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ABSTRACT BOOK

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Numerical modelling of stress-strain analysis at an underground quarry in the Apuan Alps marble district (Italy)

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The stress-strain analysis of rocky slopes is a valuable tool for checking and monitoring the stability conditions and guaranteeing safety conditions of the workplaces for the personnel involved in mining activities. The present research, which has been carried out in the framework of a project involving the University of Siena and the *USL Toscana Nord Ovest - Unità Operativa Ingegneria Mineraria* supported by Tuscany Region (Italy), represents the application of a methodological approach for studying the stress-strain distribution in some quarries of the Apuan Alps mining area. The project provides for an in-depth study of the knowledge on the in-situ stress field and on the deformability of the rock. It was carried out by means of numerical modeling according to Finite Elements Methods (FEM) and Distinct Elements Methods (DEM). The survey method involved: i) acquisition of the 3D geometric information of the quarry area by means of a georeferenced ground-based and aerial laser scanner survey; ii) acquisition of data about the rock mass through engineering-geological survey; iii) laboratory tests on samples for determining the physical and mechanical characteristics of the marbles; iv) in situ rock stress measurement campaign by four CSIRO-type tests and six Doorstopper-type tests executed at different positions and at various depths in the underground extraction chamber hanging wall (a CSIRO-type cell was installed in a predrilled borehole – at a depth of 10.1 m – as a future monitoring sensor); v) creation of numerical models of the chamber, both in 2D and 3D, and their calibration on the in situ results; vi) extrapolation of the calibrated models to the future planned excavation phases; vii) comparison of foreseen behavior with assumed strength criteria or crack initiation thresholds. The data obtained from the various steps flowed into several numerical models that were validated by a rigorous back analysis assessment using least squares procedures. Numerical modelling of stress-strain analyses will allow to increase the safety conditions for the personnel of the underground marble quarry, to improve the excavation efficiency and continuous production and, finally, to design the long-term planning of mining activities.