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Assessment of waterfront location in hardened concrete by GPR within COST Action TU1208

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This work focuses on the analysis of the capability of Ground-Penetrating radar (GPR) technique for evaluating how the water penetrates into concrete samples by means of the assessment of the waterfront advance. Research activities have been carried out during a Short-Term Scientific Missions (STSMs) funded by the COST (European Cooperation in Science and Technology) Action TU1208 "Civil Engineering Applications of Ground Penetrating Radar" in November 2015.

The evaluation of water penetrability is crucial in most building materials, such us concrete, since, water and aggressive chemical agents dissolved therein contribute to the deterioration of the material. A number of techniques have been developed to measure their advance in concrete. Although the most common method for measuring water content is the gravimetric method by observing the change in mass, this method has a large number of disadvantages. In this context, non-destructive techniques as GPR play an interesting role. In particular, the application of GPR in the building materials area is providing very promising and interesting results regarding the building materials characterization and especially concrete deterioration evaluation [1-3]. In addition, recent experimental studies highlight the strong relation between wave propagation parameters (velocity and energy level) and water content advance [4-5].

Water content has a decisive influence on dielectric properties and those might be assessed by the study of the wave properties that are derived by using GPR. Therefore, the waterfront advance will result in a change on wave parameters. In line with this, this research is focused on the development of specific processing algorithms necessary to understand how the water penetrates and how the wave parameters will be affected regarding the location of the antenna in reference to the water absorption direction. For this purpose, concrete samples were manufactured, which after curing (90 days) and oven drying were immersed into water for a certain time. Then, GPR measurements, with a 2 GHz central frequency antenna, were performed at specific time intervals, placing the antenna on the same side of the concrete samples that was immersed into water. After conducting GPR measurements, concrete samples were broken in two pieces to perform the visual analysis of the waterfront advance.

After processing the GPR records velocity increments ware calculated and analyzed. Very accurate adjustments were found between the velocity increments and the waterfront depth, regardless the wave peaks of the direct and reflected wave used to calculate velocity increments.

These results are of quite importance, because even if we are not able to locate the waterfront reflection or if it is overlapped with the direct wave signal, we might predict the waterfront position with high reliability.

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