Structural health monitoring and NDT of masonry structures: Research and practice

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The international disasters database indicates that seismic activity, floods and landslides hazard are among the major causes of hazard that endanger the worldwide building stock. These causes can have catastrophic effects on existing structures and infrastructures, with dramatic implications for the life of the individual and the health of the community in general.

Existing structures and infrastructures, the most of which designed without contemporary criteria, represent one of the most significant safety concerns worldwide since they are vulnerable to significant structural and non-structural damage, and even collapse, when subjected to medium-to-strong exceptional load conditions or even simple maintenance debts. These conditions resulted in fatalities and significant economic losses, which promoted the development of the assessment and retrofit procedures for existing structures against both static and dynamic loads.

The assessment of existing structures and infrastructures is a hence a contemporary challenge shared by stakeholders, engineers and researchers with the main goals of structural safety, risk control and lifetime extension.

In this framework, structural health monitoring (SHM) and non-destructive (ND) testing play a major role, providing data on the condition and existing damage, and allowing to define adequate remedial measures. The SHM process involves the observation of a system (e.g., bridge, building, tower, church, etc.) over time using periodically sampled response measurements from an array of sensors, the extraction of damage-sensitive features from these measurements, and the statistical analysis of these features to determine the current state of system health. For long-term SHM, the output of this process is periodically updated with information regarding the ability of the structure to perform its intended function considering the inevitable aging and degradation resulting from operational environments. After extreme events, such as earthquakes, blast loadings or floods, SHM is used for rapid condition screening and aims to provide, in nearly real time, reliable information regarding the integrity of the structure.

This special issue focused on the attention on all the opportunities of NDT and SHM in a hazardous environment. Researchers, practitioners and general readers will find an issue in

which recent developments in theoretical, computational, experimental and practical aspects in the areas of identification, control and Structural Health Monitoring applied to civil structure is dealt with in a wide-ranging way.

The SI covers – among the others – very relevant aspects such as (i) the application of the Internet of Thing (IoT) paradigm to the SHM of masonry structures, (ii) new stress sensors and new radar applications,

(iii) the damage identification applications for curved structures, (iv) the use of artificial intelligence to build digital twins, (v) long-term dynamic monitoring to detect anomalous structural behaviours in slender masonry structures (perhaps one of the main classes of heritage buildings where the dynamic identification and vibration-based SHM find their best potential), (vi) damage identification applications for adobe structures, (vii) vibration monitoring as a means for better understanding the full-scale response of real complex structures subjected to earthquakes.

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