

## Building-Pit Survey: Calculation of Excavation-Volume

TLS (Terrestrial Laser Scanning) is the most practicable workflow for this kind of application. The main factors are high speed data-acquisition in combination with high accuracy of the acquired data. The results can be delivered as written reports or as map-plots. The paper describes shortly the workflow of data-acquisition and points out the deliverable results.

### Project Key-Facts:

<b>RIEGL instrument</b>	LMS Z-420i
<b>Object of interest</b>	building-pit, Health-Center Bad Sauerbrunn (Austria)
<b>Client's order</b>	calculation of excavation-volume and visualization of results on printable plots.
<b>Project management</b>	Alpine Austria and Riegl LMS

### Process Key-Facts:

<b>Number of field surveys</b>	2
<b>Time needed for each campaign</b>	3.5 hours measuring time
<b>Time needed for post processing</b>	1 day
<b>Acquisition workflow</b>	high resolution panorama scan (VxH 80x360°), registration of scan-data was realized by retro-reflectors measured by the local-surveyor
<b>Acquisition platform</b>	standard surveying tripod

### Scanner at work:



The field survey was carried out before starting excavation and after finishing excavation. Fig. 1 shows the situation in field. The panorama-images were automatically calculated from the images, taken by the mounted calibrated camera. This image-data can be used either for texturing the resulting 3D-model, or extracting 3D-measurements based on the laserscan-data (3D-monoplotting).



Fig.1

Riegl's RiSCANPRO software offers tools for automatic extraction of noisy data like vegetation, vehicles, etc. After removing these wrong measurements, the point-cloud, consisting of around one million points per data-set, is triangulated to get a closed surface-mesh of the data. The final 3d-surfaces of the two measurement-campaigns colored by height are shown in Fig. 2.

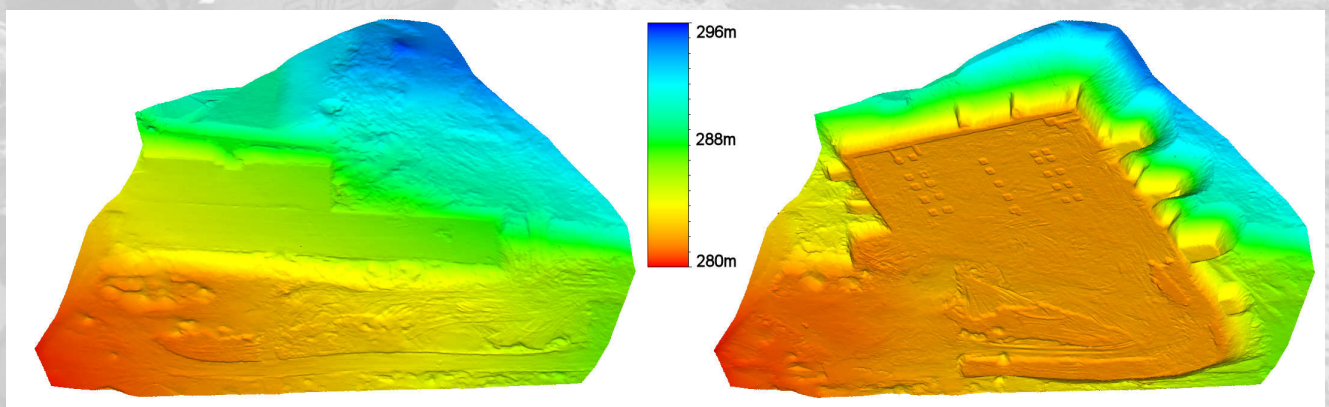


Fig. 2

Based on the 3D-surfaces contour-lines and profiles of any orientation are extracted automatically (Fig.3) The resulting 3D-polylines can be exported in dxf-format to AutoCAD. By defining an outline-polygon the excavation-volume is calculated. The results are shown in numbers as cut- and fill-volume, and can be also visualized by coloring the 3D-surfaces according to their height-differences (Fig. 4).

