TOPO-GEODESIC WORKS REQUIRED FOR EVALUATION OF EXCAVATED VOLUMES FROM RĂZBOIENI CLAY QUARRY, ALBA

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Abstract

Through studies and research in this paper was intended to carry out the calculations of volumes of clay excavated from Razboieni quarry, Alba county, in order to locate and quantify the amount of material excavated from an excavation in case of embankments. Topographic surveys were made by specialized teams strictly following the steps of obtaining the topographic plan: enriching the support network, obtaining the levelling network and obtaining the topographic plans. The measurements followed by office calculations performed by automated methods and through dedicated software will determine the volumes of the amount of sterile soil respectively the amount of extracted clay.

Key words: clay, embankments, network, volume.

INTRODUCTION

In the work of mining and quarrying extraction, volume calculation is very important both economically and in terms of development and automation of the calculation. In this paper we want to put out the differences between working methods and differences that we have obtained from the measurement and calculation of the volume of sterile soil, and clay excavated during 2007-2009 from the "Groapa Mare" quarry near the city of Razboieni , Alba county (Figure 1).

Figure 1. Orthophotomap of the clay quarry

The calculation methods were developed along with technology. One of the classical methods of calculating volumes is the truncated pyramid method. This method consists of construction of fixed transversal profiles on the embankments. Calculating the areas of the geometrical figures formed by the profile before and after excavation and measuring the digging depth and the distance between two or more profiles we can calculate the volume of the excavated material (Dima et al., 1996; Fodor, 1980). This calculation method requires a lot of attention and working time. The development of computer technology and informatics brought benefits by creating programs and software that performs these calculations much faster and more accurate

MATERIALS AND METHODS

To facilitate measurements, around the clay quarry area there were built a network of points whose coordinates were determined with high precision and were materialized in the ground by concrete terminals. These points were stuffed from the state geodetic network. The topographic survey of the area was made by traverse method combined with removal. Points determined with high precision (Table 1) and the ability to target state geodetic network points allows us to verify all measurements and to reduce the

errors (Ortelecan, 2006), (Figure 2). The equipment that was used to make the measurements was the Leica TCR 805 total station.
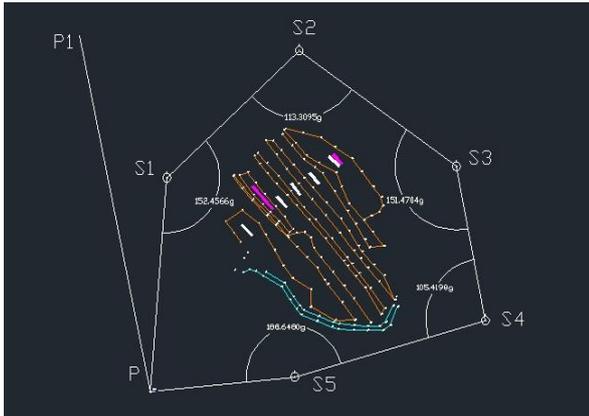

Figure 2. Traverse method

Table 1. Coordinates of the network points around the quarry

Point	x	y
P	550728.6000	412245.6300
1	550937.5287	412262.0165
2	551061.6615	412396.4140
3	550948.6479	412556.0574
4	550798.2995	412585.3590
5	550743.1733	412391.9140

At the office we have downloaded the data from de device and we made the topographic plans for the measurements from the years 2007 and 2009. Using specialized software enabling a 3D design we managed to make 3D models showing approximately the real situation of land during the time we are analyzing the amount of clay that is excavated. The software we used for the analysis of volume calculations are:

- Surfer 9.8
- AutoCAD 2004 – TopoLT
- AutoCAD Civil 3D 2013

RESULTS AND DISCUSSIONS

After realizing the 3D models with all three software in both of the years 2007 and 2009 , we overlapped them. The difference between the two 3D models is the amount of the excavated material from the quarry between years 2007 and 2009 (Figure 3, Figure 4). With AutoCAD Civil 3D 2013 we obtained the following 3D models :
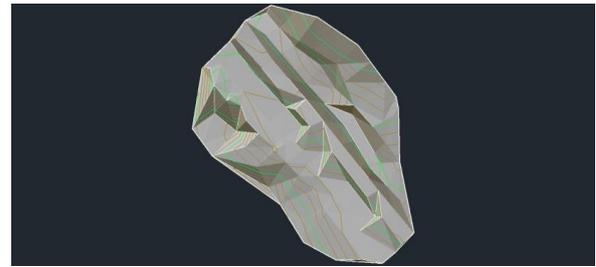

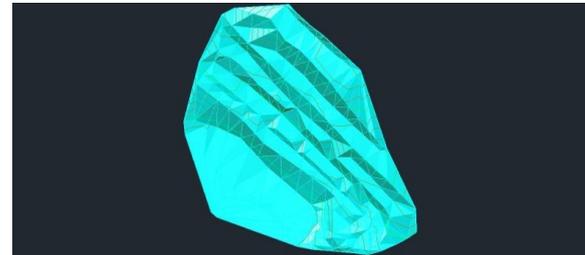Figure 3. AutoCAD Civil3D 2013 2007 exploitation

Figure 4. AutoCAD Civil3D 2013 2009 exploitation

The models were made using Tin surface option which can develop a series of definitions like drawing objects, borders, major contour, minor contour, triangles, 3D geometry.

