



## Numerical analysis for the evaluation of the stability of underground cavities in calcarenite interacting with buildings

Riccardo Castellanza (1), Piernicola Lollino (3), Matteo Oryem Ciantia (2), Claudio di Prisco (2), Giovanni Crosta (1), and Gabriele Frigerio (1)

(1) Department of Earth and Environmental Sciences, Università degli Studi di Milano Bicocca, 20126 Milano, Italy.  
(riccardo.castellanza@unimib.it), (2) DICA, Politecnico di Milano, 20133 Milano, Italy (ciantia@stru.polimi.it), (3) CNR – IRPI, Via Amendola 122/i, Bari, (p.lollino@ba.irpi.cnr.it)

Soft and highly porous rocks such as tuffs and calcarenites are very common rocks. Due to their porous calcareous structure they are quite prone to water induced weathering mechanisms. Onshore and inland natural underground cavities are evident signs of these phenomena and of the effects in terms of failure.

These materials have been largely employed in the past as building and ornamental stones and as sites to excavate underground cavities for different uses. The world famous Unesco site of “Sassi di Matera”, the underground cavities in Canosa di Puglia and Gravina di Puglia, or the calcarenite cliff and natural caves of Polignano a Mare are the most representative cases. Nowadays, many of these are deteriorating because of weathering due to humidity, water infiltration, environmental pollution, and direct exposure to marine aerosols and meteoric water precipitations.

In all these cases, a careful assessment of the safety of the built environment and a conscious identification of the safety measures cannot be separated from the analysis of the interaction between the cavities and the overlying buildings, and of the evolution and spatial distribution of the weathering processes.

This contribute summarizes the authors' experience on the subject and suggests a methodological approach to quantitatively assess the stability of underground cavities. Starting from experimental evidences at micro and macroscale, the main debonding mechanisms have been taken into account in numerical models. The time-evolution scenarios of the weathering processes is introduced in three-dimensional numerical modelling. The intention is to provide a potentially useful tool for risk assessment in similar complex geomechanical situations.