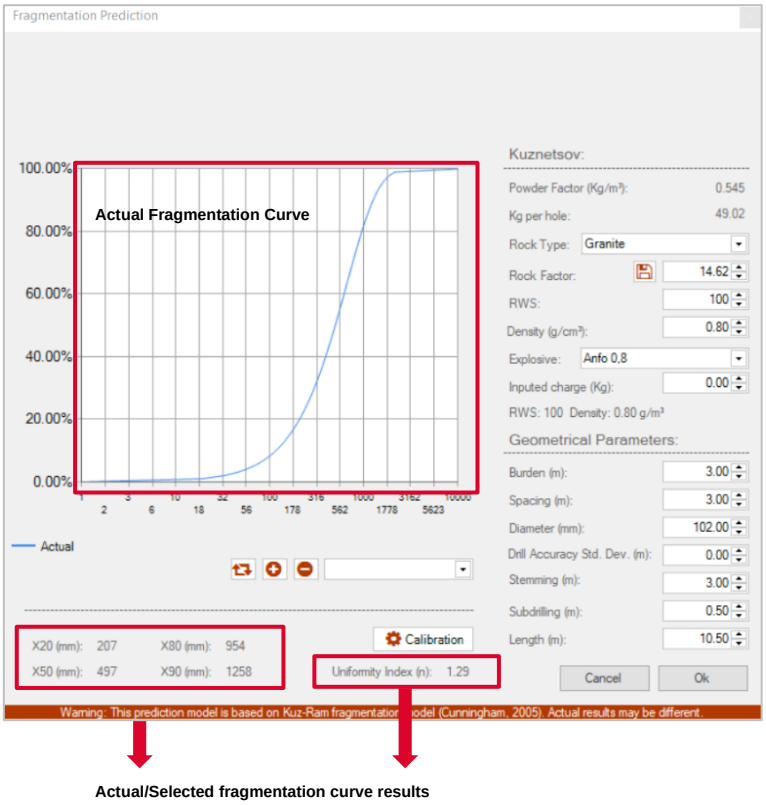


Figure 367 – Fragmentation Prediction window.

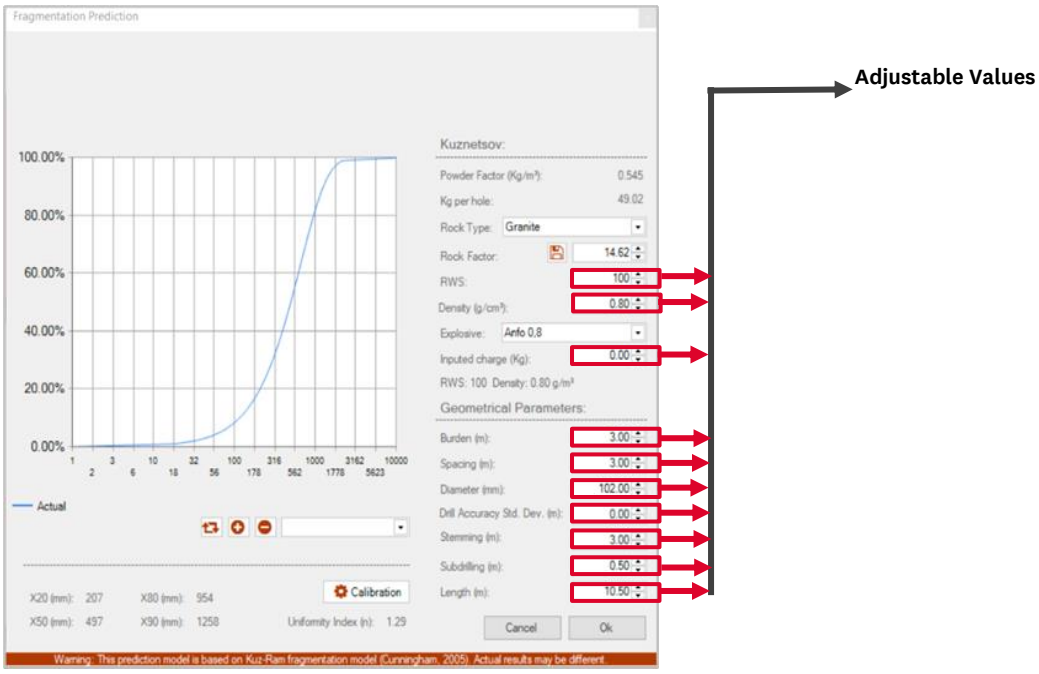


Figure 368 - Fragmentation Prediction window: Adjustable values.

14.2. Add or Reset a Fragmentation Curve

To **Add** a new fragmentation curve:

- Click on the **Add** button and enter a new name for the curve.

To **delete** an existing curve:

- Click on the **Delete** button.

To clear all curves:

- Click on **Clear List** button.

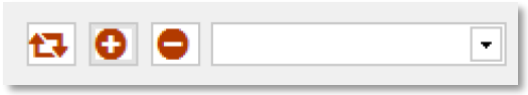


Figure 369 - Tab to create or delete a new fragmentation curve.

14.3. Calibration

Clicking the **Calibration** button allows users to input real blasting results. The model in O-PitSurface will then update the rock factor. A confirmation window will appear, asking if you want to confirm the changes (see Figure 370). Confirming will update the rock factor accordingly.

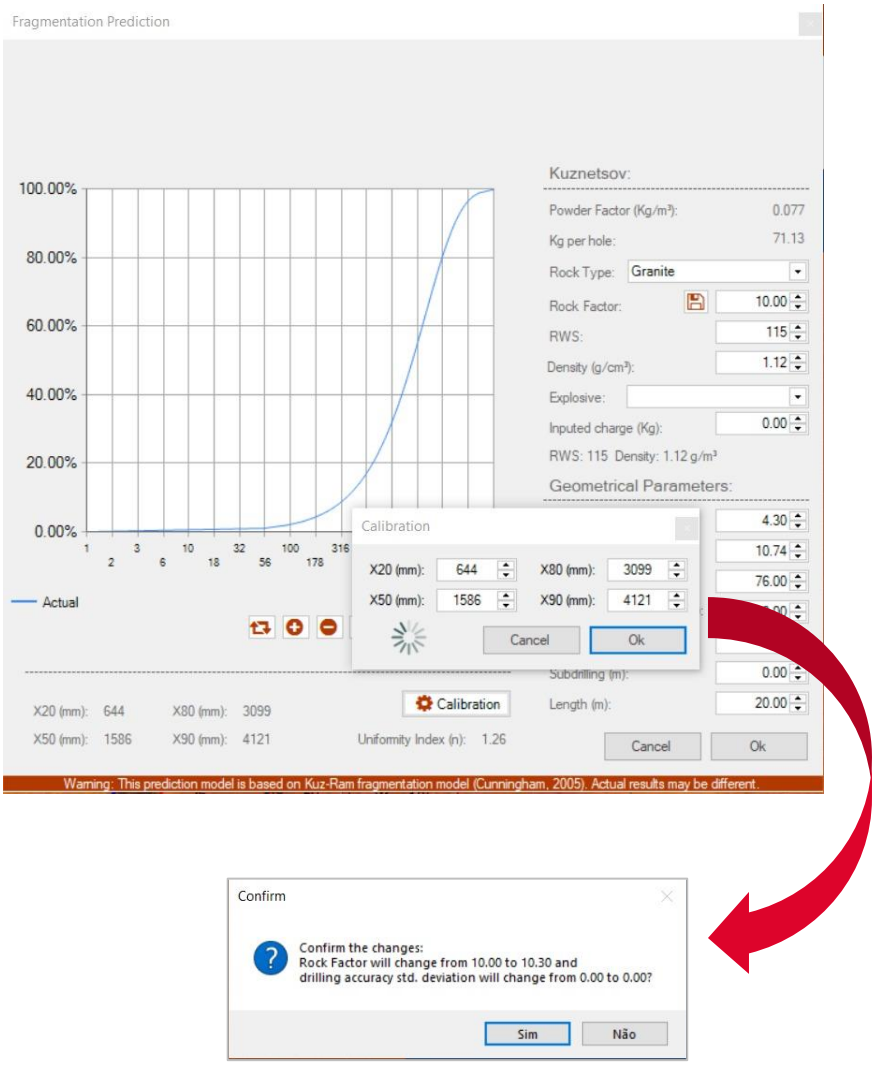


Figure 370 - Calibration of fragmentation and confirmation of rock factor changes.

To save the updated rock factor:

- Click on the **Update** button .

14.4. Optimization

In this section, **users can optimize various parameters related to blasting design**. The window allows users to input the following information: **Costs** of **Initiation (per hole), Explosive (per Kg), Drilling (per meter)** (Figure 371-A). The operator can also add the **Density (Kg/m²)** and **RWS** (Figure 371 - A).
Additionally, users can view data for the selected project (Figure 371-B), including: **Diameter (mm), Bench High (m), Burden (m), Spacing (m), Subdrilling (m), Stemming (m), Number of holes, Number of Rows, Volume (m³)** and **Rock Factor.**

Users can define constraints for both Fragmentations and Geometry.:
Fragmentation constraints: **Limit (%)** of fragmentation and the **Oversize (mm)** (Figure 371-C).

Geometry Constraints: **Spacing by burden, Stemming by burden, Subdrilling by burden, Uniformity Index, Stiffness Ratio, Volume (m²)** and **Oversize (mm)** (Figure 371-E).

Finally, the user can review the Cost information in dollar (Figure 371-F).

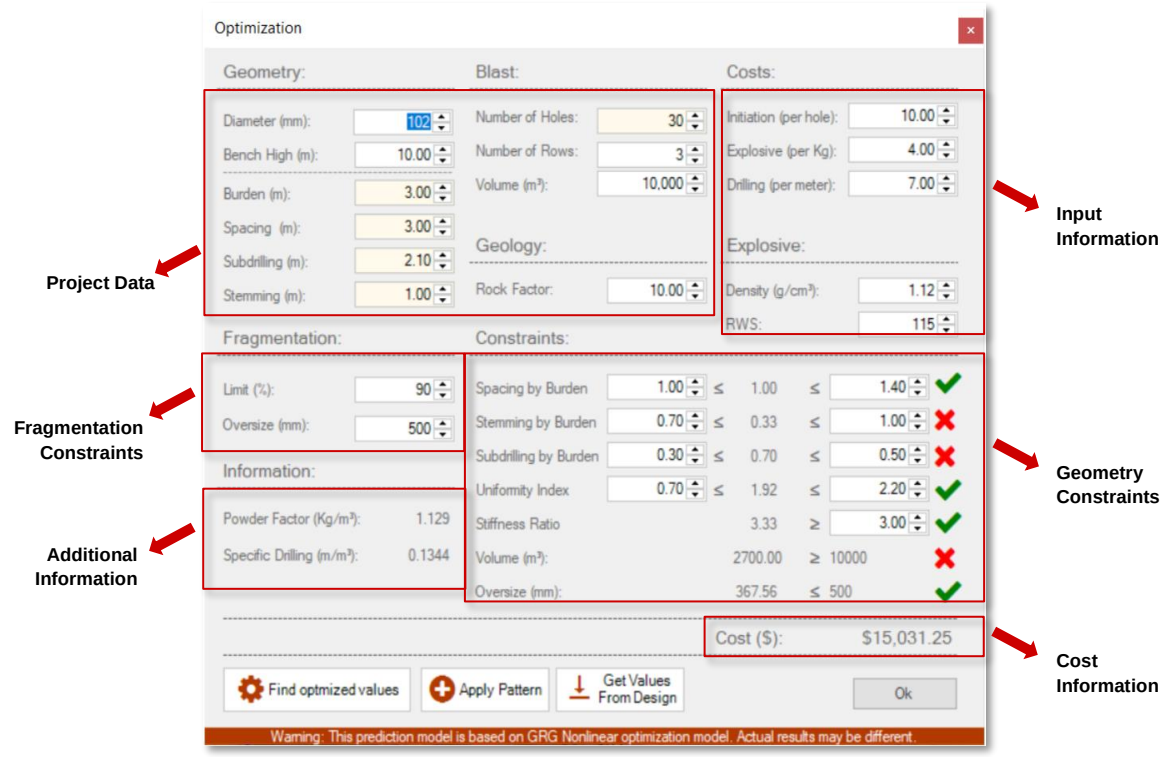


Figure 371 - A: Input information; B: Project Data; C: Fragmentation Constraints; D: Additional information; E: Geometry constraints; F: Cost information.

14.4.1. Find Optimized Values

Click the **Find Optimized Values** button to calculate the optimal Burden, Spacing, Subdrilling, and Stemming values that fit the defined constraints. This prediction model uses the GRG Nonlinear Optimization method. Please note that actual results may vary.

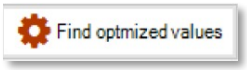


Figure 372 - Optimized value button.

If all values are marked green, it indicates that they are optimized and meet all constraints.

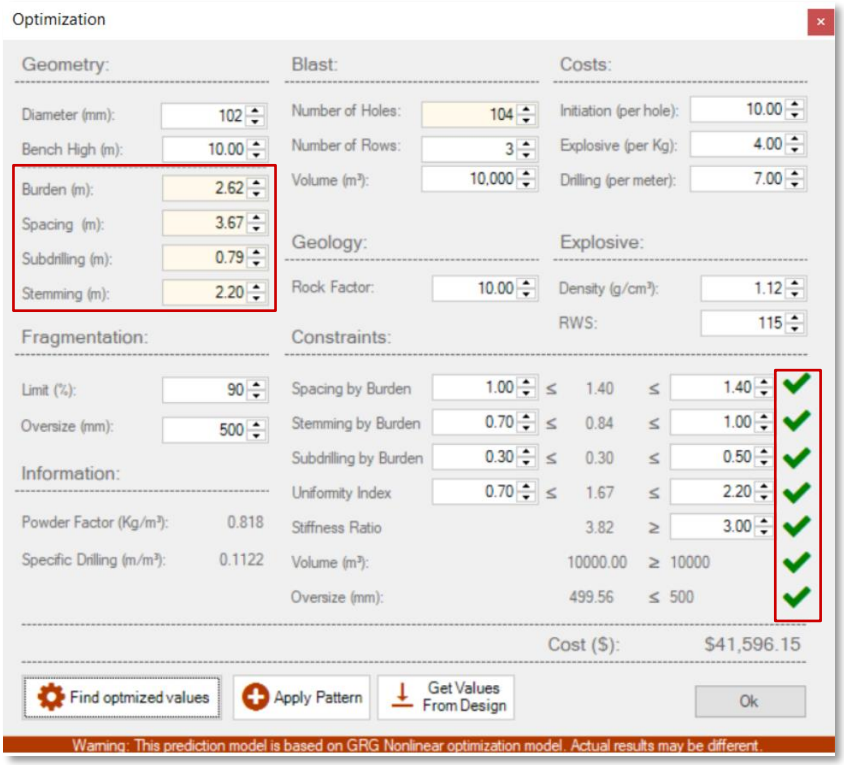


Figure 373 - Optimized values.

14.4.2. Apply Pattern

To create a new pattern based on the optimized values, click the **Apply Pattern** button.

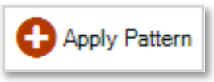


Figure 374 - Apply pattern button.

Upon clicking **Apply Pattern**, the software will prompt you to confirm whether you want to delete the existing boreholes and replace them with the newly optimized ones (Figure 375).

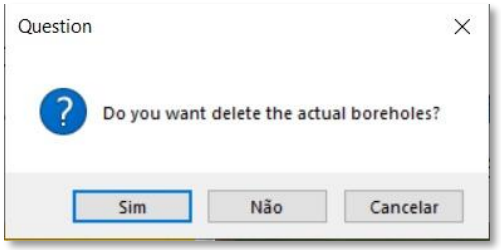


Figure 375- Confirmation Prompt for Replacing Boreholes.

14.4.3. Get Values from Design

By clicking on the button **Get Values from Design** the user makes a reset to all the optimized values and gets the values from the beginning.

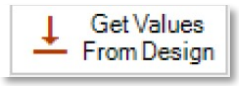


Figure 376 - Get Values from Design button.

14.5. Verify: Geometry, Structures, Connections and Verify all

The **Verify** button identifies anomalies in various parameters including geometric, structural, and connection issues. It checks for irregularities in burden, spacing, subdrilling, stemming, and borehole length. Additionally, if vibration data is available, the tool highlights critical structures potentially affected by the blast. It also detects problems with borehole connections, such as excessively short detonators. Examples of these alerts are shown in Figure 377.

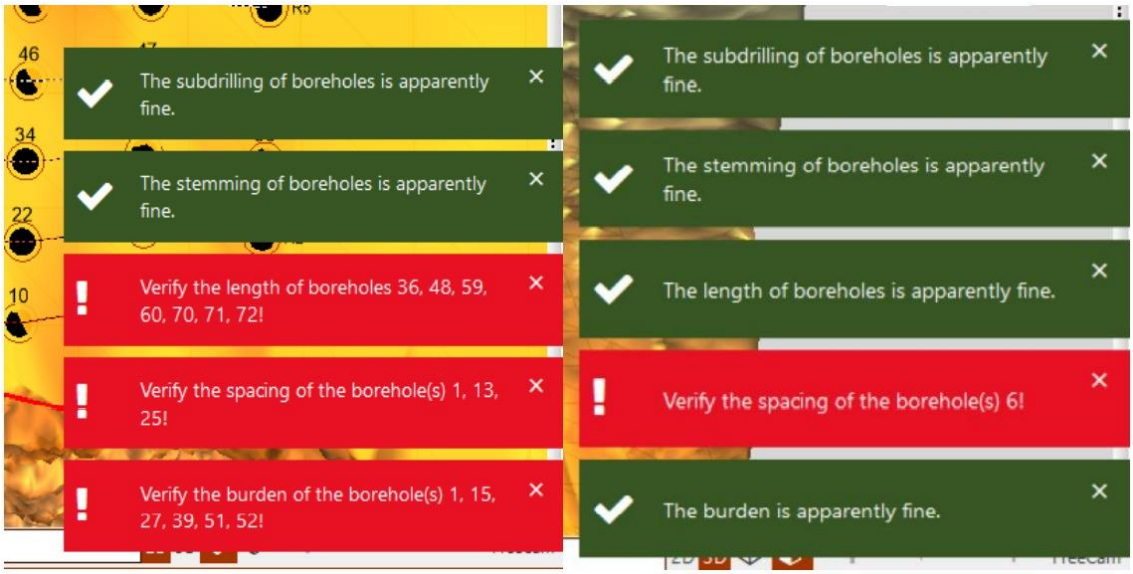


Figure 377 - Search button results.

14.5.1. Filter Holes by Geometry

The **Filter Holes by Geometry** feature allows users to filter boreholes based on length, subdrilling, stemming, and diameter. Users can also apply inclination if the hole's angle definition is set (refer to **Figure 66**). Once interval numbers are entered, holes meeting the specified criteria will be highlighted.

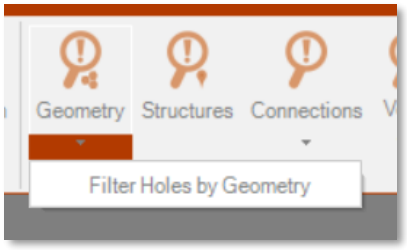


Figure 378 - Geometry: Filter Holes by Geometry.

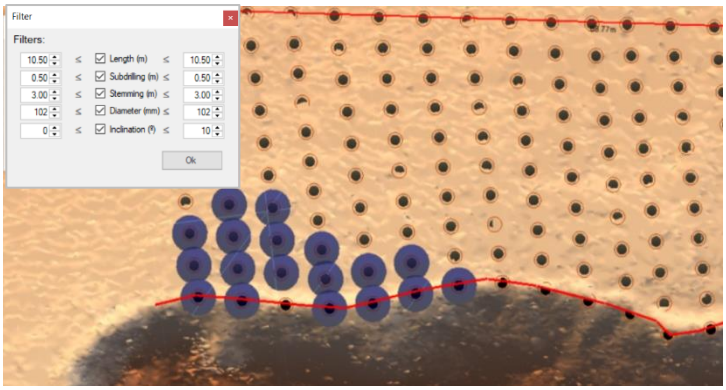


Figure 379 - Filter Holes by Geometry window.

14.5.2. Check Different Inner Delays

Under the Connections icon, the "**Check Different Inner Delays**" option allows users to detect discrepancies in delay times within the same deck of a borehole. If varying delays are found within the extra detonators of a selected borehole, a warning message will be displayed, as this tool specifically checks for inconsistencies in the timing of extra detonators.

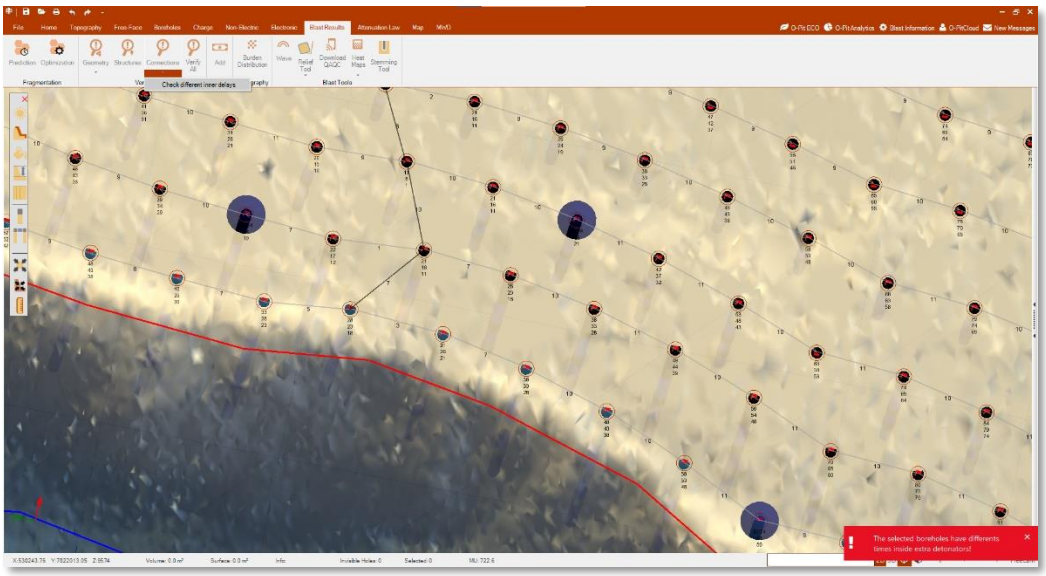


Figure 380 - Check different inner delays.

