Editorial

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Biographical notes: Vasilis Sarhosis (BEng, MSc, PhD, MASCE) is an Assistant Professor in Civil Engineering at Newcastle University. Previously he was a Research Associate at the School of Engineering at Cardiff University and Research Fellow at the Institute for Resilience Infrastructure at the University of Leeds. His research interest falls within the development of multiphase (thermo/hydro/mechanical) numerical models of jointed and blocky materials including masonry and rock. He is an Associate Editor of the International Journal of Masonry Research and Innovation, Editor of the book "*Computational Modelling of Masonry Structures using the Discrete Element Method*", Executive Committee Member of the International Committee of Monuments and Site (ICOMOSS, UK) and has published more than 50 scientific journals and conference proceedings.

Katalin Bagi is a Full Professor at the Department of Structural Mechanics of Budapest University of Technology and Economics. With a Diploma in Structural Engineering and a PhD in Discrete Element Modelling, she was the Researcher of the Hungarian Academy of Sciences until 2006 and worked in the field of granular micromechanics and discrete element modelling. She became the Doctor of Science at the Hungarian Academy of Sciences in 2006. After becoming a university faculty member in 2007, she started to study masonry mechanics and numerical modelling of masonry structures. She is mostly interested in the theoretical and numerical aspects of the field. She has organised several conferences and workshops, and authored or edited about 80 publications. Recently she holds undergraduate and postgraduate courses in structural mechanics and organises different talent care activities.

Nenad J.N. Bićanić (Dipl. Ing. Zagreb, PhD Swansea) was a Professor Emeritus and a former Regius Professor of Civil Engineering at the University of Glasgow. Author of numerous papers in refereed international journals and conferences, related to the finite element, discrete element, discontinuous deformation analysis, non smooth contact dynamics, constitutive modelling of quasi-brittle materials (concrete, rock, masonry), multi-physics problems in discontinuous media (flow in jointed rock, hydraulic fracturing, high temperature behaviour of concrete). Organiser of an established continuous series of international conferences on *Computational Modelling of Concrete Structures (EURO-C)* since 1984. Founder member and past president (1996) of ACME-UK (UK Association for Computational Mechanics in Engineering - UK). Fellow of the *Institution of Civil Engineers (FICE)* and Fellow of the *International Association for Computational Mechanics (FIACM)* since 1999. European Editor for the *International Journal Computers&Concrete* and a member of advisory boards of several international journals, including *International Journal of Cohesive Frictional Materials*.

The need to predict the in-service behaviour and the load-carrying capacity of masonry structures has motivated researchers to develop a whole series of approximations, numerical techniques and computational tools which are characterised by different levels of complexity. For a computational model to adequately represent the behaviour of a structure, both the constitutive model itself and the associated material parameters must be selected carefully by the modeller. It should also be considered that analysis and assessment of masonry structures may be achieved with relatively little site-specific data and with an awareness that deformability and strength properties of both masonry units (e.g., bricks, stones) and mortar may vary considerably. The latter is due to the heterogeneous nature of masonry and or damage or deterioration that may be present in different constituent parts of the structure. The possibility of performing non-destructive and minor destructive tests is very interesting, since it allows one to obtain valuable data that can be later used as input parameters in the computational models. However, such methods often tend to be insufficient in characterising structural materials in a way to suit advanced modelling. With historical construction forms, *in situ* destructive tests or the testing of specimen samples of masonry removed from the actual structure that are large enough to be representative, is not usually possible. Even with masonry structures that are not classified as being of historical importance, it can be difficult to interpret the results of non-destructive or minor destructive tests and to relate them to the material parameters required for the use in a computational model. So, it is often the case that small-scale and/or manageable masonry specimens are tested in the laboratory. Numerical simulations are then developed and validated against such controlled laboratory tests. Once the behaviour of the small-scale systems is well understood and numerical results validated against experimental ones, then it is possible to develop simple idealisations for the predictive capability and response of a more complex and larger size masonry structures. Engineering judgement and the modeller’s experience remain paramount in such cases.

This thematic issue on “*Numerical Modelling of Masonry Structures*” comprises six contributions from different groups of researchers. Contributions cover a wide range of both experimental and computational techniques; the latter includes analyses at different levels of sophistication and methodological approaches.

