

Renders technology in Italian Renaissance. The case of the Lucchesian villas.

L. Bolondi
@MIT, TU Delft

Render technology: a new approach of the research

Scientific investigations on building materials are necessary for a correct and effective restoration of historical buildings, but they could be very expensive and long. Five years ago, at the beginning of this investigation, this observation was the starting point of the research project (Bolondi 2009).

Preliminary knowledge of the chemical, physical and petrographic properties of ancient building materials is essential in order to choose or create the most compatible restoration materials to be used. Unfortunately, every construction to be restored is often considered as a unique case and data coming from (former) researches on buildings possessing similar characteristics are not available.

Through the historical and architectural analysis of the territory around the building to be restored, however, it is frequently possible to find several constructions similar to it in many aspects: time of construction, architectural style, materials used, etc. In the past, several groups of constructions were built in some areas (around the historical centers, along pilgrimage routes, etc.) in the same periods. Every group of building has common characters in functions, architectural structure and building technology and can be defined as a system of cultural heritage. All the buildings belonging to a system are part of a more complex and structured situation, they are a piece of a puzzle that is not complete without all of them.

To consider every building not just as a single case study, but as part of a bigger and structured system, allows to carry out investigations sharing research tasks and procedures and also results and experience. Unfortunately, no research project had ever been carried out on the basis of this assumption, and a completely new approach had to be developed.

Several questions arose from this assumption, they all needed to be solved and this research was meant to answer them: is it actually possible to demonstrate that - even in the cultural heritage field- *'unity is strength'*? Which kind of guideline should be applied to the case-studies? Which building material should be considered first? What could be the ideal system of cultural heritage we could start from?

All these questions started to be answered during a short research on the gardens of the Villas around Lucca (Bolondi 2008), a city in the north of Tuscany (Italy).

The research on the System of Lucchesian Villas

Around the beautiful center of Lucca, villas (countryside properties) were built between the 15th and the 19th century, that can be considered as forming a System. The System of the Lucchesian Villas is a kind of *ring* or a *crown* of villas built around the ancient city walls and having certain characteristics in common. As a diffused and homogenous group, they characterize the territory around the center. Every villa is a property, often surrounded by an enclosure, where the summer rest of the landlords and the agricultural activity of farmers perfectly co-existed. Inside the villa enclosure, several buildings are present: the palace, farms, churches, stables, grottos, nymphaeums, etc.

The System consists of about 300 villas: it is the perfect case-study to be used as a starting point to verify the assumption that large scale and homogenously carried out studies would lead to more essential knowledge, at a lower cost.