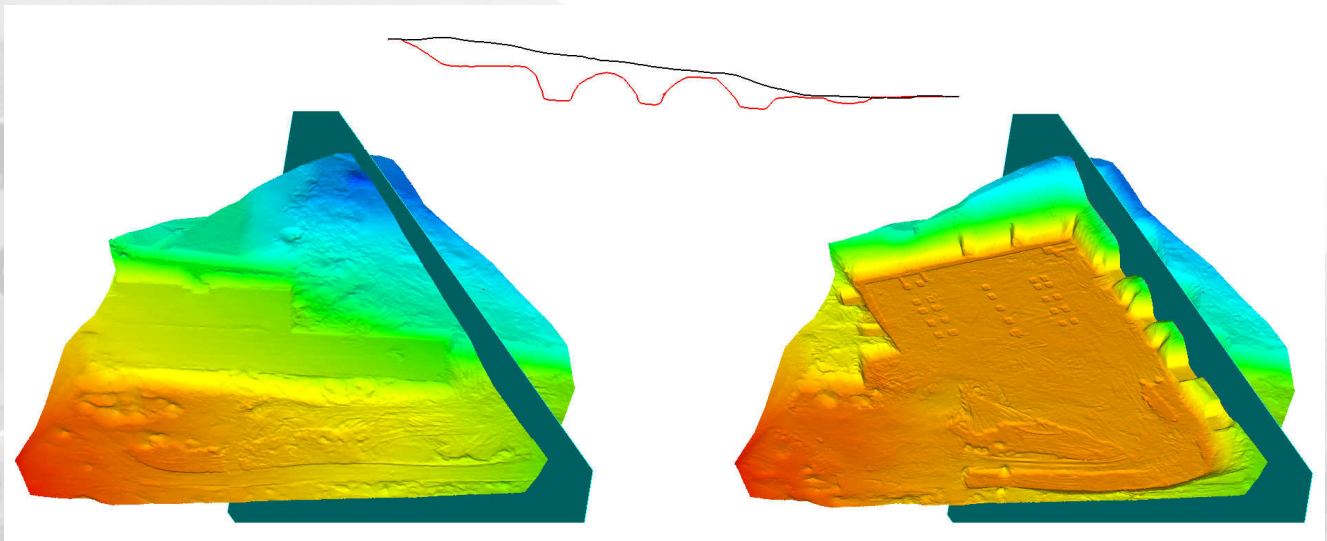


Fig. 3

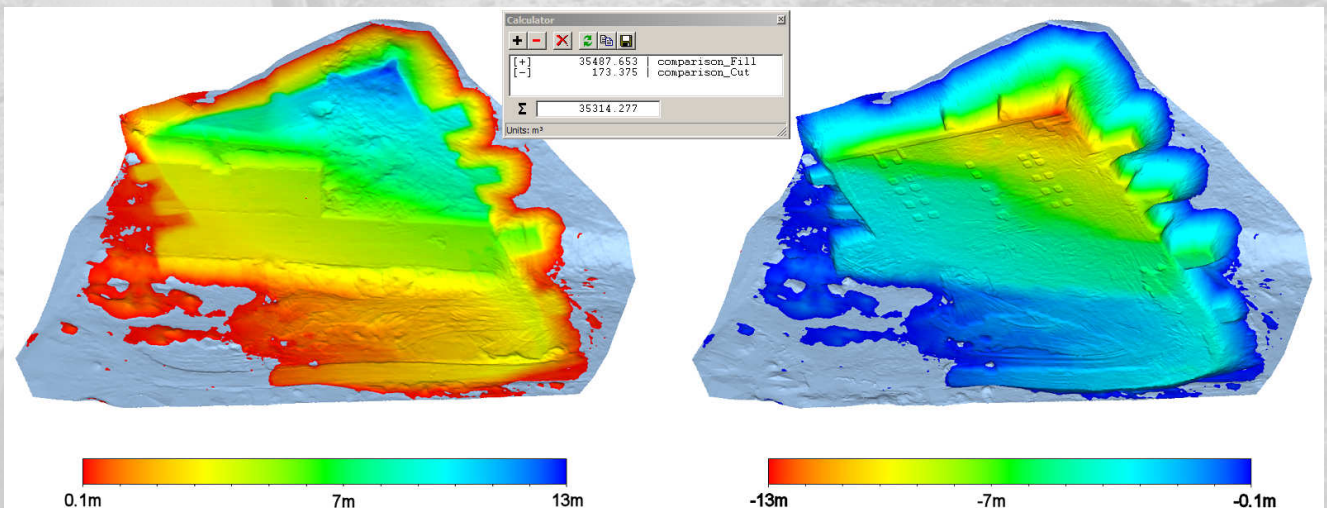


Fig. 4

The costs of excavation differ according to the excavated height. Therefore it is necessary to calculate volumes for separated layers of excavated height. In this special case-study the price per m<sup>3</sup> excavated material