

PETROGRAPHIC CHARACTERIZATION OF RENDERS FROM THE LUCCHESIAN VILLAS

Laura Bolondi,
TU Delft, Faculty of Architecture
Julianalaan 134, 2628 BL Delft, The Netherlands

Timo G. Nijland, Rob P.J. van Hees
TNO Built Environment and Geosciences
P.O. Box 49, 2600 AA Delft, The Netherlands

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Abstract

Around the Tuscan city of Lucca, a complex system of about 300 villa has developed between 15th and 19th centuries in a ring of territory called the Six Miles District. Nowadays, many of the buildings inside the villas enclosures are damaged and their materials – in particular renders - need to be restored. A research program was developed taking into account the complexity of the Lucchesian Villa System and economic aspects of the research: simple and clear results should be obtained avoiding expensive and long test procedures. The majority of the villas are private property, and special attention had to be reserved to landlords in order to keep them involved in the research. Four Villas from the north / northeastern part of the Six Miles District have been selected on the basis of their history, importance and available archival sources. About 80 samples of renders have been collected from ten different buildings of these villas; 19 of these have been analyzed with polarization-and-fluorescence microscopy (PFM) in order to identify materials, establish stratigraphies and mutual correlations and relationships, as part of providing a basis for selection of compatible restoration materials.

Introduction

The famous walls of the city of Lucca - one of the renowned small cities of Tuscany -, are enveloped by the so-called Six Miles District containing a complex system of more than 300 villas, developed between 15th and 19th centuries. Each villa is characterized by a peculiar and unique history and was built with different materials. Together, they form a micro-cosmos, in which tradition and technique developed together, both independently from other Villas and strictly connected with them. Every villa is not just a single entity, but must be considered as a part of a more complex reality: the System of Lucchesian Villas. Although with their own particular features, villas show common architectural and technological characteristics.

Many of these buildings are now damaged and their materials need to be restored. The most common damage mechanisms are powdering and detachment of the renders. Due to the position of the building, often near green areas and trees, also biological growth or colonization by small insects occur in both the external and inner surface of the render.

During the 1960s, an important Lucchesian historian, Isa Belli Barsali, developed an elaborate history about the Lucchesian Villas and their development in Lucca's territory [1,2]. This has been the starting point for all the modern research on the villas and their gardens. However, no modern scientific studies have been performed on the materials originally used to make and subsequently restore the villas plasters and renders, nor have they been characterized physically and chemically. Only an essay by Giovanni di Vincenzo Saminati, written at the end of 16th century, provides information on how the mortars were made and used. He described exactly the materials and their origin, systems and structures of palaces and other architecture of Lucchesian Villas.

In many cases, including Lucca, cultural heritages are not considered as systems, but just as single entities, when one of them needs to be restored. No specific studies and plans have been done from a scientific point of view, in order to identify the origin of materials used to create ancient systems of buildings. Generally, during the restoration of a single architectural entity, no studies are performed of the system as a whole, or if other buildings of the same

system have already been restored with particular materials and what are the results of such restorations. Considering a building as part of a system, scientific research, development of intervention strategies and above all preventive conservation of buildings and their constituting materials can be easier and more effective. In this perspective – if similarities in materials composition and construction are found – efforts, time and money can be saved, and experience with other buildings of the same system can serve as a basis for a new restoration approaches and to avoid mistakes.

In order to understand the Lucchesian Villas System, first a historical and archive research about both the Lucchesian Villas System and the northeastern part of the district has been performed [3]. Four individual villas have been selected and analyzed; the landlords have been involved since the beginning of the research. The selected Villas are four of the most famous and important buildings of the entire system.

They have been selected on the basis of their importance, ability to recognize different periods of construction and to identify sampling localities. Three of them are open to the public.

In a second stage, 80 samples of render have been collected from the selected buildings. Samples have been collected in the same week, in order to avoid differences in weather conditions. Chemical tests were completed on 21 samples selected from the four villas on the basis of the preliminary observation by a stereomicroscope. Results are reported in [4]. In a third stage, a selection of 19 samples, in part the same as used for chemical analyses, have been chosen to be analysed by polarization-and-fluorescence microscopy (PFM). These results are reported in this paper.

