

# **Survey and characterization of historical mortars of the church of San Pedro Apóstol in Polvoranca (Leganés, Madrid): constructive aspects and petrological analysis**

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*SUMMARY: This research studies the mineral composition characterization and internal texture of selected mortars collected from the church of San Pedro Apóstol of Polvoranca (Leganés, Madrid). The aim of the survey is to provide as much additional information as possible through the archaeological investigation so as to achieve a better understanding of the remains and to establish the chronology of the archaeological group.*

*The church, founded in medieval times, suffered an important reformation during the 17<sup>th</sup> century directed by the architect José de Villarreal. The temple is one of the best examples of Baroque architecture made of brick masonry –with the use of gypsum mortar joints—preserved in the area of Madrid.*

*The analysis of mortars helps in establishing a construction chronology differentiating medieval and modern phases of the church architecture allowing for a better interpretation and understanding of the remains of this interesting built group.*

*KEY-WORDS: architecture archaeology, lime and gypsum mortars, baroque masonry*

## **INTRODUCTION**

The present work analyzes the mineral characterization of masonry and paving mortars discovered with the archaeological samples of the *Iglesia de San Pedro Apóstol de Polvoranca* (Saint Peter Church at Polvoranca) (17<sup>th</sup> century)

The aim of the study is to research the composition and morphological characteristics of the church mortars so as to establish a constructive-historical chronology and improve the archaeological studies developed in this church.

These test and characterization works of historical mortars have been developed within a greater archaeological research project carried out through July 2006 to May 2008, and was

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sponsored by the Autonomous Region of Madrid through its General Direction of Architecture in agreement with the General Direction of Historical Heritage.

The documentation and constructive-historical surveys of the building group were performed by Gonzalo López-Muñiz Moragas (documentalist) and Fernando Vela Cossío (archaeologist). The archaeological excavation works were directed by the archaeologists Esther Villafuela Arranz and Alicia Gómez Fajardo (technicians of Arqueólogos Consultores company). Miguel Ángel García Valero (archaeologist) was in charge of the technical coordination and Fernando Vela Cossío was responsible for the scientific coordination of the project.

## **Documentary and historiography studies**

### **Historical aspects**

The first time the town of Polvoranca is mentioned was in 1343 in a document of king Alfonso XI, issued in Algeciras, and in this place, the presence of the Jews is stated. More recently, in 1987 the town hall of Leganes expropriated the ruins of the building to be later integrated within a park. The documentation and historical surveys of the remains of the church of San Pedro Apóstol de Polvoranca (Leganés, Madrid) have included the historical period between these two dates –1343 and 1987.

In 1570, the Count of Orgaz sells the village of Polvoranca to Mr. Antonio León, who founded the estate of Polvoranca. It is very possible that at that date, a church would have been there, maybe of low medieval art period, since in 1575 an entry at the construction works book is acknowledged for a quantity of 50 quarters of pesetas to Pedro Lossana, corresponding to the demolition work of the church tower. The new project of the tower was commissioned to Juan Díaz, from Madrid, who finished the work in 1602. This is stated in the construction works book where the payment for finishing the tower construction is noted down.

During the second half of the 17th century the building, which was in very bad state, goes under reconstruction works and is improved. In 1654, the church was appraised by the building master Juan León, and on December 27 that same year, the architect José de Villareal, main building master of the Royal Alcázar, visited the temple appointed by the Royal Council and suggested the project of the new building to be built. The document refers to a new church of Jesuit plan with a straight head sanctuary, a transept shown only on the elevation, an aisle and three inter-communicated chapels at each side of the main aisle. In 1655 José de Villareal visits the place for the second time and the reformation works started maintaining the bell tower of the old church and substituting some of the old chapels by an entrance forechurch and a sacristy. On June 10<sup>th</sup> of that year the Royal Council approves the final project of José de Villareal and establishes a tender process for the construction works in Madrid and Toledo. The budget adds up to seven thousand ducats. The clerks of works Francisco Palancares and Jerónimo Bodega bid for the church works in Madrid, and were appointed for the construction on July 8<sup>th</sup>. The works were finished by Bodega alone in 1662 and he acknowledged the completion of the works to the church parish on July 13<sup>th</sup> 1662. The works were finally appraised by the friar Lorenzo San Nicolás on September 25<sup>th</sup> of that same year.

