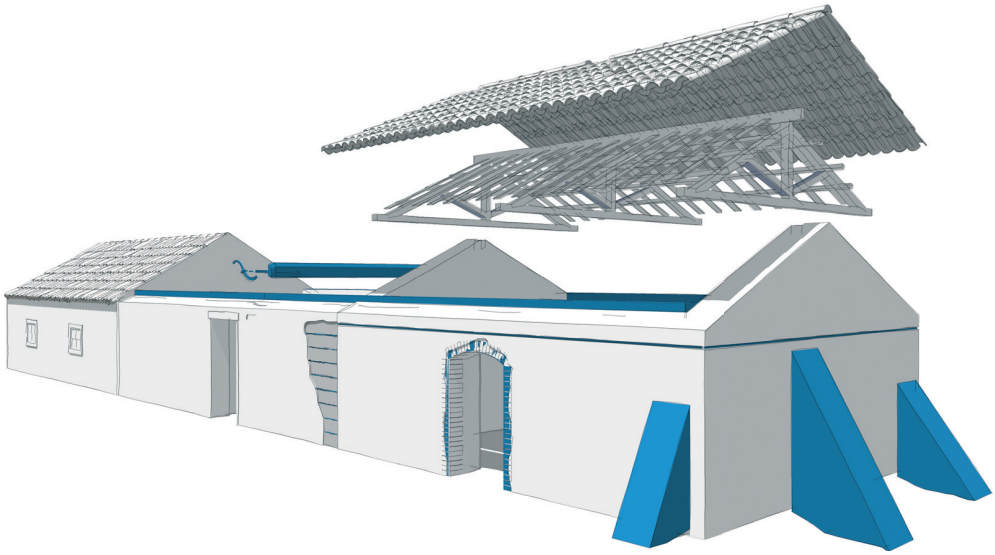
# SEISMIC RETROFITTING

## *Learning from Vernacular Architecture*



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SEISMIC-V: VERNACULAR SEISMIC CULTURE IN PORTUGAL
RESEARCH PROJECT FUNDED UNDER THE NATIONAL RESEARCH AGENCY FCT

# Seismic Retrofitting: Learning from Vernacular Architecture

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# Preface

Local communities have adapted for centuries to challenging surroundings, resulting from unforeseen natural hazards. Vernacular architecture reveals often very intelligent responses when adjusting to the environment. So, the questions were: How did local populations prepare their dwellings to face frequent earthquakes? How could seismic retrofitting perseverance be identified in vernacular architecture? It was to respond to this gap in knowledge, that the research project 'Seismic-V: Vernacular Seismic Culture in Portugal' was submitted for approval by the Portuguese National Research Agency FCT. The Foundation for Science and Technology validated the project with an excellent evaluation and funding. The jury panel enhanced the project's outcomes, as an important contribution for the population's safety.

The research project was coordinated by Escola Superior Gallaecia, as project leader, and by the Departments of Civil Engineering at the University of Minho and the University of Aveiro, as partners. Relevant findings and project results were accomplished thanks to a consistent cross-collaboration between the three institutions, which addressed a complementary expertise within the research project.

The fundamental contribution and aims of this publication were to enhance the disciplinary interest in vernacular architecture and its contribution to risk mitigation in responding to Natural Hazards; to encourage academic and scientific research collaboration among different disciplines, while contributing to the improvement of the vernacular architecture, which more than half of the world's population, still inhabits nowadays.

This publication is structured in 6 parts: the first is dedicated to the framework of the research; the second part concerns Local Seismic Culture (LSC) around the world; the third part focusses on the identification of LSC in Portugal; the fourth part is devoted to the LSC assessment by regions, the fifth part concerns the typology performance study related to 3 identified housing typologies; and finally the sixth part, closing the publication, concerns the conclusions of the project and its recommendations.

The emerged findings brought consistent and systematic outcomes, reaching different publics, through different publications and the project's website. The entailed research methodology also emerged as a result of the project, as it could be extrapolated and applied to other contexts, creating further findings. The research revealed the existence of a local seismic culture, in terms of reactive or preventive seismic resistant measures, able to survive, in areas with frequent earthquakes, if properly maintained.

'Seismic retrofitting: learning from vernacular architecture' brings together 43 chapters with new perspectives on seismic retrofitting techniques and relevant data addressing vernacular architecture, an amazing source of knowledge still relevant, in the present world. The publication gathered the contributions of international researchers and experts, invited as key-references in the disciplinary field. 50 authors presented case studies from Latin America, the Mediterranean, eastern Asia and the Himalayas region. There are references to examples from at least 18 countries, on 4 continents. This is the case of Algeria, Bolivia, Bhutan, Chile, China, Egypt, El Salvador, Greece, Haiti, Italy, Japan, Mexico, Morocco, Nepal, Nicaragua, Peru, Romania, Taiwan, and a closer detailed analysis of Portugal.

The research project and this publication were possible thanks to the funding granted by FCT – Foundation for Science and Technology, in the framework of the Portuguese research project Seismic-V (PTDC/ATP-AQI/3934/2012), Scientific Research Projects and Technological Development Program. The research project received the Aegis of the Chair UNESCO – Earthen Architecture | ICOMOS – CIAV | ICOMOS-ISCEAH | PROTERRA Iberian Network and the Institutional support provided by UNIVEUR-Ravello, Italy, and the DRCN – Northern Portugal Regional Directorate for Culture.

To all the authors, collaborators, and consultants that contributed to the research project and to this publication, with quality, consistency and high standards, thank you.

Mariana R. Correia, Paulo B. Lourenço, Humberto Varum
Editors of the publication, July 2015

## Vernacular architecture: A paradigm of the local seismic culture


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# Seismic retrofitting of historic earthen buildings


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