Out-of-plane behaviour of tuff and brick masonry walls strengthened with FRCM composite materials

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ABSTRACT

Strengthening with composite materials is becoming more and more an effective solution for increasing the structural safety of masonry buildings, often subjected to severe degradation or potentially vulnerable to seismic events.

Structural retrofitting can be performed according to different techniques, based on Fiber Reinforced Polymer (FRP) or Fiber Reinforced Cementitious Matrix (FRCM) strengthening systems. The second class of composite systems is usually preferred nowadays thanks to some important advantages such as better compatibility with the substrate, applicability on wet surfaces, fire resistance, permeability and reversibility.

Several experimental and numerical studies are present in the literature concerning masonry panels strengthening with FRP systems, but the knowledge about the use of FRCMs is still partially limited, in particular if the out-of-plane behaviour of walls is taken into account, with the experimental and numerical database available resulting mainly restricted to monotonic cases.

In this framework, results of an experimental campaign devoted to the study of the out-of-plane behaviour of tuff and brick masonry walls strengthened with different types of FRCM systems will be presented and discussed in this paper.

The adopted experimental set-up, able to independently apply an axial force and out-of-plane horizontal forces on the wall, allowed to evaluate failure modes and structural performance of the same steel, basalt and aramid-glass FRCM systems applied on brick and tuff substrates, also using a different number of plies.

Starting from preliminary materials characterization tests, results will be analyzed and discussed in accordance with ACI 549.4R-13 approach in order to verify and validate predictive formulas.

Experimental outcomes, if compared to the unreinforced case, showed, in general, good performance of FRCM composite materials, with a proper exploitation of their tensile capacity, proving their effectiveness for the out-of-plane strengthening of historical masonry walls.