In the 18th century, in 1719, the Austrian troops occupying Polvoranca during the Succession War in Spain sacked the palace and church causing important damages to some

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of the town houses. When the soldiers withdrew from the town, some citizens of Leganés despoiled everything which was of some value. Later, in 1740, the Marquis of Leganés took over the estate of Polvoranca and in 1756 the restoration and enlargement of the palace started. The palace finally resulted in a rectangular structure with a large central courtyard. The palace had fifteen pieces including a snow well, two stables, one carriage, a pantry, and an underground room used as prison. Since then, we have very little information about Polvoranca until 1818 when it becomes integrated with the municipality of Leganés. In 1852 the temple is retiled --financed by the marquis of Prado Alegre-- and in 1861 a new restoration project is commissioned to D. Antonio de Cachevera y Lángara. In 1868 the marquises of Prado Alegre ordered the last citizens to leave Polvoranca due to malaria fevers which devastated the population. Once the town had been evacuated, all the buildings were demolished except for the palace and church. In 1881 the lands of the estate of Polvoranca were auctioned, and the Duran family from Leganés bought them. A decade later, in 1893, the archbishop of Toledo sold them also the parish church.

### **Building compound description**

The church of San Pedro Apóstol shows a longitudinal plan type; a very common type in Madrilean architecture of the time. The changes of the church have not implied a simplification of the longitudinal axis plan. It presents one aisle with a barrel vault and with open web spandrels.

On the northern side, the church has lateral chapels interconnected, whereas on the southern side two areas open to the exterior form an atrium. To solve the transept, a dome has been constructed over four huge piers. Nowadays, the left arm of the transept has been destroyed. The façade presents some *vignolesque* type reminiscences, since it because two simple wings used as composition elements. Nevertheless, the church shows a little plastic façade front, rectangular in shape and with a strong vertical sense. It is crowned by a triangular pediment, slightly tilted and with a large oculus inside.

At the north-eastern side of the church, the bottom side, the remains of the tower can be found, whereas, at the south-west a wing tied to the atrium body can be seen. The atrium hence, is situated at the south side and is covered by a groin vault. Very little has remained from the tower, which has almost entirely disappeared. Only some small parts of the southern walls are still maintained, showing the existence of a possible *Mudejar* building decorated with horseshoe arches at the top level. As will later be seen, the main material used for the construction of the building is brick for the wall masonry and stone for the plinths.

The interior of the church, very deteriorated, includes gypsum plastering decorated with mouldings. The church dome, which has collapsed, showed an intermediate solution regarding the Madrilean typology: from the exterior, the dome was covered by a cubic body crowned by a helm roof lantern.



Figure 1. South façade of the church of San Pedro Apóstol of Polvoranca.



Figure 2. North façade of the church of San Pedro Apóstol of Polvoranca.



Figure 3. Remains of the building compound of Polvoranca: church, palace and tower.

## **Mortars macroscopic approach**

During the research, several visits to the church of San Pedro Apóstol de Polvoranca were performed. Two types of mortars could be identified: one used for the joints as binding agents for the bricks in the church masonry, and another one, used for the interior plastering of the church.

The interior plastering of the church is composed of two layers: one is a levelling layer of centimetre thickness of traditional plaster. This layer includes some non-hydrated grains, possibly of anhydrite with easily seen impurities. The other layer is a finishing coat of millimetre thickness of a fine plaster, whiter in the inside but darkened on the external side due to time aging.

The conservation of the cladding is relatively good in some of the wall panes, whereas in some other parts it has spalled, and some are covered with graffiti paintings.

The face brick masonry shows uniform joint mortar and a centimetre thickness of traditional gypsum material.

