World Academy of Science, Engineering and Technology
International Journal of Materials and Textile Engineering
Vol:17, No:05, 2023

Multiscale Modelling of Textile Reinforced Concrete: A Literature Review

Authors : Anicet Dansou

Abstract : Textile reinforced concrete (TRC)is increasingly used nowadays in various fields, in particular civil engineering, where it is mainly used for the reinforcement of damaged reinforced concrete structures. TRC is a composite material composed of multi- or uni-axial textile reinforcements coupled with a fine-grained cementitious matrix. The TRC composite is an alternative solution to the traditional Fiber Reinforcement Polymer (FRP) composite. It has good mechanical performance and better temperature stability but also, it makes it possible to meet the criteria of sustainable development better.TRCs are highly anisotropic composite materials with nonlinear hardening behavior; their macroscopic behavior depends on multi-scale mechanisms. The characterization of these materials through numerical simulation has been the subject of many studies. Since TRCs are multiscale material by definition, numerical multi-scale approaches have emerged as one of the most suitable methods for the simulation of TRCs. They aim to incorporate information pertaining to microscale constitute behavior, mesoscale behavior, and macro-scale structure response within a unified model that enables rapid simulation of structures. The computational costs are hence significantly reduced compared to standard simulation at a fine scale. The fine scale information can be implicitly introduced in the macro scale model: approaches of this type are called non-classical. A representative volume element is defined, and the fine scale information are homogenized over it. Analytical and computational homogenization and nested mesh methods belong to these approaches. On the other hand, in classical approaches, the fine scale information are explicitly introduced in the macro scale model. Such approaches pertain to adaptive mesh refinement strategies, sub-modelling, domain decomposition, and multigrid methods This research presents the main principles of numerical multiscale approaches. Advantages and limitations are identified according to several criteria: the assumptions made (fidelity), the number of input parameters required, the calculation costs (efficiency), etc. A bibliographic study of recent results and advances and of the scientific obstacles to be overcome in order to achieve an effective simulation of textile reinforced concrete in civil engineering is presented. A comparative study is further carried out between several methods for the simulation of TRCs used for the structural reinforcement of reinforced concrete structures.

Keywords : composites structures, multiscale methods, numerical modeling, textile reinforced concrete
Conference Title : ICTRC 2023 : International Conference on Textile Reinforced Concrete
Conference Location : Amsterdam, Netherlands
Conference Dates : May 04-05, 2023