

The Ducal Palace of Sassuolo

Avantgarde technology and in-depth chemical analysis of the original building materials resulted in a superb restoration that enabled this splendid monument to be opened to the public.

by *Natasha Calandrino and Carlo Rossi*

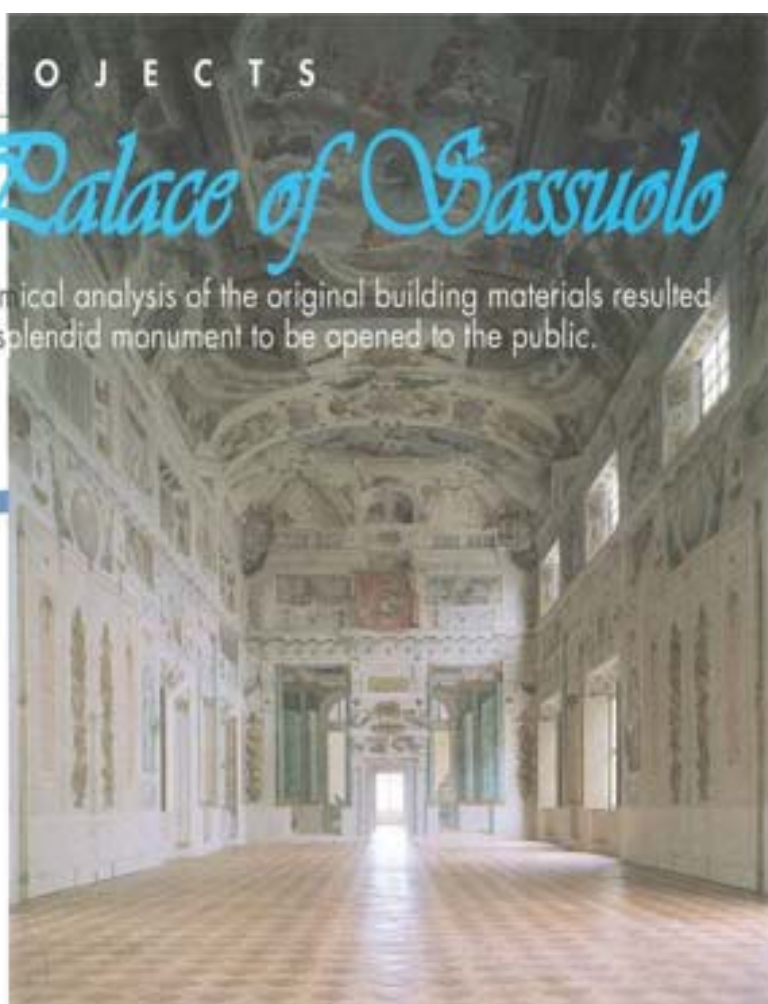
The Ducal Palace of Sassuolo is one of the most beautiful treasures of Northern Italian baroque. It was originally built as a small castle in the Middle Ages and later became a holiday retreat of the Dukes of Este. In 1598 Duke Francis the First transferred the capital of his Duchy to Modena and made plans to transform the nearby castle of Sassuolo into a showplace for his court.

The task of remodeling the old chateau fell to Bartolomeo Avanzini, a leading exponent of Roman baroque architecture, and the set designer Gaspare Vigarani, who began work in 1634. The existing building was completely altered and was redesigned as a three-story palace surrounded by formal gardens, an enormous park, stables and a fish pond (the "Fontanazzo"). Jean Boulanger, the court painter,



executed the spectacular frescoes of the vast ducal apartments.

The vicissitudes of the succeeding centuries were not kind to the palace but the structure was preserved intact. Although it had fallen into neglect it still retained much of its old grandeur. In 1987 the palace was removed from the jurisdiction of the Ministry of Defense and came under that of the Ministry of Cultural and Environmental Resources.



A committee was formed to coordinate the ten-year restoration project that culminated in the recent opening of the palace as a museum.

Restoring the floors: a winning collaboration

The restoration of the Ducal Palace of Sassuolo, sponsored by the Ministry of Cultural and Environmental Resources under the direction of the Superintendence of Artistic and Historical Resources of Modena and Reggio Emilia, included a painstaking restoration of the palace floors that had deteriorated with the ravages of time.

The seventeenth century flooring of the main floor, the "piano nobile", of the Ducal Palace was wholly restored with hi-tech products.