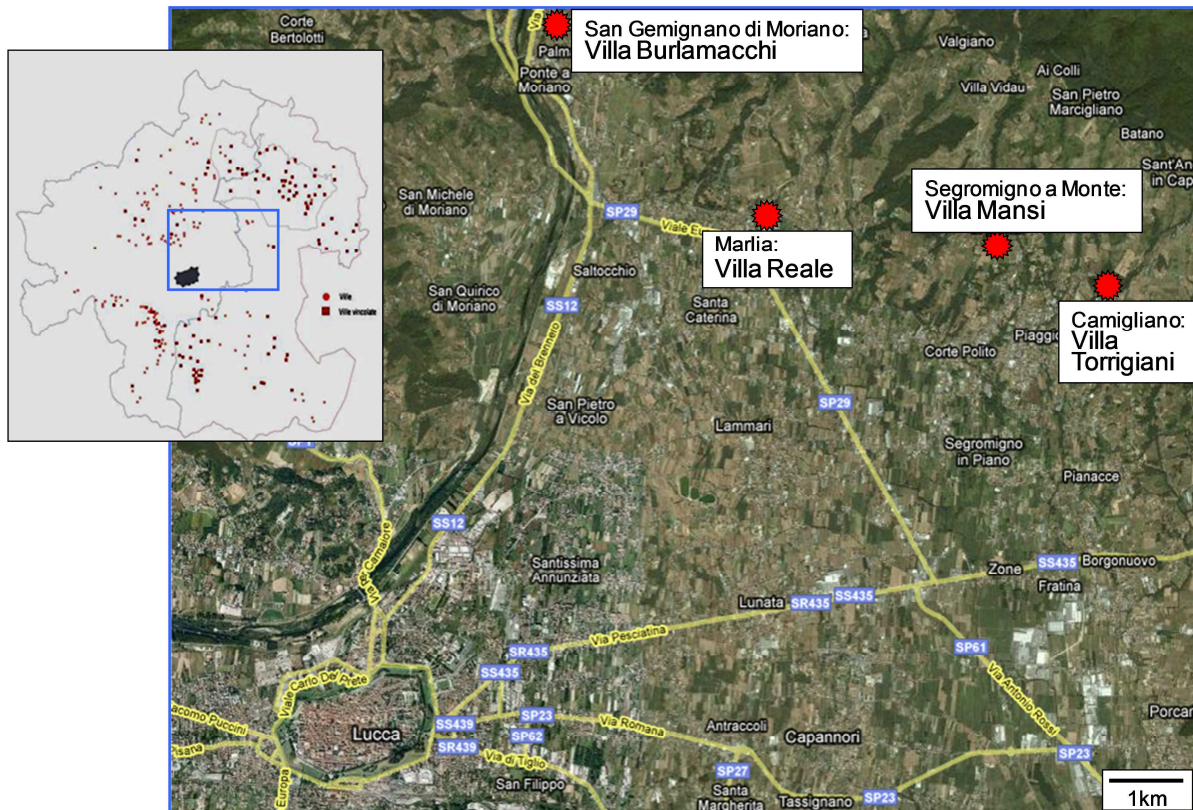


Fig. 1. Selected case-studies and their position in the System.

Obviously, not all the villas could be considered. As a starting point, four of them were selected among the most important and famous ones (Fig. 1). The villas were selected also because they are private properties: when the landlords are going to restore them, they probably will not verify the possible existence of former

researches on the surrounding properties. They have the building materials to be restored usually analyzed without following a common guideline of research, which means that the obtained results are representative for a given situation only, and not to be compared with the output of other researches concerning the same *system*. To show them how to share the scientific knowledge about their properties and how to contribute to the project was one of the goals of the research since its beginning.

Subsequently, renders were considered the perfect material to start with: they are the *skin* of the building, they face the environment and are the first part of the building to be damaged. Moreover, they need special attention in the restoration process: it is very difficult to evaluate their compatibility with the new restoration materials. The renders of the villas in Lucca seemed to be quite old, but they usually did not show any serious damage.

After a complete historical analysis of the Lucchesian Villas System, a more detailed research was carried out on the four selected villas. The first and most significant result was that no scientific data were available about any of the materials used in the System. For some of the villas, only the kind of natural stone used as structural element was stated in literature, but no details about the quarry were reported.

The very first book written about the villas was the Giovanni di Vincenzo Saminati's treatise *Dell'edificar case e palazzi in villa* (About building houses and palaces in the countryside), dating end of 16th century (Saminati 1580). Saminati described – amongst other things- the procedure to create durable and good building materials to be used in the villas. He listed the materials to be used, but he did not refer to the recipes, i.e. the ratio of the raw materials to be mixed. Another important research was carried out in the 1960's by Isa Belli Barsali (Belli Barsali 1964). She reconstructed the history of every villa in the System, but she did not report scientific data about their materials.

Considered case-studies and sampling

The four considered villas were chosen on the basis of their importance, of the historical documents available in the archives and of their geographical position in the System: they all are in the north-eastern area of the Lucca's territory. All villas are private properties and were modified in the 17th-18th century as well.

Villa Burlamacchi was built in the 16th century. In 18th century, two 16th century small buildings, the oil-mill and the chapel, have been incorporated to the palace of villa (Fig. 2). In the enclosure, the old parish and the lemon-house are present. They are situated on two lateral terraces immediately below the hill Villa Burlamacchi was built

on. Samples were taken from four buildings of the villa: palace, chapel, lemon-house and parish.



Fig. 2. Villa Burlamacchi, palace.



Fig. 3. Villa Reale, Villa del Vescovo palace.

