Compressive Strength Estimation of Marble Specimens using Acoustic Emission Hits in Time and Natural Time Domains: Preliminary Results

George Hloupis (1), Ilias Stavrakas (1), Filippos Vallianatos (2), and Dimos Triantis (1)

(1) Laboratory of Electrical Characterization of Materials and Electronic Devices, Technological Educational Institute of Athens, 12210, Greece., (2) Technological Educational Institute of Crete, laboratory of Geophysics and Seismology, Greece.

The current study deals with preliminary results of characteristic patterns derived from acoustic emissions during compressional stress. Two loading cycles were applied to a specimen of 4cm x 4cm x 10 cm Dionysos marble while acoustic emissions (AE) were recorded using one acoustic sensor coupled at the expected direction of the main crack (at the center of the specimen). The produced time series comprised from the number of counts per AE hit under increasing and constant load. Processing took place in two domains: in conventional time domain (t), using multiresolution wavelet analysis for the study of temporal variation of the wavelet-coefficients' standard deviation (SDEV) [1] and in natural time domain (χ), using the variance ($\kappa 1$) of natural-time transformed time-series [2,3]. Results in both cases, dictate that identification of the region where the increasing stress (σ), exceeds 40% of the ultimate compressional strength (σ^*), is possible. More specific, in conventional time domain, the temporal evolution of SDEV presents a sharp change around σ^* during first loading cycle and less than σ^* during second loading cycle. In natural time domain, the $\kappa 1$ value clearly oscillate around 0.07 at natural time indexes corresponding to σ^* during first loading cycle. Merging both results leads to a preliminary observation that we have an identification of the time when the compressional stress exceeds σ^*.

References

[1] Telesca, L., Hloupis, G., Nikolintaga, I., Vallianatos, F.,."Temporal patterns in southern Aegean seismicity revealed by the multiresolution wavelet analysis", Communications in Nonlinear Science and Numerical Simulation, vol. 12, issue 8, pp 1418-1426, 2007

[2] P. A. Varotsos, N. V. Sarlis, and E. S. Skordas, "Natural Time Analysis: The New View of Time. Precursory Seismic Electric Signals, Earthquakes and other Complex Time-Series", Springer-Verlag, Berlin, Heidelberg, 2011.

[3] N. V. Sarlis, P. A. Varotsos, and E. S. Skordas, "Flux Avalances in YBa2Cu307-x films and rice piles: natural time domain analysis", Physical Review B, 73, 054504, 2006.