Preface

Gabriele Milani

Department of Architecture,
Built Environment and Construction Engineering ABC,
Technical University of Milan,
Piazza Leonardo da Vinci 32, 20133 Milan, Italy
Email: gabriele.milani@polimi.it

Masonry, probably with timber, has been one of the structural materials used by humankind since the first centuries of civilisation in a variety of applications that spans from housing to infrastructures. The reason is the simplicity of execution: the art of laying stones or bricks on top of each other, either with or without mortar, is intuitive and allows to refine an almost infinite variation of technologies that, transmitted generation by generation through rules of thumb, still nowadays demonstrates its efficiency and beauty. Despite building in masonry seems simple, there are many issues that deserve to be deeply understood quantitatively and the specialised scientific community is still facing difficult challenges spanning from the conservation of the built heritage to the not less important innovation of the construction industry.

The construction market accounts for about 10% of the GDP of the countries (for EU-27 this is 9.6% according to FIEC). In the last decades, important developments on materials and applications were introduced (such as prefabricated wall systems, self-interlocking blocks, seismic resistant infils, sustainable earthen buildings, etc.) but the technique to assemble bricks, blocks and stones remains essentially unchanged and very similar to that used thousands of years ago.

Conservation and rehabilitation account for about 1/3 of the market in developed countries, reaching over 50% in many countries. The built heritage is therefore an important sub-sector of research for masonry. On the other hand, the requirements for energy conservation and sustainability (where reuse and rehabilitation play a major role) just cannot be addressed without reshaping our existing built environment. Cultural heritage buildings, in particular, are part of the identity of societies and the public pressure requires their conservation in good conditions limiting the interventions to the strict necessary.

When compared with concrete or steel, we can affirm that masonry is one of the most efficient solutions for housing, maintaining the cost low – an important issue especially in all those markets that are hugely growing, as for instance in developing countries – showing a good level of eco-efficiency and allowing a reasonable comfort. However, in view of the important climate changes the new generations will face with, safety against extreme events (e.g., earthquakes, blast and tornadoes) will require an improvement of the mechanical properties of the materials, sophisticated design and engineers with a deep knowledge of the structural behaviour.

The need to address extremely difficult problems related to both existing and new masonry buildings induced not only by extreme events, but also by fire exposure and degradation has grown in the recent years, making us aware that the resilience of our built stock has to be increased, considering also that our cultural heritage is invaluable. This is an irreversible trend that needs to be implemented in the next 5–10 years. Huge economic efforts have been made by many national governments for the safeguard of masonry buildings belonging to historical city centres. Recent trends are aimed at a vulnerability reduction by means of non-traditional strengthening techniques, which is essentially based on the utilisation of fibre reinforced plastics (FRP) and textile reinforced mortars (TRM).

We expect however to see major changes from the conceptual developments to the implementation, together with huge improvements in different sub-fields such as experimental characterisations, simulation techniques assisted with powerful computers, innovative surveys and diagnosis, and new products.

Despite the fact that the scientific research on masonry is nowadays quite advanced and multi-disciplinary, there are still several difficulties in the interpretation of complex phenomena, which depend on many causes, among the others the most important being masonry heterogeneous character, the brittle behaviour in both tension and compression, the cohesive-frictional response under tangential actions, the geometric complexity of some structural elements such as domes and vaults, etc.

The present special issue of *International Journal of Masonry Research and Innovation* includes a selection of seven thoroughly revised and extended papers originally presented as short papers at the 10th International Masonry Conference 10th IMC, which took place 9 to 11 July 2019 at the Technical University of Milan (Politecnico di Milano), Milan, Italy. IMC confirmed in Milan the successful series started more than 30 years ago (1986) in London, where the First International Masonry Conference, organised by the former British Masonry Society (now International Masonry Society – IMS), took place. The conference has now a four-year rhythm and a very international character. To corroborate this last conclusion, it is worth remembering that the last three editions were organised respectively in Italy (10th IMC), Portugal (9th IMC) and Germany (8th IMC), i.e., outside the UK.