Villa Reale has a complex history. During the 11th century, the Avvocati family owned the property, which was later sold to the Buonvisi family. After the family crash in 1629, the villa was sold to the Orsetti in 1651. The Orsetti family owned the property

until 1806, when Elisa Baciocchi, Napoleon's sister, chose the villa to be her country residence. She made the last landlord -Lelio Orsetti- and the Bishop of Lucca sell their villas to her: Villa del Vescovo is still part of Villa Reale property (Fig. 3). In 1814, Elisa Baciocchi's properties passed to the Bourbon-Parma family. In 1847, the property went to the Duchy of Tuscany and -in 1860- to the Italian state. In 1862, it was given to the widow and heirs of Charles of Bourbon-Capua. Since 1924, Villa Reale is property of the Pecci Blunt family. They restored both the palace and the garden in the 1940's. Samples have been collected from three 16th century buildings, viz. the palace of Villa del Vescovo, the chapel of San Biagio and the stable of the Villa dell'Orologio.



Fig. 4. Villa Mansi, Palazzina dell'Orologio.

Villa Mansi is first mentioned in 1599, when the building was sold to the Cenami family. It had probably been built in the second half of 16th century. In 17th century, the Cenami family radically transformed the villa. The Palazzina dell'Orologio was built during this phase, along the western wall of the enclosure of Villa Mansi (Fig. 4). It can be easily recognized in the layout of the property due to its V-shape. Due to the recent restoration of the palace of Villa, the 18th century Palazzina dell'Orologio (literally *building of the clock*) was the only building sampled in this study.

Villa Torrigiani is one of the most famous Lucchesian Villas. Its history and the numerous phases of its development have been studied in detail by many historians of garden architecture. Despite its popularity, only the palace of the villa has been studied. Some other small but important buildings inside the villa itself, such as the small coffeehouse, built at the end of 17th century at the eastern side of the garden, have only rarely been considered. Originally it was the private chapel of the Santini family (Fig. 5). Inside the enclosure of Villa Torrigiani, another important building is present: the farm. It had several functions: storage and stable, court with wash-house, gardener's house and friars' house. In front of the main gate of the Villa the

so-called Borgo a Parigi is located. It is constituted by two constructions built in Medieval style during the 18th century on a pre-existent architecture. Samples have been collected from the coffeehouse, the Farm and Borgo a Parigi; the palace's renders have been restored three years ago and they could not be sampled.



Fig. 5. Villa Torrigiani, coffeehouse.

Research procedure

80 samples were collected from all the villas. All of them were documented and the sampling location was reported in a very detailed form, which was developed for this research and made available for future investigations within the Villa System.

All samples were analyzed with the stereomicroscopy, in order to divide them into groups on the basis of their characteristics (binder/aggregate ratio, kind of aggregate, etc.). After this screening, a representative group of samples was selected to be further analyzed.

The tests to be performed were carefully selected, in order to choose the most complete, but also fast and less expensive ones. These criteria should be followed in planning the investigations of most villas, where not expensive or extremely detailed analyses are necessary.

The tests were carried out in the laboratories of TNO, Delft (the Netherlands) and at the Faculty of Civil Engineering of the Aristotle University of Thessaloniki (Greece). The tests selected and performed during the first part of the research were:

- Polarization-and-Fluorescence Microscopy (PFM), in order to have a detailed petrographic characterization of the samples;

- High Pressure Liquid Chromatography (HPLC), to verify the presence of salt ions that could cause damage;
- Analysis of soluble and insoluble parts of the mortar, to have a general idea of the chemical composition of the binder and of the binder/aggregate ratio;
- Loss of ignition, to find out the carbonation level of the renders.
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In the last two years, analyses focused in particular on a kind of mortar sampled in Villa Torrigiani and in Villa Mansi: *cocciopesto* (i.e. ground brick). This is a special kind of mortar, used since the Roman times, with specific hydraulic properties given by brick powder mixed in the render and reacting with lime. A few *cocciopesto* samples were analyzed by means of:

- Fourier Transformed Infrared Spectroscopy (FTIR), to identify the main chemical bonds in the mortars;
- X-ray Diffraction (XRD), to find out crystalline elements in the binder, such as CaO;
- Atomic Force Microscopy (AFM), to investigate the chemical reaction between lime and brick powder;
- Scanning Electron Microscopy (SEM), to verify the effectiveness of AFM;
- Mercury Intrusion Porosimetry (MIP), to define the pore size distribution of the *cocciopesto*.