Selected Case-Studies

Four Villas, viz. Villa Burlamacchi, Villa Reale, Villa Mansi and Villa Torrigiani, have been chosen as case-studies. They were chosen on the basis of both geographical and architectural features. All villas are located in about 10 km in the north/northeast of the Six Miles District, at the slopes of the Apennine chain. They are all at the same elevation of about 100 m above the sea-level and near the same rivers, notably river Serchio. The geographic conditions are

relevant in attempt to deduce the provenance of raw materials used to produce the renders. In order to do so, territory, its geology and history and building periods of every considered villa are evaluated.



Figure 1: Map of the geographical position of selected villas

The architectural features of the palace of villa and of the other buildings inside the enclosure are also fundamental in order to try to evaluate possible similarities in building techniques and materials. Villas Burlamacchi, Reale and Torrigiani were built during the 18th century, on the foundations of preexisting 16th century buildings.

Villa Mansi was also built in the 18th century, but its Palazzina dell'Orologio was built ex novo in the second quarter of 18th century [1]. The Villa Reale compound still contains 16th century buildings. In selection of buildings and sampling localities, the present condition of the buildings was also taken into account, recently restored ones being avoided.

Villa Burlamacchi

“Villa Burlamacchi, then Volpi, Massagli, Bianchi, Fortuna and today Valle” – but the landlords are actually of another family – was originally built in the 16th century as a country villa, where summer rest and agricultural production coexisted. Over centuries, the main palace was changed: in 18th century, two 16th century small buildings, the oil-mill and the chapel, have been incorporated to create a balustrade decorated with tile motive. The same decoration completes and crowns the roofs of the old Parrish and of the Limonaia, which are situated on two lateral terraces leaning forward to the valley of the river Serchio, immediately below the hill Villa Burlamacchi was built on. Samples were taken from four buildings of the villa: Palace, chapel, lemon-house and parish.



Figure 2: Villa Burlamacchi palace

Villa Reale

“Villa Buonvisi, then Orsetti today Pecci-Blunt” in Marlia has a complex history. In the area, the presence of a noble palace is documented since medieval times. During the 11th century, the Avvocati family was owner of the property,

successively sold to Buonvisi family. After Buonvisi's crash in 1629, the villa was sold to Lelio and Oliveri Orsetti in 1651. The Orsetti family has been landlord of the property until 1806, when Elisa Baciocchi, Napoleon's sister, chose the villa of Marlia to be her country residence. She made the last landlord – Lelio Orsetti – and the Bishop of Lucca to sell their villas to her: Villa del Vescovo is still part of Villa Reale property. In 1814, Felice and Elisa Baciocchi's properties passed to the Bourbon-Parma family. In 1847, the property passed to the Duchy of Tuscany and – in 1860 – to the Italian state. In 1862, it had been given to the widow and heirs of Charles of Bourbon-Capua. Since 1924, Villa Reale is property of the Pecci Blunt family. Anna Laetitia and Cecil Pecci Blunt restored both the palace and the garden in the 1940's and allowed the access to the public. Samples have been collected from 16th century buildings, viz. the palace of Villa del Vescovo, San Biagio chapel and Villa dell'Orologio.



Figure 3: Villa del Vescovo, western façade

Villa Mansi

Villa Cenami, today Mansi, is first mentioned in 1599, when the building – property of Nicolao Benedetti – was sold to the Cenami family. It had probably been built in the second half of 16th century, following the typical style of that

time. In 17th century, the Cenami family undertook a transformation process that lasted until the following century. Famous and important artists and architects attracted to Lucca to improve its aspects and build walls, churches and palaces: Muzio Oddi from Urbino and Filippo Juvara from Messina were only two of them. They worked on the Villa Mansi buildings and garden, giving an international air to the cultural landscape of Lucca.

The Palazzina dell'Orologio was built during the Cenami family period, along the western wall of Villa Mansi enclosure. It is easily recognized in the layout of the property due to its particular V-shape. Due to the recent restoration of the palace of Villa, the 18th century Palazzina dell'Orologio was the only building sampled in this study.



