Effect of water transport on self-healing due to further hydration in cement paste

Haoliang Huang [1)], Guang Ye [1, 2)] and Leo Pel [3)]

1) *Microlab, Faculty of civil Engineering and Geosciences, Delft University of Technology*
2) *Magnel Laboratory for Concrete Research, Department of Structural Engineering, Ghent University*
3) *Department of Applied Physics, Transport in Permeable media, Eindhoven University of Technology*

Email: haoliang.huang@tudelft.nl

Abstract

Cracks are unavoidable in reinforced concrete structures because of the design for the function of reinforcement. A substantial amount of cement remains unhydrated in concrete, i.e., especially in high performance concrete. When extra water penetrates into cracks, further hydration of unhydrated cement grains is promoted and cracks can be healed by the reaction products. Because cement paste is in general a unsaturated porous medium, water in cracks tends to migrate into the bulk paste due to capillary action. If the extra water in cracks is limited the efficiency of self-healing may be reduced by this water migration. However up to this moment there is no quantitative description on the effect of water migration on self healing due to further hydration.

In this paper, the kinetics of water migration from cracks into the bulk cement paste was studied by Nuclear Magnetics Resonance (NMR). By means of NMR, water content of the bulk cement paste as a function of time was quantified. In addition, a microstructure-based model was used to simulate the migration process of water. In this model the water diffusivity was obtained by Lattice Boltzmann method. Afterward the water migration from cracks into bulk cement paste was simulated by finite element method and compared to the measurements. In the end, the effect of the water migration on self-healing due to further hydration can be determined.