

# MECHANICAL AND BOND PERFORMANCE OF FLAX-BASED NATURAL COMPOSITES FOR SUSTAINABLE RETROFITTING

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## ABSTRACT

The construction sector is a major contributor to global emissions, with building materials accounting for nearly 40% of total emissions. Sustainable urban regeneration, achieved by rehabilitating rather than replacing existing structures, is therefore essential. In seismic regions such as Italy, however, structural safety must also be addressed by reducing the vulnerability of the built environment. Recently developed retrofitting solutions include fibre-reinforced composites with inorganic matrices (Textile Reinforced Mortars - TRMs). Compared to epoxy-based composite systems, TRMs exhibit superior chemical compatibility with masonry, reversibility for heritage applications, higher fire resistance, and lower environmental impact. Moreover, structural properties of plant-based fibres, such as flax, hemp, sisal, and jute, are increasingly investigated. Their use with inorganic matrices enabled the development of Natural Textile Reinforced Mortars (NTRMs), a green strengthening system. However, current knowledge of NTRMs remains limited, as their mechanical behaviour strongly depends on fibre properties, textile architecture, and bond performance with matrices and masonry substrates. The study aims to address some of these gaps by presenting the first results of a comprehensive experimental program on flax-based NTRM (F-NTRM) systems for masonry strengthening. Direct tensile tests on dry textiles were performed to assess the mechanical response, whereas single-lap shear tests on strengthened masonry blocks were then conducted to evaluate bond behaviour. It is highlighted that this work is part of the REHARZE project, funded under the PRIN 2022 program.

**KEYWORDS:** Sustainable composite materials; Masonry; External strengthening; Tensile tests; Direct single-lap shear tests.