The conference was a cojoin event by Technical University of Milan and IMS and I can proudly affirm that its success in terms of attendees, quality of the presentations and variety of topics can be rarely seen in the large portfolio of congresses that every year take place everywhere in the world on similar topics. Over 150 delegates coming from 30 different countries attended the conference and more than 200 papers were presented. In addition, parallel events for architects and engineers and a student competition with eight participating teams were organised. The success received confirmed the increasing interest of a diversified scientific and technical community interested on masonry research in general, including theoretical approaches, advanced numerical modelling, experimentation, design, conservation of architectural heritage, new technological solutions, fire resistance and much more.

In this special issue, Giordano et al. (2020) summarise their four years of experience in structural health monitoring (SHM) on a case study in Italy: the San Pietro Bell Tower in Perugia.

Barontini et al. (2020) in the second paper discuss the performance of a bio-inspired anomaly detection algorithm for unsupervised SHM on a Manueline masonry church.

Medina et al. (2020) discuss another interesting case-study belonging to the Spanish cultural heritage, focusing on the structural analysis of the San Juan de Dios basilica dome.

Shetty et al. (2020) use X-ray microfocus computed tomography and digital image correlation to have an insight into the crack initiation zone in brick masonry couplets.

Chiozzi et al. (2020) present an adaptive upper bound limit analysis based on NURBS elements and a genetic algorithm adaptation scheme of the mesh to analyse masonry arch bridges.

Zarrin and Totoev (2020) evaluate elastic modulus and thrust force of a semi-interlocking masonry panel.

Finally, Cocchetti and Rizzi (2020) present a nonlinear programming numerical approach suitable to evaluate the limit self-standing conditions of circular masonry arches, which accounts also for limited friction.

I am particularly proud to publish a selection of the best papers presented at the congress in *International Journal of Masonry Research and Innovation*, being at the same time Editor-in-Chief of the journal and having served as the Chairman for such an important congress. I am pretty sure that the readers will enjoy all papers. I wish to thank first of all Inderscience for the possibility they gave me, all the authors for the work done in the preparation of the extended papers and for the efforts spent in improving the original versions prior final publication, with the aim to fit the high standards of the journal. All manuscripts underwent double-blind technical peer review, according to the strict rules established by Inderscience for *IJMRI*, specifically conceived to maintain the scientific level of the journal very high. A special thank goes finally to all the reviewers for the time they spent in the reviewing phase and for the useful suggestions they provided, aimed at improving the final version of the published papers.

References

Barontini, A., Masciotta, M.G., Amado-Mendes, P. and Ramos, L.F. (2020) 'Performance assessment of a bio-inspired anomaly detection algorithm for unsupervised SHM: application to a Manueline masonry church', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10029898.

Chiozzi, A., Grillanda, N., Milani, G. and Tralli, A. (2020) 'Limit analysis of masonry arch bridges through an adaptive GA-nurbs upper-bound approach', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10029896.

Cocchetti, G. and Rizzi, E. (2020) 'Nonlinear programming numerical formulation to acquire limit self-standing conditions of circular masonry arches accounting for limited friction', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10027148.

Giordano, P.F., Ubertini, F., Cavalagli, N., Kita, A. and Masciotta, M.G. (2020) 'Four years of structural health monitoring of the San Pietro Bell Tower in Perugia, Italy: two years before the earthquake versus two years after', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10029897.

Medina, J.S., Pareja, R.B. and Casares, J.A.G. (2020) 'Structural and constructive analysis of San Juan de Dios basilica dome, in Granada (Spain)', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10029899.

Shetty, N., Livitsanos, G., Verstrynge, E., Aggelis, D.G., Van Hemelrijck, D., Van Balen K. and Wevers, M. (2020) 'Observation of crack initiation zone in brick masonry couplets under compression using X-ray microfocus computed tomography and digital image correlation', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10026202.

Zarrin, O. and Totoev, Y.Z. (2020) 'Evaluating elastic modulus and thrust force of semi-interlocking masonry panel', *International Journal of Masonry Research and Innovation*, Vol. 5, No. 4, DOI: 10.1504/IJMRI.2020.10029903.