

The Ruspoli Chapel at the Holy Gates Cemetery in Florence. Material and diagnostic survey for conservation.

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Porte Sante (Holy Gates) is one of the monumental cemeteries in Florence, located within the fortified bastion of the Basilica di San Miniato al Monte. In the 1840s, the town council decided to find a large area near Florence to use as a cemetery. The Fortress of San Miniato was chosen for the solemnity of the place. The first project was entrusted to Niccolò Matas in 1844 and in the 1860s the architect Mariano Falcini designed a new project using the area of the sixteenth-century fortress that surrounded the church. The Holy Gates cemetery surprised visitors with its commingling of styles: it was important to appear so, in order to show the dignity of their own social class. This eclectic mix reveals monuments whose style, materials and construction methods are interesting. One of these examples is the Ruspoli chapel, designed in 1891 by Giovanni Paciarelli, who was an architect sensitive to modernism and the designer of Paggi Palace in Florence. The chapel, commissioned by the Valsè-Pontellini family, stands out in the landscape for its precious texture of exotic carvings and inlays of polychrome marble, mosaics and ornamented glass. Today it is in a poor state of conservation. The recovery of the chapel must be accomplished by a careful restoration project whose foundation is the comprehensive knowledge of the good that can be achieved through survey operations, historical analysis and diagnostic investigations. The use of photogrammetry software allowed us to make a virtual 3D model, which forms the basis for subsequent analyses and evaluations of the state of the conservation of the building. Such a study will be applied to other artifacts in the cemetery by implementing current and future studies on the whole complex of the Holy Gates.

Key words:

Ruspoli chapel, Holy Gates cemetery, historical building, material survey, diagnostic survey.

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1. INTRODUCTION

The monumental cemetery in Florence called the "Porte Sante" (Holy Gates) is located on the hill of San Miniato al Monte. It dates back to the 40s of the nineteenth century, when the city of Florence

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built a cemetery area suitable for the construction of monuments for prominent people. In 1844, the architect Niccolò Matas was entrusted with its design, for which he recommended a solution “worthy of a distinguished city,” and the conservation of Michelangelo’s walls. During the 1860s, the architect Mariano Falcini (a collaborator of Florentine architect Giuseppe Poggi on the urban plan of Florence in the nineteenth century that designed the Synagogue of Florence) was commissioned to draw up a plan for a new project, which would make use of the entire fortress. In 1864, the new project was published, confirming the choices of Matas’ project (Matas was also the designer of the facade of the Basilica of Santa Croce in Florence).

Finally, in the early 1900s the architect Enrico Dante Fantappiè was entrusted with an enlargement project and the design of a number of chapels. Fantappiè was an Italian master of Eclecticism. There are many of his projects in the Florentine area, where he designed private buildings such as the Villa Frittelli in Calenzano. In 1927, the monumental entrance to the complex was placed in front of the Basilica (Fig. 1).

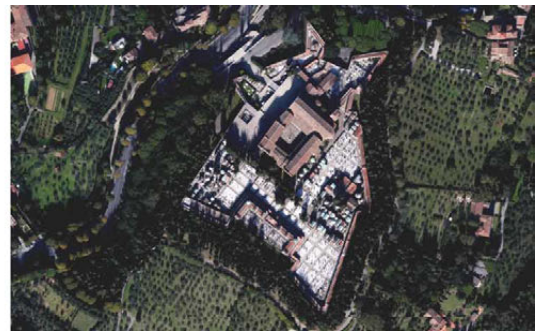


Figure 1. The cemetery “Porte Sante” of Florence (left; www.wikipedia.it). Satellite view of the cemetery “Porte Sante” of Florence (right).

2. RUSPOLI CHAPEL

2.1 Giovanni Paciarelli, Architect

The Ruspoli Chapel was designed by architect Giovanni Paciarelli (Siena 1862 - Florence 1929). His works are an expression of the Florentine modernistic tendencies.

The Tuscan contribution to modernism is not so homogeneous within its own borders. In a city like Siena, the presence of Liberty buildings is an exception, while in cities such as Lucca and the centers along the coasts of Versilia, modernist style was successfully affirmed. Florence was the capital of the Tuscan Liberty style, thanks in particular to its greatest protagonist, Giovanni Michelazzi (1879-1920). Unfortunately, there were no conditions for creating a “school” in Florence such as in Milan or Palermo.

The Liberty style was inaugurated in Florence by the Paggi palace, designed by architect Giovanni Paciarelli in 1903. In general, the new architectural language was especially welcomed in the areas of expansion, while remaining an exception in the historic center.

In the early 1900s Paciarelli designed numerous projects in Florence and the surrounding area. His most important works are the Paggi Palace and the Gaddi Palace, the tenement in via Mattonaia in Florence and St. Martin's Church in Montughi (Florence).

