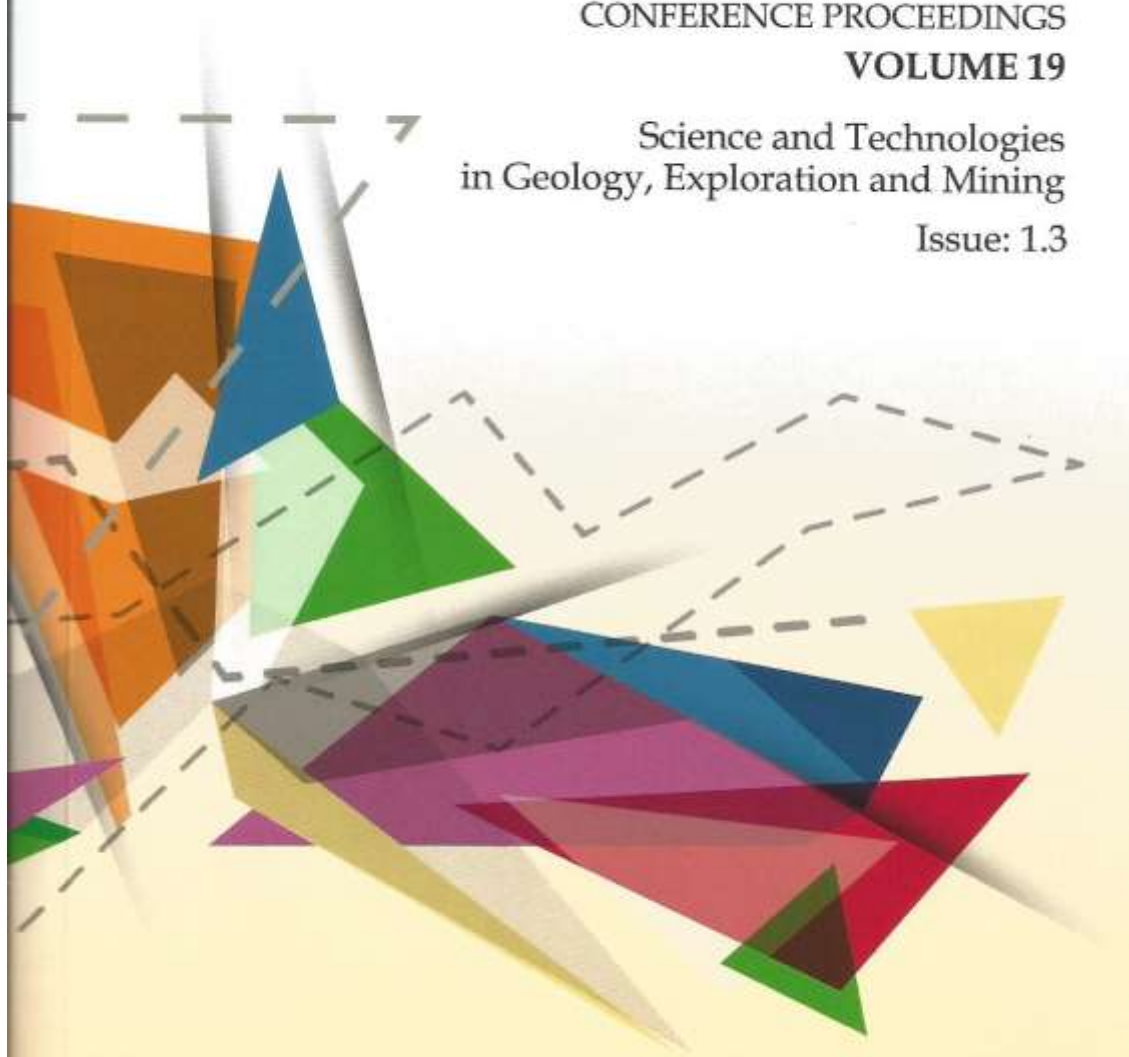


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Issue: 1.3



EXPLORATION AND MINING
MINERAL PROCESSING

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MINERAL PROCESSING

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APPLICATION OF THE QGIS 3.4 SOFTWARE IN DRILLING AND BLASTING AT SURFACE MINE IN BANJA

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ABSTRACT

Geographic Information System (GIS) is a computer system build to capture, store, manipulate, analyse, manage and display all kinds of spatial or geographical data.

