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## Brick technology in the roman *villa* (I-III c. AD) of Costigliole Saluzzo (Piedmont, Italy)

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The excavation of the *villa rustica* of Costigliole Saluzzo – one of the largest rural settlements of north-western Italy during the Roman age – brought to light a huge quantity of building materials pertaining to the different parts of the *villa* and to other adjacent constructions.

Among the ceramic materials, tiles, curved tiles and north-Italian *sesquipedales* bricks are very common. Other artifacts are less diffused, like a specific kind of brick which is unparalleled in other sites of Roman Piedmont so far: it is usually less compact and hard in comparison with other building materials, and shows differences in color and composition (*e.g.*, a particular concentration of vegetal elements in the fabric). Moreover, the fire which caused the destruction of the *villa* was responsible for the excellent preservation of many parts of the wall structures made in perishable materials in the technique of *opus craticium* (*e.g.*, fragments bearing the traces of the original *incannucciata*, reed structure).

EDX determination revealed a non-calcareous paste for all the analyzed samples, the composition of the *incannucciata* samples show slight differences from all the other samples, quite homogeneous. The overall original firing temperatures evaluated by means of a multitechnique approach (XRPD, SEM, TGA and FTIR) could be assumed between 800 and 1100 °C for all the intentionally fired materials, on average higher than those reported by other authors. A higher temperature in the firing process of this kind of materials results in a mechanical strength increase, suggesting technological advanced knowledge and capability. Moreover, SEM examination of fresh fractures allows ascertaining relict voids of vegetal fragments burnt during the firing step in samples pertaining to the rare type of bricks described *supra*, usually occurring in the foundations and in the bases of few structures related to the *pars urbana* of the building. It seems plausible that the increasing thermal insulation and/or enhancing the freeze-thaw resistance of the final product was the final aim of this technological choice. The expedient of creating voids in the clayey structure to increase thermal insulation and resistance in archaeological building materials was never described before, to the authors' knowledge. The physical mechanism bestowing these characteristics to the bricks was evidently not known, but its effect had been certainly observed, since the procedure of adding straw to limit shrinkage and avoid cracks formation is attested in analogous materials. The adoption of this procedure would suggest good technological knowledge and skills and particular attention in the evaluation and planning of the long-term features of the buildings.

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