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Rebar corrosion monitoring with a multisensor non-destructive geophysical techniques.

Enzo Rizzo[1,2], **Giacomo Fornasari**[1,2], Luigi Capozzoli[2], Gregory De Martino[2], and Valeria Giampaolo[2]

[1]University of Ferrara, Dipartimento di Fisica e Scienze della Terra, Ferrara, Italy (enzo.rizzo@unife.it)
[2]CNR-IMAA, Laboratorio Hydrogeosite, Marsico Nuovo-Tito

Rebar Corrosion is one of the main causes of deterioration of engineering reinforced structure. This degradation reduces the service life and durability of the structures. Such degradation can result in the collapse of engineering structures. When the first cracks are noticed on the concrete surface, corrosion has generally reached an advanced stage and maintenance action is required. The early detection of rebar corrosion of bridges, tunnel, buildings and other civil engineering structures is important to reduce the expensive cost to repair the deteriorated structure. Several techniques have been developed for understanding the mechanism and kinetics of the corrosion of rebar, but the paper defines the interest of combining several NDT for field inspection to overcome the limitation of measuring instantaneous corrosion rates and to improve the estimation of the service life of RC structures. Non-destructive testing and evaluation of the rebar corrosion is a major issue for predicting the service life of reinforced concrete structures.

This paper introduces a laboratory test, that was performed at Geophysical Laboratory of Ferrara University. The test consisted in a multisensor application concerning rebar corrosion monitoring using different geophysical methods on a concrete sample of about 50 x 30 cm with one steel rebar of 10 mm diameter. An accelerating reinforcement bar corrosion using direct current (DC) power supply with 5% sodium chloride (NaCl) solution was used to induce rebar corrosion. The 2GHz GPR antenna by IDS, the ERT with Abem Terrameter and Self-Potential with Keithley multivoltmeter at high impedance were used for rebar corrosion monitoring. A multisensor approach should reduce the errors resulting from measurements, and improve synergistically the estimation of service life of the RC.

Each technique provided specific information, but a data integration method used in the operating system will further improve the overall quality of diagnosis. The collected data were used for an integration approach to obtain an evolution of the phenomenon of corrosion of the reinforcement bar. All the three methods were able to detect the physical parameter variation during the corrosion phenomena, but more attention is necessary on natural corrosion, that is a slow process and the properties of the experimental steel–concrete interface may not be representative of natural corrosion. However, each of these geophysical methods possesses certain advantages and limitations, therefore a combination of these geophysical techniques, with an multisensor

approach is recommended to use to obtain the corrosion condition of steel and the condition of concrete cover. Moreover, extrapolating laboratory results performed with a single rebar to a large structure with interconnected rebars thus remains challenging. Therefore, during the next experiments, special care must be taken regarding the design and preparation of the samples to obtain meaningful information for field application.