The Emilceramica, Mapei and Fila companies combined forces in a truly unique collaborative effort of preservation and restoration. The technical problems posed by the total state of disrepair of the antique floors made an interdisciplinary approach indispensable, with each

company contributing its own research facilities, materials and know-how. The criteria which characterized every aspect of the restoration were in-depth chemical analysis of the original materials and a faithful historical reconstruction of the techniques originally used, as required by the strict parameters of the Ministry for Cultural Resources.

Investigating the materials

In order to determine the criteria for the best restoration techniques to adopt in restoring the terra cotta floor to its

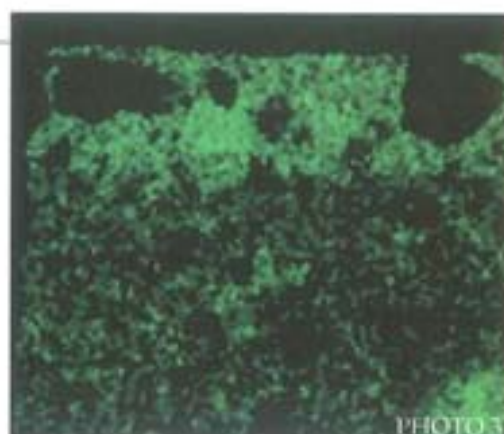
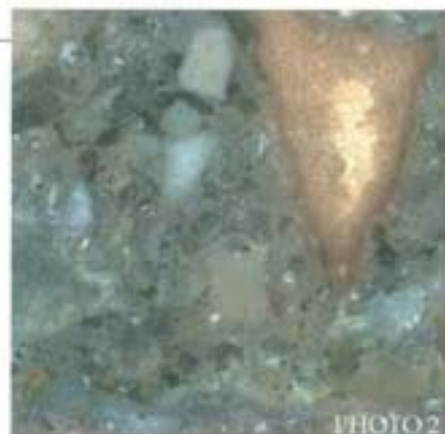
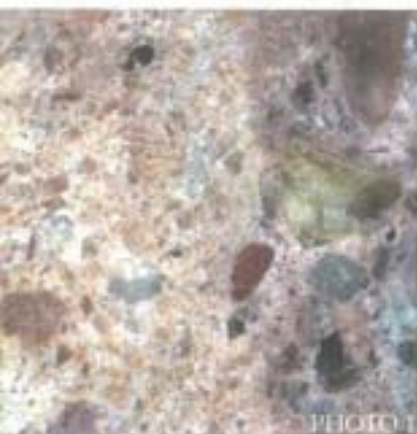


Photo 1
A "collar" 0.2 to 0.3 mm thick composed predominantly of calcium carbonate is visible on the surface of the terracotta tile. The collar is caused by lime in the mortar bed that migrates into the body of the tile itself and subsequently carbonates

Photo 2
Morphological analysis – EDAX mapping of calcium distribution (80x). The surface collar contains more calcium than the body of the tile. This confirms that the calcium has penetrated into the tile from the mortar

Photo 3
Morphological analysis under the optical microscope. The structure of the mortar appears continuous, though heterogeneous. Analysis revealed numerous micro- and macro-cavities evenly distributed throughout the matrix.

original luster, the state of preservation of the materials had to be evaluated. A preliminary examination was performed on the mortar and terracotta tiles used in building the palace. Some cracked and otherwise damaged pieces were to be restored while others would have to be replaced with new tiles, handmade like the old ones. The Mapei Laboratory examined samples from the Ducal Palace with the most sophisticated instruments, such as the SEM, the scanning electron microscope, and XRD, X-ray diffraction.

The mortar's state of preservation was determined by the soluble salt content which turned out to be very low, indicating that it had held up well. The mortar was a system originally composed of common lime mixed with primarily siliceous aggregate and "reactive silicates", e.g. clay. It developed its mechanical strength through a chemical reaction, the carbonation of the common lime, a process which occurred over the course of centuries. This long span of time, however, allowed the lime to penetrate approximately 200µ into the