Figure 4: Southern part of the Palazzina dell'Orologio

Villa Torrigiani

“Villa Santini, then Torrigiani today Colonna” at Camigliano is one of the most famous Lucchesian Villas. Its history and the numerous periods of

its development have been studied in detail by many historians of gardens architecture.

Despite its popularity, only the palace of villa has been considered in previous studies. Some other small but important buildings inside the villa itself, such as the small coffeehouse, built at the end of 17th century in the eastern side of the garden, have only rarely been considered.. Originally it was the private chapel of the Santini family. On a map of 1798, this building is indicated as the “Old Church”, to be distinguished from the “New Church” built in 18th century just outside the enclosure and still in use as private chapel.

Inside the enclosure of Villa Torrigiani, another important building is present: the farm. It is a complex structure of different buildings. On the map of 1798, five functions/places are indicated for the farm: storage and stable, court with wash-house, gardener’s house and friars’ house.

Probably, the buildings date from different periods, new ones being added to the pre-existing farm building. Borgo a Parigi is a particularity of Villa Torrigiani. It is constituted by two twin areas in front of the main entrance of the villa. Probably, they were built in Medieval style during 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 not sampled.



Figure 5: Southwestern view of the coffeehouse

Results

Villa Burlamacchi

Five samples from Villa Burlamacchi were analyzed by PFM: they differ in structure depending from the building they have been collected from. This is probably due to different restorations periods of the buildings in the villa. However, aggregates in the different renders are similar, mainly constituted by quartz, sandstone and minor amounts of limestone and metamorphic rock, as is the type of binder: lime, with minute, not indentified pozzolanic (or hydraulic) additives. Samples from the palace of villa are composed by up to four layers, most show a mortar with two lime washes on top. One sample (VB-PV-R-06) from the palace of villa contains a second external render layer characterized by the presence of a green pigment. Samples from the parish show a complex stratigraphy of eight different layers, with three renders separated by finishing layers.

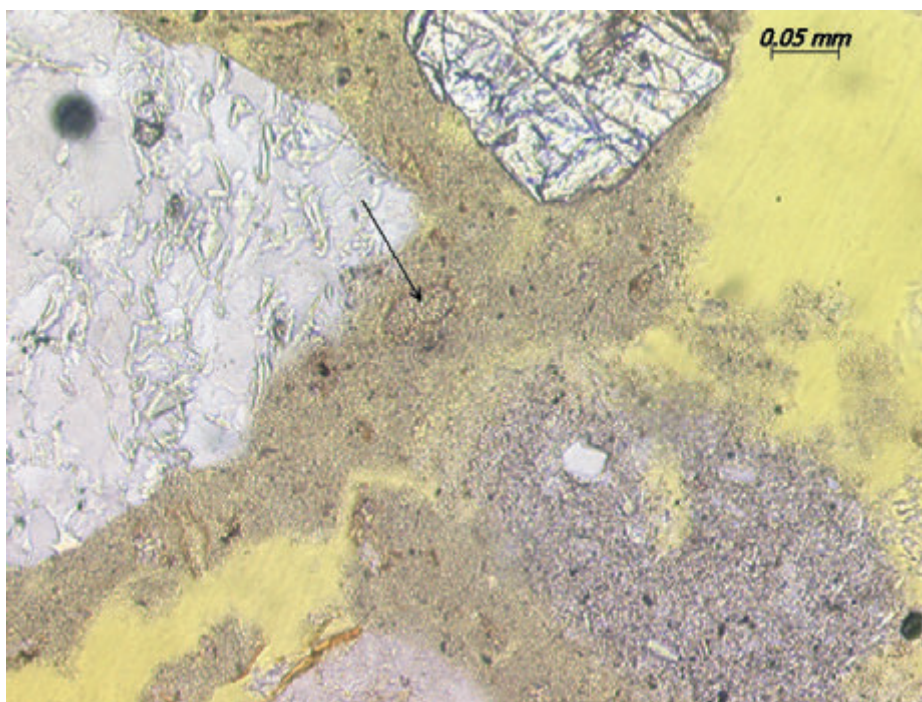


Figure 6: Sample VB-PV-R-06, minute pozzolanic components in Layer 1
(all pictures plain polarized light)

