

STONE QUARRY SCANNING TECHNIQUES USING DR TOTAL STATIONS

Aurelian-Stelian BUDA, lecturer PhD. eng. - University of Oradea, Faculty of Architecture and Constructions – mail: budaarelian@yahoo.com

Éva Magdolna KONCSAG, lecturer PhD. stud. eng. - University „1 Decembrie 1918” Alba Iulia, Faculty of Sciences – mail: eva_koncsag@yahoo.com

Norbert-Szabolcs SUBA, assistant PhD. stud. eng. - University of Oradea, Faculty of Architecture and Constructions, mail: suba_norbert@yahoo.com

Abstract: *The data acquisition and processing technique described below will highly facilitate the scanning procedure of stone quarries (and not only), and will also contribute to a more efficient way of exploiting these quarries, which are very important environmental and economical requirements. At the base of this technique stands an almost classical total station, with servo drive and reflectorless measuring capabilities. This total station can comply with the precision required in these types of measurements, and the data processing software allows us to plan the future exploitings. This technique, having in mind the more and more exigent requirements of different public and governmental agencies, makes possible for achieving greater accuracy and allows the efficient management of small to medium size quarries.*

Keywords: *step-by-step scanning, stone quarry, volume calculation*

1. Legal basis

In Romania, mining activities are governed by laws and reglementations. The law governing activities in the mining domain is the Law of the Mines (Law no. 85/2003), and the topographical activity in mining is reglemented by the Mining Topography Reglementation.

The latter mentioned indicates the ways to obtain field data, the presentation mode of the final products, as well as the required periodicity of making these observations.

If we apply the technology-method principle, then we must treat the mining domain at current standards.

The main beneficiaries of these information are:

- NAMR (National Agency for Mineral Resources – or ANRM in Romanian)
- NACREP and OCREP (National Agency of Cadastre and Real Estate Publicity and territorial Offices of Cadastre and Real Estate Publicity – or ANCPI and OCPI in Romanian)
- National Agency for Protecting the Environment
- town halls
- other institutions

2. Applied method

The basis for this work is the scanning of the working front through laser tracker (step by step) and processing these information with adequate programmes. The scanned objective is the Urviş stone quarry in Bihor county, Romania.

The comparative calculations are the result of the necessity to make two measurements over the same entity or to distinguish a result by two different calculation methods.

The scanning of the working front represents a series of advantages:

- reduced work time
- when using the Total Station-GPS technology with stationing bases which were anterior determined, the problem of the classical positioning disappears
- for volume calculations, only the excavated zones are used
- reduced time span for obtaining the results
- revelation of the zones in the snag

3. Technology used

For data acquisition we used the Trimble S6 Total Station. In the following picture, we will present the characteristics of the total station regarding the scanning process and the total station itself.



		Trimble S6
<i>selection of scanned surface</i>		polygonal, rectangle, specify 3 points, through the telescope
<i>angle accuracy</i>		5" (1.5 mgon)
<i>distance accuracy</i>	<i>Standard</i>	± (3 mm + 2 ppm)
	<i>Tracking</i>	± (10 mm + 2 ppm)
<i>scanning speed</i>	<i>Standard</i>	1 point / 1 - 5 sec.
	<i>Tracking</i>	1 point / 0.4 sec
<i>min. dist. between pts.</i>		10 mm

Fig. 1. The Trimble S6 Total Station and some technical details

This total station has the possibility to measure points in reflectorless mode up to 150-200 meters on hard rock surface. Also, the total station has a large amount of memory at its disposal to record all the data from the field. The scanning process was realized using steps between 0,5 – 1 meters (due to the large surface and the lack of important details) and manual observations were added in the zones of higher importance.

The points resulted from the scanning process were imported and processed in the Trimble Business Center software, which gives us the possibility to create the 3D model of the scanned area from the point cloud obtained after the scanning. Besides this, the software allows us to overlay different models created after different scanning sessions in order to calculate the excavated volume.

