A micropolar model to study chaotic historical masonry structures.

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The wide-range concern for the conservation of old structures and gems of ancient architecture calls for a deep knowledge of the buildings and particularly for mechanics models of walls built of stones with random properties and shapes.

Periodic masonry structures have already been properly modeled by resorting to micropolar continuum [Trovalusci & Masiani, 2005]; here, we propose a homogenization approach to describe masonry-like materials with random microstructure as Cosserat continua. To this end, we adopt the macro-homogeneity (Hill-Mandel type) condition accounting for non-symmetric strain and stress as well as couple-stress and curvature tensors.

The presence of disorder led us to the choice of a homogenization technique based on the determination of the finite-size scaling from a Statistical Volume Element (SVE) [Ostoja-Starzewski, 2006] to a Representative Volume Element (RVE).

Firstly a procedure proposed by [Du & Ostoja-Starzewski, 2006] where the RVE is approached in terms of two hierarchies of bounds stemming, respectively, from Dirichlet and Neumann boundary value problems set up on the SVE is extended to the Cosserat case.

Then, considering [Sab, 1992], we propose a new procedure in which periodic boundary conditions are enforced on the random medium.

Various combinations of matrix and inclusion phases are examined and a statistical study is carried out in order to extract the "averaged" homogenized constitutive constants for fixed control windows (mesoscale) and we strive to establish the best fitting approach.

Short references:


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