Assessing and mitigating corrosion in historic concrete: the NUK case study

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The preservation of historic concrete buildings, such as the UNESCO-listed National and University Library (NUK) in Ljubljana, requires non-destructive diagnostic methods to evaluate material degradation with minimal intervention. Among the main causes of deterioration in such structures is the corrosion of embedded steel, initiated by environmental exposure. Unlike atmospheric corrosion, corrosion in reinforced concrete often results from carbonation-induced pH reduction, leading to the loss of steel passivity. This process remains hidden until advanced stages, presenting unique diagnostic challenges.

This study aims to assess the corrosion condition of selected historic concrete components of NUK—primarily architecturally complex windowsills and decorative roof tiles—using an individualized, non-destructive testing (NDT) approach. These elements are particularly exposed to weathering, and no reliable documentation exists regarding their internal structure. To avoid damaging the valuable heritage components, a combination of NDT techniques is being applied, including Ferroscan for locating and mapping reinforcement, half-cell potential measurements to identify corrosion-prone zones, and X-ray computed microtomography for high-resolution 3D visualization of internal structure, reinforcement, cracks, voids, and corrosion damage—also supporting digital archiving and replication.

In addition to diagnostics, the potential application of electrochemical realkalisation is being explored for elements in early stages of corrosion. This technique aims to restore the alkaline environment of carbonated concrete by introducing an external alkaline solution and applying electrical current to generate OH^- ions near the reinforcement. It is minimally invasive and may slow the corrosion process, though its effectiveness depends on factors such as concrete composition and moisture content.

The study highlights the critical role of NDT in developing sustainable preservation practices for historic concrete and supporting informed conservation strategies, enabling either preservation in situ or accurate replication where necessary.