11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

DISCRETE AND CONTINUOUS MODELS FOR THE IN PLANE MODAL ANALYSIS OF MASONRY STRUCTURES

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Key Words: *masonry like material, modal analysis, compatible identification, discrete model, micro-polar continuum*

A modal analysis, developed in plane dynamics and linear elasticity, for periodic masonry structure is presented and validated both by means of a continuum modelling within the frame of the micro-polar continuum theory and of a discrete model (DEM) within the frame of a molecular dynamic algorithm.

For running-bond masonry brickwork numerical micro-polar models already exist (Masiani and Trovalusci 1996; Stefanou et al. 2008) in static frameworks (Stefanou et al. 2008) and in dynamic frameworks (Stefanou et al. 2010; Bagigalupo and Gambarotta 2012).

Here the aim is twofold: i) a multi-scale modal analysis both at Representative elementary Volume (REV) level -micro-scale- and at masonry panel level -macro-scale-; ii) a multi-model analysis both with continuum micro-structured and discrete models such as to evaluate sensitivity to masonry local microstructure and sensitivity to characteristic length of REV by reference to masonry panel size.

Two models are presented and compared. A discrete element model and a continuous micropolar model based on analytical homogenization procedures. Both models are based on the following assumptions: i) the structure is composed of rigid blocks; ii) the mortar joints are modelled as interfaces. The rigid block hypothesis is particularly suitable for historical masonry, in which stone blocks may be assumed as rigid bodies. Continuum homogenized model provides, in an analytical form, constitutive equivalent elastic functions, mass and inertia; discrete model describes masonry as a rigid skeleton such as to evaluate both its global and local behaviour.

A parametric analysis is carried out to investigate the effect of i) masonry texture (running versus header bond); ii) size of heterogeneity (block dimensions) respect panel dimensions. Modal analysis is hence carried on for a REV and different panels. Focus is on the sensitivity to heterogeneity size such as to verify models reliability and applicability field.

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