ENHANCING THE RESILIENCE OF CONCRETE INFRASTRUCTURE USING POST-INSTALLED STEEL STRENGTHENING SYSTEMS

ABSTRACT A large share of Europe's reinforced-concrete (RC) transport infrastructure was constructed several decades ago and is now affected by ageing, fatigue, and increasing service demands. Sustainable asset management therefore requires strengthening techniques that are structurally efficient, rapidly deployable, and minimally disruptive to traffic.

This contribution presents two innovative post-installed (PI) steel systems for the shear and punching-shear strengthening of existing RC members. In both cases, the technique employs steel threaded rods bonded in drilled holes with a high-performance injection mortar. Importantly, installation from one side only enables fast execution in bridge decks and other transport structures, where maintaining service continuity is critical.

The paper provides a detailed overview of the comprehensive research programme underpinning the qualification of these new solutions, including full-scale beam tests (up to 100 cm deep) and slab tests (300 cm in diameter) under static, cyclic (up to 5M cycles), and elevated-temperature conditions. The results of the assessment confirmed that robustly anchored PI steel elements exhibit a structural behaviour that is qualitatively equivalent to conventional cast-in reinforcement. Based on these findings, design equations were developed in accordance with Eurocode 2 and calibrated through Design Assisted by Testing (DAT) to quantify the structural performance and meet the reliability requirements set in Eurocode 0. Ultimately, both systems obtained general construction technique permits in Germany (allgemeine Bauartgenehmigungen, aBGs), supporting their deployment in the field.

Examples of practical applications confirm that the proposed PI systems provide a reliable, code-aligned, and construction-efficient solution for extending the service life of RC structures, providing a route to safer, faster, and more sustainable infrastructure management when existing concrete members are structurally deficient in shear or punching shear.