Moreover, some of the samples analyzed with HPLC were also tested with Ion Chromatography (IC). Other samples were analyzed with SEM as well, in order to identify the pigments used in the color layers.

Results and conclusions

The results of this research concern the chemical and petrographic composition of the mortars, their properties and, in particular, the very good resistance of *cocciopesto* in a salt-loaded environment. In particular:

- the building technology used in the production of these materials was very advanced: they were not just used to protect the structures from the environment, but they had an aesthetic role as well;
- the aggregate of all of the renders exactly corresponds to the geological composition of the soil of the villa they were collected from;
- straw and wood were respectively used in Villa Torrigiani and Villa Reale as additives to limit shrinkage during curing (Fig. 6);
- at least two finishing layers were present in all samples, a lime wash to smooth the surface and a color layer (Fig. 7);
- AFM was effective in demonstrating that there was a chemical reaction between lime and brick powder in *cocciopesto* mortars;

- cocchiopesto in Villa Mansi has a very high content of sodium chloride and sodium sulfate, but its pores size is large enough to permit salt crystallization without creating mechanical strength and, as a consequence, damage;
- the high technological quality of these mortars could be used in designing new building materials to restore not just one of the villas, but several buildings in the System.

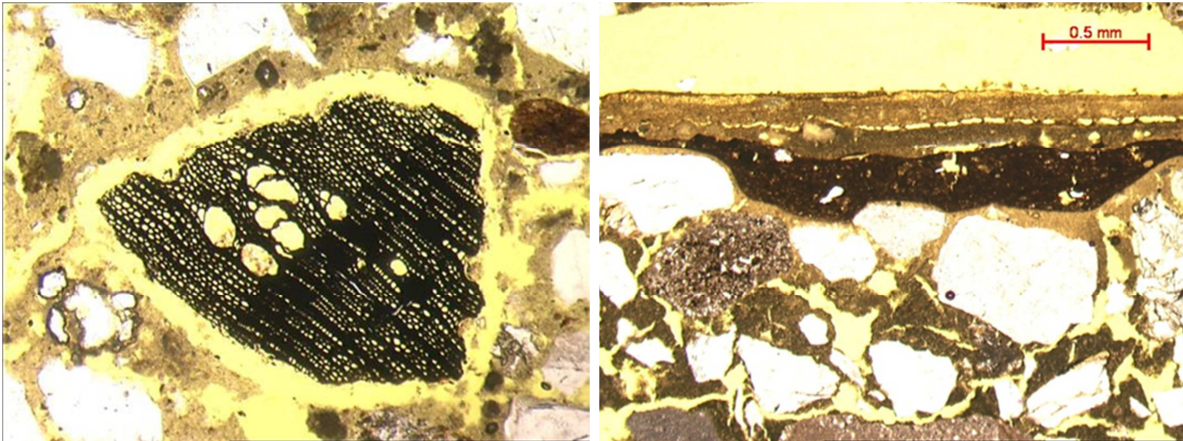


Fig. 6. Microphotograph of a wood fragment in Villa Reale.

Fig. 7. Microphotograph of finishing layers in Villa Reale sample

Concluding, four practical considerations:

- the case studies selection procedure is the most important part of the research. Without a representative group of samples, a complete overview of material characters is not possible, even with the most accurate and expensive tests;
- during the whole research project, the focus has to be kept on the data necessary to achieve a durable and effective restoration;
- sharing results and experience is extremely important, in order to avoid mistakes and waste of time and efforts;
- protection of ancient buildings, in particular of their materials, is necessary in order to learn from the traditional techniques how to improve modern building technologies.

In the past two years, this research procedure has been applied to another group of constructions, built in the Netherlands between late 19th and early 20th century: the effectiveness of the guidelines developed for the Lucchesian Villas System was proved and a further step in the application of this approach to the systems of cultural heritage was taken.

References

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