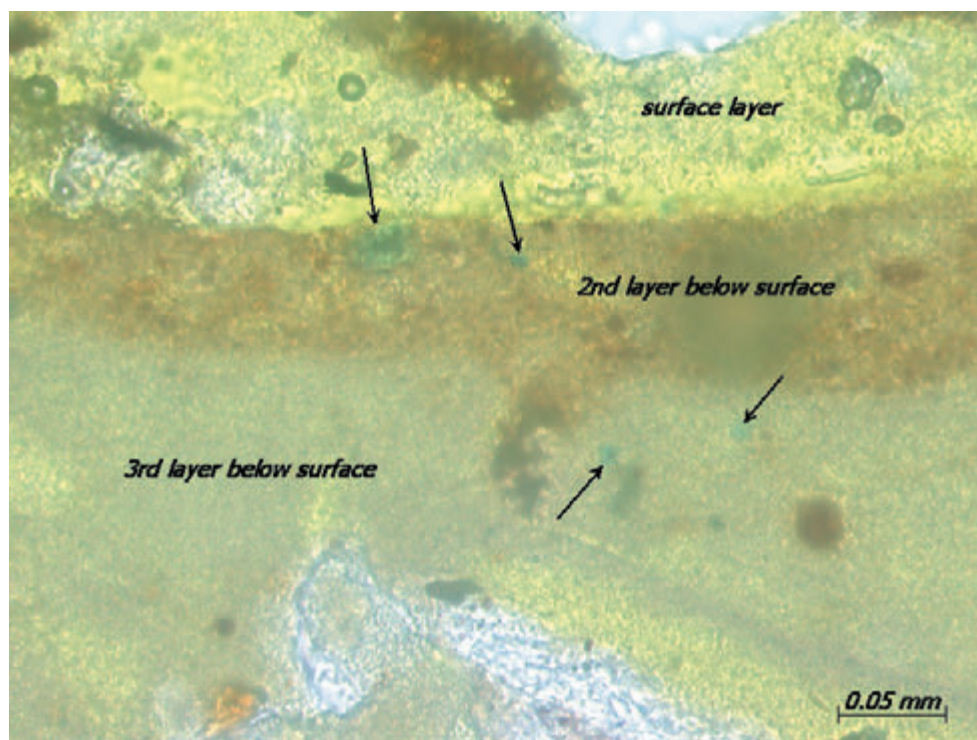


Figure 7: Sample VB-PV-R-06, green pigment in Layers 2 and 3

Villa Reale

Six samples from Villa Reale have been analyzed with PFM: one from the Orthodox chapel, two from Villa del Vescovo and three from Villa dell'Orologio (from different sides of the building). Samples VR-VV-R-05, VR-VV-R-07, from Villa del Vescovo, and VR-VOW-R-02 from the west side of Villa dell'Orologio are composed by three layers: a couple of renders and a finishing (lime wash or colour) layer, recomposed in this way. In Sample VR-C-R-01, from San Biagio's chapel, a single render and a double finishing layer (lime wash and colour) occur. Sample VR-VO-R-02 from the central building of Villa dell'Orologio is composed by six different layers: three renders and three finishing layers (two colours and a lime wash). Sample VR-VOE-R-01 from the eastern wall of Villa dell'Orologio differs from other samples in composition and structure: it is constituted by a cement-based render and a colour layer. Aggregate composition is

similar in all the samples: quartz, sandstone and limestone are most abundant; schist is also present. The microstructure of the lime-based binder differs in internal grain size and porosity. In the matrix, wood occurs: in Italian building tradition, wood chips were sometimes added to mortars to avoid or limit shrinkage. On the basis of PFM observation, a stratigraphic chronology of the analyzed renders was deduced.