The volume was calculated using the volumes dashboard (the Cut and the Fill) (*** http://usa.autodesk.com/civil-3d/).

TopoLT is an extension for AutoCAD used in the topography for several operations. The program is developed by a Romanian company (Ionel, 2004, 2004; ***http://www.topolt.com/).

For the volume calculation the program automatically overlap the chosen 3D model and calculates the Cut and Fill volumes (Figure 5, Figure 6).

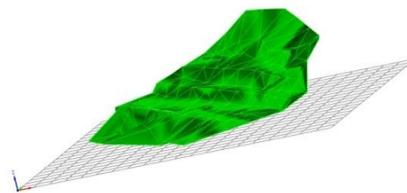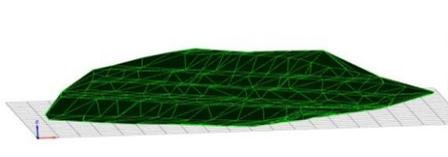Figure 5. AutoCAD 2004 – TopoLT 2007 exploitation

Figure 6. AutoCAD 2004 – TopoLT 2009 exploitation

Figure 7. Surfer v.9.8 2007 exploitation

With the Surfer Version 9.8 we used the coordinates to create a grid file. With the grid file we were able to create the 3D model. (Figure 7, Figure 8) With the 3D model the software calculates automatically the volumes (***http://www.goldensoftware.com/).
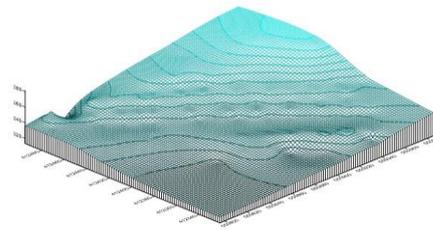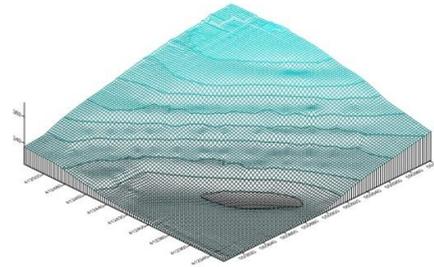

Figure 8. Surfer v.9.8 2009 exploitation

Table 2. Results of the volume calculations

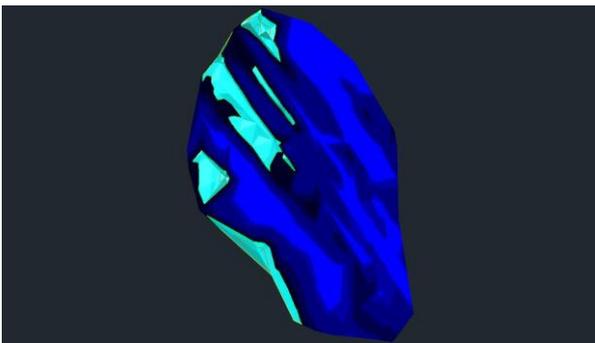| Software	Cut	Fill	Cut+Fill
Autodesk Autocad Civil3D 2013 (fig. 3, fig. 4)	91304.01 m³	1508.10 m³	92812.11 m³
Autodesk Autocad 2004 – TopoLT (fig. 5, fig. 6)	91717.43 m³	1341.93 m³	93059.36 m³
Golden Software Surfer v.9.8 (fig. 7,fig. 8)	90942.35 m³	1720.12 m³	92662.47 m³

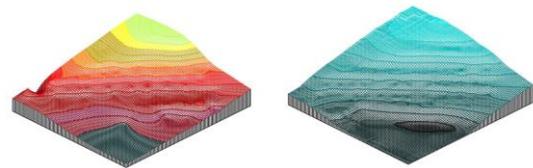Figure 9. Autocad Civil3D 2013 – The overlapping of the 3D models

Figure 10. Autocad 2004 – TopoLT - The overlapping of the 3D models

Figure 11. Surfer v.9.8 – Comparison between the 3D models

CONCLUSIONS

Between these three software programs the most precise is the AutoCAD Civil 3D 2013 from AutoDesk because it makes the best 3D model using a triangulated irregular network (Figure 9, Figure 10). The TopoLT extension of AutoCAD works on the same principle as AutoCAD Civil 3D 2013 but it is not accurate as this because AutoCAD Civil 3D 2013   the newest version of the AutoCAD programs and it is fully improved from the previous versions.

The volume calculation results that we have obtained using the Surfer v.9.8 (Figure 11) program are not very accurate as the results from both the AutoCAD Civil3D 2013 and TopoLT extension of AutoCAD 2004 because the 3D models were made on different principles and construction methods. Also in Surfer v.9.8 we couldn't overlap the two 3D models so we couldn't see the cuts and the fills between the two measurements in 2007 and 2009 (Table 2).

ACKNOWLEDGEMENTS

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***http://www.goldensoftware.com/
***http://www.topolt.com/
***http://usa.autodesk.com/civil-3d/