Geophysical Research Abstracts
Vol. 14, EGU2012-13976, 2012
EGU General Assembly 2012

Non-destructive testing for the structures and civil infrastructures characterization

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This work evaluates the ability of non-conventional NDT techniques such as GPR, geoelectrical method and conventional ones such as infrared thermography (IRT) and sonic test for the characterization of building structures in laboratory and in-situ. Moreover, the integration of the different techniques were evaluated in order to reduce the degree of uncertainties associated.
The presence of electromagnetic, resistivity or thermal anomalies in the behavior may be related to the presence of defects, crack, decay or moisture. The research was conducted in two phases: the first phase was performed in laboratory and the second one mainly in the field work. The laboratory experiments proceeded to calibrate the geophysical techniques GPR and geoelectrical method on building structures. A multi-layer structure was reconstructed in laboratory, in order to simulate a back-bridge: asphalt, reinforced concrete, sand and gravel layers. In the deep sandy layer, PVC, aluminum and steel pipes were introduced. This structure has also been brought to crack in a predetermined area and hidden internal fractures were investigated. GPR has allowed to characterize the panel in a non-invasive mode; radar maps were developed using various algorithms during post-process about 2D maps and 3D models with aerial acquisition of 400 MHz, 900MHz, 1500MHz, 2000MHz. Geoelectrical testing was performed with a network of 25 electrodes spaced at mutual distance of 5 cm. Two different configurations were used dipole-dipole and pole-dipole approaches.
In the second phase, we proceeded to the analysis of pre-tensioned concrete in order to detect the possible presence of criticality in the structure. For this purpose by GPR 2GHz antenna, a ’70 years precast bridge characterized by a high state of decay was studied; then were also analyzed a pillar and a beam of recent production directly into the processing plant. Moreover, results obtained using GPR were compared with those obtained through the use of infrared thermography and sonic testing. Finally, we investigated a radiant floor by GPR (900 MHz to 2000 MHz antennas) and long-wave infrared camera. Non-destructive diagnostic techniques allow to investigate a building structure in reinforced concrete or masonry without altering the characteristics of the element investigated. For this reason, geo-electrical and electromagnetic surveys of masonry are a suitable non-destructive tool for the diagnosis of a deteriorated concrete structure. Moreover, the integration of different NDT techniques (conventional and no-conventional) is a very powerful to maximize the capabilities and to compensate for the limitations of each method.