

ANNALS OF GEOPHYSICS

PREFACE

The strong earthquakes striking Italy in this third millennium, in the Molise region (2002), in the city of L'Aquila (2009), in the Emilia Romagna region (2012) and just recently devastating the Amatrice municipality (August, 2016) and other villages in Central Italy, once again testify to the very high seismic hazard of the country. Such high seismic risk is both due to the geodynamic framework of this part of the Mediterranean area and the exceptional vulnerability of its cultural and historical heritage.

In this special issue of "Annals of Geophysics", the main results of a three-year long project named "Seismic Risk Reduction in Eastern Sicily" are presented to a wide range of researchers including geologists, geophysicists and environmental, civil, geotechnical earthquake and Civil Defence engineers.

The seismic hazard in Eastern Sicily is well known, mainly for the long catalogue of dramatic seismic events that struck this sector of Italy in the past: Messina-Reggio Calabria in 1908, Catania in 1818, Val di Noto in 1693, Siracusa in 1542 and the Hyblean area in 1169, are only the more well-known episodes of a long and tragic history of destruction, which has claimed the lives of more than 200,000 people.

The drastic increase in building density over recent decades has raised the level of awareness and concern of citizens and authorities about the vulnerability in eastern Sicily. An important element in developing strategies for the prevention and reduction of seismic risk is the evaluation of the structural behavior under seismic actions. For existing buildings, the problem mainly arises in the assessment of their vulnerability, a difficult challenge since it involves so many constructions to investigate in a reasonable time.

The project, seeking to apply innovative approaches for seismic risk evaluation and reduction, was divided into a number of working teams whose objectives have been defined as follows:

WT 2: New protocols for experimental trials of low cost analysis aimed at defining specific dossiers for individual buildings

WT 3: Installation of geophysical sensors to monitor and acquire seismic data in some selected edifices

WT 4: Design and production of new low cost sensors for structural monitoring

WT 5: Geological models and seismic characterization for specific sites

WT 6: Seismic vulnerability of specific sites based on geotechnical parameters and on the analysis of the soil-structure interaction

WT 7: Design and implementation of a software (ALERTSIS) for seismic alert warning system and testing the applied methodology

WT 8: Experimental trials on destroyed buildings

WT 9: Protocols for the recycling of materials from destroyed buildings

The partners of the project were both public institutions and small-medium companies with offices and venues in Sicily.

This special issue illustrates the results of three years' research activity by a multidisciplinary research team, with geologists, geophysics, geotechnical, structural and industrial engineers, in the field of analysis and mitigation of seismic risk in a Mediterranean area subjected to medium-high earthquake risk. This issue contains the most important results achieved and can be considered a guideline for the multidisciplinary task of assessing the seismic hazard, evaluating the seismic risk, preventing seismic risk of new constructions and for mitigating seismic risk in existing constructions.

- For Task 1:** General introduction to seismicity in Eastern Sicily (Part I); on-site investigations for the seismic response analysis of specific sites, based on different and advanced methods (Part II) and innovative technologies for seismic monitoring (Part III).
- For Task 2:** Static and dynamic geotechnical characterization of soils (Part IV); site effects evaluation (Part V); vulnerability analysis of buildings including soil-structure interaction of shallow foundations (Part VI); developments of early warning systems for the structural monitoring of buildings (Part VII) and use of recycled aggregates for construction and concrete mixture design (Part VIII).
- Part I** is devoted to a general introduction on seismicity and to the multiscale interaction structure of several seismic sequences occurred in the Eastern Sicily in the last decade. (Siino et al.).
- Part II** describes outlines/gives many examples of applying standard and innovative procedures to study site response (Pino et al., Scolaro et al., Capilleri et al.(1),Capilleri et al., (2) Paratore et al.,).
- Part III** is a general introduction to a perspective kind of seismic monitoring in urban areas, with emphasis on the structural monitoring of single edifices (D'Alessandro et al., Zuccarello et al., Massimino et al.).
- Part IV** is related to soil characterization and seismic action, which represents the biggest uncertainty in the overall process of designing and retrofitting buildings. In particular, the section discusses the earthquake scenario given by the two destructive earthquakes of 1693, the modelling of the moderate earthquake of December 13, 1990 and the seismic response evaluation from micro-tremors and from numerical analysis. The seismic vulnerability of the city of Catania and static and dynamic properties of the soil in Catania (Castelli et al.(1)) have been widely investigated. A geotechnical dynamic characterization has also been proposed for a test site in the city of Messina (Castelli et al.(2)). Recent improvements for the emergency management have also been achieved (Castelli et al.(3)).
- Part V** focuses on seismic response analysis and site effects, which is an important tool in earthquake geotechnical engineering studies. Site effects evaluation shows great spatial variability in the urban area of Catania, due to the geological and geolithological features, as well as the non-linear behavior of the soil. An evaluation of site effects by means of 1-D numerical analysis has been performed (Ferraro et al.).
- Part VI** concerns the vulnerability analysis of buildings, including soil-structure interaction of shallow foundations. Dynamic behavior of coupled soil-structure systems by means of FEM analysis for the seismic risk mitigation of a building in Catania (Italy) has been investigated (Abate et al.).
- Part VII** reviews the developments of early warning systems for the structural monitoring of buildings (Zuccarello et al.). An Advanced Multi-Sensor based Early Warning System for the structural monitoring of buildings has been proposed (Andò et al.).
- Part VIII** deals with the use of recycled aggregate for construction. Use of recycled aggregate for road sub-base construction and concrete mixture design has been proposed by Contrafatto et al.

The results so far obtained by the Research Project on Seismic Risk Reduction in Eastern Sicily, could be considered a pilot project for detailed earthquake scenario analyses and for seismic prevention of damage in many Mediterranean cities, characterized, as are the cities of Catania and Messina, by high seismic risk.

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