ERIES-RESTORING – REtrofitting of STOne masonRy using INnovative Grid-based composites

Summary

The seismic assessment/retrofit of existing masonry buildings has become in the past years a matter of high priority in seismically prone countries with a significant presence of built cultural heritage, such as several European and Mediterranean countries, accentuated by recent and mandatory legal sources. Moreover, the change of focus from building replacement to rehabilitation of the existing stock is a step towards greater sustainability, a topic for which more and more awareness is being raised.

The proposed project aims at spanning the information gap about factors affecting the seismic effectiveness of Composite Reinforced Mortars (CRM) applied to existing rubble stone masonry buildings by experimental research. The in-plane cyclic behaviour of innovative strengthening solutions compatible with historic masonry materials will be tested on full-size rubble stone masonry piers and will be compared with the non-retrofitted pier response. CRM, consisting of a glass-FRP mesh embedded in natural hydraulic mortar, will be applied to one or both sides of the specimen.

The outcomes will provide useful data for the future development of design guidelines and building code requirements, currently missing, about the design of CRM as a strengthening solution for existing masonry structures. This will contribute to the reduction of their vulnerability and of the associated losses after earthquake events.

The proposed project comprises 6 full-scale double-leaf rubble masonry piers, which will be built to represent the current conditions of ancient buildings typical of European and Mediterranean countries. The experimental campaign will address 3 retrofit configurations of rubble stone masonry: unreinforced (bare) condition, serving as a reference; CRM strengthening on one side of the wall; and CRM strengthening on both sides. The CRM solution will consist of a glass-FRP mesh embedded in natural hydraulic lime mortar, compatible with the substrate of historical buildings, with connectors distributed across the facade to provide transverse confinement.

In-plane quasi-static cyclic shear-compression tests will be carried out under double-fixed boundary conditions, considering two different pier geometries (Figure 1). The height/length (h/l) aspect ratios of the piers to be studied are h/l = 1.5 and h/l = 0.69. The specimens with a slender aspect ratio will include parts of the adjacent spandrels, to allow CRM development as for masonry piers between windows. The squat piers correspond to walls without openings or with large spacing between them.

Vertical and diagonal compression tests will be carried out to characterize the bare and retrofitted piers.

The proposed experimental campaign aims at bridging the information gap on the cyclic behaviour of CRM-strengthened rubble stone masonry piers of existing buildings in European and Mediterranean countries. To this end, the specific objectives are the following:

- Provide reference values in terms of failure mode, strength and, most important, deformation capacity of masonry piers retrofitted with CRM on one or both sides, obtained from in-plane quasi-static and high-rate cyclic shear-compression tests.
- Study the influence of different aspect ratios on the behaviour of masonry walls retrofitted with CRM.

Figure 1. Unreinforced (bare) slender pier and wallets for characterization under vertical compression.

Project Reference

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