COMPUTATIONAL MODELING OF MASONRY STRUCTURES

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Abstract
The development of adequate stress analyses for masonry structures represents an important task not only for verifying the stability of masonry constructions, as old buildings, historical town and monumental structures, but also to properly design effective strengthening and repairing interventions. Thus, several numerical techniques, based on different modeling approaches, have been developed to investigate and to predict the behavior of masonry structures. Micro-models consider the units and the mortar joints separately, characterized by different constitutive laws; thus, the structural analysis is performed considering each constituent of the masonry material. The mechanical properties that characterize the models adopted for units and mortar joints, are obtained through experimental tests conducted on the single material components (compressive test, tensile test, bending test, etc.). Micro-macro, i.e. multiscale, models consider different constitutive laws for the units and the mortar joints; then, a homogenization procedure is performed obtaining a macro-model for masonry that is used to develop the structural analysis. Even in this case, the mechanical properties of units and mortar joints are obtained through experimental tests. Macro-models, or macroscopic models, are based on the use of phenomenological constitutive laws for the masonry material; i.e. the stress-strain relationships adopted for the structural analysis are derived performing tests on masonry, without distinguishing the blocks and the mortar behavior.The micromechanical, the multiscale and the macromechanical approaches are presented, giving some details for specific models proposed in the last years. In particular, the discussion is limited to models (micro, micro-macro and macro) framed in the 2D small strain and displacement approach.

Short C.V.

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RESEARCH FIELDS AND ACTIVITY: mechanics of structures and materials, with particular reference to theoretical and computational problems relevant to nonlinear material responses:

Material constitutive modeling: static and dynamic response for cohesive and ductile materials, advanced materials (shape memory alloys); micromechanics and homogenization techniques: analysis of composite materials characterized by nonlinear behavior of the constituents; multiscale analysis of heterogeneous structures: structural analyses developed considering different scales, i.e. the scale of the structure and the scale of the material; mechanics of masonry materials and structures: development of specific constitutive laws, computational procedures for the analysis of masonry structures; analysis of plate and shells: development of models and finite elements.