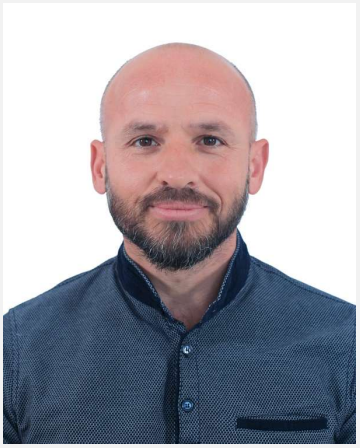
CERIS : Civil Engineering Research and Innovation for Sustainability

Seismic rehabilitation of old buildings. Strengthening of load-bearing brick masonry walls using twisted steel bars



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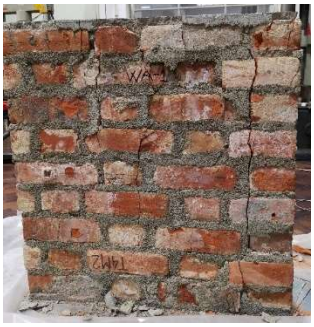
Summary

Old masonry buildings constitute a considerable percentage of the overall building stock, especially in old city centers, bearing heritage values and reflecting the building construction techniques of the time. Given their vulnerability against earthquakes, these buildings need attention in terms of structural performance, particularly considering that they were designed without the present codes that account for seismic actions. The retrofitting of old buildings requires a conservative approach, taking into account the traditional masonry construction methods and materials, with non-invasive strengthening techniques to increase their strength and ductility.

(…) The proposed strengthening is done using near surface mounted (NSM) twisted stainless steel bars (TSB) and traditional concrete reinforcing steel bars (SB). Slots to accommodate bars are cut in the brick walls and a pre-mixed mortar is used to fix them in place. This technique has low impact on the architectural/heritage aspect of the building, is cost-effective and easy to apply, requiring relatively simple surface preparation prior to the execution. For the mechanical characterization of this solution an extensive experimental campaign was carried out on thirty-three masonry wallettes, forty-five triplets, and two real-scale masonry walls, as well as on their constituting elements. The specimens were xvi assembled using solid clay bricks and bedding mortars with the same proportions as reported in building design documents of the time. Specimens were subjected to experimental tests such as axial compression test, diagonal compression test, triplet test, and cyclic shake table tests. These tests were carried out on the unreinforced and reinforced specimens and their effectiveness was evaluated. Additionally, numerical simulations of these experimental tests were performed and calibrated with the experimental data. The results obtained from the static and cyclic tests showed that the proposed strengthening solution leads to a higher shear strength and improved ductility of the brick masonry walls.

Keywords

Seismic rehabilitation of old buildings, shear strength, diagonal testing, shake table, twisted steel bars, brick masonry walls.



Axial compression (URM)

Diagonal compression (URM)

Diagonal compression (Reinforced)

In-plane initial shear

Full-scale masonry walls (shaking table)