14.6. Add Costs

In this option the user can add extra costs to the blast. To do this:

1) First chooses the costs to be added
2) Specify the quantity for each cost type
3) Apply all changes.

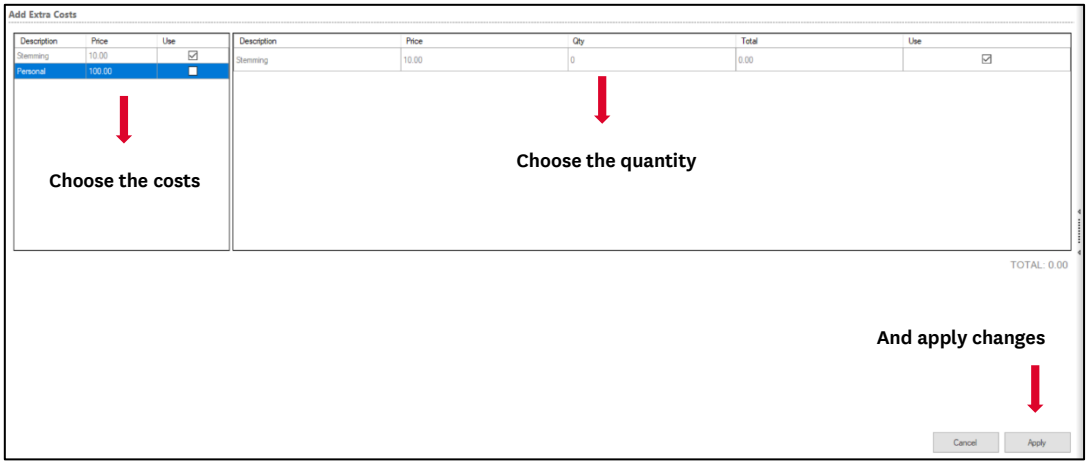


Figure 381 - Add costs window.

14.7. Burden Distribution

The **Burden Distribution** tool provides a visual representation of the pattern geometry distribution:

- **Red areas** indicate bad distribution, such as improper hole inclination, burden, stemming, spacing etc.
- **Green areas** signify optimal distribution, with well-positioned holes relative to the free face.
- **Blue areas** indicate excessive distance from the free face, for example.

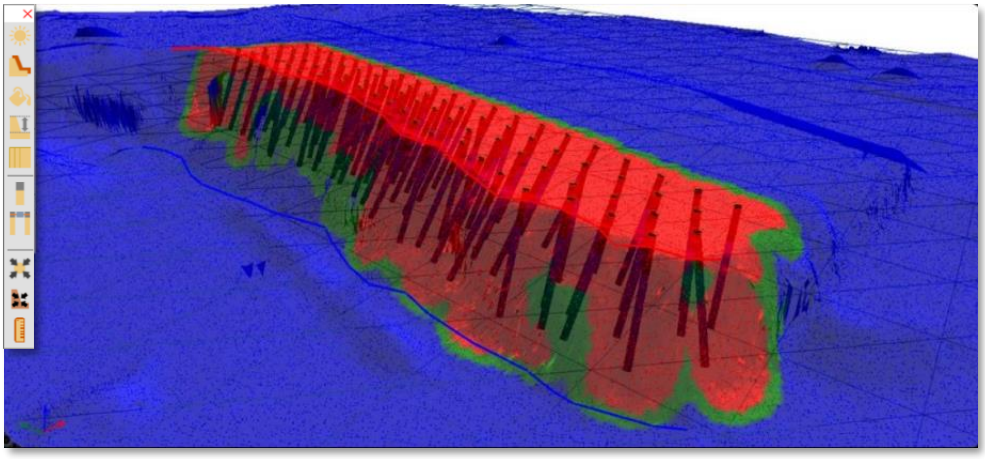


Figure 382 - Burden Distribution tool.

14.8. Wave

The **Wave** option allows users to compare detonation times of holes with the signature hole wave.
Once the blast is loaded and timing is set, users can view the detonation peaks of each hole in the **Wave Analysis** window (Figure 383).

Figure 383 - Wave Analysis window.

Users can then import seismographic data, including time and vertical/transversal/longitudinal or SUM vector information. To align the seismographic data with the detonation times, users can apply an offset (Figure 384). This offset adjusts the seismograph's initial measurement to match the first hole's detonation, facilitating accurate analysis of the results.

After that the user can import the seismographic information (time and vertical/transversal/longitudinal or SUM vector). The user will be able to put an off-set (Figure 384) to combine the first measurement from the seismograph with the first hole blasting (Figure 385) and make the analyses based on those results.

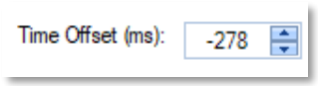


Figure 384 - Time Off-set field.

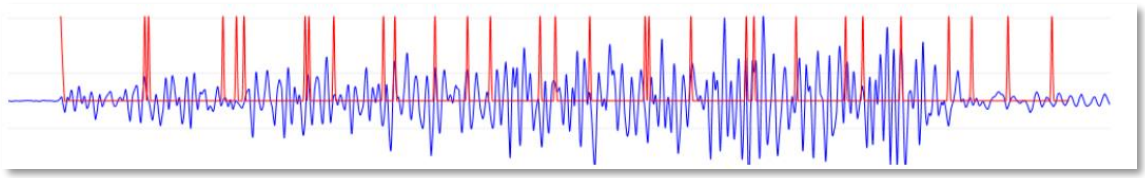


Figure 385 - Seismographic information combined with the detonation time of holes.

14.9. Relief Tool

The Relief Tool displays the relative difference in blasting time for each hole in a pattern.

Steps to Use the Relief Tool:

1. **Select the Relief Tool:**
    - Once selected, the user will see a column with colors representing the timing in milliseconds (ms).
    - A gradient of colors will be displayed on the pattern, visually indicating the timing differences.

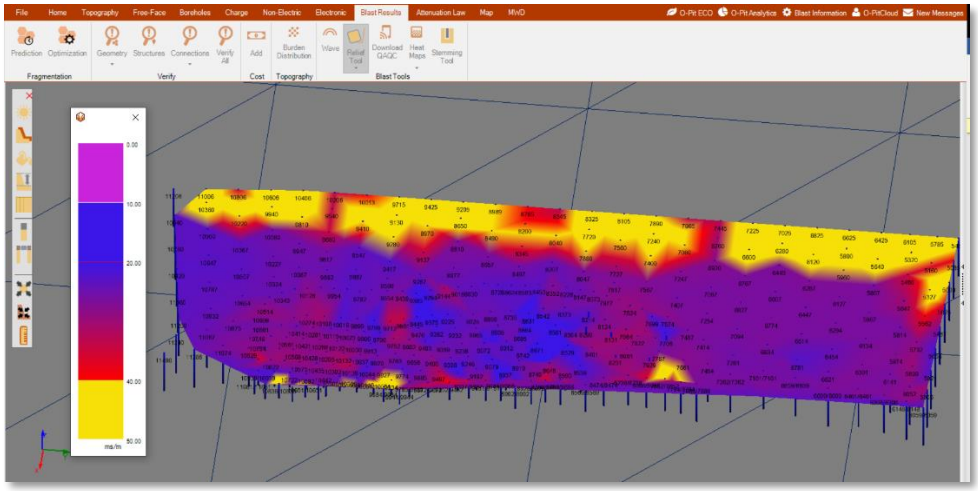


Figure 386 - Relief tool.

Edit Colors and Gradients:

- The user can edit the colors within a specified range.
- Alternatively, the user can use a gradient to represent the range of timings.

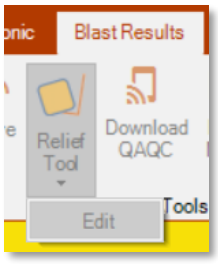


Figure 387 - Relief Tool: Edit.

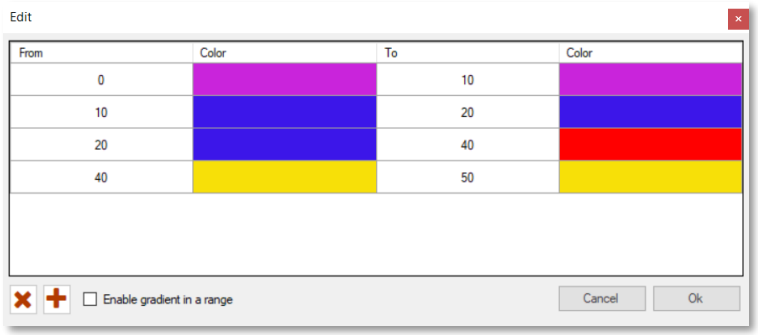


Figure 388 - Relief Tool: Edit window.

14.10. Download QAQC

This option enables the user to download field data from O-PitApp into the O-PitSurface, ensuring that the software reflects the latest updates from the field.

Select Project and Blast:

- The user must choose the desired project and blast from O-PitCloud to download.
- After clicking on **Download the selected blast** , the blast will be downloaded to the software
- After downloading, the user must select the same blast again (on O-PitCloud) and click on **Update Holes**. If there is new information available, a window will display updates for each hole.

Figure 389 - Download the selected blast button.

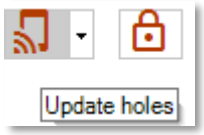


Figure 390 - Update holes button.

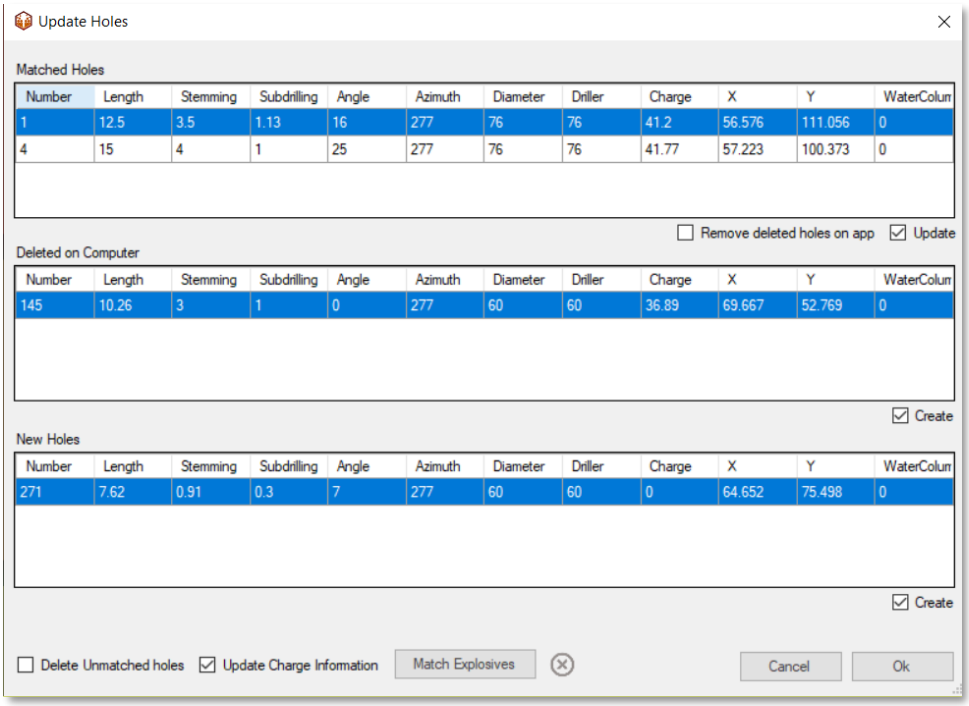


Figure 391 - Update Holes window.

The user can review and manage data through the following sections and its checkboxes:

- **Matched Holes:** Shows Holes present in both O-PitSurface and the O-PitApp, allowing new information to be updated. Options:
    - **Remove deleted holes on app:** Removes holes that were deleted in the app from O-PitSurface
    - **Update:** Updates matches holes with the latest information from the app.

- **Deleted on Computer**: Displays holes removed from the O-PitSurface but still present in the O-PitApp.

- **New holes**: Shows new holes created in the O-PitApp that need to be added to O-PitSurface.
    - **Create:** Adds these new holes to O-PitSurface

Checkboxes:

- **Delete Unmatched Holes:** Removes holes that have no corresponding information in either the app or software.
- **Update Charge Information:** Updates the explosive type or other details to match the app's data.

Match Explosives:

- Click the "**Match Explosives**" button (Figure 392) to align the charge information with changes made in the app.
- This opens the **Associate Explosives** window where the user can select the correct explosive from a dropdown list, updating the server information with the explosive added in the database (Figure 393).
- After completing the matching, a verified icon will appear next to "Match Explosives" to indicate successful synchronization. (Figure 394).

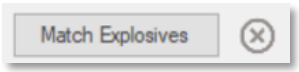


Figure 392 - Match explosive.

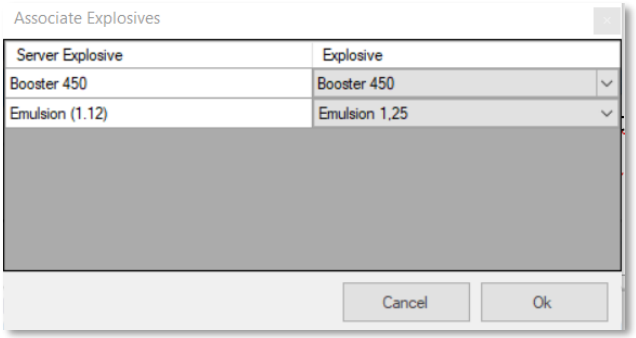


Figure 393 - Associate explosive window.

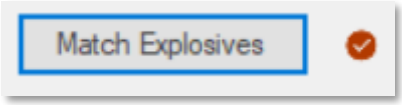


Figure 394 - Match Explosives was done.

Match Diameter Information:

- Similar to explosives, if modifications are made to the diameter information in the application, the software will compare the updated data with the information registered in the database.
- This ensures that any changes in the application are reflected in the O-PitSurface database, keeping the data consistent and accurate.

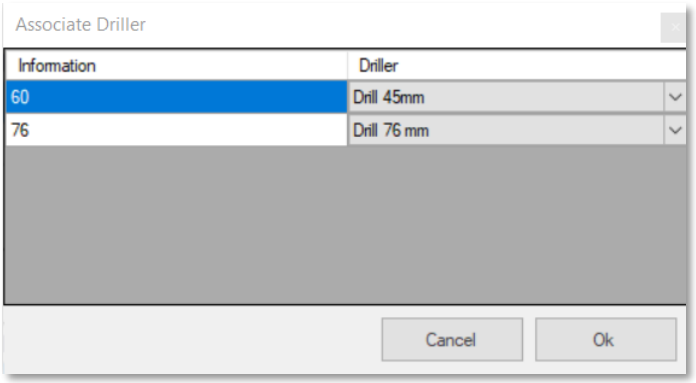


Figure 395 - Match driller information.

14.11. Heat Maps

The Heat Maps tool allows the user to analyse blast parameters by generating visual heat maps based on various attributes of the boreholes. This feature helps in understanding the distribution and impact of different blast parameters across the blast pattern. Analysis Parameters: Altitude, Depth, Subdrilling, Water Level, Charge, Stemming, Powder Factor (Figure 396).

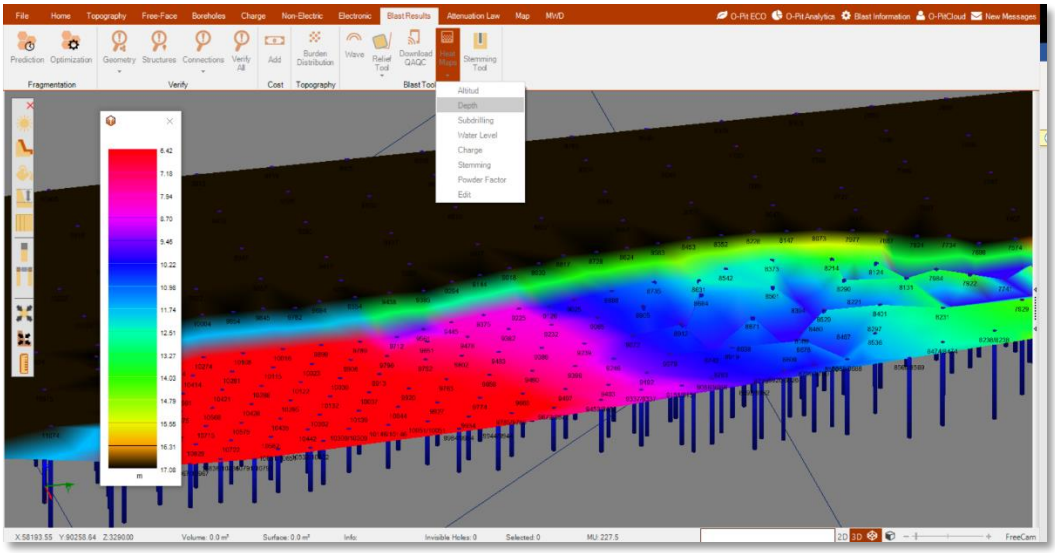


Figure 396 - Heat Map tool example showing variations in depth.

How It Works:

1. **Select Parameters:** The user selects the parameters to visualize from the available list. The heat maps will then display variations in these parameters across the blast pattern.
2. **Generate Heat Maps:** The tool creates heat maps where different colors represent varying levels of the selected parameters. For instance, areas with high charge may be shown in one color, while areas with low stemming might be displayed in another.
3. **Edit Heat Maps:** The user can click on the **Edit** button to adjust the scale and color schemes of the heat maps. This feature allows customization to better reflect the data and enhance visual interpretation.

Figure 397 - Heat maps edit window.

4. **Interpret Results:** The user can use the heat maps to identify potential issues, and areas for improvement. For example:

- **Altitude and Depth:** Assess how these factors vary across the blast pattern and their impact on blasting effectiveness.
- **Charge and Powder Factor:** Identify areas with excessive or insufficient charge and adjust the design accordingly.
- **Stemming and Water Level:** Evaluate how stemming and water levels affect the blast and make necessary adjustments.

14.12. Stemming Tool

The Stemming Tool (Figure 398) is designed to adjust field parameters, such as stemming and explosives, in order to achieve a specific granulometry of the blasting material. This tool **allows the user to simulate and optimize blasting operations by defining various parameters**, analyzing their impacts, and ultimately optimizing performance according to specific needs.
The Stemming Tool enables the simulation of scenarios with different explosives and mixtures, and allows the adjustment of some geometrical parameters, considering the stemming and burden relation, to achieve the desired granulometry target.

P.S: This functionality is only available for users who have purchased the MWD Module.

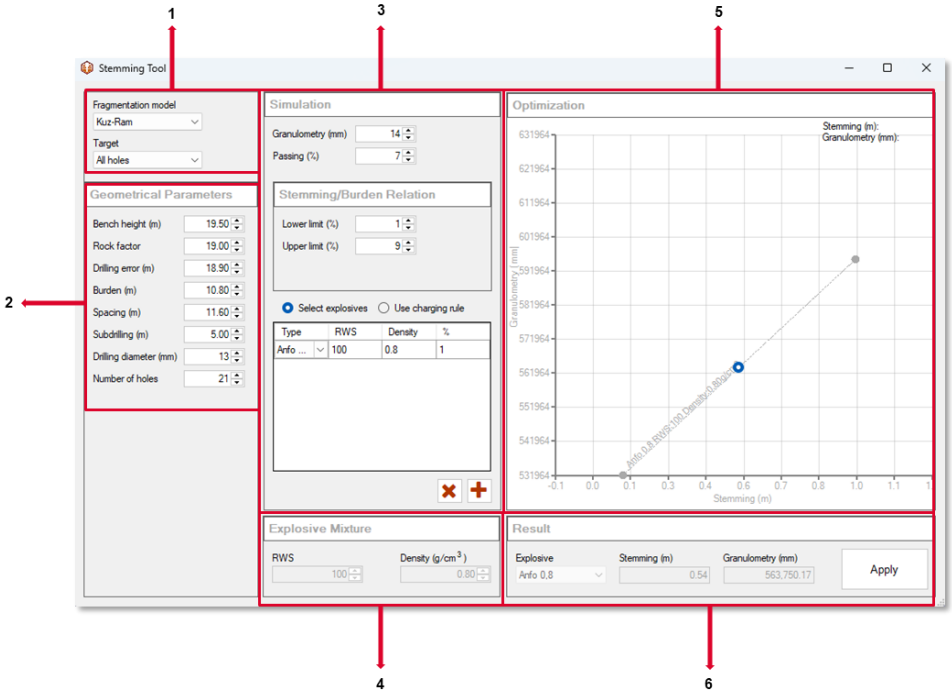


Figure 398 - Stemming Tool window. 1: Fragmentation Model and Target; 2: Geometrical Parameters; 3: Simulation; 4: Explosive Mixture info; 5: Optimization graphic; 6: Result.

The Stemming Tool window is divided into six sections:

1. **Fragmentation Model:** Clicking on the Fragmentation Model button reveals the available fragmentation models. The user can choose to apply a model to all boreholes or specific zones.
2. **Geometrical Parameters:** This section allows the user to input specific data related to the geometrical parameters of a blast.

