ARCHITECTURAL AND ENVIRONMENTAL IMPACT OF RETROFITTING TECHNIQUES TO PREVENT IN-PLANE «DOMINO» FAILURE MODES OF UNREINFORCED MASONRY BUILDINGS

R. Liberotti[1], F. Cluni[2], F. Faralli[3] and V. Gusella[4]

Department of Civil and Environmental Engineering (D.I.C.A.)
University of Perugia, Via Goffredo Duranti, 93, 06125, Perugia (PG), Italy
[1] riccardo.liberotti@studenti.unipg.it
[2] federico.cluni@unipg.it
[3] francesco.faralli@unipg.it
[4] vittorio.gusella@unipg.it

Key Words: *Heritage, Composites, Applications, Modelling.*

The preservation of heritage buildings is not just about the structural safety, but it is necessarily related to the central themes of restoration, fruition and reuse of ancient buildings. Such topic requires an interdisciplinary design approach that involves - among the others - structural engineering, numerical modelling and architecture in order to address the challenges of contemporary times also in terms of interests of the stakeholders and heritage management. In this regard, the opportunities offered by natural F.R.C.M. (Fibre Reinforced Cementitious Matrix) composites, made of basaltic fibres and lime mortar, are analysed [1].
The main objective of the research is to expand the state of the art concerning the influence of such composites with reference to the applications on «in falso» masonries: load bearing walls built without a direct load path to the ground and acting like «wall beams» in case of collapse of the underlying masonry vaults. On this, an experimental campaign started in co-operation with the Kimia S.p.a., an Italian company with decades of experience in the field, in order to make a comparative assessment about the influence of composites in the prevention of knock-on collapses due to the aforementioned scenario, with the benefit of avoiding interventions on the vaults and without damaging unmovable artistic assets and valuable architectural features (e.g. precious pavings, mosaics, vaulted surfaces etc.). Furthermore, rather than the «canon» widespread intervention, an innovative application of F.R.C.M. is bands is proposed, aimed at interventions with reduced quantities of composite material and therefore improving its use in the heritage even more.
Finally, a 3D Finite Element formulation for the case in question is analysed. The masonry is discretized by the Simplified Micro-Modelling through the modelling of a homogeneous unit, partitioned in bricks and mortar joints on the boundaries, characterized by a cohesive behaviour at the interfaces. Then, the model foresees the inclusion of interventions in composites, after a preliminary calibration through strategies that, relying on the experimental data and based on literature, allow to recreate the complex behaviour of F.R.C.M. composite materials [2, 3].

REFERENCES

[1] Chen, X. Zhang, Y. Huo, H. Wu, Z. Study of high tensile strength of natural continuous basalt fibers. *Journal of Natural Fibers,* Vol **17**(2), 1–9, 2018.
[2] Grande, E. Milani, G. Bertolesi, E. Fagone, M. Rotunno, T. Modeling of the Tensile Behavior FRCM Systems for Repair and Strengthening Interventions of Masonry Structures, *Frontiers in Built Environment*, Vol **6**, 51, 2020.
[3] Minafò, G. Oddo, M.C. La Mendola, L. Formulation of a truss element for modelling the tensile response of FRCM strips. *Construction and Building Materials*, 125576, 2021.