Department for Constructions and Restoration
University of Florence

The research team of the Department for Constructions and Restoration participating in the project ***Tools for the modelling and assessment of the structural behaviour of ancient constructions: the NOSA-ITACA code*** has been involved for many years in modelling the static and dynamic behaviour of masonry buildings. To this aim, it has conducting numerous experimental analyses aimed at assessing and characterising the behaviour of materials only weakly resistant to tension. In this framework a constitutive equation for one-dimensional elements [10] has been studied and implemented in the finite element code MADY for the dynamic analysis of slender masonry structures such as arches, towers and walls subjected to out-of-plane vibrations [18, 27]. The constitutive equations have subsequently been applied to study the stability of masonry pillars subjected to eccentric vertical loads [5, 7, 14, 26].
The group's research activities have also focused on studying the equilibrium of masonry panels, in which regard a new method has been proposed to determine explicit equilibrated, admissible stress fields, which can be used within the framework of limit analysis [28] to calculate collapse loads [8, 12, 16, 17, 20, 23]. This activity has been conducted in collaboration with Miroslav Silhavy of the Mathematics Institute of the Academy of Sciences of the Czech Republic.
Over the years, various experimental techniques have been defined for analysing the inelastic response of heterogeneous brittle materials, such as age-old stone building materials and bricks [11, 13, 22, 26]. The team has conducted theoretical and experimental research studies aimed at assessing both the qualitative and quantitative impact of using advanced materials and technologies, such as the application of high tensile strength fibres, on the structural behaviour of masonry elements [3, 4, 6, 9, 15, 19, 21, 24].
A large part of the team's scientific activity has been conducted within the framework of the following research projects:.

- ***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).
- ***Vaulted masonry structures: theoretical and experimental research on prototypes of cross vaults to be employed in rebuilding historic centers damaged by the recent earthquakes***, MIUR – PRIN (1998-2000).
- ***Stability of masonry structures***, MIUR – PRIN (2002-2003).
- ***Nonlinear dynamics,*** MIUR – PRIN (2003-2004).
- ***Experimental and tacit scientific knowledge and actions for the conservation of constructions made of raw earth in the South of Italy: development, testing and assessment of a web-based knowledge management tool***, MIUR – PRIN (2005-2008).
- ***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).
- ***Delamination under cyclic actions for r.c. and masonry structures, assessment of the anchorage length, development of anchorage mechanical systems***, research project DPC ReLUIS 2005-2008 Linea 8:
- ***Development and analysis of new materials for seismic retrofitting***, research project DPC ReLUIS 2009-2012 Linea 8:

In 2009 a numerical analysis of the Church of Santa Maria della Roccella (Roccelletta di Borgia, CZ), commissioned by the Monuments and Fine Arts Office of the Calabria region, was conducted in collaboration with ISTI-CNR. The study was aimed at assessing the seismic vulnerability of the structures and took into account the instructions provided in 2007 by the guidelines of the Ministry for Cultural Heritage concerning the assessment and reduction of the seismic risk of the architectural heritage.