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Terrestrial and airborne laser scanner techniques applied to rock slope instability analysis: the case of Einser-Cima Una (Sexten Dolomites, Italy)

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A representative characterization of a rock instability phenomenon is a fundamental task in the understanding of its evolution and the forecasting of possible further slope failure. The first step towards a complete study of the unstable slope consists in its detailed geometrical, geomechanical and kinematical characterization in order to generate a high resolution 3D digital model of the investigated area, recognize the main discontinuity sets of the rock mass, evaluate displacements and deformations occurred between subsequent surveys. This kind of study can be carried out by means of remote sensing techniques like terrestrial (TLS) and airborne laser scanner (ALS), which allow detailed investigations of a rock cliff in remote and safe mode. In particular, TLS allows the acquisition of the sub-vertical cliffs, whereas ALS provides information over wide areas with higher performances in sub-planar surfaces.

These remote sensing techniques has been applied to analyze the northern rock wall of Einser-Cima (Fischleintal-Val Fiscalina, Sexten Dolomites, Bozen, Italy), whose higher portion was involved by a large (45000 m3) rock collapse occurred on October 12th, 2007. Two TLS measurements sessions were carried out, in November 2007 and in October 2008 respectively, considering two suitable viewpoints placed at about 200 m distance from the main failure surface, providing a sampling step of 10 cm. The analysis of TLS data allowed a detailed reconstruction of the surface geometry as well as a description of orientation, persistence, spacing and aperture of the rock mass discontinuity sets and the characterization of orientation and roughness of the failure planes. Moreover, comparisons between the two TLS-based point clouds allowed the analysis of displacements and deformations, as well an accurate evaluation of the open joint apertures.

ALS data of the whole region acquired by the Geological Service of Bozen Province in 2004-2005 was also available. These data, having a mean sampling step of about 40-50 cm, represents the conditions before the cited 2007 landslide. In this way, direct comparison between the ALS and TLS data provided a volume estimate of the fallen rock mass. Integration of ALS and TLS data allowed also the characterization of the main structural and geomechanical features, both at the slope scale and on wider area. Finally, the obtained values about joint apertures were validated by direct measures provided by extensometers installed in higher critical joints.