4. Work process – in pictures



Fig. 2. Work zone – stone quarry, Urviş locality, Bihor county



Fig. 3. Work zone – stone quarry, Urviş locality, Bihor county



Fig. 4. Scanned zone in detail – stone quarry, Urviş locality, Bihor county

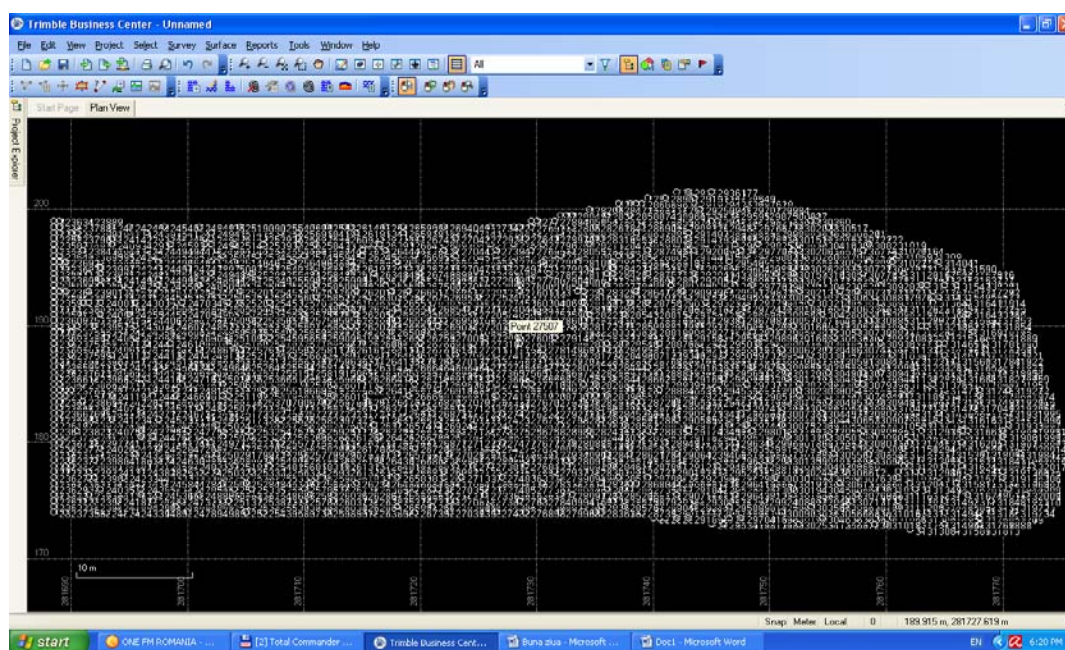


Fig. 5. Point cloud obtained after the first scanning session

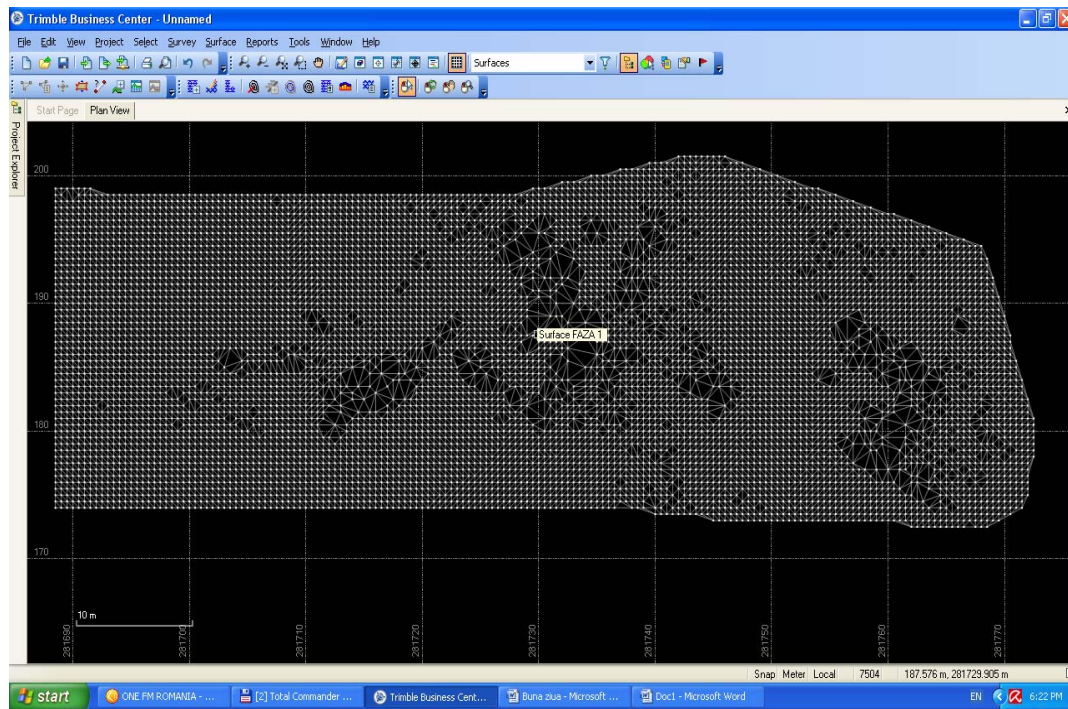


Fig. 6. TIN (Triangular Irregular Network)
 created after the first scanning session, before the blasting