GIS can also be used in the mining sector, to manage various mineral resources or to manage the exploitation of different minerals. This enables us to have in disposition all data, to all ore deposits and exploitation places, at one location and at the same time, enabling viewing, reading and printing those data that interest us.

Having the data of different exploitation places, in GIS we can also put the data of various jobs that are made in the exploitation of useful minerals, where some of these data that are very important for the exploitation of solid materials are the drilling and blasting data.

With the help of GIS it is possible for these data to appear separate or united. Separated if we want to present each the drilling and blasting elements separated and united if we want to present the aggregated data for each blasting field.

For the limestone mine "BAG" in Banja by utilizing the opportunities offered by QGIS 3.4 software , it's be possible to place on a database the data of drilling and blasting, for each drilling separately and for each field. This enables us to access this data anytime and anywhere.

Keywords: KosovaREF01, Drilling, Blasting, Software, Data

INTRODUCTION


Application of the QGIS 3.4 software in the field of drilling and blasting technology is of great importance to the mining sector because it enables us to have all the data in one location and we can have very easy access to the data we care about.

This can be done for a particular mine or can be done for all mines at the state level.


In order to make it possible to present the data in their real geographic position, it is necessary first to make the basic map, in the coordinate system of that country, in this case the coordinate system of the Republic of Kosovo (KosovaREF01).

After the made the basic map, then the introduction of Vector and Raster data is started for all the necessary data, for a realistic presentation of the drilling and blasting data.

DEFINITION OF THE COORDINATE SYSTEM KosovaREF01 IN QGIS

To define the coordinate system KosovaREF01, first we need to go to the *Settings* menu after opening the menu to click on  **Custom Projections...** and after clicking on this, a table will be opened as in Figure 1. where the coordinate system data should be entered.

The procedure for establishing the coordinating system data is:

1. Clicking in button  and will open the new place for to put the coordinate system data.
2. In the field *Name* write the name of coordinate system **KosovaREF01**.
3. In the field *Parameters* putting the parameters of Geographic Coordinate system.
4. Than clicking in the button **OK** and now will make the **KosovaREF01** coordinate system like a Figure 1.[5]

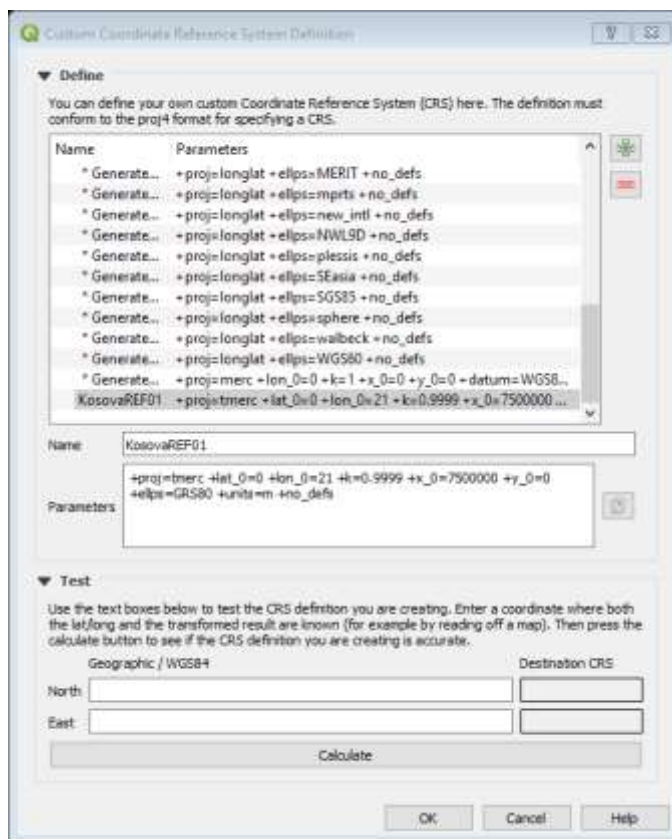


Figure 1. The KosovaREF01 Coordinate System

THE DATA OF DRILLING AND BLASTING

To set the drilling and blasting data on QGIS 3.4, you must first work a *Comma Separated Values (.csv)* file, which can be accessed using the Microsoft Excel program [1], [3], [4], [5].