3. **Simulation:** The user can simulate granulometry by inputting granulometry data, specifying passing percentages, defining the stemming/burden relation (both upper and lower limits), and selecting the explosive type or applying a charging rule.
4. **Explosive Mixture:** This section displays the RWS and density information related to the type of explosive. It collects and presents the data inputted by the user for the explosive mixtures used in the simulation.
5. **Optimization Graph:** After configuring the parameters, the user can review the optimization graph to observe the correlation between granulometry and stemming. This section provides detailed values for each explosive and shows how well the parameters align with the desired outcomes.
6. **Result:** This section shows the explosive, stemming (m), and granulometry (mm) results based on the input data. The user can apply these optimized parameters by clicking on the Apply button.

15. Attenuation Law

The Attenuation Law tab presents all the tools and applications to predict and visualize different attenuation laws.

Figure 399 - Attenuation Law module.

15.1. Import Data

To start the user can import their data by clicking in the button **Import Data.**

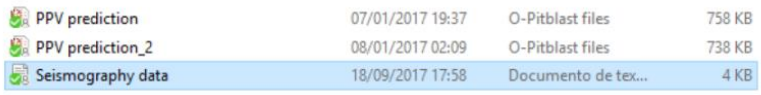


Figure 400 - Import seismography data.

Then for each column the user must put the correct parameter or open a XYZ coordinates file by clicking in the **Open file** button . When everything is ready the user must click on **Import the coordinates** button (Figure 401).

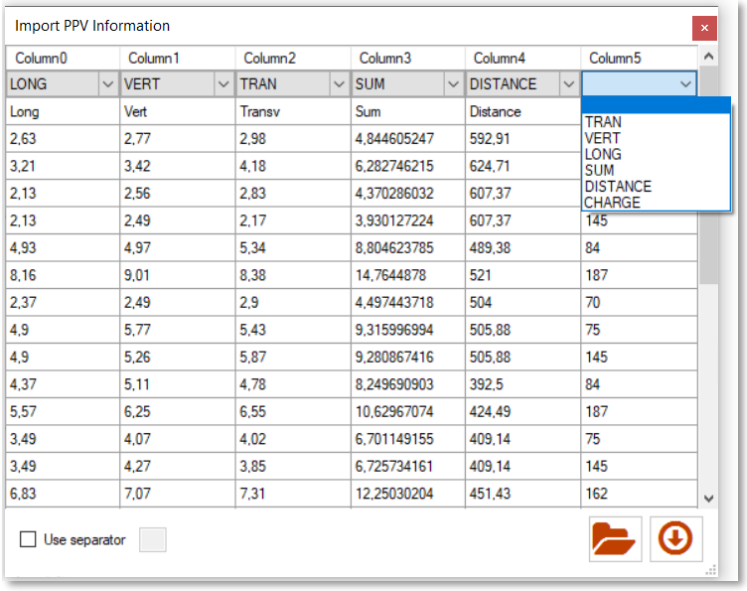


Figure 401 - Import PPV Information window.

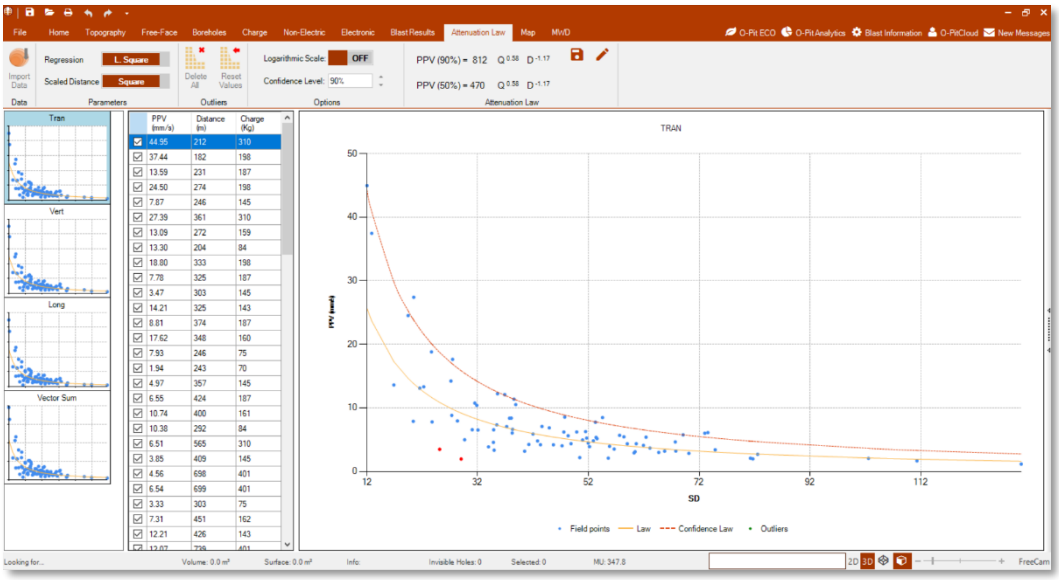


Figure 402 - Final result of importing data.

15.1.1. Overview of the Imported Data

The window will show three important screens. The channel data (Figure 403 – A): along of that channel the user can see multiple choices of graphics that are associated to the information that was imported. The raw data that was imported by the user (Figure 403 – B) and the PPV/SD Graphic were the user can see the graphics and all the field points and the law and confidence level curve (Figure 403 – C).

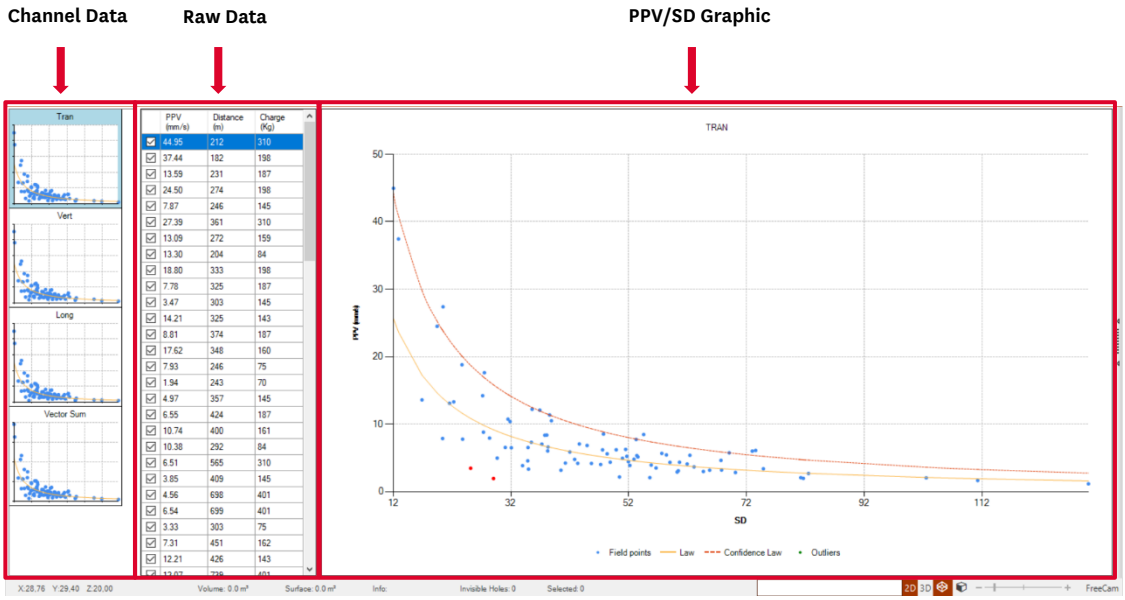


Figure 403 - A: Channel data; B: Raw data; C: PPV/SD Graphic.

15.1.2. Regression/Scaled Distance

The Regression/Scaled Distance tool enables the user to define the most effective method for representing field data in relation to scaled distance. This functionality provides several options for analysing and visualizing the impact of different parameters on the blasting results. The user can choose from the following methods:

Regression:

Least Square or Least Residue Method;

Scaled Distance:

Square root or Cubic root.

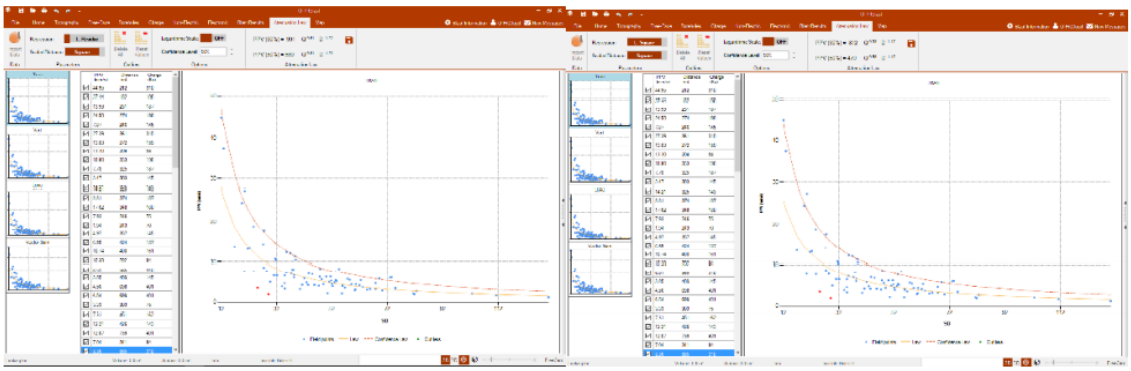


Figure 404 - Left (A): Regression with L. Residue and Square Scaled Distance; Right (B): Regression with L. Square and Square Scaled Distance.

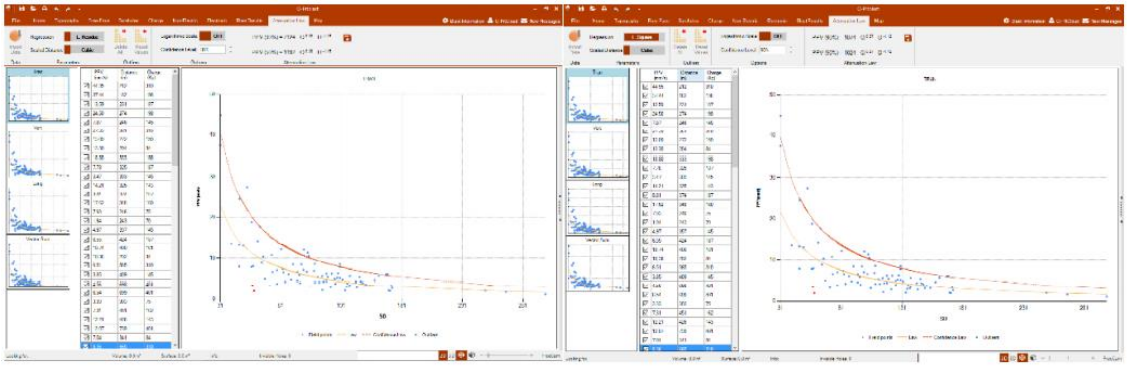


Figure 405 - Left (A): Regression with L. Residue and Cube Scaled Distance; Right (B): Regression with L. Square and Cube Scaled Distance.

15.1.3. Logarithmic Scale and Confidence Level

The user can press the button **Logarithmic Scale** to visualize the graphic at a logarithmic scale. The button will say ON when the logarithmic scale is appearing. The user can also change the confidence level up to 99% - this modification will change the confidence level and the attenuation law curve.

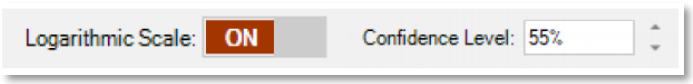


Figure 406 - Logarithmic Scale and Confidence level tabs.

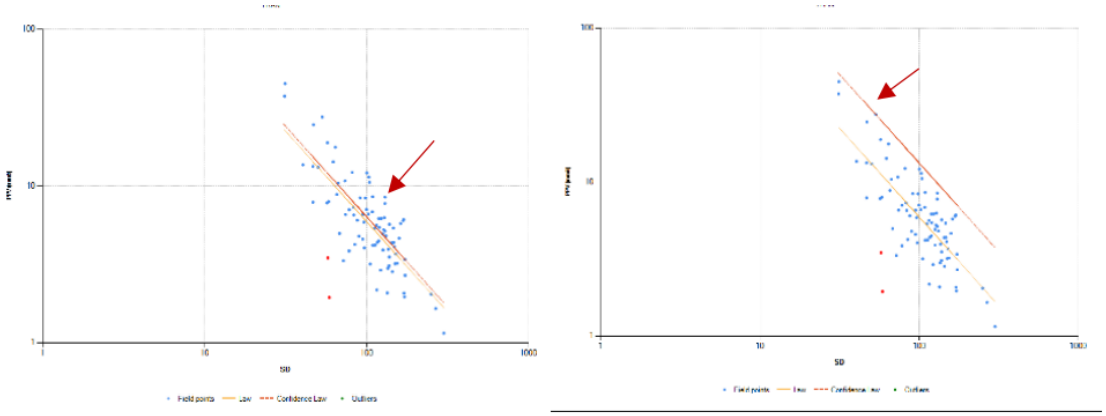


Figure 407 - Left (A): Confidence level 55%; Right (B): Confidence level 99%.

15.1.4. Outliers

Also, in Attenuation Law module exist outliers (9.1) and the user can delete them by clicking on the **Delete All** button . If the user wants to recover the outlier's information, he must click on the **Reset Values** button .

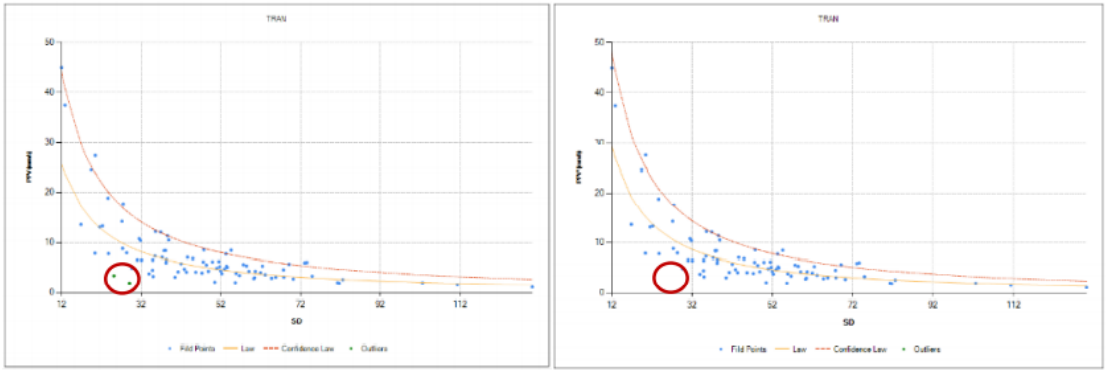


Figure 408 - Left (A): PPV/SD Graphic with outliers; Right (B): PPV/SD Graphic without outliers.

15.1.5. Attenuation Law

In this section, the user can view and manage the defined attenuation law, taking into account the chosen confidence level (confidence level: chapter 15.1.3).

Viewing the Attenuation Law:

- The user can see the attenuation law displayed on the screen. The yellow line represents the attenuation law at a 50% confidence level and remains constant.
- The red line represents the attenuation law corresponding to the selected confidence level, which can vary based on user settings.

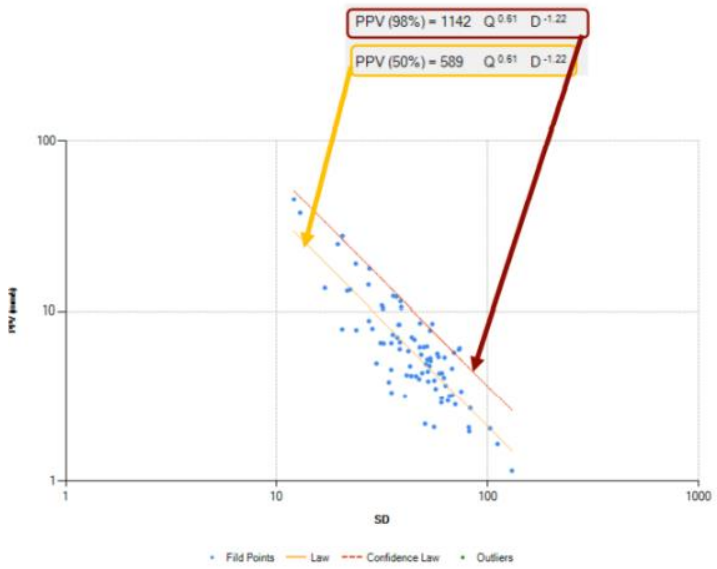


Figure 409 - Curves/lines and their respective attenuation law.

Saving and Editing the Attenuation Law:

- **Save New Law:** To save the current attenuation law as a new one, the user can click the "**Save**" button (Figure 410). A dialog will appear where the user can enter a name and description for the new attenuation law (Figure 411).

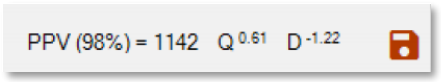


Figure 410 - Attenuation law to the selected information.

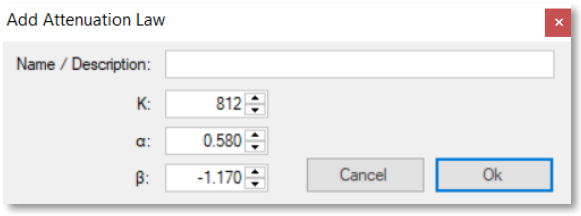


Figure 411 - Add a new Attenuation Law.

- **Edit Existing Law:** To make changes to an existing attenuation law, the user can click the "**Edit Attenuation Law**" button . This allows modification of the law parameters as needed

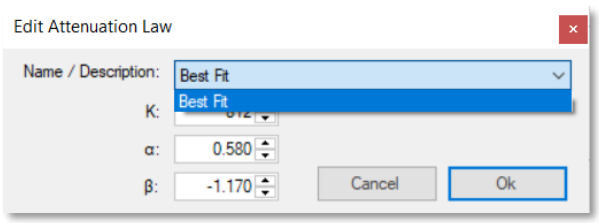


Figure 412 - Edit Attenuation Law window.

The yellow line corresponds to the attenuation law at 50% level of confidence, and it never changes; the red line corresponds to the level of confidence that the user chooses.

16. Map

The Map tab provides tools and applications to visualize blast designs and register critical structures within the site using Google Maps.

Figure 413 - Map Module.

16.1. Hemisphere and UTM Zone

To effectively use the mapping tools, the user must have coordinate information for the terrain imported into the system. The user needs to define:

- **Hemisphere**: The hemisphere in which the coordinates are located (Northern or Southern).
- **UTM Zone**: The appropriate UTM (Universal Transverse Mercator) zone for the coordinates.

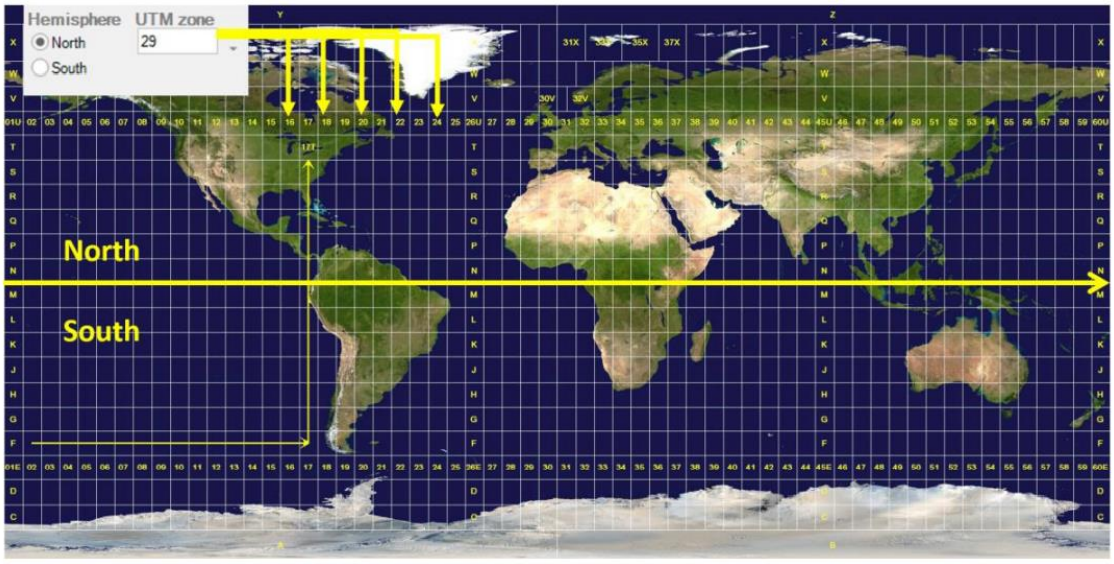


Figure 414 - Hemispheres and UTM zones.

Additionally, the user can convert local coordinates to UTM coordinates using the UTM correction tool:

- **UTM Correction Tool**: Accessed via the correction button, this tool allows adjustments to the X and Y coordinates.

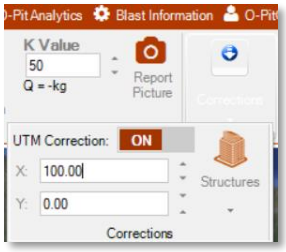


Figure 415 - UTM Correction window.

16.2. Views

There are three types of views: Map (Figure 416), Satellite (Figure 417) and Open Street Map (Figure 418).

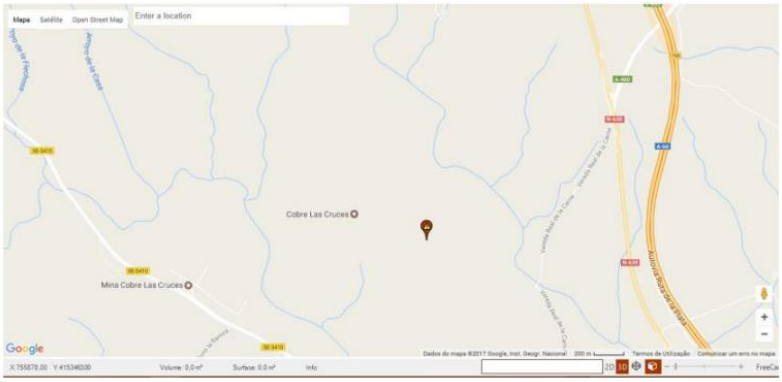


Figure 416 - Map view.

