Paper Number: 2674

# 3D reconstructions of gneiss quarries through long-range laser scanning for a quantitative volume estimation of dimension stones

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Nowadays, the economic activities of dimension stone quarries are menaced by the increase of production costs due to (i) continuously changing demand because of the evolving dimension stone fashion and (ii) increasing administrative limits and rules acting to protect the environment. These costs add to the exploitation costs related to the geological phenomena such as fractures, faults and heterogeneous rocks that hinder the processing of the stone product. In Canton Ticino (Southern Switzerland), the exploitation of dimension stone, mostly gneisses, is an important activity of valley's economies that is facing the aforementioned problems. Therefore, the sustainable development for the next decades of the dimension stone sector needs new and effective strategies to regulate and plan the quarries.

A fundamental step in this process is the building of a 3D geological model of the quarries to constrain the volume of commercial dimension stone and the volume of waste. In this context, we conducted Terrestrial Laser Scanning surveys of the quarries in the Maggia Valley to obtain a detailed 3D topography onto which the geological units were mapped. The topographic 3D model was obtained with a long-range laser scanning Riegl VZ4000 that can measure from up to 4 km of distance with a speed of 147,000 points per second. It operates with the new V-line technology, which defines the surface relief by sensing differentiated signals (echoes), even in the presence of obstacles such as vegetation.

Depending on the aesthetics of the gneisses, we defined seven types of dimension stones that, together with faults and joints, were mapped onto the 3D models of the exploitation sites. According to the orientation of the geological limits and structures, we projected the different rock units and fractures into the excavation front. This way, we obtained a 3D geological model from which we can quantitatively estimate the volume of the seven different dimension stones (with different commercial value) and waste (with low commercial value).

To verify the 3D geological models and to quantify exploited rock and waste volumes the same procedure will be repeated after ca. 6 months.

Finally, these 3D geological models can be useful to (i) decrease the exploitation costs because they yield the extraction potential of quarry, (ii) become more efficient in the exploitation and more dynamic in the market because they permit better planning and (iii) decrease the waste by limiting the excavation in regions with low-quality rocks.