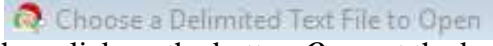
In this tabular file should be placed all the drilling and blasting data, starting from:

The geographic position of drillings, the drilling length (l), azimuth, dip, elevation, the explosive (Q), the blasted volume (V), the specific charge (q), the distance between holes in the row (a), the distance between rows (b), the stemming (l_s), the Nonel detonators, the Nonel connectors and the dynoline[6]. And these data looks like a Figure 2.

HoleID	Hole dept	Easting	Northing	Azimuth	dip	elevation	Explosive Volume (ra [m])	b [m]	Specific c	Stemming	Nonel det	Nonel Cor	Dynoline [m]
1	7	7482827	4701767	2	75	642	23.81	60.86	0.39	2.5	1	1	1
2	7	7482830	4701767	2	75	642	23.81	60.86	0.39	2.5	1	1	1
3	7	7482833	4701768	2	75	642	23.81	60.86	0.39	2.5	1	1	1
4	7	7482836	4701769	2	75	642	23.81	60.86	0.39	2.5	1	1	1
5	7	7482839	4701769	2	75	642	23.81	60.86	0.39	2.5	1	1	1
6	7	7482842	4701770	2	75	642	23.81	60.86	0.39	2.5	1	1	1
7	7	7482844	4701770	2	75	642	23.81	60.86	0.39	2.5	1	1	1
8	7	7482847	4701771	2	75	642	23.81	60.86	0.39	2.5	1	1	1
9	7	7482850	4701772	2	75	642	23.81	60.86	0.39	2.5	1	1	1
10	7	7482853	4701772	2	75	642	23.81	60.86	0.39	2.5	1	1	1
11	8	7482854	4701769	2	75	643	26.04	69.55	0.4	2.7	1	1	1

Figure 2. Drillings and blasting data

After placing the drilling and blasting data in the Microsoft Excel workbook, then we have to follow some steps to place this data in QGIS 3.4 and these steps are as follows:

1. Go to **Manage Layers Toolbar** and click the button , where it will open the dialog box **Delimited Text**.
2. Then on the right side of the field **File name**, click the button  and will open the table , select the drilling and blasting data file and then click on the button **Open** at the bottom of the table.
3. Then click on the **X field** and choose **Easting**, after that on the **Y field**, choose **Northing**.
4. Now click on the **Geometry CRS** and choose the coordinate system: **USER: 100026 – KosovaREF01**.
5. After that click on the button **Add** and will presented on the QGIS 3.4 the positions of the drillings, and they will look like in Figure 3, hereafter [2], [5].

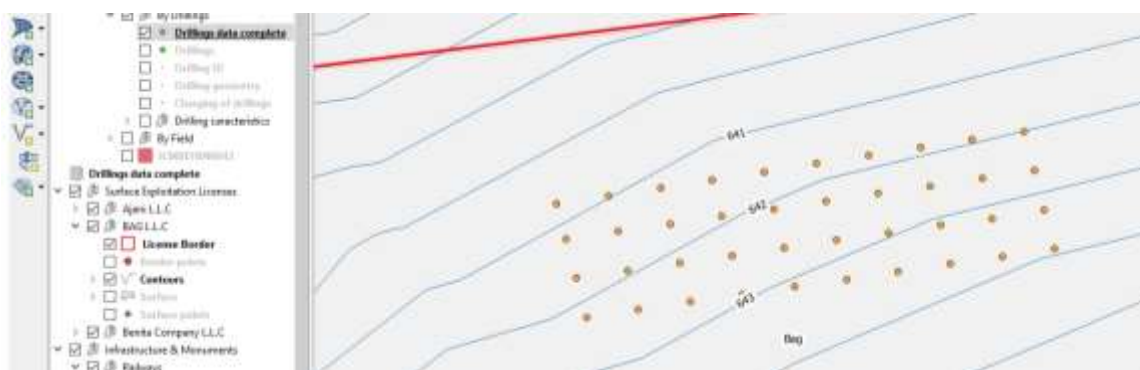


Figure 3. The presentation of drillings

After the presented of the drillings position, then it is necessary to present the data of each drilling. This is done by forming three New Layer named: **Drilling ID**, **Drilling Geometry and Charging of Drillings**, by clicking with the mouse over **Drillings** and clicking on the **Duplicate Layer** [5].