Figure 417 - Satellite view.

Figure 418 - Open Street Map view.

16.3. PPV Contour Lines

When the **PPV Prediction** box is checked, the map will display circular lines representing isolines for different distances and Peak Particle Velocity (PPV) levels. These isolines visually indicate the predicted impact zones around the blast site, helping users assess the potential effects on surrounding areas (Figure 420).

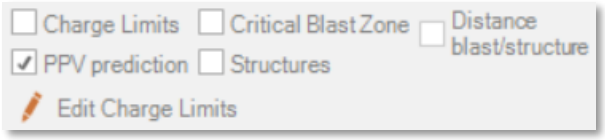


Figure 419 - PPV prediction box.

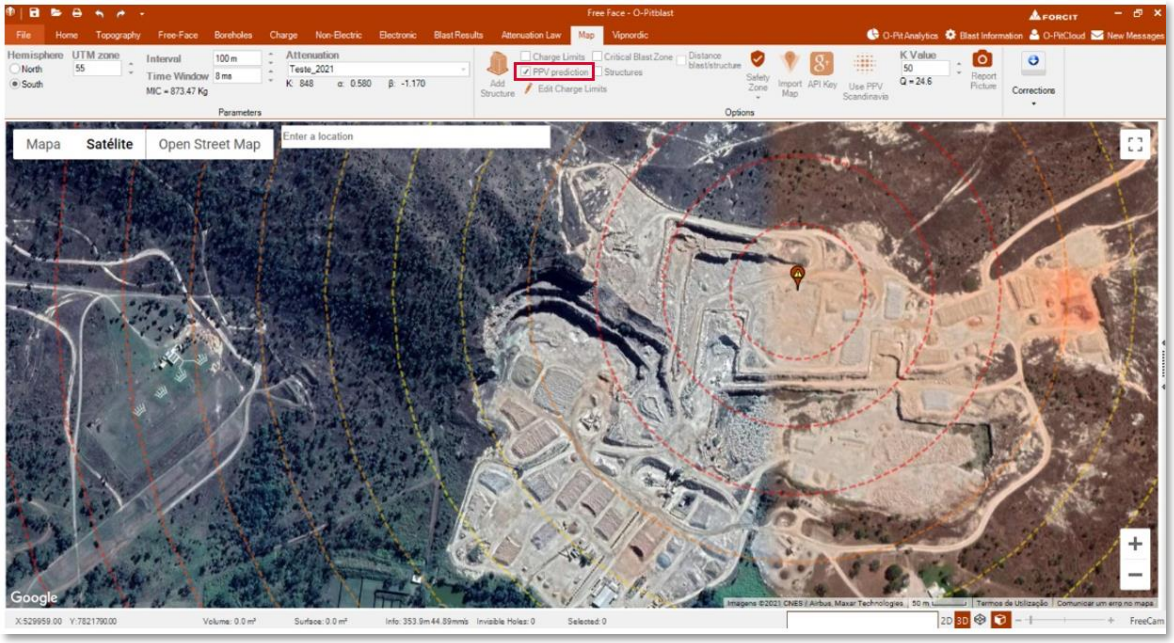


Figure 420 - PPV isolines.

If the user passes the mouse over one of the isolines it will show the PPV at that distance and the respective distance (Figure 421).

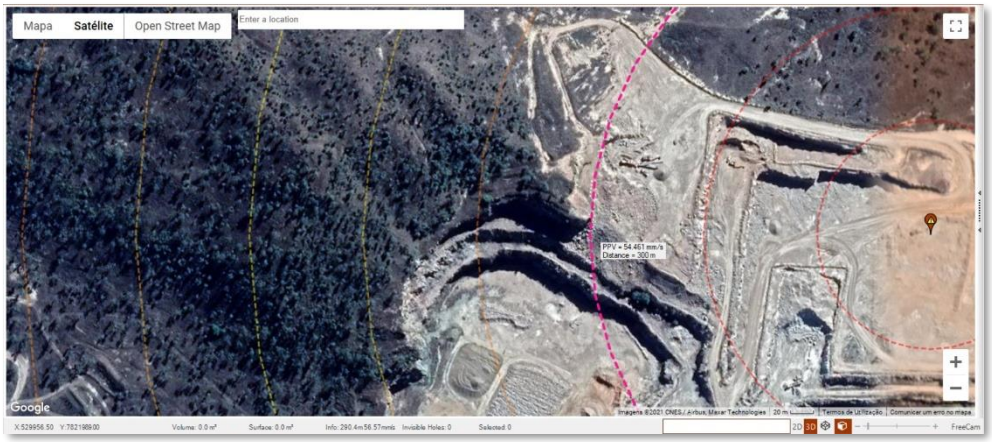


Figure 421 - Information of the isolines.

To change the number of isolines the user must define how many meters they must be separated of each other in the tab Interval (Figure 422).

Figure 422 - Interval tab.

Finally, the user can choose one of their attenuation laws. In this case there's **Best Fit** law that comes as a default, but the user can add a new one at any moment (6.3.5.7).

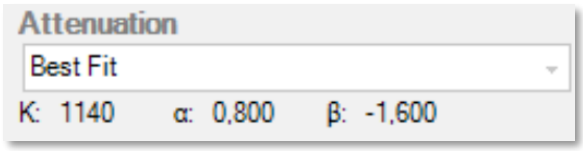


Figure 423 - Attenuation Law: Best Fit.

16.4. Time Window

On this tab the user can change the time window, in better words, this option allows you to define a time interval and calculate the number of holes blasting inside that range. This factor will change the MIC constantly.

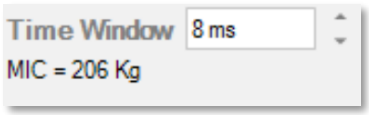


Figure 424 - Time Window Tab.

16.5. Structure

16.5.1. Add Structure

The user can add any structure he wants by clicking in **Add Structure** icon. There are some inputs that must be defined such as **PPV Limit, UTM X, UTM Y, Latitude, Longitude, Color, Acceleration, Freq, Correction X** and **Correction Y**.

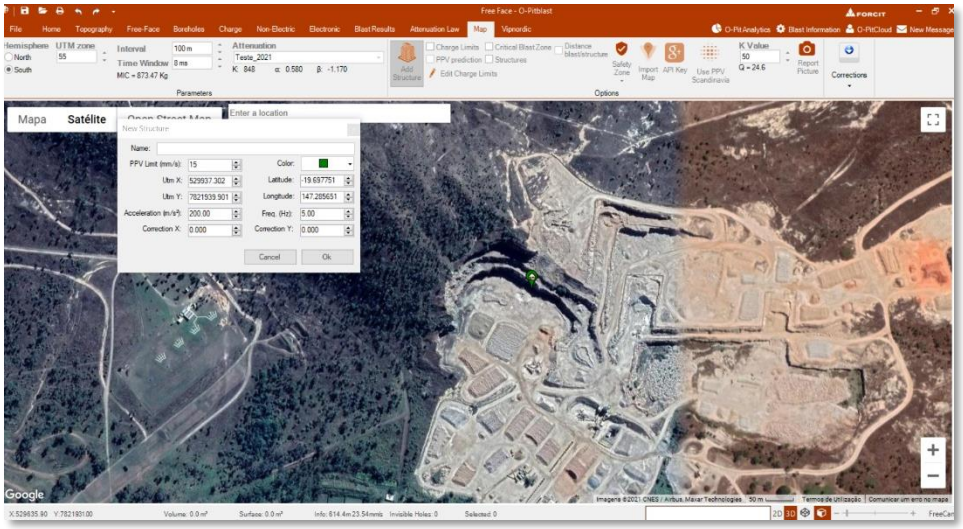


Figure 425 - Add structure window.

To see them, the user must check the Structures box. And select distance blast/structure to see the distance.

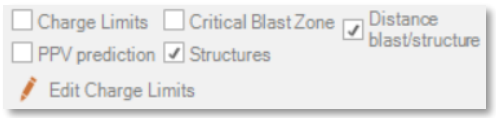


Figure 426 - Structures box.

16.5.2. Export Structure

The user can export your structure information to a .csv file. Once this tootl is selected, the export window will appear and then it is possible to select all or some of them to save (Figure 428).

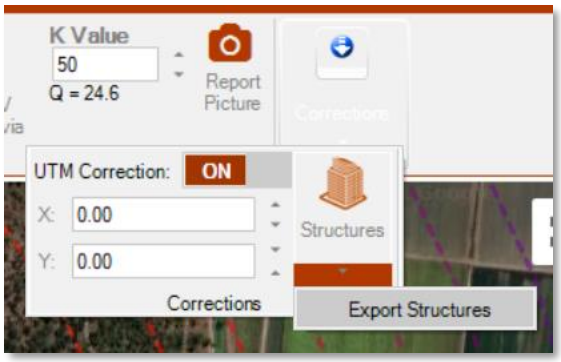


Figure 427 -Export Structures option.

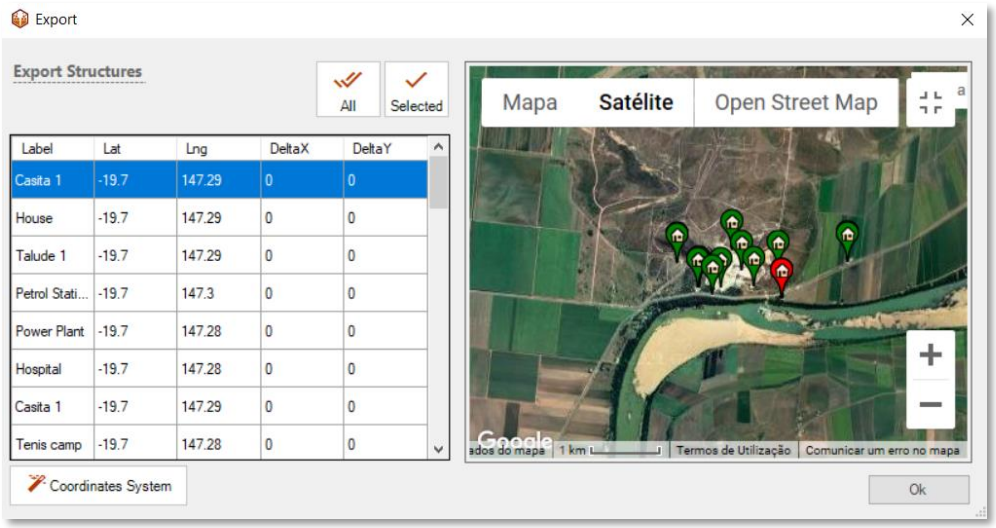


Figure 428 -Export Structures window.

16.5.3. Adjust Structure

The user can adjust your structures to the new position of your blast.

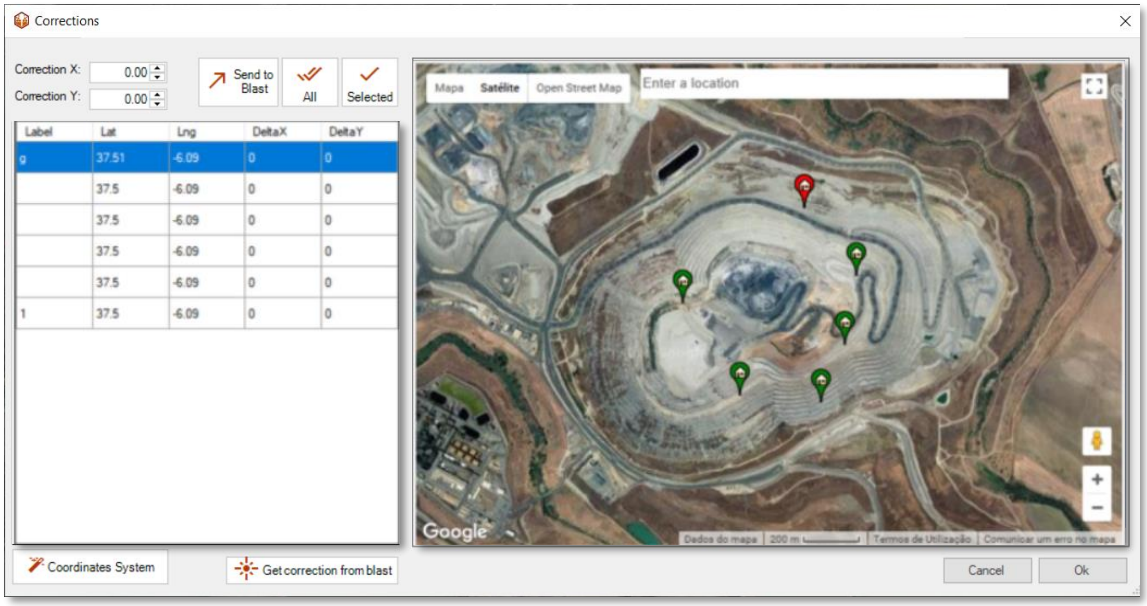


Figure 429 - Structures corrections.

16.5.3.1. Charge Limits

By checking the box **Charge Limits** the user can see the isoline that defines the charge limit of the structure selected. If the user passes the mouse over it will see the Kg of charge applied to a specific isoline.

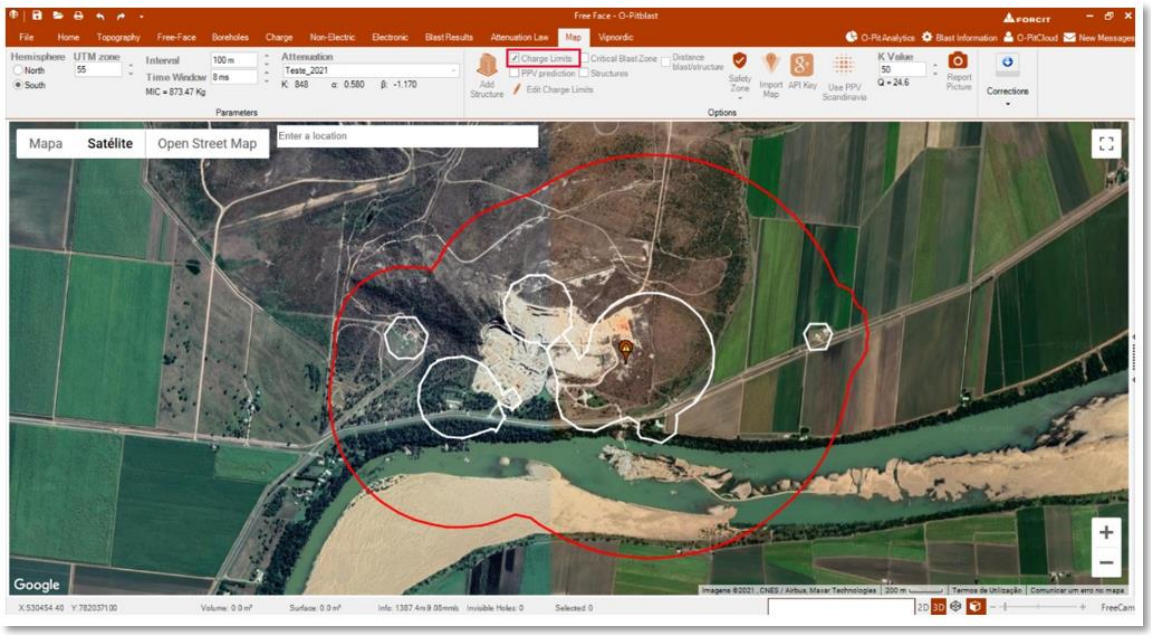


Figure 430 - Charge limits area.

16.5.3.1.1. Edit Charge Limits

The user has the possibility to change the Charge (Kg) of the isolines and the color associated to them. To validate their changes the user must click on Merge (Figure 431).

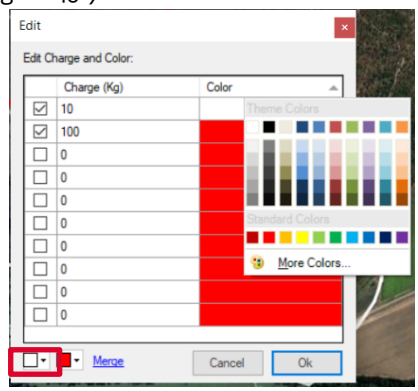


Figure 431 - Edit Charge and Color window.

16.5.4. Critical Blast Zone

If the user as the **Critical Blast Zone box** checked, it will appear a black contour that shows the critical zone. For example, the user can analyse if the blast will make some damage to the near structures.

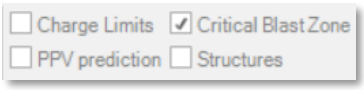


Figure 432 - Critical Blast Zone box.

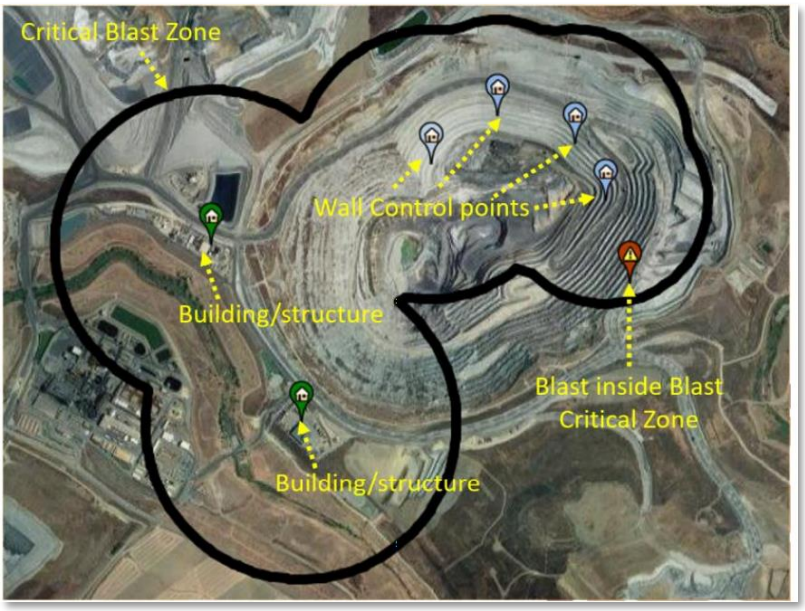


Figure 433 - Critical Blast area.

By clicking on the **Search (Chapter 14.5)** button the user can look for problems with the blast and with the structures.

Figure 434 - Detection of problems with the structures.

16.6. Safety Zone

This option allows the user to see the safety zone of the quarry or mine (see Chapter 6.3.7.2 to set the parameters for the clearance zone).

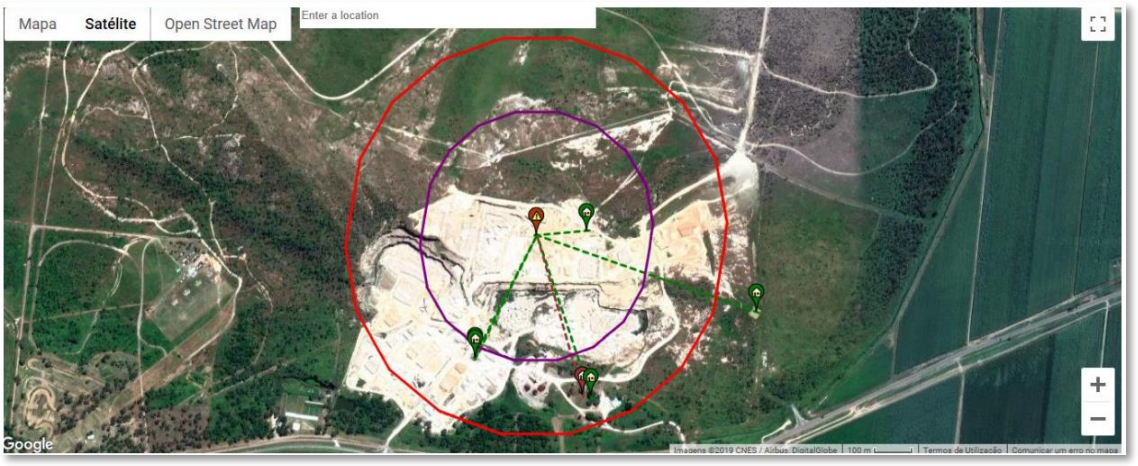


Figure 435 - Example of safety zone for personnel and equipment.

In the case shown above, the red line represents 500m to personnel and the purple line represents 300m for equipment.

16.6.1. Export Safety Zone (for Davey Bickford System)

To export safety zone data for the Davey Bickford System, the user can generate two files to be inserted into the Blast Machine via USB. Follow these steps to complete the exportation (Figure 436) :

1. Define the number of blast zones;
2. Set the safety distance of your blast (in meters);
3. Click “Calculate”;
4. Click on “Export”;
5. Specify the UTM Zone;
6. Define the file name;
7. And finally, it will have the 2 files in the destination choose by the user.

