PhD proposal: Numerical and Experimental multiscale approach for concrete durability

Duration: 40 months

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Subject:
Multi-scale approaches enable to assist the material developer by providing a rational approach to material development and concurrently assist the structural designer by providing an integrated analysis tool that incorporates fundamental material behavior. Since several years now, the present proposal authors have been involved in the development of a numerical Platform, MuMoCC, that aims to understand and predict the mechanical and the physical properties of cement-based materials from the microscale to the macroscale (see for instance [Bernard et al., 2008, 2010 and 2012; Kamali-Bernard et al., 2009 and 2011; Comby-Peyrot et al., 2009]). These numerical tools were applied successfully to investigate and highlight both the effect of the leaching phenomenon and the aggregate/matrix interface on the global mechanical behavior of cement-based materials.

In this project, other interesting and important phenomena to be study when it deals with durability aspects of concrete will be investigated using MuMoCC platform. Particularly, shrinkage, fire degradation and sulfate attack will be studied and their effect on the overall mechanical and transport properties of mortar and concrete predicted and then validated based on experimental data.

A finite element tool (Abaqus) will be used for this project. Some experiments including mechanical, physical and chemical tests will be done in order to improve the understanding of the different studied phenomena and to get the necessary data for the modeling work. Finally, a good knowledge of the use of finite element tools and some knowledge on cement-based materials would be appreciated.