The Paggi Palace was built in 1903. Its arcade's theme is in line with the nearby Piazza della Repubblica, with massive shelves supporting the balconies on the first floor. Other modernist elements include ceramic floral friezes and tripartite windows (Fig. 2).



Figure 2. Paggi Palace.



The Gaddi Palace comprises a ground floor projecting out onto the square, while the other floors stand back. There are four floors in total. It was built in 1922, based on Giovanni Paciarelli's design (Fig. 3).



Figure 3. Gaddi Palace.



Figure 4. San Martino Montughi Church.

San Martino Montughi Church was built in 1539 on top of an existing church, as per a project of Giuliano Di Baccio. The church was rebuilt in 1924; the project was carried out by Giovanni Paciarelli (Fig. 4).

The Soffiano Cemetery was built in 1894 in a hidden area in Florence. Many architects worked on this construction, the last one being Giovanni Paciarelli, who was responsible for creating the unity of the whole cemetery.

2.2 Ruspoli Chapel

The Ruspoli Chapel (Fig. 5) was designed in 1891 for the Valsè-Pontinelli family in a Neo-Byzantine style, and built by Michelangelo Giovannozzi.

The plan is square, with a porch with round arches on granite columns. The main facade is defined by a circular portal with a round arch. The lunette bears the coat of arms of the owners. At the top, on the sides of a window, is represented the Annunciation. The building is topped by a dome covered by the lantern. The other facades are decorated with stained glass single windows made by Vincenzo Cambi.

The exterior surface, made of polychrome marble, was built by marble worker Michelangelo Giovannozzi, while the door and the outer grating were made by Luciano Zalaffi.

Today, the chapel stands out in Holy Gates' cityscape thanks to its relationship with the neighboring chapels and to the precious exotic texture of its carvings and inlays.



Figure 5. The Ruspoli Chapel. Holy Gates Cemetery (Firenze).

2.3 Architectural survey and graphic restitution: from the building to its representation

Among the various traditional and digital methodologies, photomodeling is a technology that, in addition to being low cost, enables to easily obtain realistic 3D models that contain geometric and chromatic information, with few support measures that are the basis for surface diagnostics.

In this paper, we show how the application of this methodology allowed us to obtain a three-dimensional model representing the state of preservation of the artefacts, highlighting all the pathologies from a simple photographic campaign.

The introduction of these technologies has changed the field of architectural survey but in particular, it allows the restoration technicians to have 3D models on which to elaborate observations and diagnoses concerning the state of conservation of the building, while not only reducing costs, but also producing a high-level product.

2.4 The first step of the architectural survey

2.4.1 Direct survey

The first step of the Ruspoli chapel survey was to make a survey at sight. This is the first approach to object studies; in this phase, an initial rough identification of the artifact size is made and the best methods to conduct the survey are identified. To begin, we made schematic quoted drawings and other pictures with details for obtaining planimetric and elevation drawings (Fig. 6).

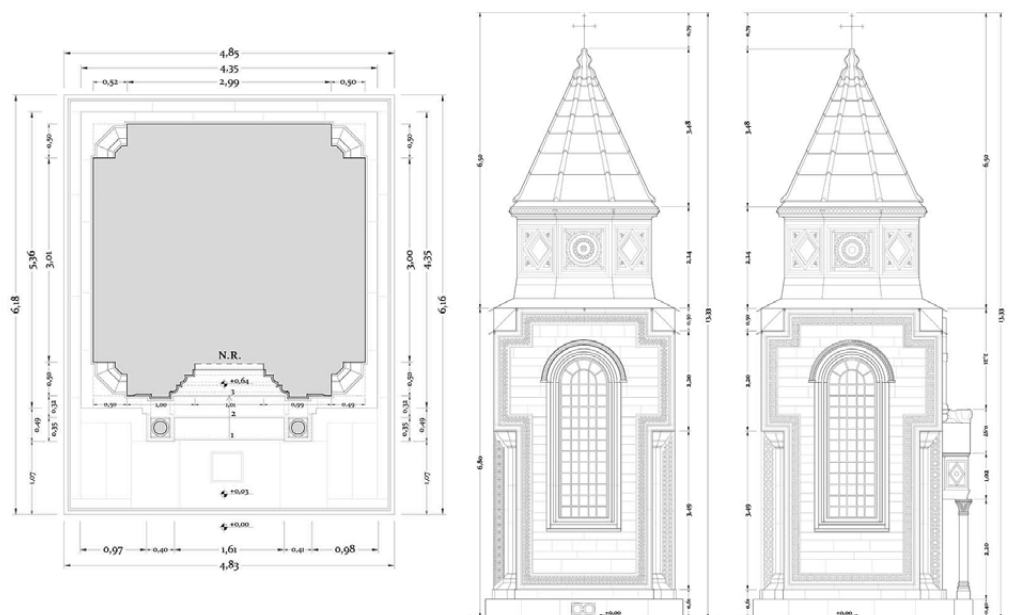


Figure 6. Survey of the Ruspoli Chapel.