The paper by Penava et al. (2016) demonstrated the development of a three-dimensional micromodel for a masonry wall panel constructed with anisotropic clay block masonry units bonded together with mortar. Initially, the physical properties of masonry constituents (bricks and mortar) were identified. Such properties were then inputted into the micromodel developed to simulate the mechanical behaviour of the masonry wall panel. A sensitivity study was undertaken on masonry compressive strength parallel and perpendicular to the bed joints. From the analysis results, it was found that in order to accurately predict masonry response, the natural variability of materials should be considered in the computational model.

The development of a computational model based on the finite element method (FEM) for the characterisation of local in-plane shear strength and failure of masonry panels has been addressed by Gambirasio et al. (2016). Advanced FEM simulations have been devised using the LS-DYNA code. Masonry bricks and mortar were modelled using the Karagozian & Case damage plasticity model. Results were compared against experimental findings. Good agreement between the experimental and numerical results was obtained. The developed model was able to capture the propagation of damage with sufficient accuracy.

Nikolic et al. (2016) presented the development of a computational model based on the finite discrete element method for the analysis and prediction of the collapse of masonry structures constructed with and without mortar joints. The numerical results showed that the model is able to capture the main features that characterise the behaviour of masonry shear walls through the whole range of loading history. The advantage of the presented model is its ability to simulate the behaviour of the masonry structure through the entire failure process from a continuum to a discontinuum, which is vital when modelling the collapse of masonry structures subjected to extreme loading conditions such as intensive seismic excitation, explosions, missile impact, etc.

Ceh et al. (2016) presented both experimental and computational dynamic sensitivity study of multiple-block stacks subjected to a double-pulse base excitation. Different overturning modes (forward, backward, global and partial) in both simulations and experiments were characterised as a function of the peak initial base velocity and the timing of the reverse impulse, controlled by the stop gap distance between the base and the stopper. The influence of the block sample scales has also been examined. Experimental study was conducted on a bespoke double-impact platform, whereas computational simulations were made using non-smooth contact dynamics technique.

Bićanić et al. (2016) considered dynamic sensitivity of constrained ordered discontinuous blocky systems with deliberate gaps or clearances, for which it is difficult to *a priori* assess or characterise the potential sensitivity to dynamic excitations without resorting to time-stepping analyses, as no eigenvalue problem exists, hence no reference can be made to the system’s eigenfrequencies and associated mode shapes. In this preliminary study, the dynamic response and the pattern formation for a simple constrained 1D block assembly subject to harmonic excitation are studied both experimentally and using two computational simulation paradigms - an explicit discrete element method and an implicit non-smooth contact dynamics method.

Lengyel and Bagi (2016) focussed on the horizontal reaction components under pointed arches of different shapes. Two alternative modelling approaches were used: continuous Timoshenko beam theory and 3DEC discrete element simulations playing the role of virtual experiments. First, the paper introduces the analytical model based on Timoshenko beam theory for curved axis and presents its predictions on the horizontal thrust for outward support displacements of increasing magnitude, as a function of the pointedness. Then the simulated behaviour of 3DEC arch models is compared to the predictions of the continuous beam model. Finally, the 3DEC results on the horizontal thrust are also compared to limit state analysis predictions presented in the literature.

Numerical simulation and modelling of masonry structures have been a subject of considerable research and practical interest for a number of decades, gradually moving away from traditional homogenisation techniques to methodologies, which recognise its discontinuous nature and built-in planes of weaknesses. Despite considerable sophistication and progress over a long time, this research field still has many open questions due to its inherent complexity. The wide range of computational techniques covered in this thematic issue is indicative of a continued strong research interest in the area of assessment of the structural behaviour of masonry subjected to both static and dynamic loadings and it goes without saying that it is reasonable to assume that the structural behaviour of masonry structures will continue to generate interest and captivate engineers and researchers for many years to come. In future, with the use of advanced computational methods of analysis and the increase in computer power and large data handling, exciting models could be developed at different scales of analysis.

The Guest Editors of the special issue on *Numerical Modelling of Masonry Structures* would like to express their gratitude to all the authors who participated in this special issue as well as to the international panel of reviewers of the submitted manuscripts, who made the publication of this special issue possible. Moreover, they would like to thank the Editor in Chief and the team of the International Journal of Masonry Research and Innovation for all their valuable support and guidance in putting together this special issue.