

Laboratory and in-situ characterisation of masonry materials in a large historical industrial building in Barcelona

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ABSTRACT

The determination of the mechanical properties of existing masonry structures faces significant difficulties due to the intrinsic complexity related to this composite material. Acquiring a full knowledge of the main parameters is necessary to design adequate conservation actions for the built cultural heritage [1]. The mechanical characterisation of existing masonry structures usually requires an optimum combination of laboratory and in-situ techniques, especially in large constructions. This research presents the detailed description of the experimental methodology followed during an extensive campaign carried out in an historical industrial building of Barcelona from the XIX century.

The experimental campaign considered minor destructive testing (MDT) techniques, both based on in-situ testing of masonry components and extraction of small samples for laboratory testing. The in-situ MDT allowed a preliminary evaluation of the variability of the properties over the large building, in order to optimize the execution of the laboratory tests. The results from different MDT techniques allowed useful cross-checking in order to keep a continuous control throughout all the experimental program. The tests were developed on the units and mortar joints of both masonry walls and vaulted floors, as well as in the plasters. The main objectives were to obtain a careful characterisation of the material components in order to evaluate their strength capacity and to choose compatible restoration materials of similar properties.

The in-situ experimental characterisation was made by using the Pin Penetration Test (PPT) and the Helix Screw Pull-off Test (HPT) [2] on the mortar joints and bricks, as well as the PPT and Pull-off Test (POT) [3] on the mortar plasters. The experimental characterisation in the laboratory consisted in: flexural and compressive testing of small samples of bricks from walls [4]; double punch testing (DPT) of mortar joints from the walls and the vaulted floors; DPT of specimens of plaster [5]; compressive testing of cylindrical samples of masonry extracted by core-drilling [6]; compressive testing of ceramic tile samples from the vaulted floors by means of a novel nonstandard setup.

The results obtained showed a good relationship between the in-situ MDT techniques and the tests carried out in the laboratory. The differences among the experimental results from different portions of the large building allowed the discovery of different material typologies deriving from different construction phases.

REFERENCES

- [1] A. W. Hendry, *Structural Masonry*, First Edit. MacMillan Education LTD, 1990.
- [2] L. Pelà, P. Roca, A. Aprile, and L. Pelà, “Combined In-Situ and Laboratory Minor Destructive Testing of Historical Mortars Combined In-Situ and Laboratory Minor Destructive Testing of Historical Mortars,” *Int. J. Archit. Herit.*, vol. 12, no. 3, pp. 334–349, 2018.
- [3] European Committee for Standardization (CEN), “EN 1015-12 Methods of test for mortar for masonry - Part 12: Determination of adhesive strength of hardened rendering and plastering mortars on substrates,” 2016.
- [4] European Committee for Standardization (CEN), *EN 772-1: Methods of test for Masonry Units - Part 1: Determination of Compressive Strength*. 2011.
- [5] DIN, “DIN 18555-9: Testing of mortar containing mineral binders - Part 9: Determining the compressive strength of hardened mortar.,” no. 0107, pp. 1–8, 1999.
- [6] L. Pelà, E. Canella, A. Aprile, and P. Roca, “Compression test of masonry core samples extracted from existing brickwork,” *Constr. Build. Mater.*, vol. 119, pp. 230–240, 2016.