Geophysical Research Abstracts
Vol. 19, EGU2017-1801, 2017
EGU General Assembly 2017

Integrated application of in situ non destructive techniques for the evaluation of the architectural elements of monumental structures.

Silvana Fais (1), Giuseppe Casula (2), Francesco Cuccuru (1), Paola Ligas (1), Maria Giovanna Bianchi (2), and Alessandro Marraccini (3)

(1) University of Cagliari, DICAAR, Department of Civil and Environmental Engineering and Architecture (DICAAR), Cagliari, Italy (sfais@unica.it), (2) Istituto Nazionale di Geofisica e Vulcanologia (INGV) Sezione di Bologna, (3) Instituto Português do Mar e da Atmosfera (IPMA) - Lisbon, Portugal

The need to integrate different non invasive geophysical datasets for an effective diagnostic process of the stone materials of cultural heritage buildings is due to the complexity of the intrinsic characteristics of the different types of stones and of their degradation process. Consequently integration between different geophysical techniques is required for the characterization of stone building materials. In order to perform the diagnostic process by different non-invasive techniques thus interpreting in a realistic way the different geophysical parameters, it is necessary to link the petrophysical characteristics of stones with the geophysical ones. In this study the complementary application of three different non invasive techniques (terrestrial laser scanner (TLS), infrared thermography and ultrasonic surface and tomography measurements) was carried out to analyse the conservation state and quality of the carbonate building materials of three inner columns of the old precious church of San Lorenzo in the historical city center of Cagliari (Sardinia). In previous works (Casula et al., 2009; Fais et al., 2015), especially the integrated application of TLS and ultrasonic techniques has been demonstrated to represent a powerful tool in evaluating the quality of the stone building materials by solving or limiting the uncertainties typical of all indirect methods. Thanks to the terrestrial laser scanner (TLS) technique it was possible to 3D model the investigated columns and their surface geometrical anomalies. The TLS measurements were complemented by several ultrasonic in situ and laboratory tests in the 24kHz - 54kHz range. The ultrasonic parameters, especially longitudinal and transversal velocities, allow to recover information on materials related with mechanical properties. A good correlation between TLS surface geometrical anomalies and the ultrasonic velocity ones is evident at the surface and in shallow parts of the investigated architectural elements. To calibrate the geophysical results and provide reliable data for the interpretation, the petrophysical properties (porosity, density, water absorption) and petrographical characteristics (especially texture) of the carbonate building materials under study were examined. By combining petrographical, petrophysical, terrestrial laser scanner and ultrasonic techniques, a consistent diagnostic process of the carbonate building materials can be achieved to detect the presence of defects, fissures, fractures, weathering process or compositional variations. The above diagnostic process is very useful also to evaluate the behavior of the carbonate building materials, facilitating the planning of urgent and long-term conservation programs and in time monitoring.

References

Casula G, Fais S, Ligas P (2009) Experimental application of 3-D laser scanning and acoustic techniques in assessing the quality of stones used in monumental structures. Int J Microstruct. Mater. Prop. 4:45–56. doi: 10.1504/IJMMP.2009.028432

Fais, S., Cuccuru, F., Ligas, P, Casula, G., Bianchi M.G. (2015) Integrated ultrasonic, laser scanning and petrographical characterisation of carbonate building materials on an architectural structure of a historic building. Bull Eng Geol Environ. doi: 10.1007/s10064-015-0815-9

Acknowledgements: This work was supported by Regione Autonoma della Sardegna (RAS), Regional Law 7th August 2007, n. 7. The authors would also like to thank Archidiocesi di Cagliari and Mons. Mario Ledda for their kind permission to work on the San Lorenzo Church.