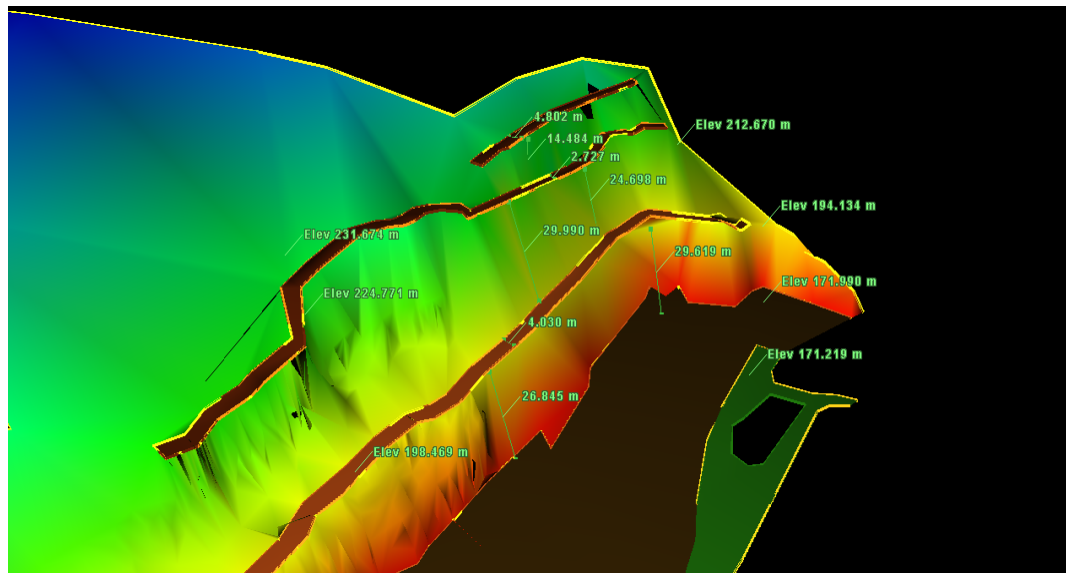


Fig. 7. Detail on measurable quantities on the scanned surface

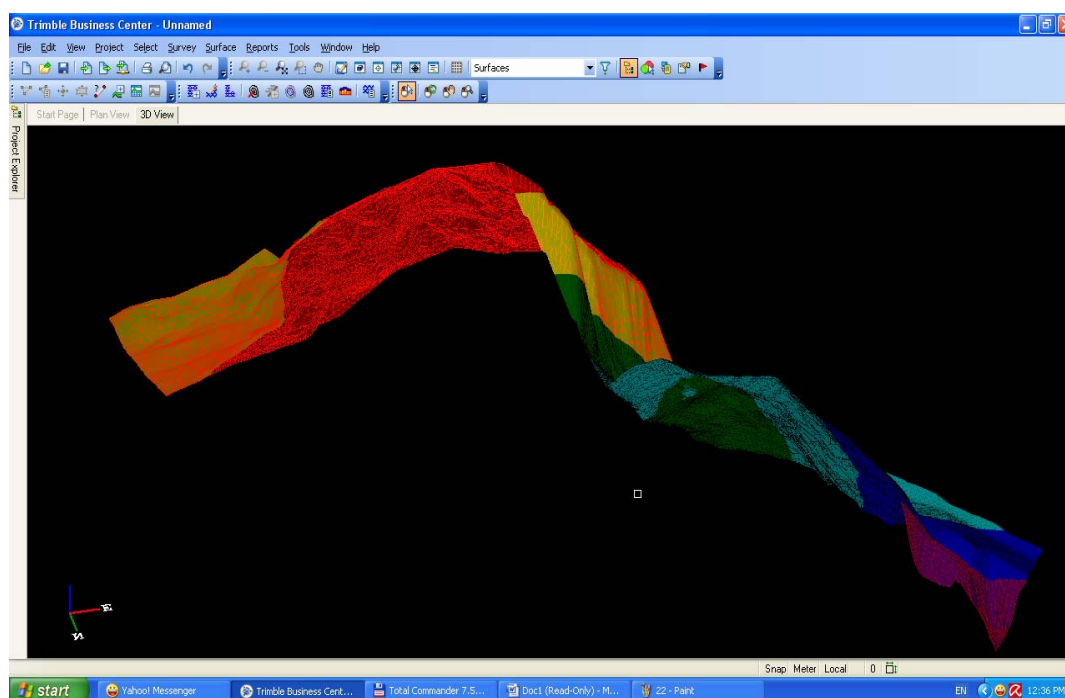


Fig. 8. Color coded 3D model

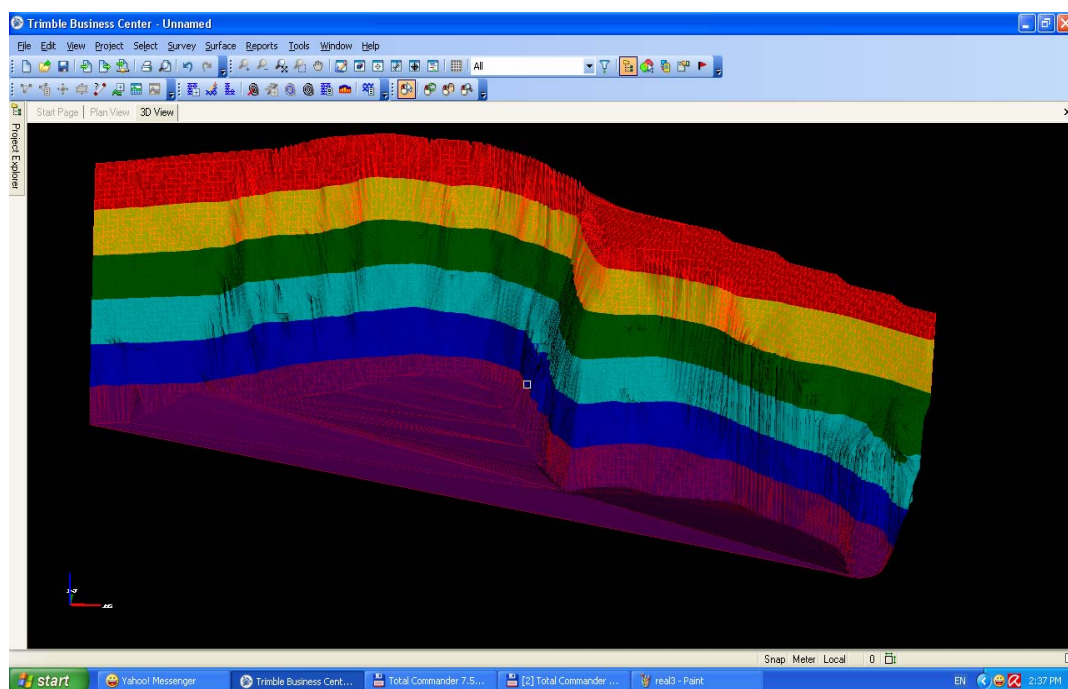


Fig. 9. Color coded (by height) 3D model of the whole site

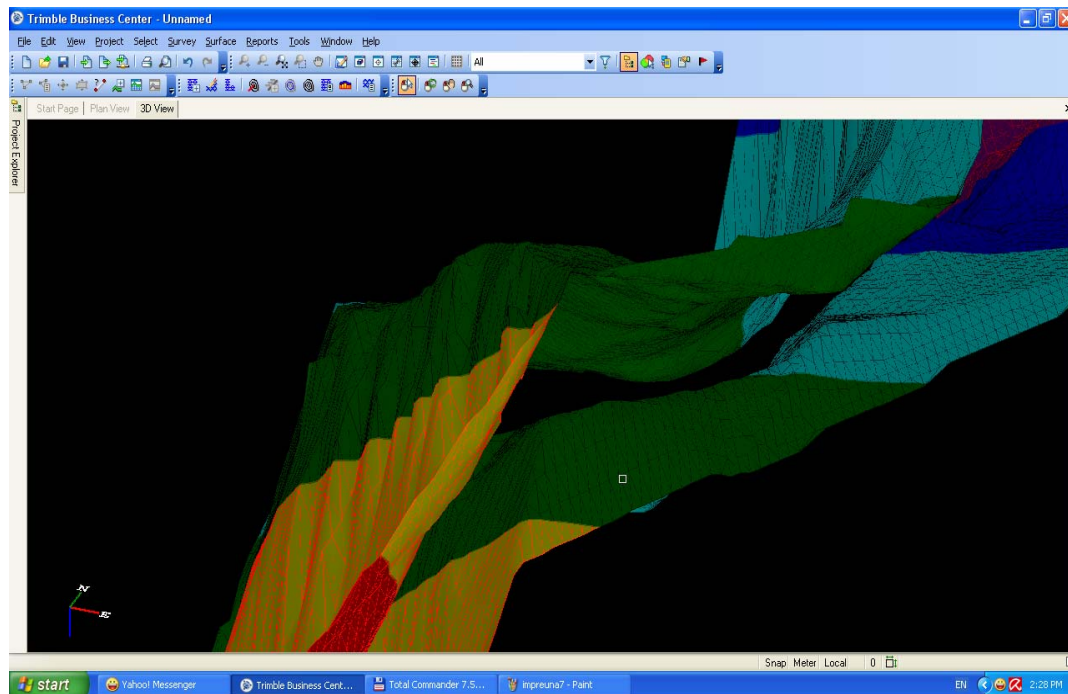


Fig. 10. Detail of overlaid models resulted from two different scanning sessions

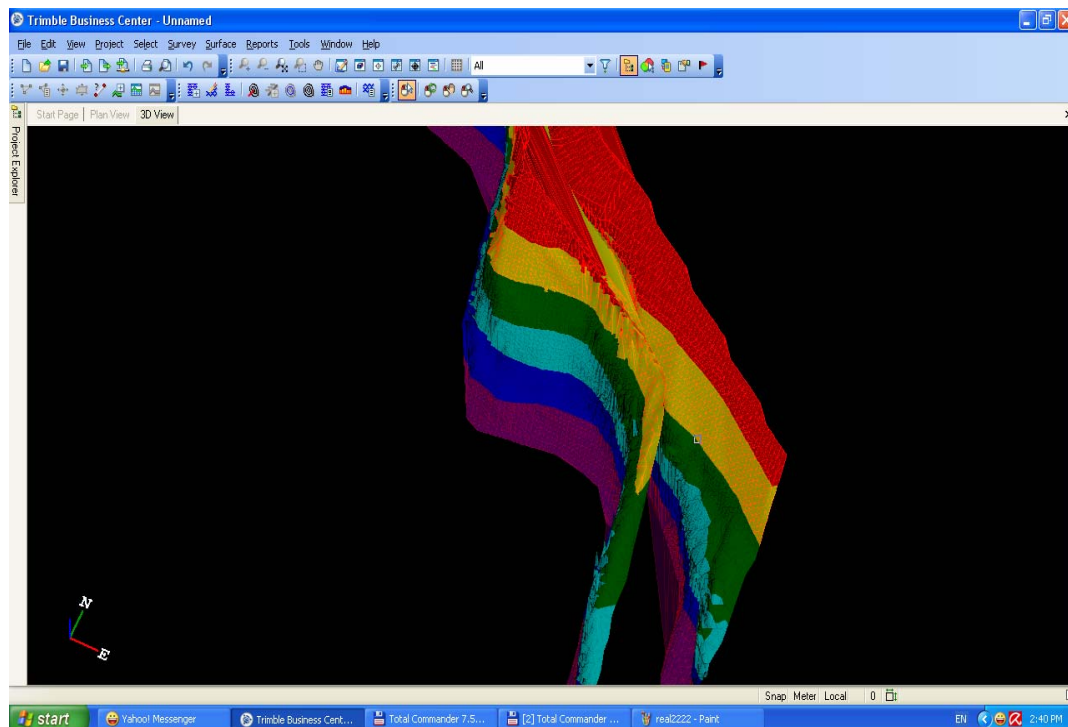


Fig. 11. Detail of overlaid sites resulted from two different scanning sessions

5. Conclusions

The presented technique makes for easier data acquisition on the field and resolves some problems which appear during the calculation of excavated volumes. The reality on the field leads to the apparition of new problems, which needs solutions based on the actual technology.

The step by step scanning technique represents a solution with applicability in the case of the small and mid-sized quarries. The used apparatus can be considered classical if we have in mind that scanning operations can be made with any total station equipped with servo direction and reflectorless distance measurement capability up to the distance of 200 – 300 meters.

In conclusion, we can better approximate the excavated volumes, which will enhance the quarry's material and economical efficiency.

6. References

1. Suba S – Suba N.Sz. – Nistor S – Buda A.S.: *Scanning techniques in creating three dimensional models*, *The National Technical-Scientific Conference „Modern technologies for the 3rd Millenium”*, Oradea, 2009.
2. *** (2009), *Trimble Navigation Limited*, www.trimble.com, 02.2010
3. *** (2009), *Wikimedia Foundation*, www.wikipedia.org, 02.2010