For the direct survey of the chapel, we used a metric rowel, rigid meter, flexometer and laser rangefinder. At first, we performed a closed polygonal survey to fix some significant starting points of the external perimeter for the restitution of details. Some points could not be measured with traditional measuring methods, so we used photo modelling. During the inspection, we noticed and took over material types, application techniques and surfaces decay.

2.4.2 Photographic survey for photo modeling

With this technique, we can make three-dimensional models on the basis of the photographic images obtained by using photogrammetry principles. An algorithm allows us to orient photos into the space, creating interactions between them and obtaining a cloud of three-dimensional points. Numerous pictures of the chapel were obtained. We used a Pentax K – 5 camera with ISO 100 to get low noise pictures to compensate for the excess of light, and working in Manual mode to avoid changes in automatic settings during the shooting.

The photo shoot was carried out from different points of view to obtain semicircles on several levels. Subsequently, the photos were transferred to a computer to generate a 3D model from them.

2.5 Restitution phase

2.5.1 Graphic restitution

In this phase, the data were processed and transformed into a format suitable for conservation, communication and diffusion. The restitution modalities used are trilateration and restitution for Cartesian coordinates.

Graphic restitution is of paramount importance in the preliminary phase of investigation and in the accurate survey of the artefact (decay, materials). The techniques of representation used were: restitution in 2D through CAD software, 3D restitution through photo modeling software and through photo planes.

2.5.2 Elaboration of pictures: photo modeling

For photo modeling, we used Agisoft Photoscan Software. The pictures were uploaded in Photoscan, on one chunk only. The most relevant point of the process was the photo alignment. During this phase, Photoscan identifies common features and points among several photos.

Subsequently, we obtained a sparse point cloud, in which Photoscan shows the points aligned only. The next step is to create a dense point cloud. Then we fix the geometry with a polygonal mesh. The result is a mesh that presents some empty areas because of the photography, a quite definite profile and a smooth mesh. The last step is the creation of texture, which is applied to the model in Photoscan, obtaining a completely textured model.

This software made it possible to extract pictures with isometric and perspective visuals. With this tool, we could export pictures to be used like photo plans, modifying them where they were poorly defined, with high definition photos.

From photo plans, we delivered the entire geometry of the artefact back in cad, integrated with direct survey so as to obtain chromatic and material data (Fig. 7).



Figure 7. Photo modeling of the Ruspoli Chapel with Photoscan.

2.6 Material analysis

2.6.1 Material survey

Buildings are physical structures, material transformed in material. Architectural spaces do not only have geometrical borders made by elements that cannot be analyzed with canonical survey instruments. There are many investigations of a technological and constructive nature that provide the answers.

The material analysis of chemical-physical and mineralogical-petrographic characteristics, the determination of mechanical and technical features, and research on what is not immediately visible (but is in turn very important for the building's "life"), is an important part of the analytic and diagnostic process, aimed at architectural understanding and conservation.

The identification of the priorities, compatibilities and effectiveness of each technique used to obtain the necessary diagnostic pictures is a key research subject.

2.6.2 Description and origin of the materials of the Ruspoli Chapel

Verde Prato (Fig. 8) is a sedimentary rock that exists on Monte Ferrato in Figline of Prato (where some old quarries, now abandoned, can still be found) and in Impruneta.

The ammonitic Red (red Verona type) (Fig. 9) is a sedimentary rock that can be found near Monsummano Terme and Garfagnana; however, the marble of the chapel could have come from the quarries of Verona.

The white marble or veined White originates in the Apuan Alps or the Montagnola Senese. It is a metamorphic rock predominantly composed of calcite.

Bardiglio marble comes mainly from the Apuan Alps. It is a metamorphic rock derived from a carbonate sedimentary rock of marine origin. The ancient granite quarries, near Florence, are located on the island of Elba. However, the granite columns in the chapel could have come from the caves of Sardinia.



Figure 8. Verde Prato.



Figure 9. Ammonitic red.



Figure 10. Lead on roof.

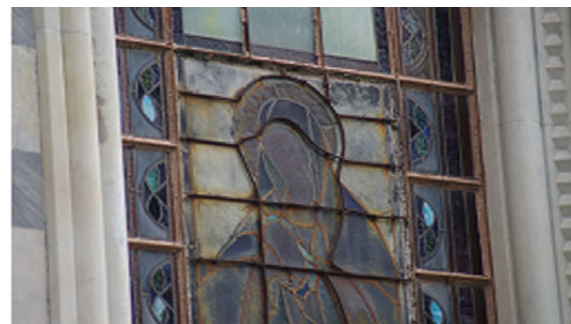


Figure 11. Glass and iron on decorated windows.