Then using the *Labels* we can present the necessary data for each drilling separately. To do this we need to follow these steps:

1. Go to *Label Toolbar* and click *Layer Labelling Options*, where it will open the *Layer Styling* dialog.
2. After this action click on the place where is written *License Border* to make the Layer selection and in this case choose it *Drilling ID*.
3. Then click on the white field on *Label with* and write the rule 'No.||format_number(("HoleID" /1),0)||' , to present the desired number format and supplements before the number [1], [3], [5].
4. Then, as desired, adjustments to the design of the data presentation are made using under the windows such as:


- | | |
|---------------|--|
| a. Text | |
| b. Formatting | |
| c. Buffer | |
| d. Background | |
| e. Shadow | |
| f. Placement | |
| g. Rendering | |








And after the adjustments made to these under the windows, then click on the *Apply* button and the data for the number of each drilling will be shown, as shown in Figure 4, below.



Figure 4. Presented the number of drilling

To set the data of each drilling according to *Drilling Geometry* layer we should follow these steps as follows:

1. Then go again to **Label Toolbar** and click **Layer Labelling Options**, where it will open **Layer Styling** dialog and as in the previous case we choose the Layer for which we have to present the data, in this case **Drilling Geometry**.
2. Then click on the slider **Single label** and choose the option **Rule-based labelling**, where an under the window will open in order to set the labelling rules.
3. Then click on **Add Rule** and will open under the window, where the rule of data submission is established and adjusting design of presentation is done.
4. Then click on the button  on the field **Label with** and the window will open, in which we write the rule of data presenting. Where on the left side of the table we write the rule 'Drilling depth = '|format_number(("Hole depth [m]" /1),2)|' m', to display the drilling depth data, then click on the **OK** button and return to the previous window [3], [5].
5. Then, as desired, adjustments to the design of the data presentation are made using under the windows such as:

- | | |
|---------------|---|
| a. Text |  |
| b. Formatting |  |
| c. Buffer |  |
| d. Background |  |
| e. Shadow |  |
| f. Placement |  |
| g. Rendering |  |

And after the adjustments made to these under the windows, then click on the **Apply** button and the data for the drilling depth of each drilling will be shown.

The same procedure from point 1 to point 5 should also be followed for setting other drilling data, such as: distance between drillings in row "a" using the rule ('a = '|format_number(("a [m]" /1),2)|' m'), the distance between rows "b" using the rule ('b = '|format_number(("b [m]" /1),2)|' m') and drilling volume data "V" using the rule ('Volume = '|format_number(("Volume [m3]" /1),2)|' m^3') [1], [5], [6].

Then click on the button **Apply** and will presented the drilling geometry data as shown in Figure 5. Below.

