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Correlation between porosimetric test and penetrometric test on masonry mortar

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In the field of preservation of Cultural Heritage, diagnostic investigations based on an interdisciplinary approach can effectively support the phases of structural diagnosis and design of compatible interventions. This approach consists of a set of procedures of data and techniques interrelation, suitable to integrate and improve the acquired information and to increase the potentiality of the methods utilized.
One of the approaches is aimed at finding correlations between different techniques of investigation, which differ for invasivity or destructivity degree, for execution mode (in situ or in laboratory), for output parameters (i.e. physical and mechanical, or chemical and physical). Correlations permit to use techniques less destructive, cheaper, and which provide directly the parameters which characterize a determined behaviour or phenomenon. Particularly interesting are those studies aimed at finding correlations between physical and mechanical parameters. The more the sample is homogeneous, the more the correlations are 'robust'.
Among different materials, masonry mortar requires a special attention when developing and setting up procedures which integrate and correlate different investigation techniques, because of its high heterogeneity.
Within this context, the paper shows the results of an investigation on the mortars of historical masonry of monuments of medieval and modern age in Basilicata (Southern Italy). The aim of the research is to find a correlation between mercury porosimetric test and penetrometric test. The former provides the porosity parameters. The latter quantify the mechanical characteristics of the mortar through micro-destructions of the material operated by a penetrometer, whose basic mechanism is realised by a calibrated spring, which drives a cylindrical hammer, which in turn strikes a drum where the pin is lodged.
The results show that the mechanical strength of the mortar is not correlated with the sole physical parameters. However, an interesting result emerges: a high correlation is present between the resistance to penetration and the fraction of pores with diameter ranging from 0.4 and 1 micron, which highlights this class of pores as governing the examined strength parameters. The correlation found induces to assume this porosity parameter as an index of mortar strength, useful for mortar classification. Although the statistical significance of the sample should be corroborated by more case studies, the results of the study are fairly repetitive on historical masonries located in different sites and built in different ages.