Investigation of Crevice Corrosion in Concrete Using Coupled Multi Electrode Arrays

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The steel-concrete interface is a complex layer consisting of many inhomogeneities and features, including cracks, crevices, slips, air voids and rust. All of these anomalies can contribute to the formation of crevice corrosion, which causes high localized corrosion rates, despite the generally favourable alkaline environment that initially develops during concrete hydration. Since access to the steel surface in concrete is limited, advanced corrosion techniques are needed to monitor the corrosion process.

In this study, custom mortar specimens will be made with embedded coupled multi-electrode arrays. A crevice will be simulated by creating an air void over some of the coupled electrodes. After 28 days of mortar curing in a humid chamber, half of the specimens will be exposed to accelerated carbonation, while the other half will carbonate naturally. In order to induce active corrosion, the specimens will also be exposed to cyclic wetting and drying, with and without 3.5 % sodium chloride solution. Corrosion will be continuously monitored by a series of zero resistance ammeters connected to the embedded coupled multi-electrode arrays. In addition, the corrosion progress during the exposure will be monitored using computed tomography.

Monitoring corrosion using a Coupled Multi-Electrode Array (CMEA) is an advanced technique for spatio-temporal measurements of corrosion and probably best suited for monitoring the crevice corrosion mechanisms inside concrete. The technique is capable of measuring small corrosion currents on every individual electrode in the array, while keeping the electrodes electrically coupled. In combination with computed tomography, the technique will be used to provide new information about the development of crevice corrosion on steel embedded in concrete.