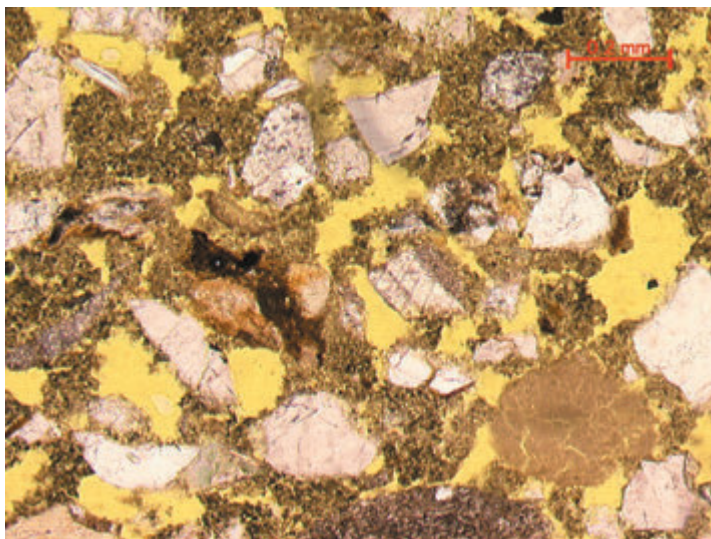


Figure 8: Sample VR-VOW-R-02, boundary between Render 1 and 2

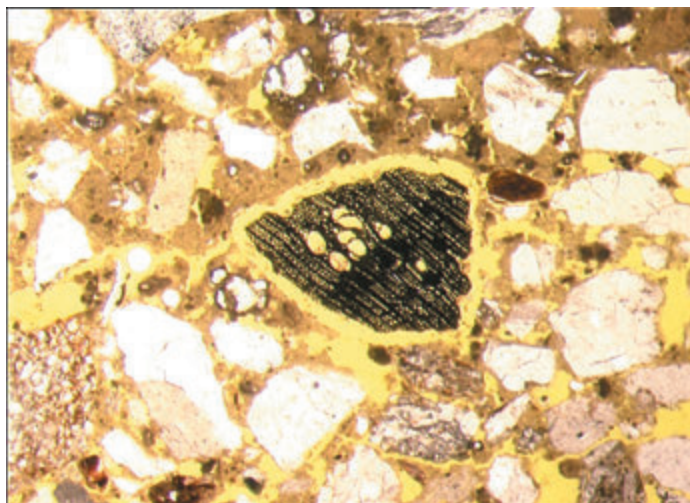


Figure 9: Sample VR-VV-R-07, wood fragment between Render 1 and 2

Villa Mansi

Four samples from the Palazzina dell'Orologio in Villa Mansi have been analyzed. Two of them were sampled on the eastern side (samples VM-POE-...), one from the western (VM-POW-...) and one from the southern part (VM-POS-...). They represent all the areas of the Palazzina, built at the end of 17th century and modified several times. The last renovation involved the southern part of the building; it was modified into a small castle – following the Neo-gothic style – in 19th century. Collected renders are composed by many layers. The most complex sample is VM-POE-R-03, in which four mortar layers occur: two pure lime and two cocciopesto renders. In the latter, fine ground brick fragments have been added as pozzolana. Sample VM-POW-R-01 is also composed by four layers: two renders, one lime-based and one cocciopesto, and two finishing layers (a lime wash and a colour). In sample VM-POS-R-01, only a render and colour layer are present; in sample VM-POE-R-02, a single render occurs.

Except for VM-POE-R-02 – containing a render not present in any other analyzed sample – and for renders 1 and 4 in VM-POE-R-03, all the renders and have been found in more than one sample, permitting a chronological reconstruction of building periods. Colour layers were also important in order to correlate samples. VM-POS-R-01 and VM-POW-R-01 have the same colour layer, indicating that the underlying layers probably represent the same mortar.

