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2D and 3D Ground Penetrating Radar monitoring of a reinforced concrete asphalt plate affected by mechanical deformation.

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The main facility of Hydrogeosite Laboratory of the Italian National Research Council (Marsico Nuovo, CNR) is a 3m x 7m x 10m reinforced concrete pool filled by siliceous sand designed for hydrologic experiments. One of its peculiarities is the possibility to vary the water table depth by using a proper hydraulic system [1].
In the framework of the FP7 ISTIMES project (Integrated System for Transport Infrastructure surveillance and Monitoring by Electromagnetic Sensing), a 3m x 3m layered structure has been purposely built and placed in the pool of the Hydrogeosite Laboratory with the aim to carry out a long term monitoring, by using jointly several electromagnetic sensing technologies, during two different phases simulating the rising of the water table and a mechanical solicitation.
Several layers composed the structure from the top to the bottom, such as: 5 cm of asphalt; 5-10 cm of reinforced concrete; 20-25 cm of conglomerate, 55 cm of sand. Moreover, in the sand layer, three (metallic and plastic) pipes of different size were buried to simulate utilities.
Ground Penetrating Radar (GPR) surveys were performed by using a the GSSI SIR 3000 system equipped with 400 MHz and 1500 MHz central frequency antennas. Surveys carried out by means of 400 MHz antenna allowed to detect and localize the three pipes (one in plastic and two in metal) and to investigate the effects of the sand water content on their radar signature. Surveys carried out by using 1500 MHz antenna were focused to characterize the shallower layers of the structure.
The Hydrogeosite experiment consisted in following stages:
• Arising of a water table by infiltration from the bottom;
• Water gravity infiltration condescendingly;
• Infiltration by peristaltic pump in the very shallow layers of the structure;
• Water table drawdown;
• Mechanical structure deformation;
• Asphalt plate restoration after mechanical solicitation.

After each stage a series of GPR surveys was performed. Moreover, a zero setting acquisition was carried out before perturbing the plate. Described experience demonstrates the GPR is a reliable technique for the:

• foundation soil characterization and monitoring
• Reinforced structural elements monitoring
• asphalt/reinforced concrete characterization and monitoring
• detection of water infiltration, structural elements, defects
• evaluation of restoration intervention.

In fact, the GPR technique was able to investigate the layers beyond the asphalt and provides a spatial resolution complying with the needs of the technical problem at hand by use of different antennas. Moreover noticeable performances of this technique can be further improved by implementing 3D processing and MT inversion procedures in order to increase the amount of information by the survey [2].
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