

RESIST-2020 – Seismic Rehabilitation of Old Masonry-Concrete Buildings

Summary

Motivation and objectives

Project RESIST focuses on improving the resilience of the built heritage against catastrophic events and on saving lives through the seismic strengthening of old buildings.

The main objective of this project is to develop an innovative solution based on two complementary techniques for seismic strengthening of brick masonry bearing walls of old building. These techniques are simple to execute and consist of: (i) application of near surface mounted twisted steel bars (TSB), either horizontally (at brick joints) and/or vertically (through mechanically opened slots) to endow resistance and ductility for in-plane and out-of-plane seismic loading; (ii) advanced shear walls tying (SWT) in the shear panels (areas between windows or doors spans), to avoid their usual collapse by X-shape fracturing during earthquakes, which pawn the overall safety of the structure.

The seismic strengthening of old buildings inherently promotes sustainability in construction as an alternative to demolishing and reconstructing research approach and methods.

The research work is based on experimental tests and numerical modelling. Experimental tests aim at assessing the actual behavior of the old brick walls and determine the effect of the reinforcing solutions proposed. The numerical models will constitute a design tool to evaluate the behavior of the walls and to dimensioning of the strengthening solutions.

Innovation

The strengthening solution proposed should provide important advantages with respect to: ductility, energy dissipation, cost, intrusiveness and complexity.

The proposed strengthening techniques constitute a coherent and complete tool set which considers general zones of the walls (TSB technique) and the most critical zones of piers, located between spans of windows / doors (the so called shear panels or shear walls) (SWT technique).

In terms of numerical models, the innovation is mainly related to the multi-parametric macro-element to reproduce the behavior of simple or strengthened wall elements with reduced computational effort.

The elaboration of the Design Manual will ensure the applicability, in practice, of these innovations.

Expected results

The main results to obtain are:

- Establishment of an innovative solution for seismic strengthening of old buildings based on two complementary techniques.
- Development of simplified numerical models and design rules for simulating the behavior and dimensioning the strengthening elements of masonry walls.
- Elaboration of a Design Manual for old buildings seismic strengthening based on the proposed solution.
- Application of the developed techniques in real context with the partners João Appleton, a major designer in the area of building rehabilitation, and HCI Construction, a major contractor in the area of building rehabilitation.



Figure 1. Full-scale reinforced wall test on the seismic table.

Project Reference

PTDC/ECI-EGC/30567/2017

Leading Institution

IST-ID – Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal)

Partners

LNEC – National Laboratory for Civil Engineering (Portugal), UMinho – University of Minho (Portugal)

CERIS Principal Investigator

João Gomes Ferreira
(joao.gomes.ferreira@tecnico.ulisboa.pt)

CERIS Research Team

Luís Guerreiro, Fernando Branco, Jorge Proença, João Azevedo, António Gago

Funding

FCT – Fundação para a Ciência e a Tecnologia

Period

2018-2022

Total

239 590.75€

CERIS

100 588.75€

Project Website

-