Structural performance and durability issues of vernacular schist masonry

Carlos E. Barroso[†], Daniel V. Oliveira[*] and Luís F. Ramos[††]

[†] ISISE & IB-S, University of Minho, Portugal
e-mail: arq.carlosbarroso@gmail.com, web: http://www.isise.net

[*] ISISE & IB-S, University of Minho, Portugal
e-mail: danvco@civil.uminho.pt, web: http://www.isise.net

[††] ISISE & IB-S, University of Minho, Portugal
e-mail: lramos@civil.uminho.pt, web: http://www.isise.net

ABSTRACT

Stone masonry is recognized as one of the most common vernacular construction techniques used around the world. Although centuries of proven resilience and high adaptability to context, structural stone masonry has been progressively replaced by industrial and concrete-based materials and building systems along the last decades in countries such as Portugal. Nowadays, due to the absence of experienced masons, an important part of traditional stone masonry constructive know-how is endangered. In face of growing concerns regarding heritage preservation, researchers are aware of the need to scientifically know such structures. Being less studied, vernacular schist rubble masonry was selected as case study and tested to characterize mechanical behaviour and durability parameters. The potential of retrofitting such structures was also assessed [1].

A series of 18 multi-leaf wallets (60x60 x30 cm^3) were built following local building tradition [2], using soil as bedding and joint mortar, and prepared according to 3 different setups of 6 specimens each: *i)* non-coated; *ii)* coated with commercial lime mortar; *iii)* coated with commercial lime mortar and injected with lime-based grout. The experimental campaign was designed and implemented in stages for a period of three years: *i)* stones and mortars experimental characterization; *ii)* axial compression testing of reference specimens (3 of each set); *iii)* specimens salt accelerated aging by full immersion wet-dry test (20% NaCl solution) [3]; *iv)* followed by compression testing.

Damage progression was monitored throughout the salt testing by visual inspection, mass variation and sonic testing [4]. Results confirm rubble masonry's low mechanical performance, high deformation capability to readjust and sustain loading. Grout retrofitting improved rubble walls' stiffness and loading capacity on an average of 10 times. Results aged walls show a consistent loss of strength in non-coated (washing of mortars and chemical damage) and coated walls (high internal moisture content). No consistent strength loss was observed in retrofitted walls, proven its potential in the protection rubble masonry against water and salt penetration, thus improving global durability.

REFERENCES

[1] D. V. Oliveira, R.A. Silva, E. Garbin and P.B. Lourenço, Strengthening of three-leaf stone masonry walls: An experimental research, Mater. Struct. Constr. 45 (2012) 1259–1276. doi:10.1617/s11527-012-9832-3.

[2] C.E. Barroso, D. V. Oliveira, L.F. Ramos, Vernacular schist farm walls: materials, construction techniques and sustainable rebuilding solutions, J. Build. Eng. 15 (2018) 334–352. doi:10.1016/j.jobe.2017.12.001.

[3] T. Wijffels, B. Lubelli, Development of a new accelerated salt crystallization test, Heron. 51 (2006) 63–75.

[4] H. Van Eldere, F. Ramos, E. Verstrynge, N. Shetty, K. Van Balen, C.E. Barroso, The Application

of Sonic Testing on Double-LEaf Historical Portuguese Madonry to Obtains Morphology and Mechanical Properties, in: R. Aguilar, D. Torrealva, S. Moreira, M.A. Pando, L.F. Ramos (Eds.), Struct. Anal. Hist. Constr. (RILEM Bookseries), 1st ed., Springer International Publishing, 2019: pp. 661–668. doi:10.1007/978-3-319-99441-3.