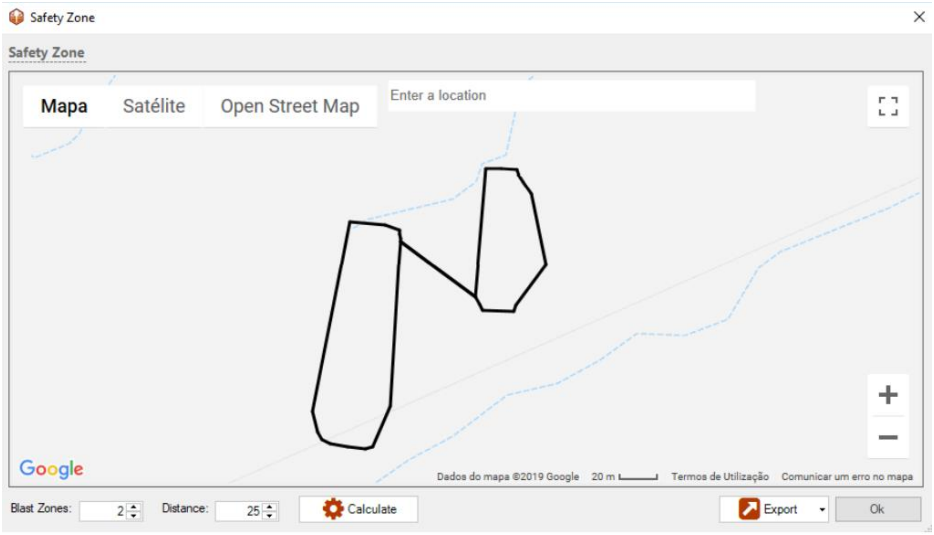


Figure 436 - Safety Zone.

16.7. Import Map

With this tool the user can import a map by selecting an area on the Map ( ) and then making the cut ( ).

Figure 437 - Import Map window.

After that, the loading will be done for make the preview terrain and the user can as a new terrain.

16.8. Report Picture

The user can use this tool to take a picture for the report (Figure 38).

17. MWD

This module is comprised of three key tools: **MWD Data**, **Select Hole**, and **Selective Charge**. These tools are designed to facilitate the import, analysis, and application of actions using MWD (Measurement While Drilling) data.

Figure 438 - MWD Module.

P.S: This Module is only available for users who have purchased the MWD Module.

Icon		*Description*
	MWD Data	Importing MWD data and analyzing data from Outlires, Histogram, Parameter Color and Planes
	Select Hole	Holes selection tool
	Selective Charge	Charge holes based on parameter data

17.1. MWD Data

The MWD Data tool provides advanced capabilities for importing and analyzing drilling data, ensuring complete and efficient access to the information collected during the drilling process.

Clicking on the **MWD Data** button opens the MWD Data window, which is organized into five tabs (Figure 439):
Data Tab: Where user imports and validate MWD data.
Outliers Tab: Identifies and manages anomalous values in the MWD data.
Histogram Tab: Configures and displays histograms for analyzing data distributions.
Parameter Color Tab: Allows customization of color schemes for different parameter values to enhance data visualization.
Planes Tab: Facilitates the creation and management of reference planes for spatial analysis.

17.1.1. Data Tab - Importing MWD Data:

In the **Data** tab, after clicking on the **Select File** button (Figure 439), an import window will be opened allowing users to browse for MWD data files in .XML format stored on computer (Figure 440).

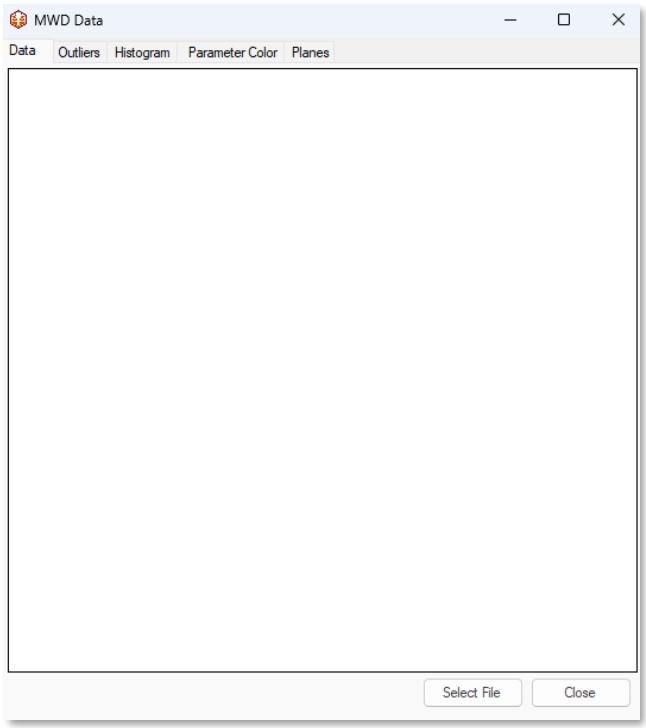


Figure 439 - MWD Data - Data Tab.

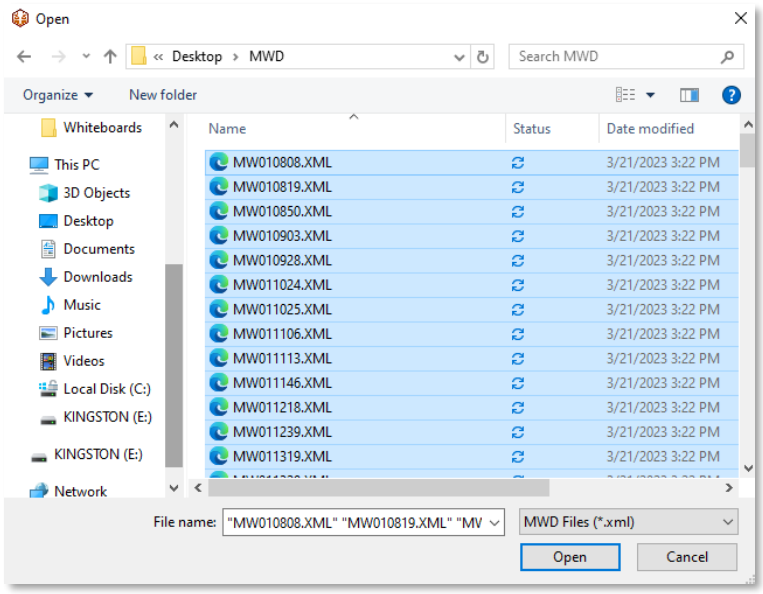


Figure 440 - Selecting MWD data for importation.

After selecting a file, the window will display information about each file, including whether it matches the current holes in the software. It will also indicate if there are any holes associated with the data or if discrepancies are present. The tool performs a comprehensive validation process to ensure the integrity of the imported data. Any discrepancies or unmatched holes will be flagged for further review.

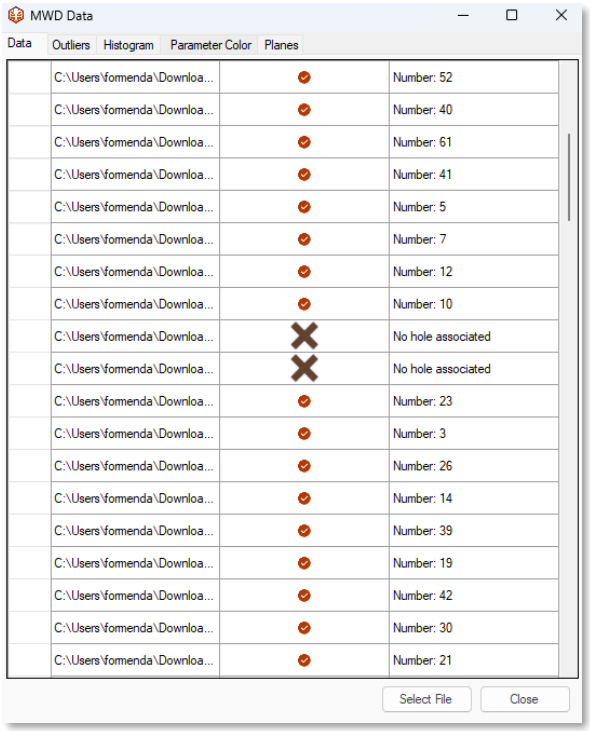


Figure 274 – MWD Data - Data Tab: Importation validation.

17.1.2. Outliers Tab

This tab is a crucial tool for identifying and managing anomalous values in MWD data, which may indicate potential issues during drilling. Users **can adjust parameters to view outliers for specific metrics**, ensuring precise and targeted data analysis. Here's how to effectively use this feature:

Automatic Hole Selection:

- **Initial Selection**: When the Outliers Tab is opened, all holes are automatically selected and displayed with highlighted colors in the blast (Figure 441; Figure 442). This default selection facilitates a comprehensive view of all data and helps in identifying discrepancies more efficiently.
- **Inspecting Specific Boreholes**: To inspect data for a specific borehole, users should first select the desired borehole (Figure 441). This action reveals detailed information about the borehole, including Length, Value, Time, Borehole Number, and outliers.
    - **Selecting a Borehole:** Click on the desired borehole to select it.
    - **Navigating Arrows**: When holes are selected, two types of navigation arrows appear, allowing users to move between the boreholes (Figure 443):
        - **Length Arrow** : This arrow helps navigate through boreholes based on their length, showing the parameter values at different depths.
        - **Borehole Number Arrow** : This arrow allows users to cycle through boreholes based on their number, facilitating easy comparison of different boreholes and viewing parameters such as Length, Depth, Value, and Time sequentially.

*Note: *When more than one hole is selected, these navigation arrows become inactive.*

- **Multi-Selection**: To select multiple holes, press the CTRL key while clicking on each hole. Selected holes will be highlighted, whereas unselected holes will appear transparent.

Parameter Selection and Statistic:

- **Parameter Dropdown List**: Allows users to select the specific parameter they wish to analyze.
- **Statistics Display**: Shows the average, length, value, time, and borehole number for the selected parameter, providing a summary of the data.

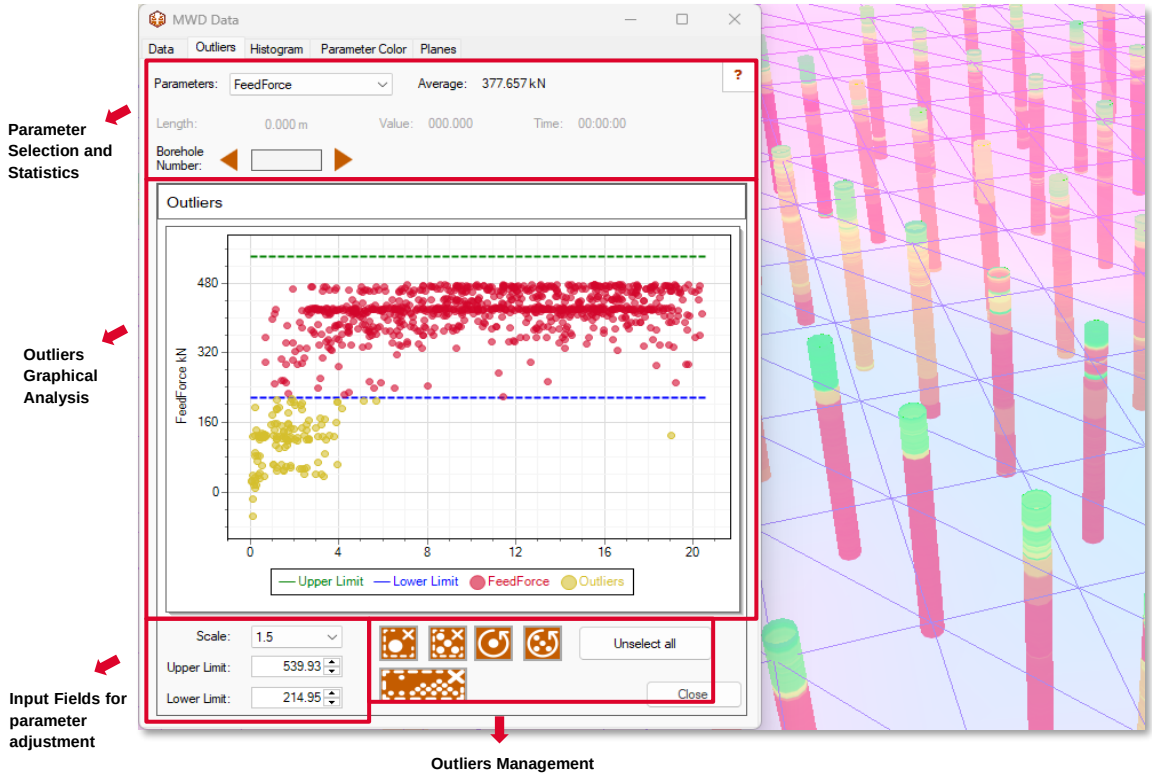


Figure 441 - MWD Data - Outliers Tab.

Figure 442 - MWD Data - Outliers Tab message.

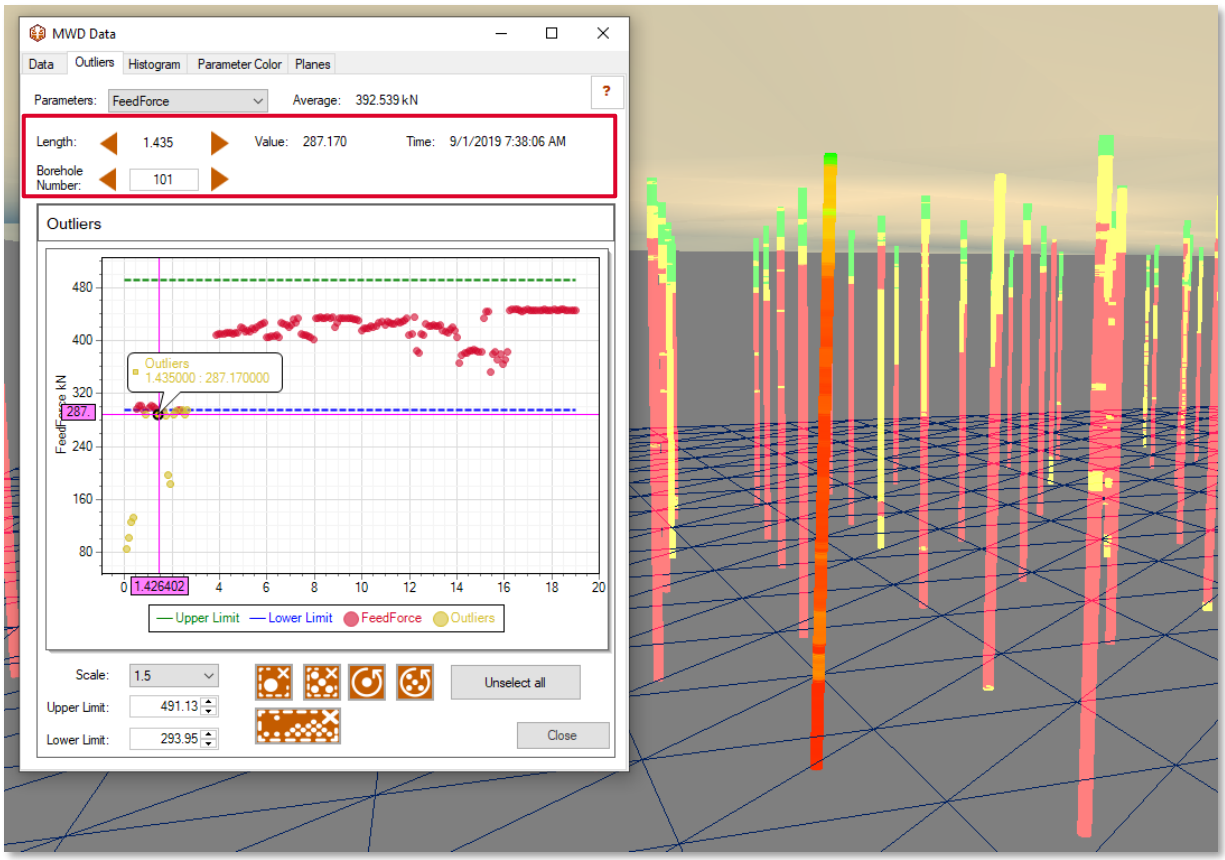


Figure 443 - MWD Data - Outliers Tab: Inspecting Borehole 101 at s 1.435m depth.

Outliers Graphical Analysis:

- The graphical representation provides the information of outliers for each parameter. **The graph displays the selected parameter, upper limit, lower limit, and outliers**, with the Y-Axis indicating the parameter values, while the X-Axis represents the compatible length for those values, indicating where the parameter values fall within the specified range.

Input Fields for Parameter Adjustment:
This allows users to filter data based on desired thresholds.

- **Scale:** Adjusts the scale of the displayed data.
- **Upper Limit:** Sets the upper threshold for the selected parameter.
- **Lower Limit:** Sets the lower threshold for the selected parameter.

Outlier Management
This section provides users with tools to handle, and process detected outliers in MWD data. This functionality is essential for cleaning up the data and addressing any anomalies detected during drilling. The functionality of each button is available when hovering the mouse cursor over any button (Figure 444). The key features include:

- **Selecting Outliers:** Users can easily select one or more outliers by clicking on them (Figure 445).
- **Deselection:** To deselect all selected holes, simply click the **Unselect All** button. This action clears all current selections, allowing users to start a new selection process if needed.
- **Deletion Options:**

- **Delete Selected Outliers:** Removes the outliers currently selected.
- **Delete all outliers of the current parameter:** Removes all outliers related to the current parameter.

- **Reset Options:**
  - **Reset the current parameter outliers to default**: Resets outliers related to the current parameter to their original state.
  - **Reset all the parameters outliers to default**: Resets outliers across all parameters to their default values.

Figure 444 – Outlier Management:Tooltip of each button.

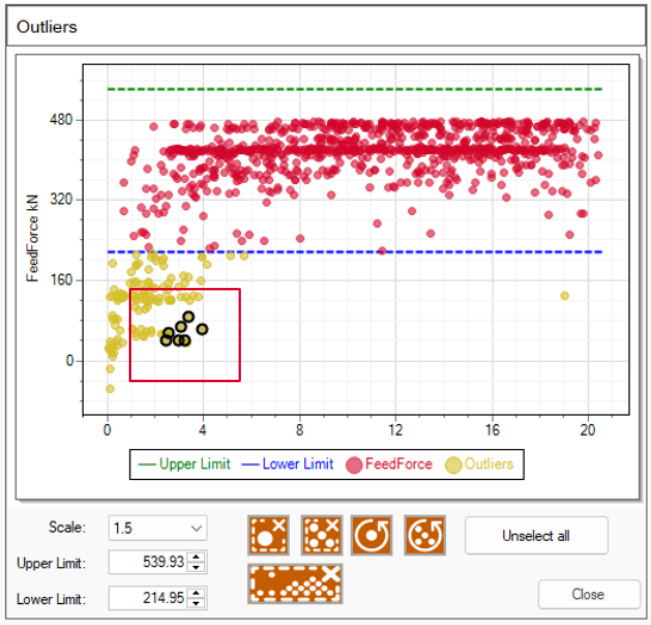


Figure 445 - MWD Data - Outliers Tab: Selected outliers in the graph.

17.1.3. Histogram Tab

In the Histogram tab (Figure 446), users can configure the desired parameter for analysis by defining the intervals or the number of columns. This tab allows for detailed examination of data distribution by enabling users to choose between different methods of binning:

- **Automatic:** Automatically determines the interval based on the data.
- **Series Width:** Users can specify the width of each interval.
- **Number of Bins:** Users can define the number of bins to group the data.

Additionally, users can check for positive or negative excesses, and add the quantities they wish to analyze. This allows for grouping values that are greater than, less than, or equal to the chosen value, providing a comprehensive view of data distribution and outliers.

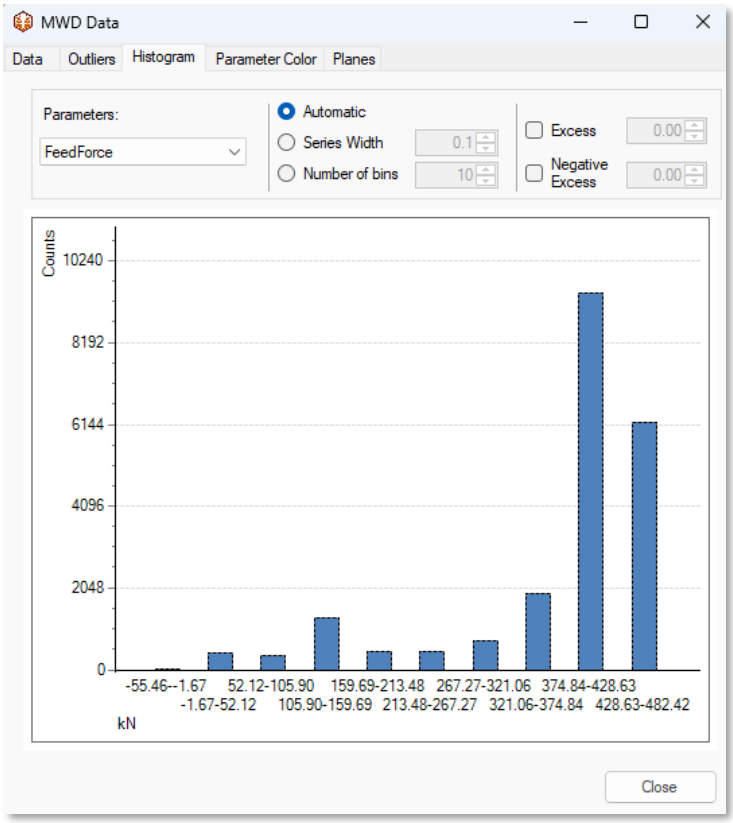


Figure 446 - MWD Data - Histogram Tab.

17.1.1. Parameter Color

The Parameter Color tab (Figure 447) allows users to define and manage the colors used to represent different parameter values in data visualizations. This feature is useful for highlighting patterns, trends, and outliers in complex data sets, facilitating the interpretation and visual analysis of information.

Key features include:

- **Lowest Value:** Text field to enter the lowest value for the color range.
- **Value #1, Value #2, and Value #3:** Text fields to enter specific color values.
- **Highest Value:** Text field to enter the highest value for the color range.
- **From Data:** Button to automatically fill in the color values based on the data.
- **Apply Default Colors:** Button to set the color values as defaults.
- **Save and Apply:** Button to save the entered color values and apply them to the holes.
- **Gradient of Colors:** Button to generate a color gradient using the colors in fields #1, #2, and #3.

