Evaluation of durability loss of Ultra-High-Performance-Concrete using air-coupled ultrasound

Nicolas Ospitia[1], Anh Nguyen[1], Nele De Belie[2], Dimitrios Aggelis[1]

[1]Mechanics of Materials and Constructions, Vrije Universiteit Brussel, Belgium, [1]Magnel-Vandepitte Laboratory for Structural Engineering and Building Materials, Ghent University, Belgium

The durability of concrete is substantially reduced by several chemical and physical degradation mechanisms. The degradation in several cases manifests itself through surface degradation and cracking, and a subsequent reduction in stiffness. Early detection, and identification of the durability loss results in a reduction of the cost of repair, and environmental impact. Elastic wave-based nondestructive techniques collect information from the mechanical properties of the material and have been used extensively for monitoring purposes. The most widely used parameter is the ultrasonic pulse velocity, which is based on the transit time of the wave from pulser to receiver. It can be measured through the thickness as well as on the surface. Although it is relatively simple and robust measurement it exhibits finite sensitivity to damage, while acoustic coupling of the sensors is usually manually applied and can account for some variation in the results. This paper presents a methodology for through-the-thickness measurements in members of ultra-high-performance concrete (UHPC) after freezing-thawing for the first time. Wave velocity dependence on frequency is exploited to provide characterization to the different length scales of heterogeneity and thus increase the sensitivity. In addition, a non-contact methodology is introduced aiming at eliminating coupling effects, with automatized scanning eventually in view.