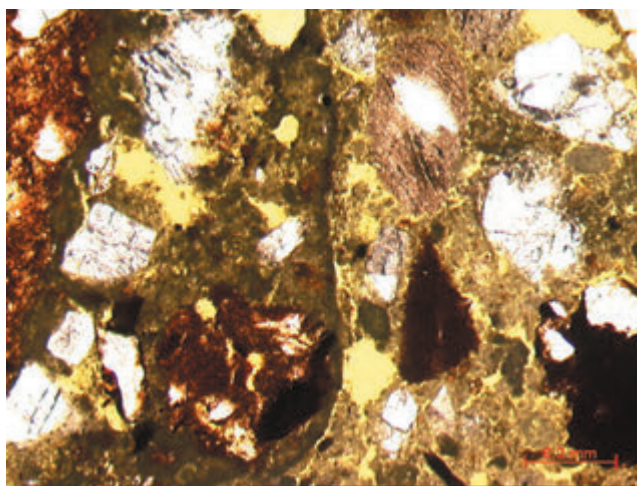


Figure 10: Sample VM-POE-R-03, boundary between Render 2 and 3

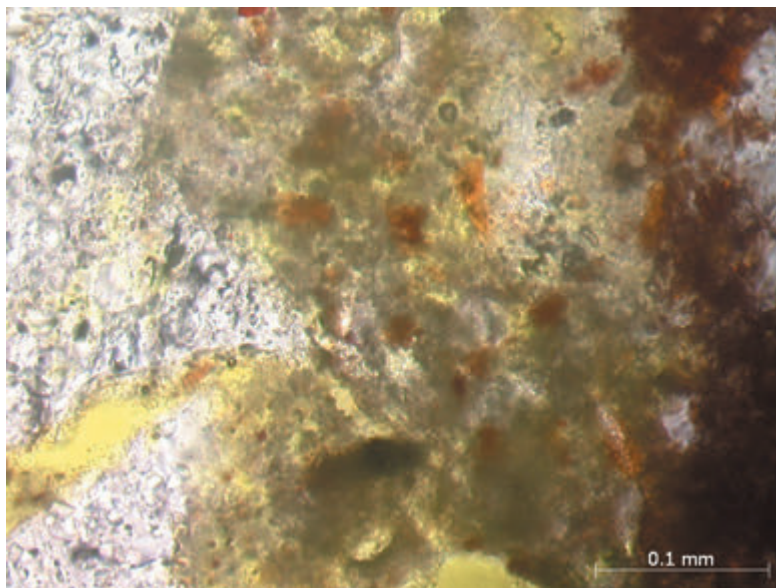


Figure 11: Sample VM-POE-R-03, binder of the external cocchiopesto layer

Villa Torrigiani

Four samples from Villa Torrigiani have been analyzed: one from the coffeehouse, two from the farm and one from the western area of Borgo a Parigi. They show a comparable structure: one or two layers of mortar and a finishing layer, either limewash or coloured layer. Renders are very thin and fine grained. Four different kinds of mortar have been detected: sample VT-F-R-07 from the farm, containing two renders, and VT-BPW-R-05 from the western part of Borgo a Parigi are composed by the same mortar. Samples VT-F-R-06 from the farm and VT-CH-R-01 from the coffeehouse are both composed by single mortars different from each other and from the one in VT-F-R-07 and VT-BPW-R-05. Renders of Villa Torrigiani are lime-based with pozzolanic or hydraulic additives; aggregates are mainly composed by quartz, sandstone, limestone and metamorphic rocks. In addition, fragments of straw are present. Similarly to the wood fragments of Villa Reale, they have probably been added to limit shrinkage.

