The 12th International DIANA Users Meeting, 11-12 October 2018, Porto, Portugal
Organized by the DIANA Users Association

Multiscale modelling of concrete material: micro- and nano-structure of cement paste

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Abstract

Development of a numerical multiscale modelling platform is purposed under the scope of our research project. The modelling focuses on concrete material, or generally cement-based material (CBM). It includes simulation of the individual components of cement paste hydration products (e.g. Calcium-Silicate-Hydrate globules) at nano ($\times 10^{-9}$ m) and micro scales ($\times 10^{-6}$ m). These models will provide the input data for the modelling in greater length scale for concrete and reinforced concrete structure. The modelling deals with fundamental cement paste characterization including elasticity, thermal properties, fracture behaviour, transport properties, etc. The concept of Representative Elementary Volume (REV) is used in our multiscale simulations. Cubic REVs are constructed using a recently developed hydration software available in the literature. The constructed REVs are then discretised and exported as Finite Element Models (FEM) to DIANA. All linear and non-linear analysis are performed in DIANA. The models deal with mostly the structural solid finite elements as well as the beam elements as a form of a lattice (combination of nodes and linear elements). The current work presents some already done simulations and discusses some advantages and shortages of the models in DIANA.

Keywords: Cement-based material, multiscale modelling, microstructure, nanostructure

Possible Meeting Topic: Modelling from simple to advanced

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