

Non-destructive material testing of monumental structures for early damage detection and quality evaluation of interventions

The non-destructive material testing and structural health monitoring of the dynamic behavior of structures and important relevant technical projects by using reliable and low-cost non-destructive equipment and sensor networks is a new scientific field aimed at a reliable understanding of their true structural behavior. Mainly, however, it aims at detecting the state of structural integrity of a construction (existence of defects, failures, etc.) in order to decide upon the continuation of its use, its repair or its demolition. The great advantage of non-destructive material testing and instrumental monitoring in relation to other damage analysis techniques is that the experimental investigations of this kind do not include assumptions, constraints and mistakes that inevitably be included to any simulation procedure and model.

Monumental structures are an important factor in the cultural heritage of Society for various reasons: either because of their long life or because of their architecture or because of religious causes, historical events or of pioneering construction techniques etc.

But having been constructed many years ago and therefore affected by continuous environmental actions for long periods, monumental structures are likely to exhibit varying degrees of structural damage. Without proper maintenance, they may be wholly or completely damaged, with not only adverse effects on safety and economy but also with an irreversible loss of cultural assets.

The integrated management and protection of monumental constructions requires periodic testing, monitoring and control, maintenance and rehabilitation. In addition, an accurate knowledge of the structural behavior of a monumental structure is very important as new intervention and repairing techniques are introduced. The lack of technical details (e.g. structural drawings and static system) makes the testing and monitoring of monumental structures very interesting from a technical point of view.

In this course students will first be trained in the basic principles of non-destructive material testing and health monitoring of monumental structures using theory and practical applications of structural dynamic analysis, the propagation of waves and some special issues of digital signal processing and management that are necessary for further study. Several types of equipment and sensors will then be presented in the laboratory, such as ultrasonic testing, thermographic and acceleration/velocity sensors, piezoelectric sensors and laser scanning vibrometers where the necessary projects will be performed. At the end of the course, each postgraduate student will be asked to perform non-destructive testing and instrumental health monitoring procedures in an existing monumental structure in the wider area of Crete, and then to evaluate and present their monitoring results as an appropriate technical report.