Fibre Reinforced Geopolymers as inorganic strengthening composites for masonry structures

E. Garbin*, M. Panizza†, S. Tamburini†, M. Natali† and G. Artioli∞

* Inter-Departmental Research Centre for the Study of Cement Materials and Hydraulic Binders - CIRCe, University of Padova, Via G. Gradenigo 6, 35151 Padova, Italy
e-mail: enrico.garbin@unipd.it, web page: http://circe.dicea.unipd.it

† Institute of Condensed Matter Chemistry and Technologies for Energy, National Research Council of Italy (CNR-ICMATE), Corso Stati Uniti 4, 35127 Padova, Italy
e-mails: matteo.panizza@icmate.cnr.it, sergio.tamburini@cnr.it, and marcostefano.natali@cnr.it, web page: http://www.icmate.cnr.it

∞ Department of Geosciences and CIRCe, University of Padova,
Via G. Gradenigo 6, 35151 Padova, Italy
e-mail: gilberto.artioli@unipd.it, web page: https://www.geoscienze.unipd.it

ABSTRACT

The study presents an assessment of externally bonded Fibre Reinforced GeoPolymers (FRGPs) as strengthening material for masonry structures. Thanks to their tailored chemical and mechanical characteristics, geopolymeric matrices can also potentially fulfil the requirements of the fundamental restoration criteria for historical buildings, with the benefit of heat-resistant performances better than those of organic matrices used in Fibre-Reinforced Polymers (FRP) [1].

A previous investigation [2] proved the suitability of the developed geopolymeric matrix for applications on fired clay masonry, from both chemico-pysical and mechanical standpoints. The research revealed a good adhesion to masonry substrates and to embedded fibre reinforcements.

Based on those outcomes, the behaviour of three FRGPs including either a bi-directional basalt mesh, a bi-directional carbon mesh and a unidirectional Ultra High Strength Steel (UHSS) fabric was explored by means of local tests on masonry components made of soft-mud clay bricks and hydraulic lime mortar. In overall, 9 single-lap shear tests on single soft-mud bricks with a bonded length of 200 mm, and 9 three-point bending tests on two brick plates, connected by a mortar joint and reinforced at the bottom face, were carried out. Lastly, the behaviour of each reinforcement exposed to alkaline environments was investigated through tensile tests on coupons immersed for 28 days in solutions simulating the alkaline conditions of the geopolimeric matrices.

The results confirmed the interesting potential of FRGPs for strengthening masonry members, highlighting a good performance of steel and carbon reinforcements. On the other hand, precautions should be taken with basalt meshes that, as expected, were more sensitive to alkaline environments.

REFERENCES

[1] G. De Felice, S. De Santis, L. Garmendia, G. Ghiassi, P. Larrinaga, P.B. Lourenço, D.V. Oliveira, F. Paolacci, C.G. Papanicolaou. Mortar-based systems for externally bonded strengthening of masonry, *Mater. Struct.*, Vol. **47**(12), pp. 2021–2037, (2014). doi:10.1617/s11527-014-0360-1

[2] Tamburini, S., Natali, M., Garbin, E., Panizza, M., Favaro, & M., Valluzzi, M.R., "Geopolymer matrix for fibre reinforced composites aimed at strengthening masonry structures", *Constr. Build. Mater.*, Vol. **141**, pp. 542-552, (2017). doi:10.1016/j.conbuildmat.2017.03.017