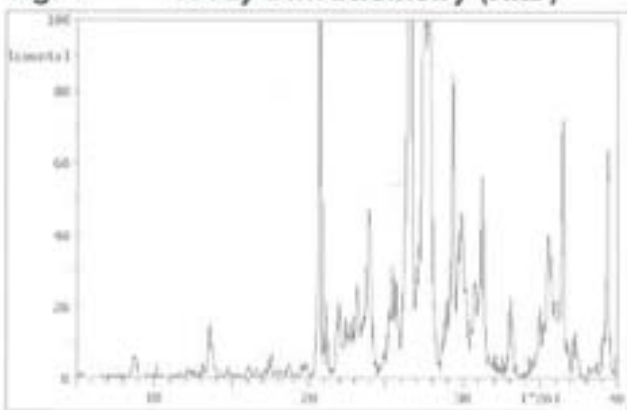
tiles before carbonating, forming a rich surface "collar" of carbonate that caused the area where the mortar interfaced with the tile to shift to the inside of the tile itself, thus weakening it. Common lime, even if mixed with "pozzolanic" materials, damages the structure of terracotta if it is not quickly converted into calcium carbonate.

The tiles analyzed showed they were composed primarily of silica with a low calcium carbonate content, a composition very similar to that of modern materials. The chemical analysis data showed they were similar to tiles fired at high temperatures with a "vitrified" body. The low amount of salts contained in the tiles was also an indication of a good state of preservation. This scientific investigation into the nature of the original materials enabled precise indications to be given as to the selection of products to be used for the restoration.

The restoration

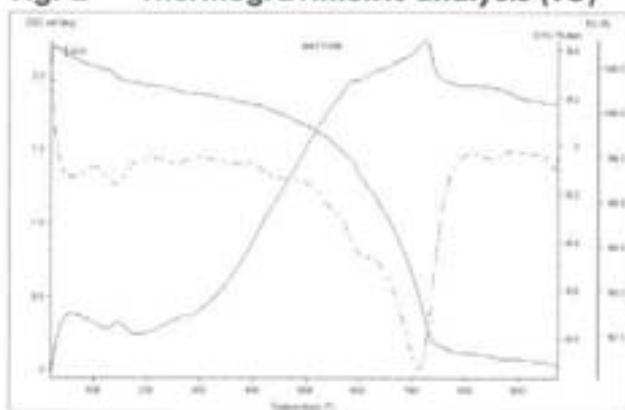
Restoration of the terra cotta was performed using products from the MAPE-ANTIQUE line of mortars for period buildings. These mortars feature

Fig. 1 X-ray Diffractometry (XRD)



The analysis shows the presence of quartz, sodium and potassium feldspar, diopside and small amounts of calcite, along with traces of the original clay (illite), confirming the predominantly silicate nature of the terracotta

Fig. 2 Thermogravimetric analysis (TG)



This analysis also confirms the siliceous matrix of the terracotta which is approx. 6% calcite. (Data and photos courtesy of the Mapei R&D Laboratories Milan - Italy)

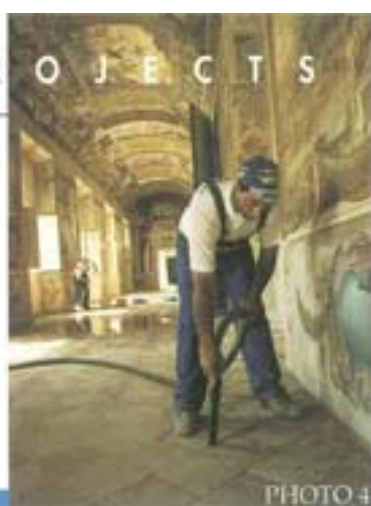


PHOTO 4



PHOTO 5

mechanical performance similar to that of "antique" mortars. Morphological analysis of the binders in MAPE-ANTIQUÉ mortars shows characteristics very similar to those of the original mortar. The photograph taken with the electron microscope shows the rounded structure typical of a "stabilized" system. These characteristics are a direct result of the low lime content in the MAPE-ANTIQUÉ system, where the concentration of lime is already minimal after only one week.

The rapid elimination of lime prevents it from penetrating into the tiles, thus eliminating the "collar" of calcium carbonate that causes the tiles to become fragile and crumble. Moreover, the low amount of salts in the formula makes the MAPE-ANTIQUÉ system insensitive to chemical and physical attack, retaining the physio-mechanical characteristics, the porosity and the vapor-permeability of antique pozzolan lime mortars.