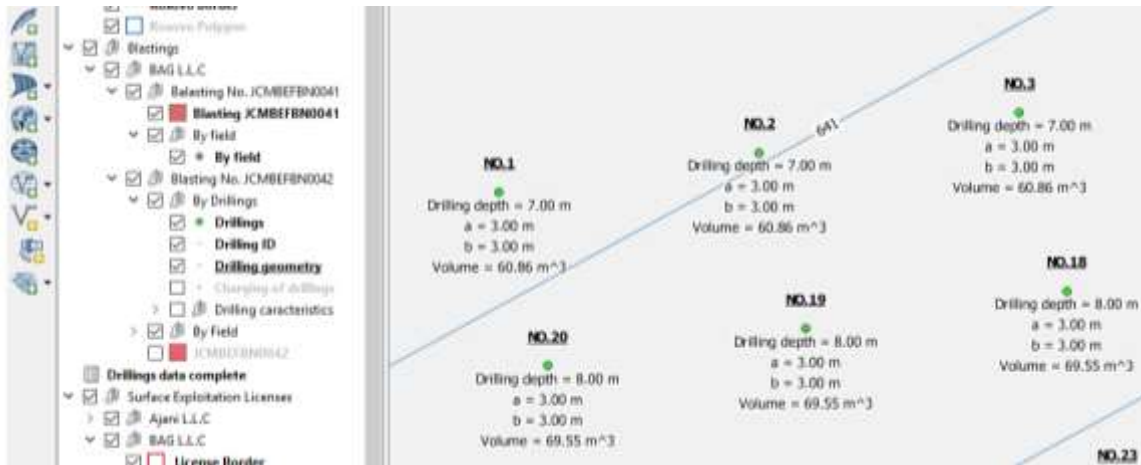


Figure 5. Presentation of drilling geometry

The same procedure as for drilling geometry data should also be followed for setting up data for filling drills with explosive and following the execution of these steps above, the filling data with explosive will appear as shown in Figure 6, below.

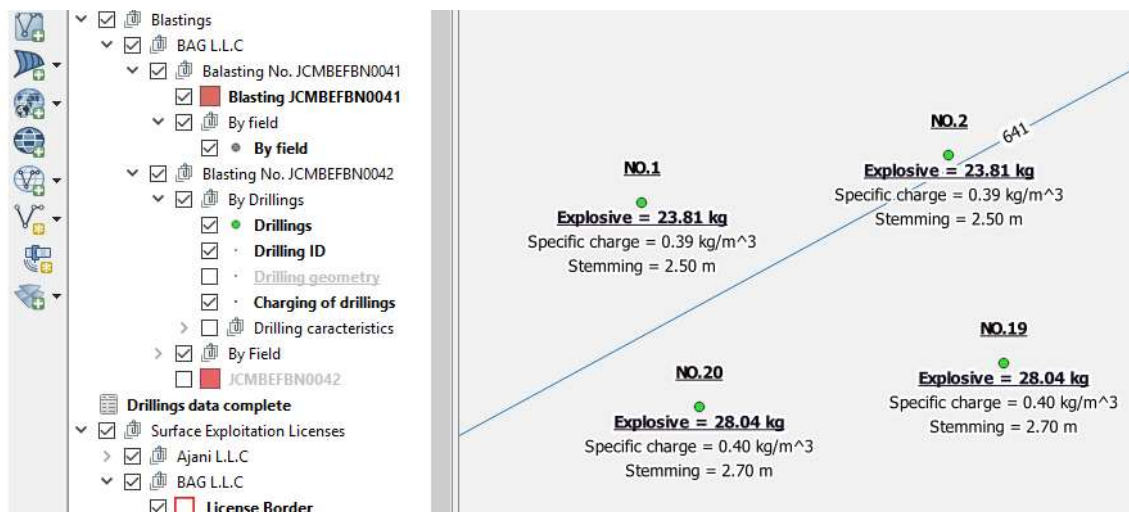


Figure 6. Presentation the filling of drillings

Also, these data can also be presented as a total for each mining field. In order to present the data as very general for each field, the *Comma Separated Values (.csv)* file should be processed, which can be worked out using the Microsoft Excel program, with the total amount data and steps should be followed the same as the data for each drilling, except that a point on the field should be taken to enable the data to be displayed at that point within the blasting field [1], [3], [4], [5]. These data after executing the steps above will look like in Figure 7, below.



Figure 7. Presentation of drilling and blasting parameters for a field

CONCLUSION

Based on what was discussed above, we can see that the use of GIS is of great importance during exploitation with blasting.

With the application of GIS in mines, it is possible to have accurate data in real time and to use those data at certain moments as needed.

QGIS 3.4 in mines can be used:

To submit mining data within the entire territory of the state, having the data such as: blasting field coordinates, drilling data, explosives data, initiation system data and security mases data. Based on these data and other data that may be located in QGIS 3.4 such as: settlements, buildings, roads, etc. We can also present the radius of impact of the blasting on the surrounding objects, depending on the amount of explosive initiated at the same time and the distance of objects from the blasting field.

It can also be used to present the data of each drilling as e.g. geographic position data of drilling, drilling depth, drilling angle, azimuth, drilling diameter, distance between drilling in the row, distance between the rows, the volume resulting from the mining of a drilling, the length of filling, the stemming, the quantity of explosive, the initiation system, the quantity of the initiating material, the specific consumption of the explosive etc. Also it can be used to create a database for internal and external using.

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