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Title

Numerical investigation of the effects of cracking and embedded reinforcement on surface concrete resistivity measurements using Wenner probe

Abstract

Electrical resistivity of concrete plays a major role in controlling the corrosion rate of embedded reinforcement in concrete. In addition, many recent studies have shown that resistivity and micro-structural changes as well as ion (e.g. chloride) ingress in concrete are highly correlated. Four-probe Wenner probe technique is the most commonly used resistivity measurement method in concrete. In the past, a number of studies have identified the factors affecting the resistivity measurements using four-point Wenner probe and provided guidelines for minimizing their disturbing effects on the readings. However, the effects of existing surface cracks and embedded reinforcement in concrete on the measurements have not been studied systematically. In this numerical study, finite element method has been used to investigate this issue by carrying out a parametric investigation. Some of the analysis parameters of the study involved (1) crack dimensions, (2) crack locations and orientations with respect to the probe position, (3) density and location of embedded reinforcement, (4) orientation of the probe with respect to reinforcement, and (5) moisture content of concrete. It was demonstrated that depending on the location and geometrical properties of the crack as well as its angle with respect to the Wenner probe, concrete resistivity measurements can contain considerable errors. The presence of rebar mesh and its misalignment with respect to the crack and the measurement direction exacerbated the errors – in some cases by over 100%. Suggestions were provided to help minimize the effects of the cracks on electrical resistivity measurements.

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