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Crack Patterns and Strengthening of Historical Unreinforced Masonry Structures

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Abstract

Recognizing possible crack patterns, discontinuities, and brittle failure mechanisms in unreinforced masonry under seismic and gravitational forces enables effective retrofitting strategies. A wide array of traditional and modern materials and strengthening techniques offer compatible, removable, and sustainable conservation options. Steel and timber tie-rods are commonly employed to support the horizontal thrust of arches, vaults, and roofs, and are particularly effective in connecting structural elements such as masonry walls and floors. Additionally, composite reinforcement systems utilizing carbon and glass fibers along with thin mortar layers can enhance tensile capacity, ultimate strength, and displacement to prevent brittle shear failures.
This study provides an overview of masonry structural diagnostics and compares traditional with advanced strengthening methods for walls, arches, vaults, and columns. It also presents recent research on automated surface crack detection in unreinforced masonry (URM) walls, with an emphasis on machine learning and deep learning algorithms.

Keywords
Historical buildings, crack patterns, masonry structures

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