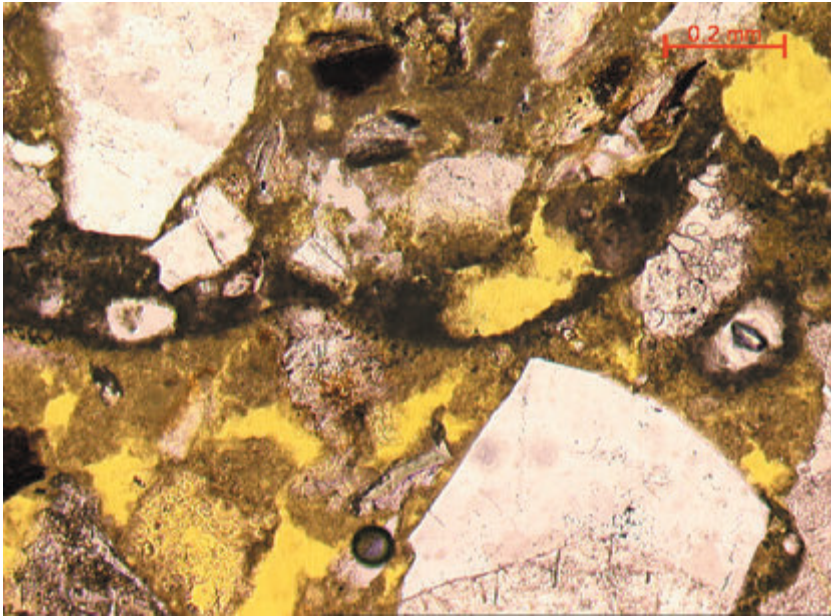


Figure 12: Sample VT-F-R-07, boundary between renders

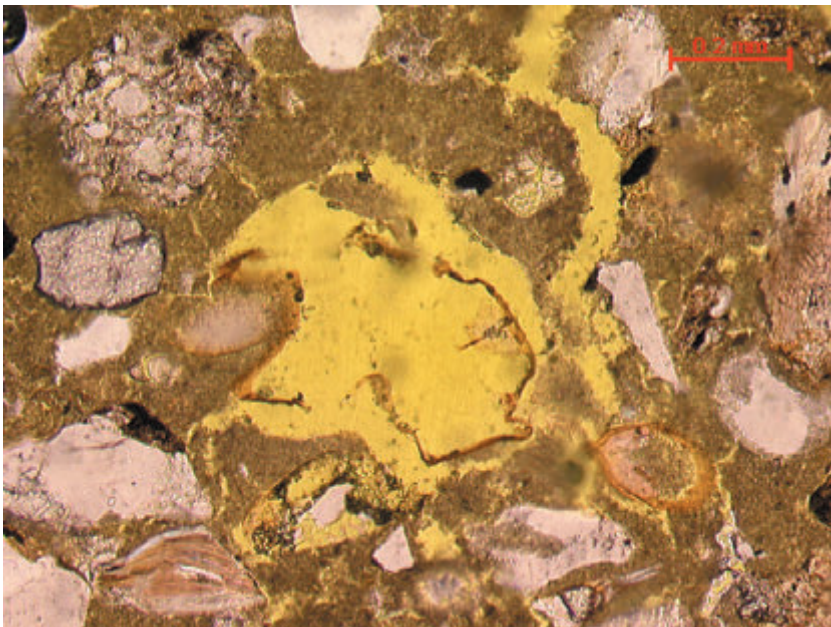


Figure 13: Sample VT-F-R-07, organic material

In the following table all the samples analyzed with PFM are compared and the presence of observed aggregates is evaluated in a scale from 1 (very abundant) to 3 (some grains). The nature of aggregates in the mix of the samples is very various: the most frequent are quartz and limestone, but numerous other fragments are also in the mortars, in a very low quantity. These fragments, however, have been very important and decisive in comparing the geology of the territory of the Villa to the content of the sampled renders.