The MAPE-ANTIQUÉ system, based on special hydraulic binders and natural sand, is especially resistant to sulfate salts, one of the major causes of degrading in period buildings. Compared to the original mortars present in the Ducal Palace, the mortar systems for period buildings of the MAPE-ANTIQUÉ line are so hard as to be virtually indestructible when exposed to the aggressive natural agents that gradually but inexorably caused the flooring in the palace to degrade. Despite their intrinsic porosity and the mechanical "delicacy" similar to the original mortar used in the Palace, the mortars of the MAPE-ANTIQUÉ line are chemically and physically insensitive to attack.

Repairing the terracotta tiles

After a thorough cleaning of the surface (Photo 4), restoration of the damaged tiles was performed with MAPE-ANTIQUÉ

FC/R fine-textured brick-colored finishing mortar, for cracks up to 2 to 3 mm wide, and with MAPE-ANTIQUÉ CC brick-colored mortar for larger size cracks (Photo 5).

Installing new tiles

Approximately 340 m² (3,660 sq ft) of new flooring had to be installed because some of the terra cotta was so damaged that it could not be repaired. New terra cotta tiles were fired with exactly the same mixes and techniques used in the past. They were set with GRANIRAPID, a two-part adhesive system formulated in the Mapei Laboratories (Photo 6). GRANIRAPID sets and cures extremely fast and is extraordinarily resistant to the aging and the vibrations caused by heavy visitor foot traffic.

The entire floor of the "piano nobile" of the Ducal Palace, 1171.65 m² (12,610 sq ft) of restored tiles and 340 m² (3,660 sq ft) of new tiles, was grouted with MAPE-ANTIQUÉ FC/R after the joints were scraped (Photo 7).

Cleaning, finishing and protective treatments were done by Fila. Manual applications of various Fila products gave the flooring highly effective protection against staining and heavy visitor foot traffic (Photo 8).

A majestic inauguration

On 12 September 1998 the Ducal Palace of Sassuolo was inaugurated in the presence of the former Italian premier Romano Prodi, The Commander of the Military Academy, Major General Gaetano Romeo, the Mayor of Sassuolo, Laura Tosi, Regional Councilors Luigi Gilli and Ferruccio Giovanelli, and the Superintendent of Artistic and Historical Resources of Modena and Reggio Emilia, Jadranka Bentini, along with numerous visitors who admired the spectacular restoration (Photos 9 and 10).

The Ducal Palace of Sassuolo was reopened to the public after its 17th century floors were painstakingly restored. The inauguration was attended by prominent cultural and political figures. Photo 10 shows Dr. Jadranka Bentini (center), Superintendent of Artistic and Historical Resources of Modena and Reggio Emilia, leading the guests on an inaugural tour of the palace.





PHOTO 6



PHOTO 7



PHOTO 8



PHOTO 9

An added attraction was an exhibit of 83 drawings from the vast Este art collections, half of which were lent by the Louvre Museum for the celebrations of Modena's 400th anniversary of its elevation to capital city status.

The restoration of the floors of the ducal apartments was the last step in the long restoration process. The public was finally able to walk through those magnificent halls, thanks to the pooled resources of Emilceramica, Mapei and Fila, three companies that share a commitment to

scientific research, avantgarde technology and painstaking historical research. □

Our thanks to Dr. Laura Bedini of the Superintendence of Artistic and Historical Resources of Modena and Reggio Emilia for her invaluable cooperation.

Carlo Rossi is the Mapei representative for the Emilia Region.

The Technical Data Sheets for the products mentioned in this article are contained in Mapei Binder No. 1, "Ceramic Tile Installation Products" and No. 3, "Building Specialty Line".



TECHNICAL DATA

Project: The Ducal Palace of Sassuolo

Built: First half of the seventeenth century

Completion of restoration: 1998

Sponsored by: The Superintendence of Artistic and Historical Resources of Modena and Reggio Emilia in collaboration with The Superintendence of Architectural and Environmental Resources of Emilia

Project Manager: Dr. Jadranka Bentini and arch. Luciano Serchia

Contractor: Immobiliverde s.r.l., Apecchio (Pesaro) Italy

Materials: original terracotta tiles and Emilceramica hand made terracotta tiles (26x26 and 33x33 cm)

Mapei Products used for the repair and grouting of the original tiles:*
MAPE-ANTIQUE FC/R
MAPE-ANTIQUE CC

Mapei Products used for setting and grouting the new tiles:*
GRANIRAPID
MAPE-ANTIQUE FC/R

*These materials are part of Mapei's European product lines.



PHOTO 10