This functionality enables users to customize their data visualizations, making it easier to spot significant variations and trends within their data.

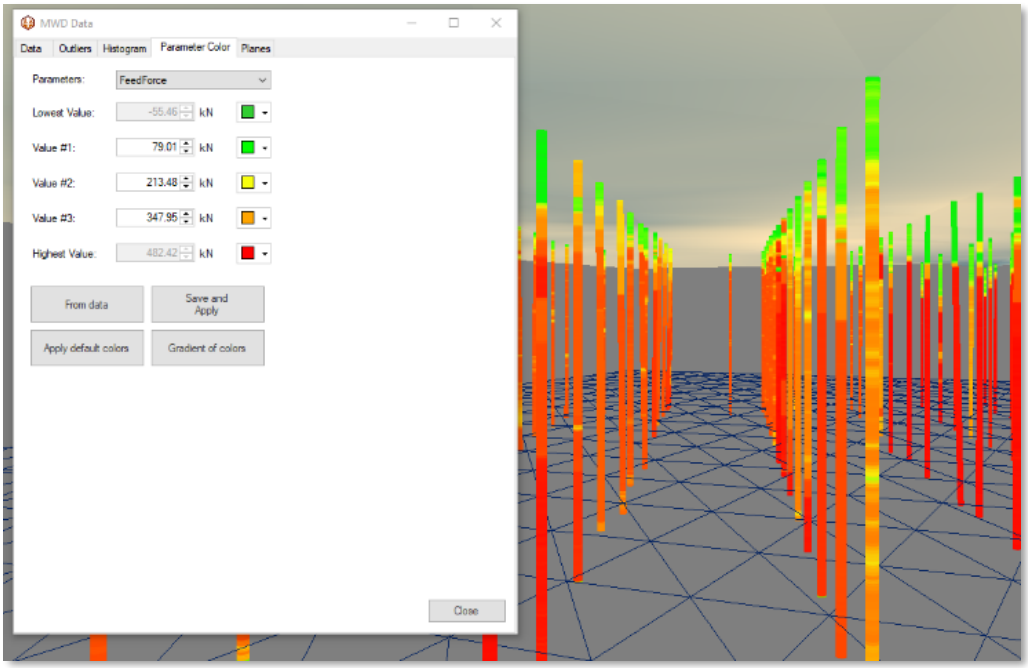


Figure 447 - MWD Data - Parameter Color Tab.

17.1.2. Planes

The Reference Plane tab (Figure 448) allows users to activate and manage both horizontal and vertical planes in the 3D scene, providing a clear visual reference for analysis.

Activating Planes

- **Horizontal Plane:** The software automatically recognizes the horizontal plane using the bench bottom as a reference. Once activated via the checkbox, an arrow will appear in the 3D scene, allowing users to move the horizontal plane (Figure 449).
- **Vertical Plane:** To create and view a vertical plane, follow these steps:
  - Click on "**Create Vertical Plane**" button.
  - Left-click, drag, and drop to define where the plane will be added (Figure 450).
  - Click on "**Calculate Vertical Plane**" button to finalize and display the plane in the 3D scene (Figure 451).
  - An arrow will appear, indicating the direction of the plane. Users can move the plane by clicking and dragging the arrow (Figure 451).

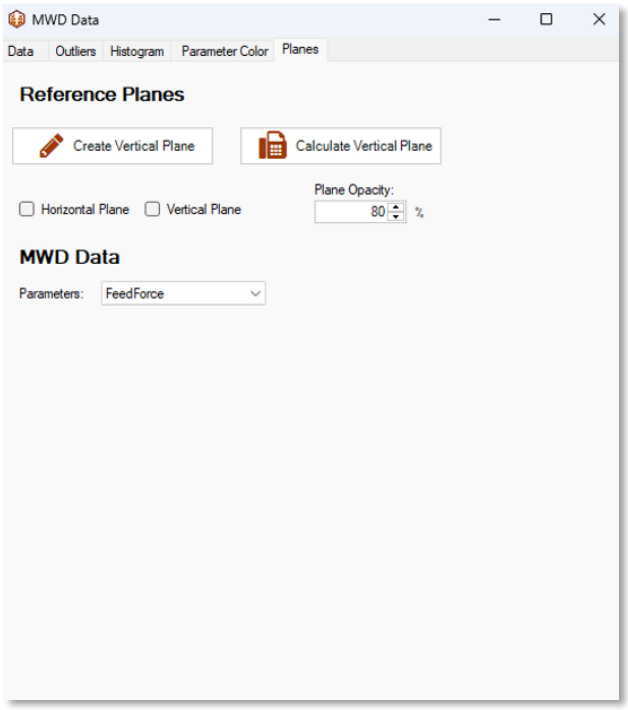


Figure 448 - MWD Data - Planes Tab.

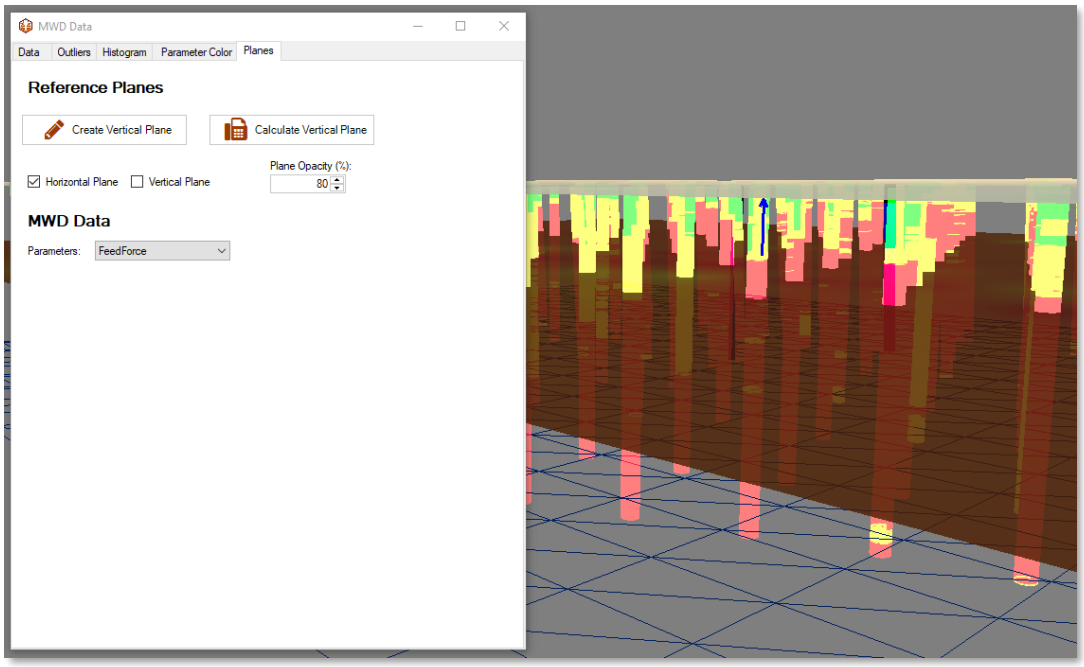


Figure 449 - MWD Data - Planes Tab: Activating Horizontal Plane.

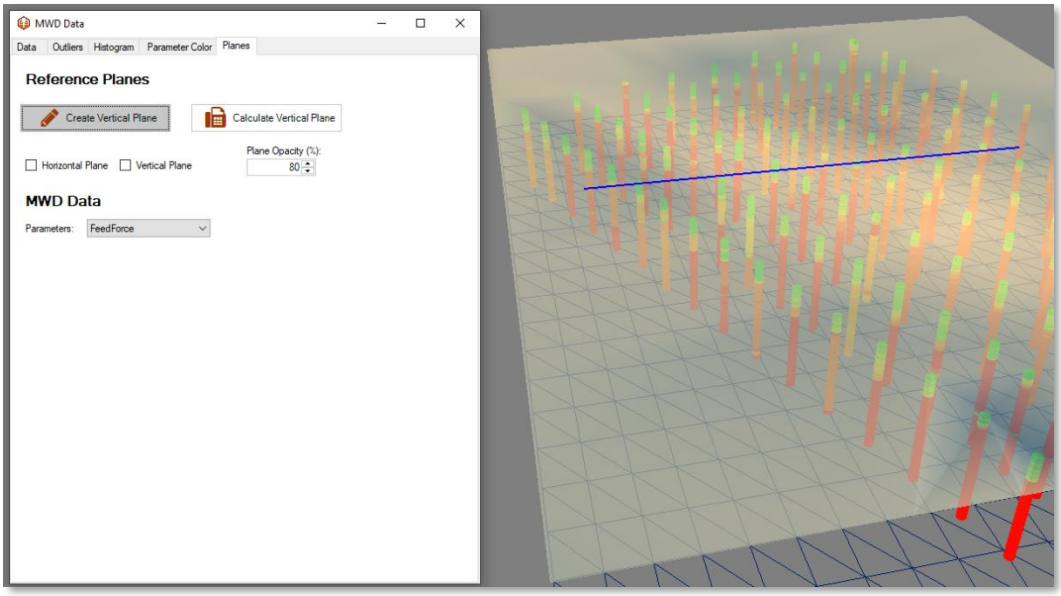


Figure 450 - MWD Data - Planes Tab: Creating Vertical Plane

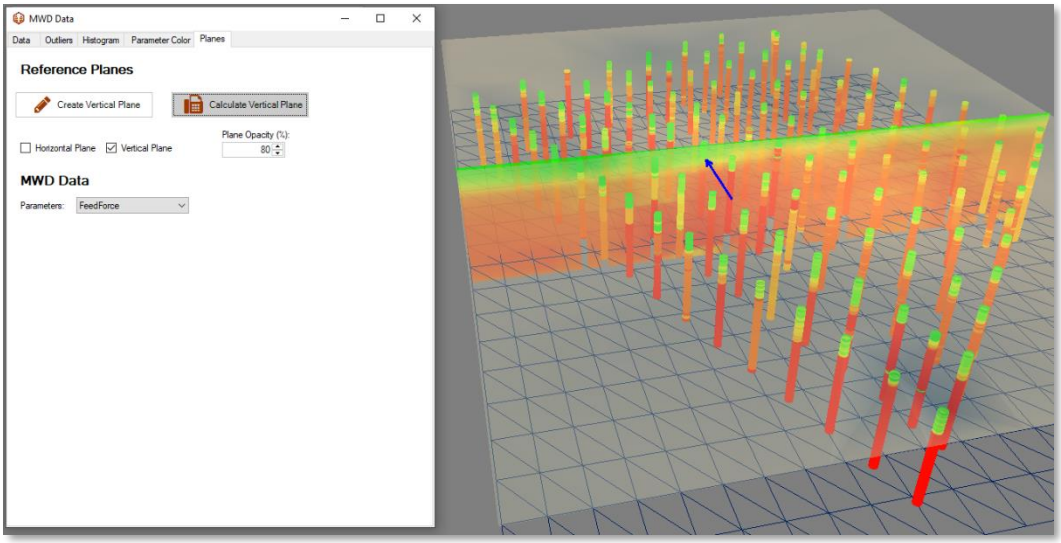


Figure 451 - MWD Data - Planes Tab: Calculating Vertical Plane.

Viewing and Adjusting Planes

- To view both the horizontal and vertical planes, activate the corresponding checkboxes.
- Users can adjust the plane's opacity through the "Plane Opacity" option to achieve the desired transparency level.
- The color of both planes is determined by settings in the "Parameter Color" section.

Parameter Analysis

In the MWD data section, users can select the specific parameter they want to analyze. This selection will define the parameter for detailed analysis within the 3D scene.

By using the Reference Plane tab, users can effectively manage and analyze drilling data, ensuring accurate and comprehensive assessments in a visually intuitive manner.

17.2. Select Hole -

The Select Hole tool enables users to select a group of boreholes for detailed analysis in the MWD Data window. It operates similarly across different modules.

To use this tool:

1. **Select Boreholes**: Left-click on the terrain and draw a polygon around the desired set of holes.
2. **Finalize Selection**: Right-click to close the polygon and complete the selection (Figure 452).
3. **Alternate Selection Method**: Press the Ctrl key and left-click on individual holes to select them one by one.

These selection methods allow users to efficiently isolate and examine specific boreholes for further analysis.

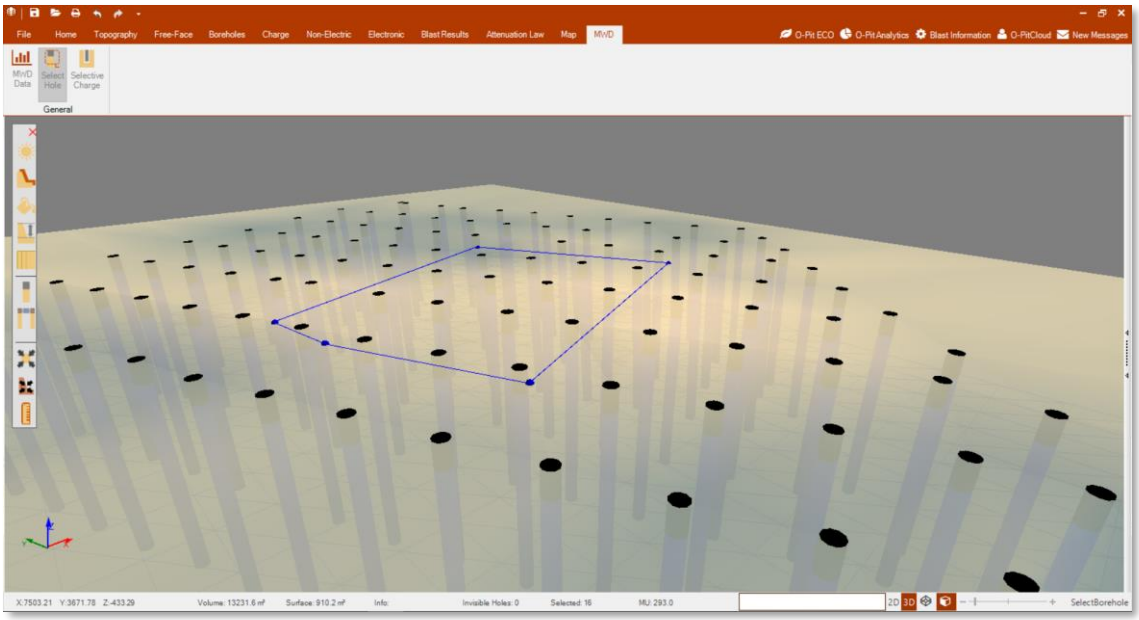


Figure 452 - MWD - Select Hole.

17.3. Selective Charge -

The Selective Charge Window (Figure 453) is designed to optimize and manage explosive charges with precision. This window provides a comprehensive set of tools for precise control over the placement and type of explosives and boosters, tailored to the specific requirements of the blast design.

The window is organized into several key sections to facilitate detailed analysis and adjustment:

1. Graphic Analysis:

- **Y-Axis**: Displays the hole length.

- **X-Axis**: Represents the selected parameter from the Parameter Dropdown List.
- This section provides a visual representation of the data, allowing users to analyze the distribution and behavior of the chosen parameter across different hole lengths.

2. Charging Application: Users can choose to apply the charging rules to:

- **Individual Hole**: Adjust charges for a single selected hole.
- **All Holes**: Apply changes to every hole within the blast design.
- **Zone**: Apply to a specific zone if zones are defined in the blast design. Note: Zone fields are activated only if zones are present in the design; otherwise, they will be deactivated.

3. Parameter and Borehole Controls:

- **Parameter Dropdown List:** Allows selection of the parameter to analyze and adjust.
- **Borehole Number Navigation**: Enable users to move between holes to view detailed information for each.

4. Rule Configuration:

- **Rule Tab**: Displays a table with the following columns:
  - **Order (#)**: Sequential rule number.
  - **From Column Value**: Starting value for the rule.
  - **To Column Value**: Ending value for the rule.
  - **Explosive Column**: Dropdown list for selecting the explosive from the user's database.
- **Rule Configuration**:
  - **Cut-off Value**: Defines the threshold at which the user-defined load rule should be applied, either individually or globally.
  - **Sensitive Range**: Determines the range for applying the user-defined load rule based on specific parameters.

5. Booster Section: This section allows users to specify the type and location of boosters to be used in the blasting process.

- **Types**: Choose from None, Interface, Bottom, or Interface and Bottom.
- **Dropdown List**: Select the booster type from the user's database.

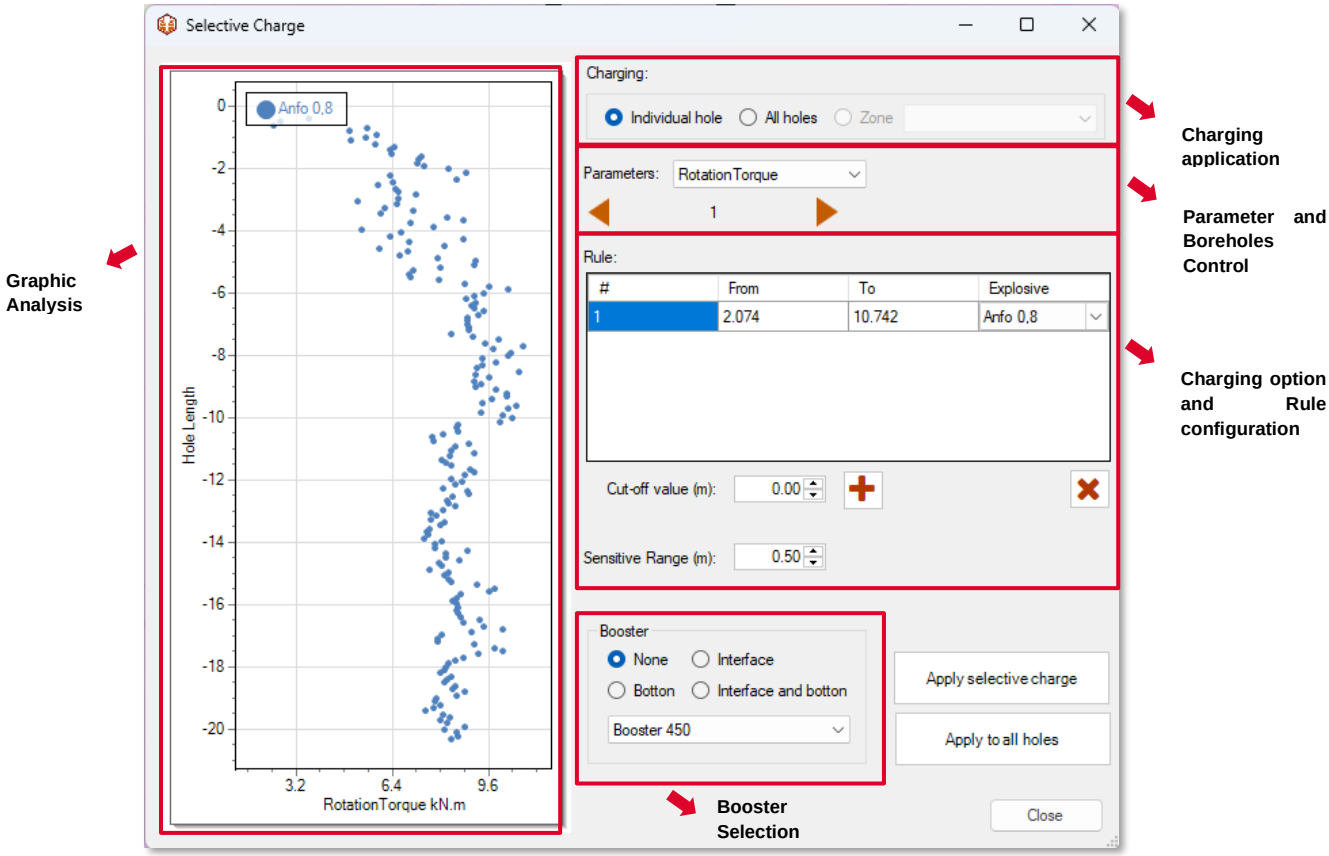


Figure 453 - Selective Charge window.

18. Blast information

In this area the user can save information of the blast. It will appear lots of information to write in like **Site Name, Country, Location, Shotfirer, DB Responsible, Date, Type of rock**, **Comments** and **Geometry** (Burden, Spacing and Bench High).

To save the information the user must click on the **Save** button .

The user can also reload previews information and put some pre-loaded comments by clicking on the button signalized in (Figure 454).

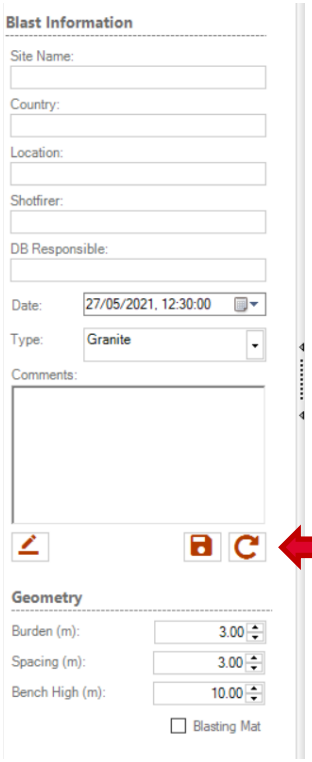


Figure 454 - Blast information area.

19. O-PitCloud

O-PitCloud is the platform where users can manage various aspects of their blasting projects. Within O-PitCloud, users can:

- **Send Blast Reports**: Share detailed reports with other users efficiently.
- **Upload New Blasts**: Add new blasting projects and data to the system.
- **Invite New Members**: Add new users to ongoing projects to collaborate effectively.

The interface provides essential information about the user's account and displays a list of projects and blasts associated with their account. This centralized access helps streamline project management and collaboration.

