Electrical Resistivity Monitoring of Reinforced Concrete Columns during Curing

Dale F. Rucker1, Nigel Crook2, and Moira Poje1

1hydroGEOPHYSICS, Inc. Tucson, AZ 85745

2hydroGEOPHYSICS, Inc. Irvine, CA 92612

**ABSTRACT**

Non-destructive testing of concrete structures is commonly used to determine internal cracking, mechanical strength, moisture, chloride diffusion, and corrosion of the reinforcing rebar. However, the metal structures that comprise the reinforcing elements may distort the measurements when using electrical- or electromagnetic-based testing methods because the metal is orders of magnitude more conductive than the concrete. The metallic rebar reinforcement reduces the sensitivity of these geophysical methods and prevent accurate data collection in portions of the concrete without metal. To understand the magnitude of the problem, we constructed test columns with varying amounts and orientations of rebar and measured the resistivity changes during the curing process over a 100 day period. Our work confirms previous work that sensitivity is greatly affected by orientation of the rebar. In addition, we demonstrate that normal curing times of 30 days may not be sufficient to realize the fully cured resistivity value or resistivity distribution within concrete. The measurement strategy and incorporation of cross-borehole style arrays also affect the success of concrete imaging. One of the more difficult aspects of collecting resistivity on older concrete is the contact resistance of the electrodes. High contact resistance (upwards of 80,000 ohms) leads to larger measurement errors and hence greater uncertainty. We hope that this work sheds light on the potential benefits of integrating the resistivity method for long term monitoring of reinforced concrete structures such as bridges, buildings, and dams.