Table 1: Type of aggregate in various renders

Sample	VT-CH-R-01	VT-F-R-06	VT-F-R-07	VT-BPW-R-05	VR-C-R-01	VR-VV-R-05	VR-VV-R-07	VR-VO-R-02	VR-VO-R-02	VR-VOW-R-02	VR-VOE-R-01	VM-POS-R-01	VM-POW-R-01	VM-POW-R-01	VM-POE-R-02	VM-POE-R-03	VM-POE-R-03	VM-POE-R-03	VM-POE-R-03	VB-PV-R-03	VB-PV-R-06	VB-P-R-01-I	VB-P-R-01-II	VB-C-R-01		
Render nr.						1	2	1	2				3	4		1	2	3	4		1	2	5			
Ground brick													1			1	1									
Quartz	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	1	1	
(Impure) sandstone	2	1	3	3	1	2	1	1	1	2	2	2	2	3	1		3	3	1		2		1	1	1	
Siltstone /chert	2	1	3	2	2	2		1	3	1	1	2	2	2	3	3	3	3		3	2		3	3	2	
Feldspar	2	2	3	3	2		2	3	2	3	3		3	2	3	3	3		3	3	3	3	3	3	2	
Mica	2	3	3				3		3	3					3							3				
Limestone				3	3	2	3	1	1	1	3	2	1	2	2	2	1	1	2	2	1	2		1	2	2
Quartz-bearing limestone	3	3				3	3		3						3	3	2			3					3	
Fossiliferous limestone		3	3	3	2																			3	3	
Marble / coarse calcite		3		3	3	3	3		3	3	3	3	3	3	3		2	3		2	2	2	3	3	3	
Cataclastic rocks		3				3		3							3	3		3								
Schist	2	3		3		3	3	3						3	3	3			2	3	3			3	3	
Other metamorphic				3		3										3		3	3						3	
Basalt				3	3		3		3		3	3				3		3		3					3	
Other volcanic												3			3								3		3	
Organic material	3				3																			3		
Slag or volcanic glass	3																							3		
Lime lumps	3	3	3	3		3			3	3	3		3	3	3								3	3	3	
Pieces of old mortar	3																									

Legend:

1 - very abundant, making up most of the aggregate, 2 - moderately abundant, 3 - some grains

Villa Torrigiani - VT-CH: coffeehouse, VT-F: farm, VT-BPW: Borgo a Parigi, western part
Villa Reale - VR-VV: Villa del Vescovo, VR-VO/VOE/VOW: Villa dell'Orologio (central, eastern and western parts)

Villa Mansi - VM-POE/POW: Palazzina dell'Orologio (east and west)

Villa Burlamacchi - VB-PV: palace, VB-P: parish, VB-C: chapel.

Discussion and Conclusion

Aim of the project was establishing a basis for scientific research of renders from Lucchesian Villas. No chemical or petrographic studies have been performed in the past to characterize the building materials of this important villa system.

Proper characterization provides a basis for the choice of compatible restoration materials and to preserve buildings from further decay. From microscopic analysis, some general observations appear for each villa: Villa Burlamacchi shows a complex stratigraphy, probably due to successive restorations. Renders were all lime-based, containing aggregates of different nature: mostly quartz, but also limestone. They correspond to local geology. Villa Reale also shows lime-based binders, with volcanic rocks, feldspar and marble in the aggregate, which could correspond to local geology. In Villa del Vescovo, part of Villa Reale property, wood from broadleaf trees is present in renders; it could not be established whether this has been added to avoid shrinkage or occurs accidentally. Buildings of the villa were originally red. This colour has been detected in all of coloured samples as the first applied colour. Probably it is hematite used as a pigment and added to a mixture of water and lime. The Palazzina dell'Orologio is the only investigated building in Villa Mansi as the palace of Villa has been restored two years ago. Renders of the Palazzina are considerably damaged and incoherent. They are all lime-based with pozzolanic additives; aggregate is mostly quartz. In this case, different *cocciopesto* renders have been encountered; they were used for both aesthetic and functional purposes: their colour and workability made them perfect to reproduce stone appearance, and their physical and chemical composition made them strong and resistant during centuries. In Villa Torrigiani, all the analyzed renders are lime-based with pozzolanic additives. The presence of straw was observed in all mortars; it has probably been added to limit shrinkage. Aggregates are mostly quartz and limestone of various compositions. In Table 1, all the analyzed samples are compared on the basis of their aggregates. The latter appears to be different for each villa, suggesting a local source, depending on surface geology of the Six Miles District. Binder is usually lime based, probably with the addition of natural pozzolanic materials. They have still to be definitely identified.

In [4] the chemical characterization of Lucchesian Villas renders is exposed. In that paper the salt content of the samples was observed and commented, because of the high durability of the original materials despite the high salt ions presence. Together with the present paper, they are the basis for the first attempt to recreate restorations materials compatible with the original ones.

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