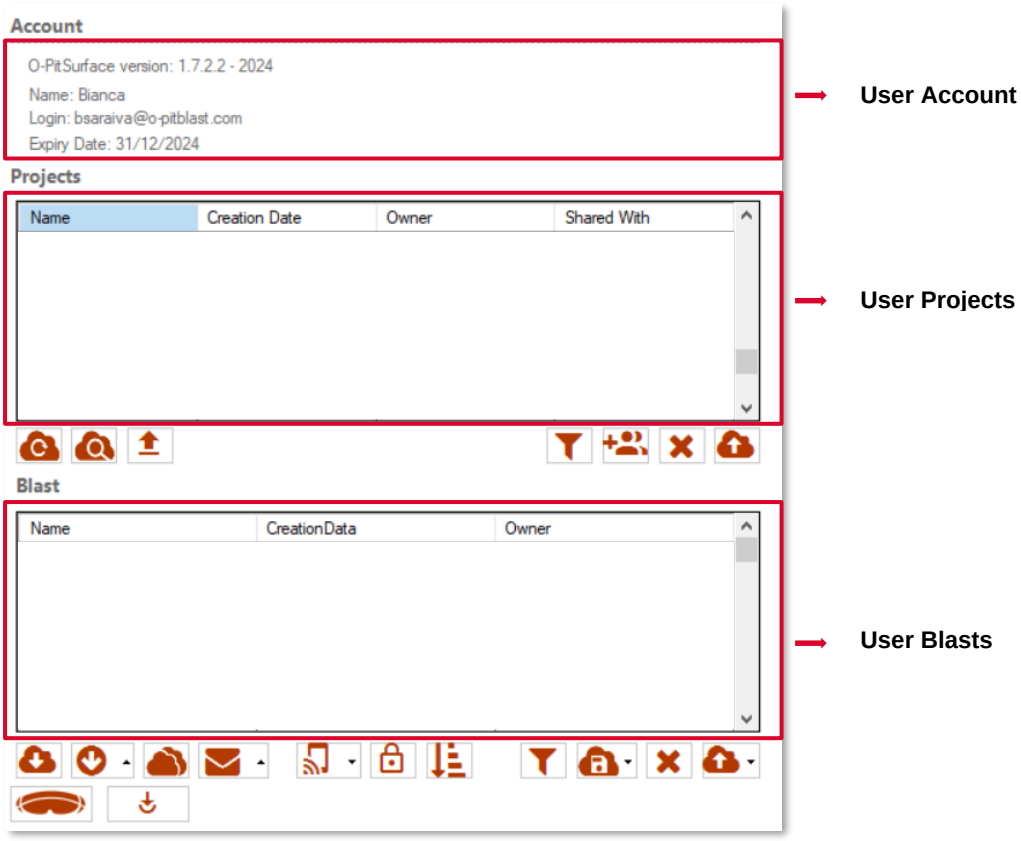


Figure 455 - O-PitCloud section.

19.1. Projects Area

In this area the user can Reload Projects Lists, Check Details from some project, invite O-Pitblast users and create or delete a project, as shown on the picture bellow.

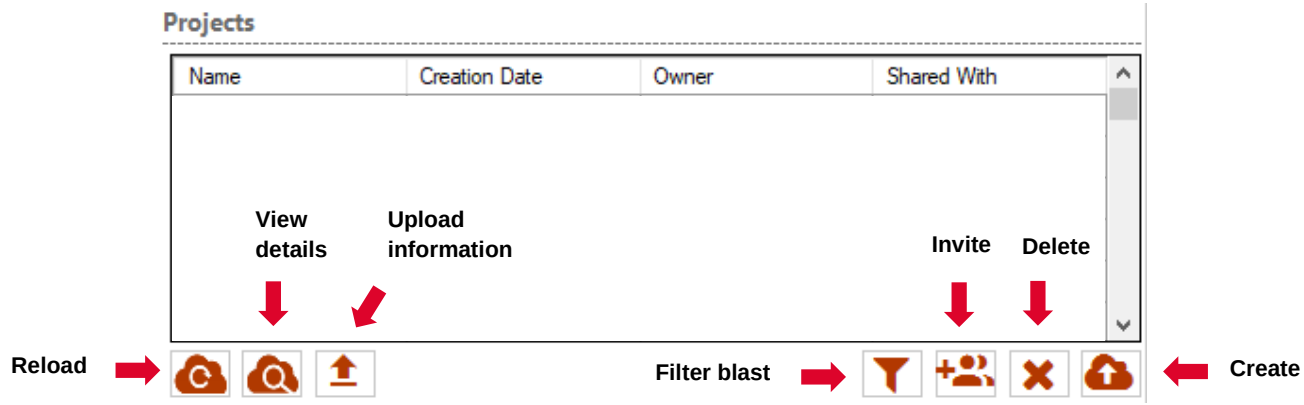


Figure 456 - Projects menu.

19.1.1. Create a New Project

To create a new project the user must click on the button **Create** a new project and create a new name for the project.

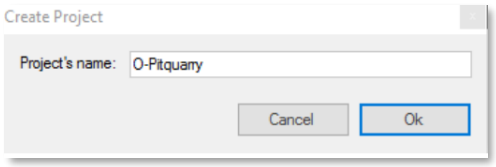


Figure 457 - Create a new project window.

19.1.2. Filter Project

This option allows the user to filter projects in the project list. Once activated, a window will appear where the user can enter the name of the desired project.

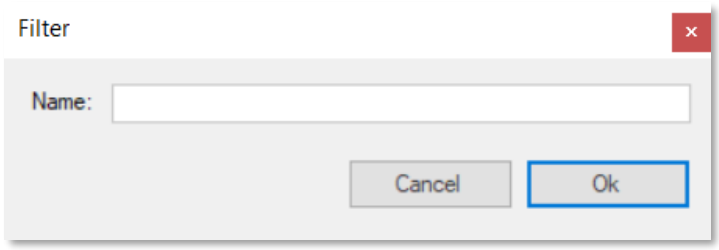


Figure 458 - Filter Blast window.

19.1.3. Invite Users

The user can invite a new user by clicking in the button **Invite** . It will pop up a window that requires the e-mail of the new user.

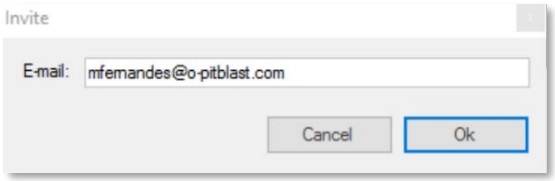


Figure 459 - E-mail invitation window.

The new user will receive a message saying, “You have new invitation”.

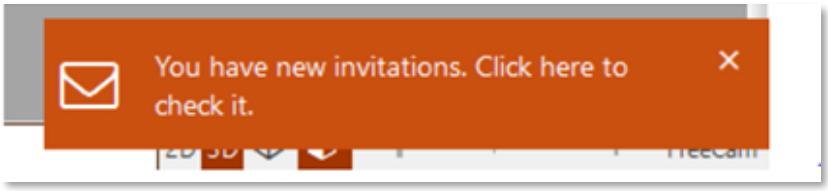


Figure 460 - Message received by the new user.

When the new user accepts the invitation, the user will receive a message saying "(...) accepted your invitation".

Figure 461 - Project to accept.

Figure 462 - Message received when the new user accepts the invitation.

19.1.4. Views Details

At this point the user can check for the details of any selected project, by clicking in **View Details** button.

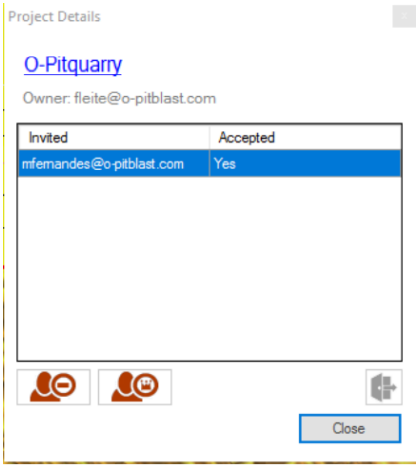


Figure 463 -Project details window.

19.1.5. Upload Information

In this button the user can upload different type of information to O-PitCloud.

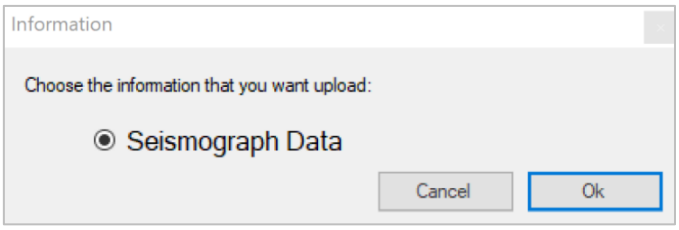


Figure 464 - Upload information window.

19.1.5.1. Seismographic Data

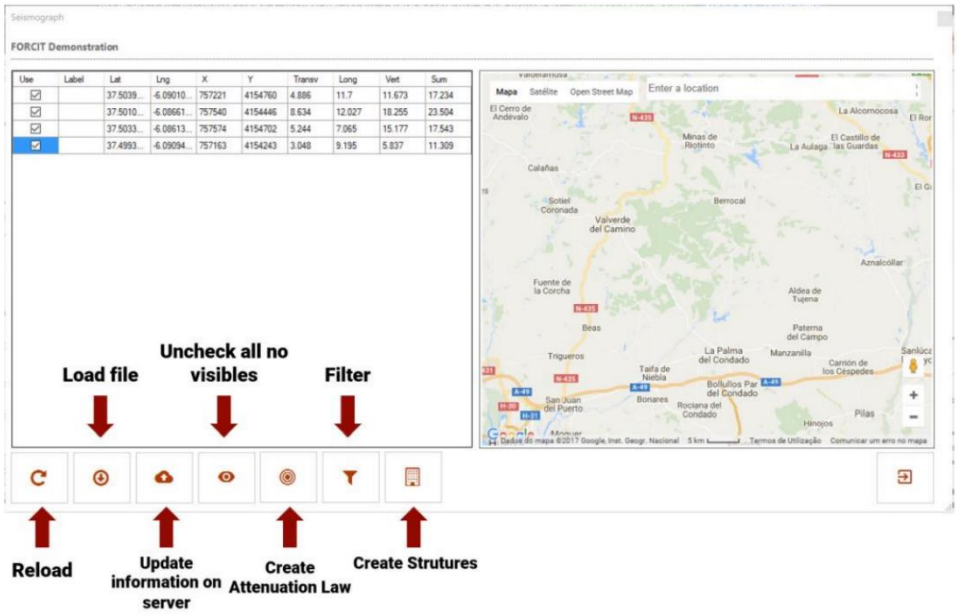


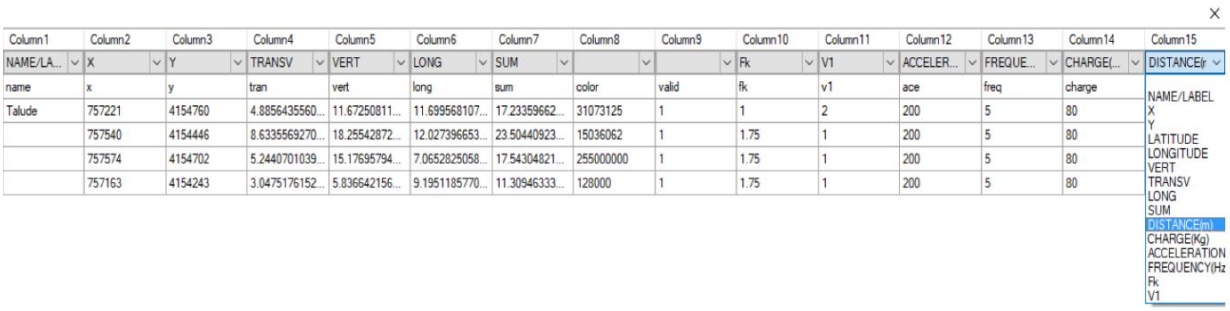
Figure 465 -Seismograph (data) window .

On this window - Figure 465 –the user can **Load** a new file (it supports .xsl, CSV .txt) that contains seismographic data and **Update** that information to the server (O-PitCloud). Also, the user can **Create** a new attenuation law, **Filter** the data and **Create** Structures.

Load file

On this icon the user can import the file with all the seismographic data. It will pop up a window to fill with all the information per column (like shown on Figure 465). The columns that belong to the coordinates (X, Y) and to the

seismographic information (Transversal, Vertical, Longitudinal, Sum), Charge and Distance (shown in Figure 465) must be rightly fill up to be possible to export.



Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9	Column10	Column11	Column12	Column13	Column14	Column15
NAME/LA...	X	Y	TRANSV	VERT	LONG	SUM			Fk	V1	ACCELER...	FREQUE...	CHARGE(...	DISTANCE(r
name	x	y	tran	vert	long	sum	color	valid	fk	v1	ace	freq	charge	
Talude	757221	4154760	4.8856435560...	11.67250811...	11.699568107...	17.23359662...	31073125	1	1	2	200	5	80	
	757540	4154446	8.6335569270...	18.25542872...	12.027396653...	23.50440923...	15036062	1	1.75	1	200	5	80	
	757574	4154702	5.2440701039...	15.17695794...	7.0652825058...	17.54304821...	255000000	1	1.75	1	200	5	80	
	757163	4154243	3.0475176152...	5.836642156...	9.1951185770...	11.30946333...	128000	1	1.75	1	200	5	80	

NAME/LABEL
X
Y
LATITUDE
LONGITUDE
VERT
TRANSV
LONG
SUM
DISTANCE(m)
CHARGE(Kg)
ACCELERATION
FREQUENCY(Hz
Fk
V1

Figure 466 - Export data window.

Once the user exports the data, all the seismographs will be placed on the map. If the markers are yellow that means that the data is NOT on the server yet.

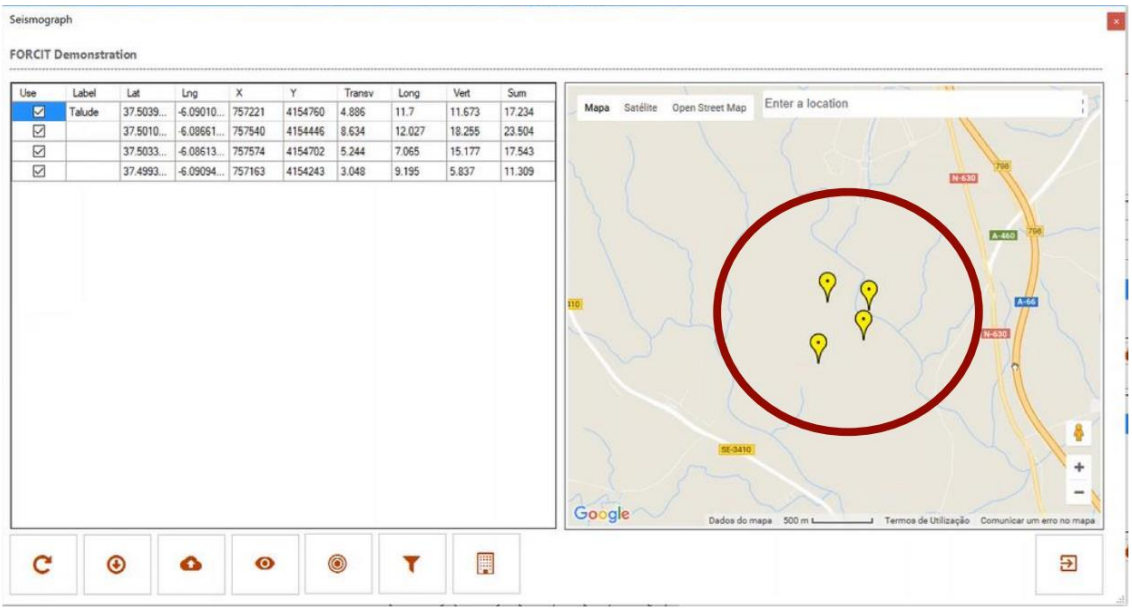


Figure 467 - Seismographs placed on the map (yellow markers).

Upload to the server

After loading the information, the user can choose the data that we want and upload to the server.

When he unchecks the data, the yellow markers will pass to black (so the user can know what seismograph is not checked) like shown on Figure 468.

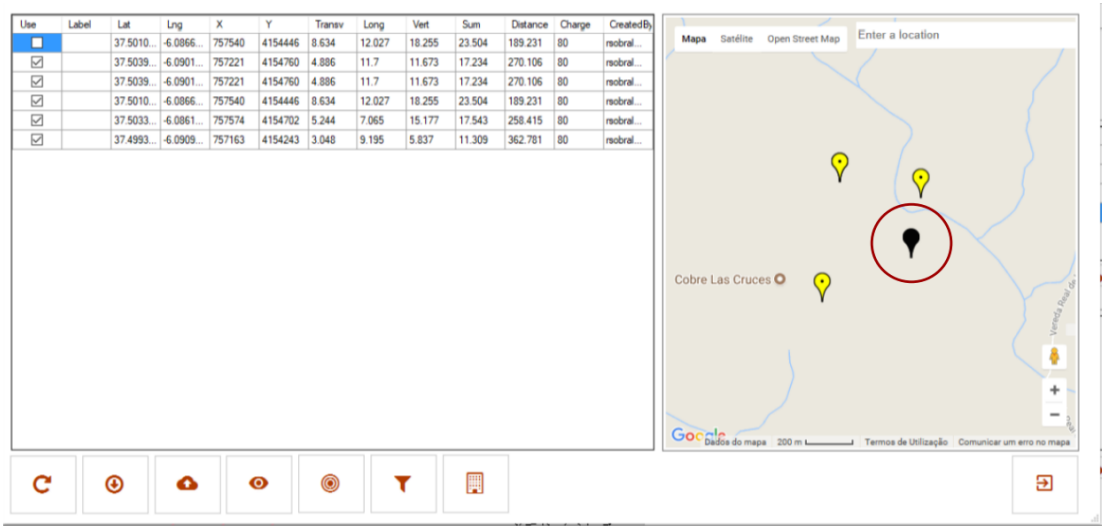


Figure 468 - Check and uncheck the data to upload.

After that selection the user clicks on the **Upload** button and all the markers will be pink. That means that the information is now on the server (Figure 469).

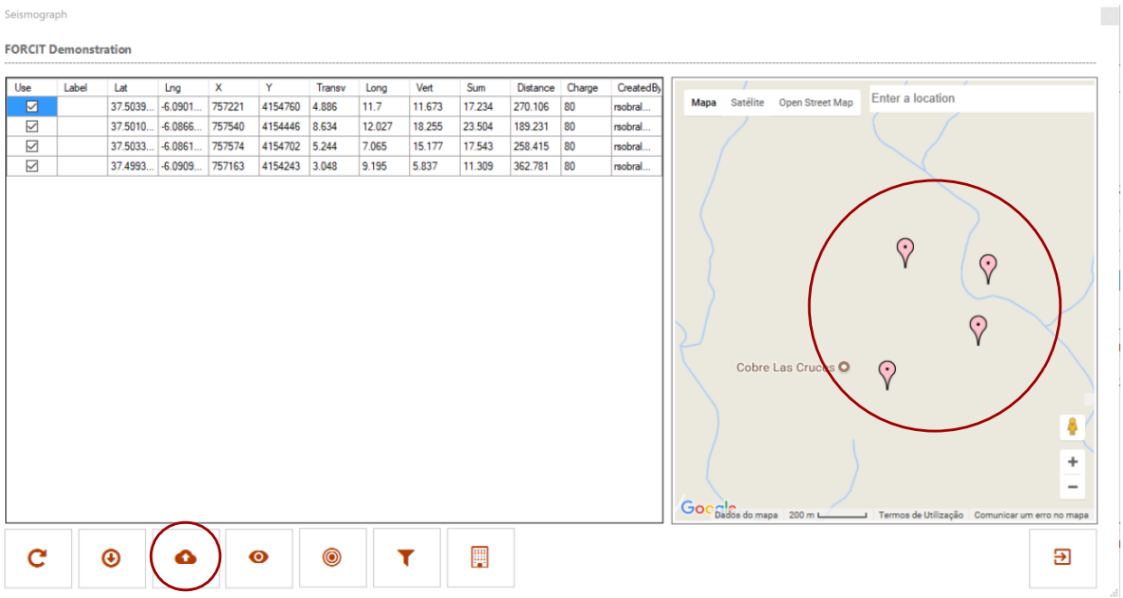


Figure 469 - Seismograph data uploaded to the server (pink).

Uncheck all (no visible)

On this option the user can unselect all the data he wants by clicking on it. The only thing that is important to do is putting the data visible on the map. After that all the information that is no on sight will disappear (uncheck) – Figure 470.

