



# Methodology for the Dynamic Identification of Damaged Unreinforced Masonry Walls through Vibrations Tests

Silvia Ientile, Antonella Cecchi, Giosuè Boscato

*IUAV University of Venice, Italy*

Pierre Argoul, Franziska Schmidt, Boumediene Nedjar, Dominique Siegert

*IFSTTAR, Marne-la-Vallée, France*

Contact: [silvia.ientile@gmail.com](mailto:silvia.ientile@gmail.com)

## Abstract

The preservation of architectural heritage from natural hazards and catastrophic events, including the seismic risk, requires in-depth investigation on structural behavior and in particular on the dynamic response of monumental and existing buildings, such as masonry structures. The support of experimental tests, dynamic identification techniques together with structural monitoring allow to a non-destructive evaluation of dynamic parameters and more in general for the seismic vulnerability assessment of heritage buildings, preserving its integrity and considering its operational status. In this paper, an experimental campaign on unreinforced masonry (URM) walls is presented on three typologies of walls considering induced damage. A methodology for the investigation of dynamic behavior of damaged URM walls proposed to support the most common dynamic identification techniques pointing out information through a simple spectral estimation.

**Keywords:** masonry, architectural heritage, dynamic vibrations, vulnerability assessment, signal processing, non-destructive tests, structural dynamic identification

## 1 Introduction

The Italian architectural heritage and the existing buildings, in general, are made up of a wide variety of structural typologies, among which the main one is represented by masonry structures. In most cases, the age of construction of these buildings is such that the state of conservation adopted reveals the vulnerability of the built heritage. In many damage scenarios of URM buildings in case of earthquake events, the failures are divided in two common modes: out-of-plane failure and in-plane failure of the walls. The occurrence of either typology depends on various factors, primarily on the geometry of the structure, the boundary conditions, the magnitude of the vertical loads and also it is influenced by the properties of the brick, mortar and brick/mortar interface [1]. Dynamic identification techniques together with structural monitoring allow to a

non-destructive evaluation of structural parameters preserving its integrity and considering its operational status, particularly suitable for existing buildings [2][3].

In this paper, a procedure for dynamic identification is presented for a typical damage situations on unreinforced masonry (URM) walls characterized by injury due to seismic actions and to the deterioration or imperfections of the building, in order to obtain reference dynamic parameters for the seismic vulnerability assessment of URM walls through ambient vibration testing.

## 2 Ambient Vibration Testing and Signal Processing

Operational Modal Analysis (OMA) is based on measuring the output responses of a structure