

Abstract

Sustainable Seismic Retrofitting of Rural Masonry Buildings with SRG Materials: Review, Perspectives, and a Strategy for Protecting Landscape and Heritage [†]

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Mixed-use rural buildings, originally designed to integrate residential spaces with agricultural and livestock-related functions, are a defining element of the Italian landscape and a tangible expression of the cultural and productive identity of rural territories. Today, however, these structures are often neglected due to poor original construction materials and advanced structural decay. In many cases, rehabilitation is considered economically unfeasible compared to demolition and new construction, leading to widespread abandonment and the loss of valuable historic rural heritage.

This work aims to identify innovative technological solutions for the structural strengthening of disused rural buildings to promote their sustainable reuse. This would allow these structures to resume their original roles linked to livestock farming and residential functions, thereby limiting land consumption and the need for new construction, while contributing to landscape preservation and reduced environmental impact.

The study focuses on the application of composite materials such as Steel Reinforced Grout (SRG), consisting of a cementitious or hydraulic matrix reinforced with ultra-high tensile strength steel (UHTSS) micro-strands. These materials have proven effective in masonry consolidation thanks to their compatibility with traditional materials, ease of application even on irregular surfaces, and ability to reinforce without significantly increasing stiffness, thus mitigating seismic risks. Several applications are explored, including wall strengthening, the creation of SRG ring beams, and the banding of masonry panels to prevent out-of-plane failures.

Through laboratory testing and numerical simulations, the effectiveness of SRG-based reinforcement is demonstrated in enhancing both the strength and ductility of masonry structures. This enables technically and economically viable recovery of buildings often excluded from investment due to high renovation costs. The approach supports the revival of their original agricultural and residential roles, offering a sustainable alternative to new construction. It reduces land consumption, safeguards rural landscapes, and protects vernacular architecture—aligning with Sustainable Development Goal 11 (Sustainable Cities and Communities).



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Moreover, avoiding new construction lowers CO₂ emissions associated with material production, contributing to Sustainable Development Goal 13 (Climate Action). The use of accessible, advanced technologies also strengthens rural infrastructure (SDG 9) and promotes responsible resource use (SDG 12), minimizing waste and environmental impact.

Ultimately, this work supports a broader vision for the sustainable regeneration of rural areas, where restoring traditional buildings helps sustain agricultural and live-stock practices, with potential benefits for local food production and the resilience of rural communities.

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