2.7 State of decay

The chapel does not present a significant crack pattern. The framework of the facade's degradation presents some pathologies due to lack of maintenance (Figs 10 and 11). The most common form of degradation is a black crust, thicker on the capitals, gray, and thinner on the base segments (Figs 12 and 13). The biological patina impacts fronts and elements that are mostly exposed to the north, and

basements, where stagnant humidity is high. The disintegration in Verde Prato shows irregularly shaped deficiencies due to its grainy structure (Fig. 14). The White marble erosion is accentuated in the parts that are most exposed to the impact of water and wind (Fig. 15). The Red Ammonitic is characterized by a diffuse erosion in the corner columns, where the elements have been oriented with the veins orthogonal to the background surface, which has enhanced this effect.



Figure 12. Black crust on the capitals.



Figure 13. Biological patina on the east face.



Figure 14. Disintegration in Verde Prato.



Figure 15. The white marble erosion.

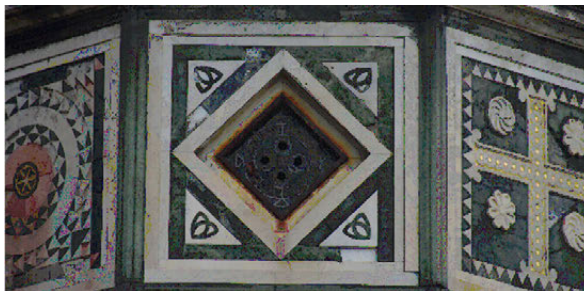


Figure 16. Red stain caused by the metal's oxidation.



Figure 17. Lack of material.

2.8 Sampling campaign definitions

The sampling, the choice of points from which to remove fragments to be subjected to physical and chemical analysis, must be targeted in relation to the research goals. It is important to minimize the number and the size of the samples, choosing the most significant areas for the problems to be investigated, under the principle of minimum intervention.

The choice of instruments and harvesting techniques must be made by an expert, depending on the substrate, type of alteration and type of analysis expected.

Chemical analysis provides qualitative data on the composition and nature of the elements, and quantitative data on the amounts of the compounds. Such data on the material behavior help us to understand the deterioration processes and to identify materials to use in restoration.

In the Ruspoli Chapel, we proceeded to the sampling of the white patina on serpentine to determine the type of material (Fig. 18). The sample was analyzed by means of infrared techniques (Fig. 19).

The graphic shows that the material was treated with gypsum and calcite, so we can presume that the chromatic alteration was caused by the stone's reaction after the treatment.

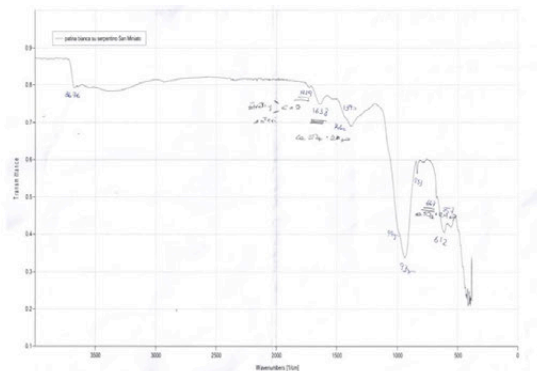


Figure 18. White film of Verde Prato sampled and analyzed. Figure 19. Infrared analysis of the white film.

Visual analysis is limited to the surface of the object or to some layers below; however, some cases require the sampling of parts through the application of non-destructive or destructive techniques.

In this work, an analysis was carried out to characterize the degradation of one of the chapel's materials using a non-destructive technique.

In these cases, the contribution of chemical analysis is crucial to knowing the composition of substances and materials used in previous interventions. This information is important for understanding the deterioration processes and for identifying the most suitable materials to be used in subsequent restoration work.

3. CONCLUSIONS

Finally, the cognitive framework obtained during the study of the Ruspoli Chapel shows that the state of conservation of the exterior of the artefact can be improved by restoring the integrity and original appearance of the building.

This paper confirms the importance of studying these types of artefacts and is an example of a procedure extending to all the cemetery chapels.

Survey, 3D modeling, direct observation and diagnostic analysis are sources of valuable information that can be incorporated into the editing of technical data sheets and managed in a general database.

Today, technologies such as GIS (Geographic Information System) allow us to have a dynamic and implementable tool at any time to analyze, plan, and manage that heritage.

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