

STRUCTURAL DIAGNOSTICS AND MONITORING OF CULTURAL HERITAGE

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The Cultural Heritage evaluation requires a multiphase and integrated diagnostic approach with extended and deepened experimental campaigns, not harmful to the object. The research group works on the development and use of advanced non-destructive and minimally invasive survey techniques, test procedures aimed at determining the health-state of historic structures and their materials (brick and stone masonry, mortar, timber). Among these, sonic tests, ultrasonics, radar, IR thermography, tomography, penetrometric tests on mortar and timber, micro-coring, lab determinations on historic samples. In addition, structural monitoring, both traditional and wireless, has been carried out. The developed testing procedures have been implemented on historic buildings together with on-site load tests or image correlation monitoring (Fig. 1). The experience gained has resulted in prestigious projects in the field of Cultural Heritage, such as the 7FP EU Project SMooHS, the agreements with regional architectonic and archaeological Superintendents and with the Galleria dell'Accademia in Florence, for monitoring large marble statues including two Michelangelo Buonarroti works: the famous David and the "Prigione Barbuto". In large marble statues, the large masses and shapes often cause high stresses in the material, especially in case of earthquakes or other vibrations. This can result in dangerous situations. Thus, non-destructive diagnostic investigations and continuous monitoring by means of minimally invasive, high sensitive and stable systems, able to give early warnings, become necessary. The David presents a severe crack pattern in the lower part of the legs. The cracks' depths estimation, important for the structural analyses, has been carried out by means of ultrasonic tests, using properly developed and optimized procedures. A wide crack in the "Prigione Barbuto" has been monitored over two years with laser triangulation sensors. The crack pattern of the David is monitored by a fiberoptic sensors FBG network, providing remotely recorded and processed information. The system is controlled by a device which also measures vibration, inclination and changes in the environmental parameters.



Fig. 1. Some structures recently surveyed: Ghirlandina tower and Modena Cathedral (UNESCO sites), Palazzina della Viola, Palazzo D'Accursio, San Barbaziano church (top); Palazzo Malvezzi, load tests on a ceiling, with details of traditional and wireless monitoring systems, and on a timber beam (bottom) (Colla).



Fig. 2. David and Prigione Barbuto at the Galleria dell'Accademia in Florence (Pascale).



Fig. 3. Ultrasound tests at the David and wireless monitoring of salt content in masonry (Colla).

MAIN PUBLICATIONS

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RESEARCH PROJECTS

SARISTU - Smart Intelligent Aircraft Structures, FP7-2011, Collaborative EU project. Project Ref: 284562.

SMooHS – Smart Monitoring of Historical Structures, FP7-2008, Collaborative EU project. Project Ref.: 212939.

Convenzione con Fondaz. "Friends of Florence" per monitoraggio dello stato fessurativo presente nel David di Michelangelo presso Galleria dell'Accademia di Firenze, delle vibrazioni alla base e di altri parametri correlabili alla situazione statica dell'opera d'arte, 2009-2011.

Convenzione con Comune di Modena per campagna di indagine sperimentale presso l'edificio storico con struttura portante di muratura di laterizi ed esterno in conci lapidei denominato "Torre Ghirlandina", a Modena, a seguito del sisma del 20-29 maggio 2012 (2013).

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