



Since 1979 the *Mechanics of Materials and Structures* Laboratory of the ISTI-CNR has been active in basic research and software development in the field of continuum mechanics, with particular focus on structural engineering.

Over the last fifteen years the Laboratory has concentrated mainly on modelling the structural behaviour of masonry constructions of particular historical and architectural interest. This research has led to the development of a constitutive equation for the various types of masonry employed in historic buildings. Such equation views masonries as nonlinear elastic materials with zero tensile strength and infinite or bounded compressive strength. As it has proven to be able to realistically model the most significant aspects of masonry's behaviour, the constitutive equation has since been implemented in the finite element code NOSA for solving equilibrium and evolution problems of solids not withstanding tension.

The code has been successfully applied to a number of studies on behalf of both private and public bodies on important historic buildings, such as the chimney of the Vecchi Macelli, the Medici Arsenal and the church of San Pietro in Vinculis in Pisa, the San Nicolò Motherhouse in Noto, the Goldoni Theatre in Livorno, the Baptistery of the Volterra Cathedral, the bell tower of Buti, the church of Santa Maria Maddalena in Morano Calabro, the church of San Ponziano and the Torre delle Ore (Clock Tower) in Lucca, the church of Santa Maria della Roccella in Roccelletta di Borgia, and the Rognosa tower in San Gimignano.

A large part of the Lab's scientific activities has been conducted within the framework of the following research projects:

- ***Dynamic analysis of age-old masonry constructions***, funded by the Region of Tuscany, Fondi Strutturali (Regolamento CEE 2081/93 - Obiettivo 2, Innovazione tecnologica, ricerca e sviluppo, Azione 3.2 Servizi Tecnologici) (1998-1999);
- ***Numerical modelling and experimental techniques for the study of the dynamic behaviour of age-old masonry constructions***, Progetto finalizzato “Cultural Heritage” of the CNR (1996-2000).;
- ***OPTOCANTIERI***, funded by the Region of Tuscany (2002-2003);
- ***Diagnostic and safeguard of architectural buildings with particular focus on the effects of seismic events and other natural disasters***, Fondo Speciale per la Ricerca di Interesse Strategico, MIUR, Legge 449/97, (2003-2006).;
- ***Static analysis of the dome of the Church of Santa Maria Maddalena in Morano Calabro (CS)***, funded by the Monuments and Fine Arts Office of the Calabria region (2004-2005);
- ***Static analysis and strengthening of masonry vaults***, funded by the Cassa di Risparmio di Lucca Foundation (2004-2005).
- ***Dynamic behaviour of age-old masonry constructions***, funded by the Cassa di Risparmio di Lucca Foundation (2006-2007);
- ***Masonry vaults and domes: classical methods and finite element modelling***, funded by the Cassa di Risparmio di Lucca Foundation (2007-2008);
- ***Seismic analysis of masonry towers and bell towers***, funded by the Cassa di Risparmio di Lucca Foundation (2009-2010);
- ***ST@rT – Sciences and Technologies for the Tuscan artistic, architectural and archeological heritage***, funded by the Region of Tuscany (2008-2011)

More recently, the Lab's research has focused on modelling masonry constructions subjected to time-dependent loads (earthquakes, traffic, etc.) and developing numerical methods to assess the seismic

vulnerability of the architectural heritage. The activities of the project *ST@rT – Sciences and Technologies for the Tuscan artistic, architectural and archeological heritage* were aimed at studying the 13<sup>th</sup>-century “Rognosa” tower in San Gimignano, which was inscribed in the Unesco World Heritage List in 1990, while the Torre delle Ore (Clock Tower) in Lucca was the object of study in the project *Seismic analysis of masonry towers and bell towers*.