is higher at a depth of 7m or more. Fig 5 shows the result of of excavated material deeper than 7m below the initial surface. The volume can be calculated also as a closed block for further analysis (e.g.: calculating profiles).

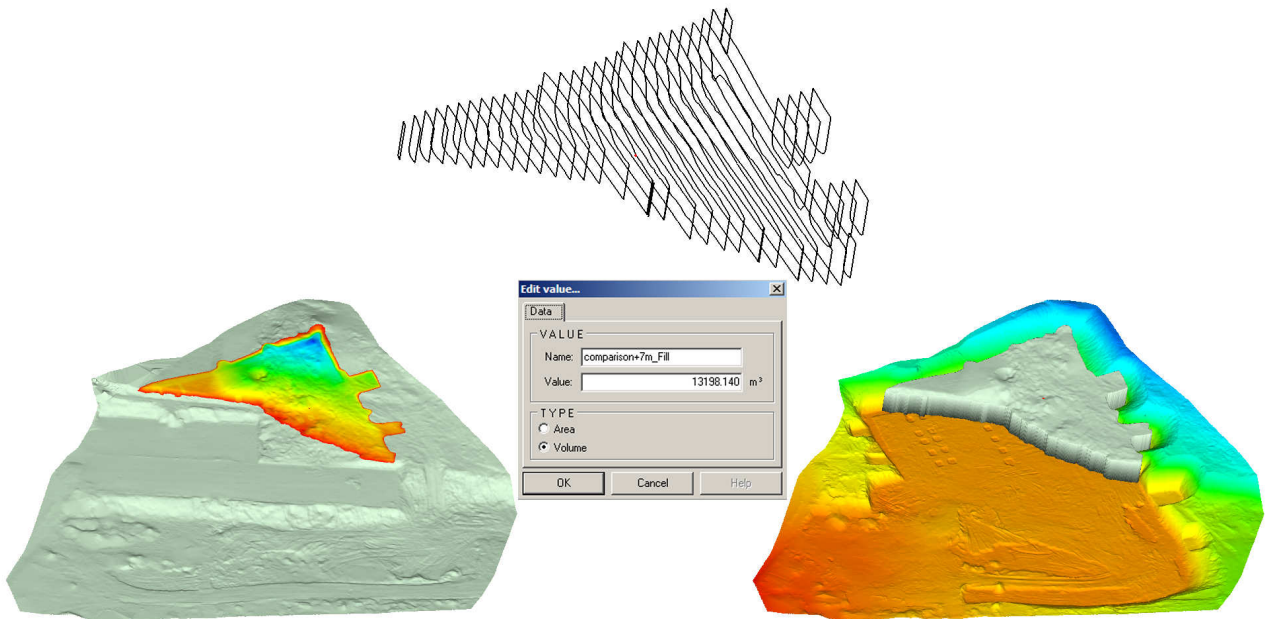


Fig. 5

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