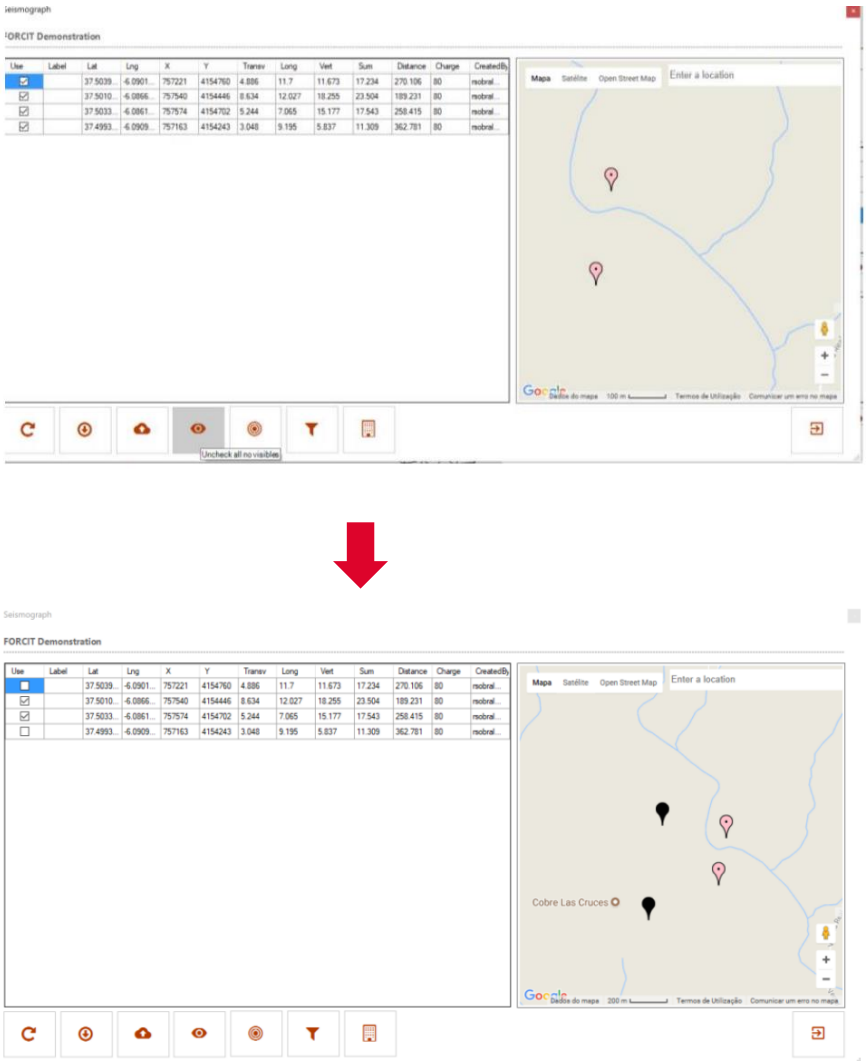


Figure 470 - Uncheck all (no visible) seismographs.

Create Attenuation Law

By clicking on this button, the user will create a new attenuation law with all the data that he selected.

In case of having some previous information, will pop-up a window asking if user want to attach the information, or delete all the information and create a new attenuation law with the new values (data) - Figure 471.

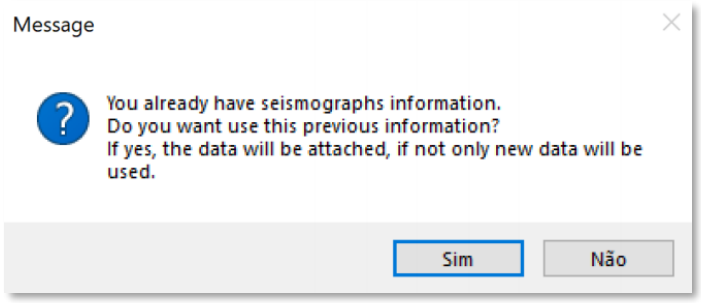


Figure 471 - Message widow - seismograph information.

In the case of choosing “Sim” (yes), the data will be attached. In case on “Não” (yes), a new data will be used.

Filter Data

In this option the user can filter the data that he wants by countless parameters like: Name, Latitude, Longitude, X, Y, Transversal, Longitudinal, Vertical and Sum. The user chooses the range of any parameter (or more than one) that he wants, and the filter will be applied, by clicking on the bottom “Apply” - Figure 472.

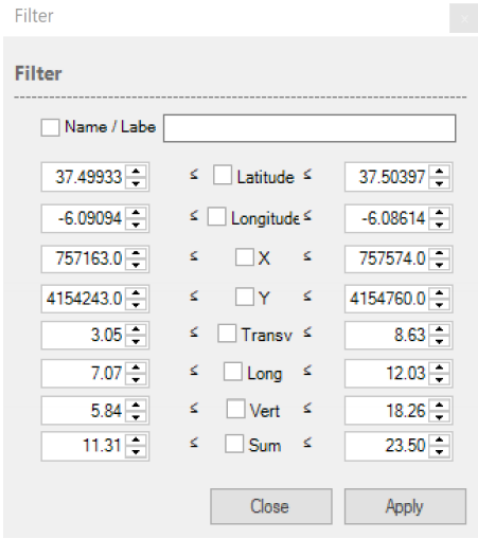


Figure 472 - Filter window.

Create Structure

Before you use this option is important to know that the PPV information is mandatory to fill (Figure 473): **Fk, V1, Acceleration and Frequency**, to become possible to create the structures. If you start filling up the first column, you must fill out the four of them.

Column10	Column11	Column12	Column13
fk	v1	ace	freq
1	2	200	5
1.75	1	200	5
1.75	1	200	5
1.75	1	200	5

Figure 473 - PPV information columns.

After that if you have the PPV information, you can create structures by clicking on Create Structures button  . This means that, in the place where the seismographs are placed, it will be added new structures on the map - Figure 474.

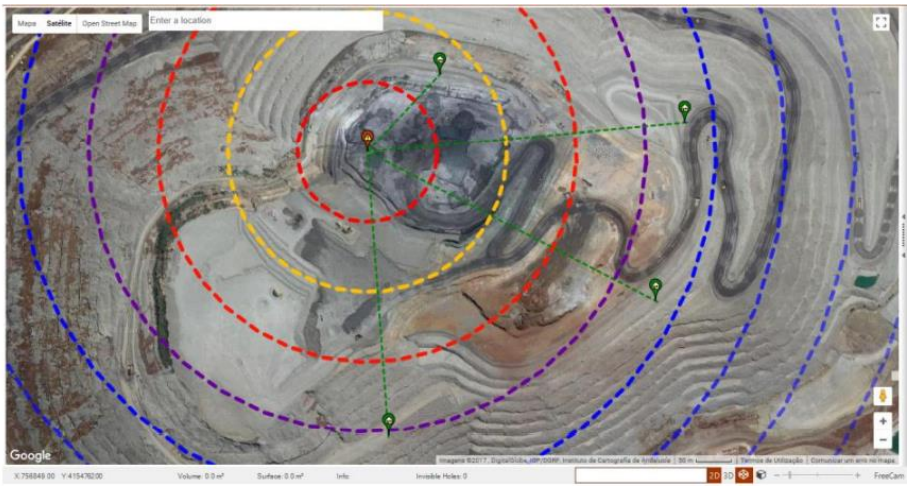


Figure 474 -Creating new structures on the map.

In case of overlap information, it will pop-up a window that allows the user to choose 3 options (Figure 475):

- Replace the structure: will make a new structure on that exact place;
- Change the position (by 10 meters): will create a new structure 10 meters aside of the other one - Figure 476;
- Don't create will not be add the new structure.

Also, the user as the option to "Repeat this option" that allows him to apply the decision to every "overlap" structure.

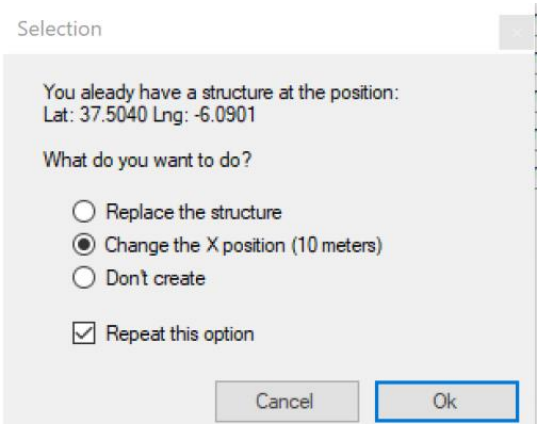


Figure 475 - "Overlap" structures window.

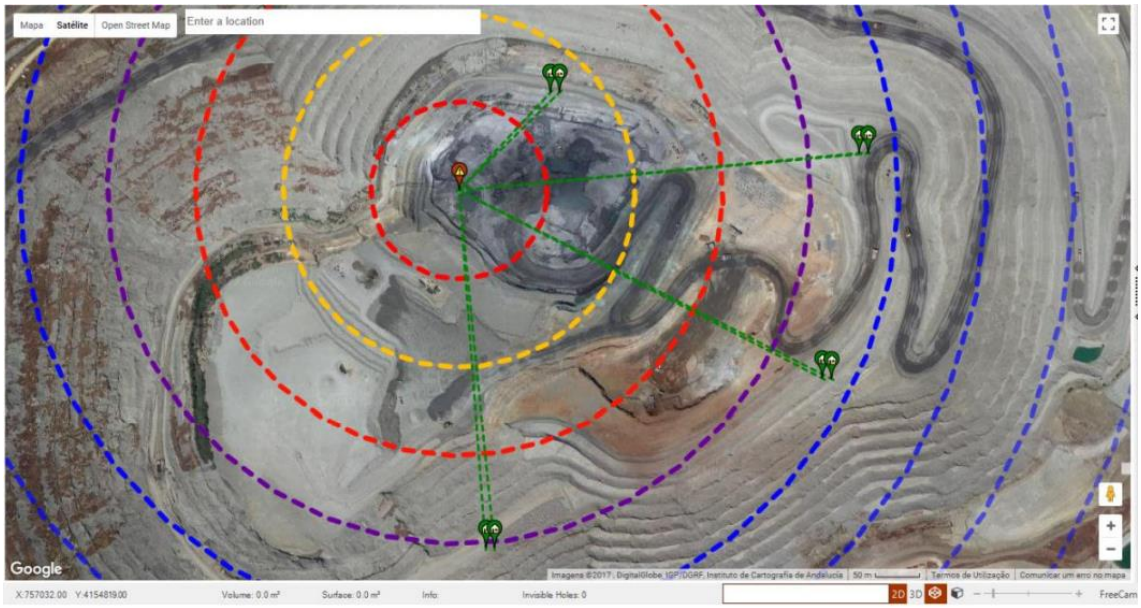


Figure 476 - Creating new structures (10 meters aside).

19.2. Blast Area

In the Blast Area, users have several options for managing their blasts:

- Download the selected blast;
- Download the QAQC information;
- Copy the selected blast to another project;
- Plan and report by e-mail;
- Update holes;
- Close or open the selected blast;
- Import layers;

- Filter;
- Update the selected blast;
- Delete; or
- Upload the selected blast.

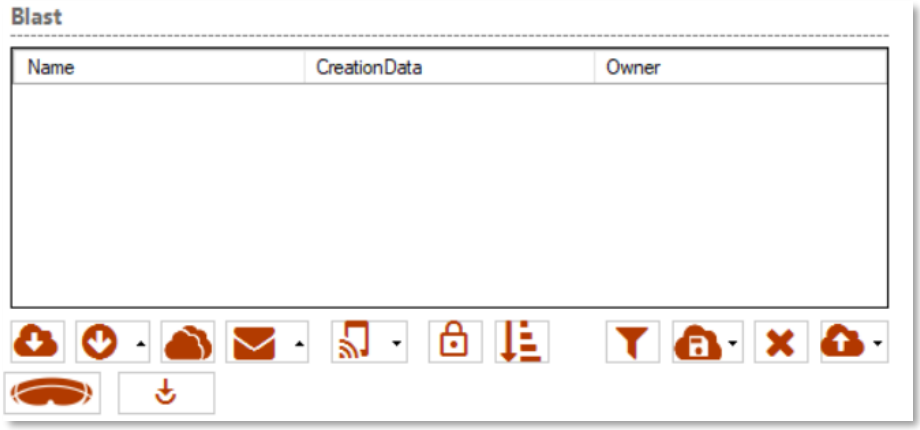


Figure 477 - Blast Area.

19.2.1. Update, Delete and Upload Blasts

Update or Delete Blasts: To update or delete a blast, select the desired blast and click the **Update/Delete** button. The system will process the update or deletion for the selected blast.

Upload New Blast: To upload a new blast, click the **Upload Blast** button. Enter the name for the new blast in the provided field and confirm the upload (Figure 478). If the project is shared with other users, they will receive an email notification about the new blast. This email will include an alert message and an attachment containing the details of the newly uploaded blast (Figure 479).

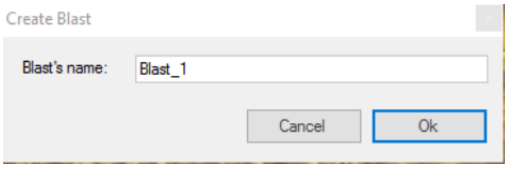


Figure 478 - Create a new blast window.

Figure 479 - E-mail received by the other users.

19.2.2. Download a Blast

To download a blast, select the desired blast and click the **Download** button. After the download is complete, the blast will be imported into the software and will appear in your project.

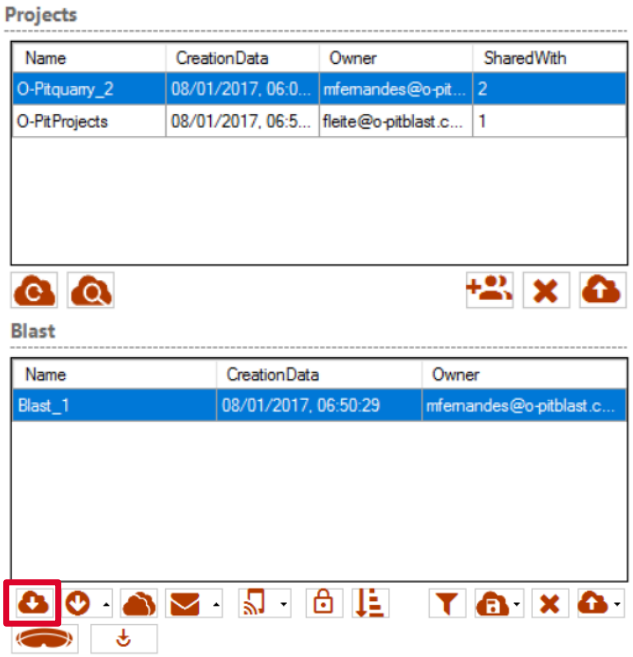


Figure 480 -Download a select blast window.

19.2.3. Download a QAQC Information and Blast Report

By clicking this button, users can access and download the QAQC information and Blast report for analysis. The QAQC data allows users to compare theoretical values with actual values and is derived from inputs entered through the O-PitApp. Upon clicking the button, a dropdown menu will appear with the following options (Figure 481):

1. **Excel File**: Download the QAQC information in Excel format.
2. **CSV File**: Download the QAQC information in CSV format.
3. **Download Blast Report**: Obtain the Blast Report, which is the same report generated and sent directly from the application.

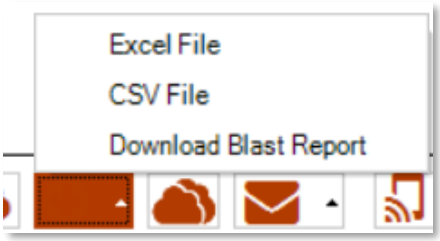


Figure 481 - Download QAQC information and Blast Report.

19.2.4. Copy to Another Project

By clicking on this button, the user can make a copy of a blast to another existing project. A window will appear with all the projects that are connected to that account, and the user must choose where he wants to copy the file.

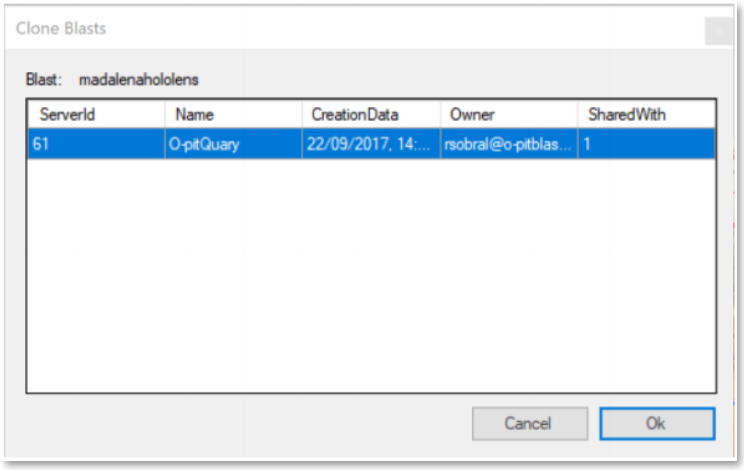


Figure 482 - Copy the selected blast to another project window.

19.2.5. Plan and Report by e-mail

The user must click on report symbol. At this point the user has two choices: send a blast report or send a blast plan. After making that choose it will pop up a window to confirm the decision and the e-mail will be sent.

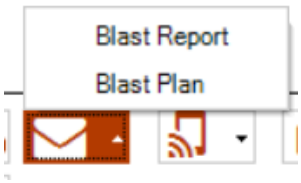


Figure 483 - Plan and Report by mail.

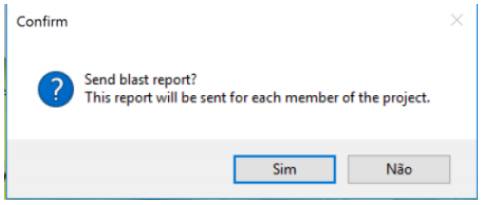


Figure 484 - Confirmation message: Send blast report.

19.2.6. Update Holes

This button is used to update the information as mentioned previously in 14.10.

19.2.7. Close or Open the Selected Blast

This button allows to block/close the blast and then no other user can make changes again. If the admin wants to open again the blast, it is only necessary click the icon again .

19.2.8. Import Layer

With this icon is possible to import layer from Cloud through drill log information which was entered into the application.

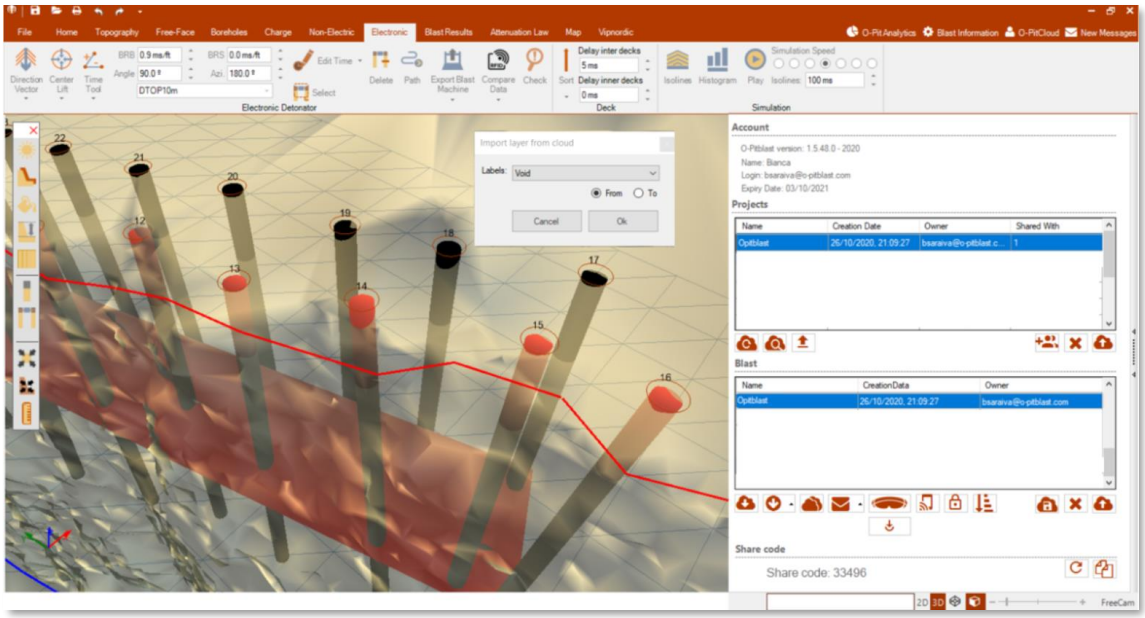


Figure 485 - Import layer from the O-PitCloud.

19.2.9. Filter Blast

This option allows the user to filter blasts within the selected project. Once activated, a window will appear where the user can enter the name of the desired blast.

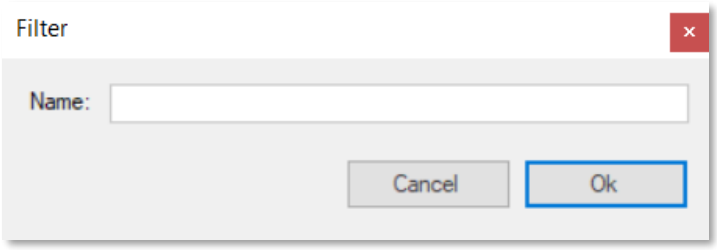


Figure 486 - Filter Blast window.

19.2.10. Share Code with Co-Workers (Share Database Information)

This option (Figure 487) enables the user to generate a code that can be shared with other O-Pitblast users. For instructions on where to paste this code, refer to Chapter 6.3.5.10.2.

The user has the following options:

- **Generate New Code**: Create a new code if the existing one does not reflect all the updated information in the database.
- **Copy Code**: Copy the generated code for sharing.

Figure 487 - Share code option.

20. Short Cuts

The following table presents the short cuts keys for each action mentioned in this Manual.

Icon	*Function*	*Shortcut*
	Save	Ctrl+S
	Open	Ctrl+O

Print	Ctrl+P
Undo	Ctrl+Z
Redo	Ctrl+Shift+Z
Toolbox	Ctrl+W
Lighting Control	L
Terrain Control	C
Change Transparency	Right-Click
Background Color	S
Bench Bottom Control	B
Show/Hide Bench Bottom	Right-Click
Hole Control	H
Timing Control	T
Centralize	Ctrl+1
Import Terrain	Ctrl+T
Import Layer	Ctrl+L
Geo-Reference	Ctrl+G
Cut Terrain	Ctrl+X
Add Holes	Ctrl+H
Edit Holes	Ctrl+E
Delete Holes	Ctrl+Del
Move Holes	Ctrl+M
Edit Toe	Ctrl+Shift+T
Select Holes	Ctrl+Q
Pattern Creation	Ctrl+Shift+P
Import Pattern	Ctrl+P
Import Polygon	Ctrl+L
Add Connection	Ctrl+Shift+A
Line Connection	Ctrl+Shift+L
Edit Timing	Ctrl+Shift+E
Initiation Hole	Ctrl+Shift+I
Delete	Ctrl+Shift+D

	Select	Ctrl+Shift+Q
	Play	Space
	Quick Zoom	Scroll + A
	Slow Zoom	Scroll + Z