IWSS2020
1st Italian Workshop on Shell and Spatial Structures
25th – 26th June 2020 – WEB MEETING

endorsed by

Analysis of masonry vaults through simplified micro-models

Marco ALFORNO*[a], Chiara CALDERINI[b], Alessia MONACO, Fiammetta VENUTI[a]

[a] *Politecnico di Torino, Torino, Italy (marco.alforno@polito.it, alessia.monaco@polito.it, fiammetta.venuti@polito.it)*

[b] *Università di Genova, Genova, Italy (chiara.calderini@unige.it)*

Abstract

Masonry vaults belong to the family of so-called form-resistant structures, meaning that they can withstand their dead load and external forces thanks to their curved surface. Therefore, geometry plays a major role in the structural behaviour of this kind of structures. Besides the well-known effects of the vault shape and dimensions, also the masonry apparatus is expected to play a key role in the global behaviour of vaulted structures. The influence of the actual brick arrangement of vaults on their structural behaviour could be taken into account through the simplified micro-modelling approach in the framework of FEM. However, the application of this approach has shown two main limits: i. a huge numerical effort, mainly due to the need to adopt ad-hoc written numerical codes to overcome the limits of commercial software in correctly describing the behaviour of block-to-block interfaces; ii. the scarce availability of experimental data on real scale masonry specimen, which can be used to validate numerical models. In this study, these difficulties are overcome by using a commercial software with built-in interface models and by validating the proposed simplified-micro model through experimental tests on an in-scale specimen of a cross vault. The validated modelling strategy is then applied to ideal masonry cross vaults subjected to self-weight, arranged with different brick patterns, in order to investigate the advantages (constructional and structural) that different masonry apparatus could offer. Comparison of results allows observing different structural behaviour (displacement field, elastic stiffness, reaction forces) for different brick patterns and makes it possible to provide a scientific validation to some speculations found in historical technical literature regarding vault construction.

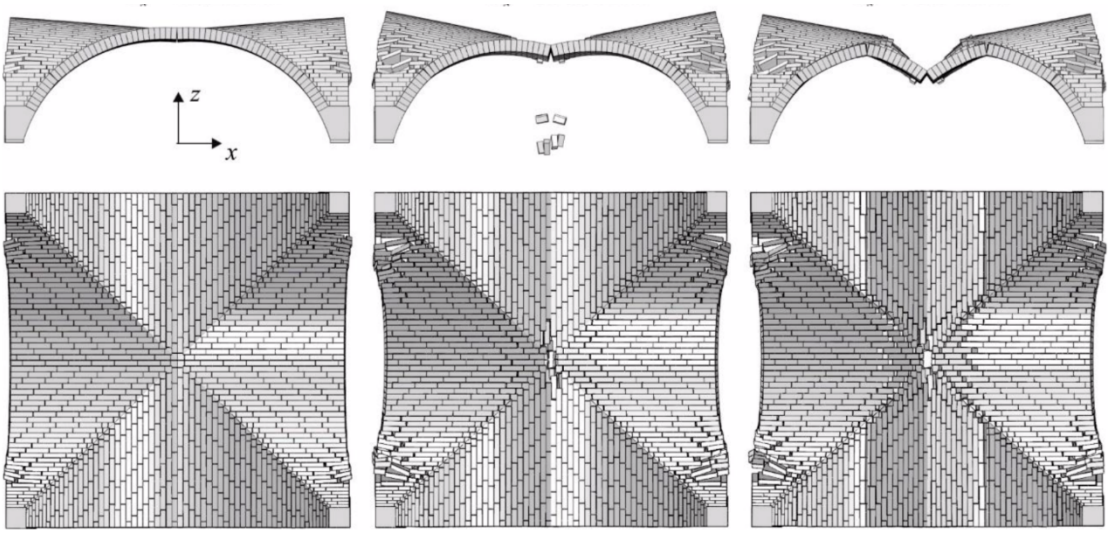

Figure 1. Evolution of the collapse mechanism in numerical simulations of the in-scale model

Keywords: cross vaults, vaults construction, in-scale models, brick pattern, micro-geometry, finite element models, simplified micro-modelling

Copyright © 2020 by M. Alforno, C. Calderini, A. Monaco, F. Venuti

Published on the IWSS2020 website: https://sites.google.com/view/iwss2020