## **ARCHAEOLOGICAL INTERVENTION**

Preventive action in this first phase of the archaeological intervention of the Church of San Pedro Apóstol de la Polvoranca in Leganés (Madrid) and of the group of buildings around it has included the partial excavation of the church crypt. This has been done performing five stratigraphic bore tests (two inside the temple, one at the southern atrium and two at the adjacent exterior area), and finally, some clearance works of the walls and structures located in the southern side of the compound. These works have allowed to confirm the documentation survey performed and have shown the whole chronological sequence ranging from the Low Medieval Age (13<sup>th</sup> century) up to the Contemporary period.

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Inside the temple, excavation of the crypt has been carried out. The central area has been almost completely cleared up although the meridional part has only partially been excavated. In addition, as it was planned, two stratigraphic tests have been performed (SE-2 and SE-3). The transversal test (SE-2) has offered very interesting data: the paving of the 17<sup>th</sup> century has been found as well as the floor slab; several existing burials have been excavated establishing their grade and the characteristics of the soil packing over the burials. The foundation system of the church has also been studied. In addition, elements of a former primitive medieval church have been found. The longitudinal bore test (SE-3) has also offered very valuable information. These works have unveiled the existence of secondary type funerary structures (ossuary) and we have discovered two foundation systems: a footing foundation made of large stone masonry, and another one made with discharge arches, as it has been described in the southern wall of the temple. This test has allowed gathering information of the floor slab and paving, and at the same time, reddish ceramic pieces of the contemporary period (17<sup>th</sup> and 18<sup>th</sup> centuries) have been collected.

The archaeological intervention has given the possibility of gathering a lot of information of the surface, especially of the historical-constructive nature of the building. This has led to a description of the paving from the southern part of the church and finding the probable location of the baptism basin, situated on the SW corner of the church.

The archaeological materials recuperated are mainly ceramic fragments of different time periods, basically from Low Medieval and Modern times; several metal elements, probably of Modern or Contemporary chronology; a bracelet or rosary made of wooden perforated beads and remains of a leather shoe belonging to an adult. A safe date prediction is not easy to make because ceramic materials recovered show no specific morphology nor decoration. But looking at the characteristics observed, it can be estimated that the totality of the recuperated material is made of lathed ceramic from Low Medieval and Modern times, without decoration and used for domestic purposes. Fragments of pitchers, some handles and some pieces with grooved decoration are the remains found. The metal material found includes several copper pieces accompanying a child's burial, a wrought iron nail, of Modern-contemporary times (18<sup>th</sup> century) and a nickel coin struck in 1975.



Figure 4. State of the interior mortar rendering



Figure 5. State of the church dome interior mortar rendering

# **INSTRUMENTAL ANALYSIS. RESULTS AND DISCUSION**

## **Materials and methods**

### **Materials**

A field trip was organized to visit the church and to take the following test samples:

- P1B Jointing mortar in the structure found in sample test 2 North from the archaeological campaign (paving top level)
- P2A Paving mortar found in sample test 2 North from the archaeological campaign (paving low level)
- P3 Interior structure mortar from sample test 2 South.
- P4 Brick jointing mortar of the arch discovered at foundation level on the South façade of the church, at test sample 3 of the archaeological campaign.
- P6A Vault mortar of the church crypt.
- P6C Mortar of face bricks taken from the North façade of the church.
- P8 Jointing mortar representative of the tower structure at the South-east part of the archaeological compound.

### **Methods**

X- Ray diffraction by means of crystalline powder.

Chemical analysis of grinding sample and homogenized by electronic microscopy and microanalysis scanner.

Image study by Scanner Electronic Microscopy of different areas from each sample, and using different magnifications.

## **Results and discussion**

Once the mineral composition has been determined by X-Ray diffraction, the main components of the different mortars used as construction materials can be reconstructed. This is done by assimilating quartz and feldspar to the aggregate, calcite to carbonated lime, gypsum to construction setting plaster and clay to impurities.

With the analytical tool of X-Ray diffraction a comparative study has been carried out.

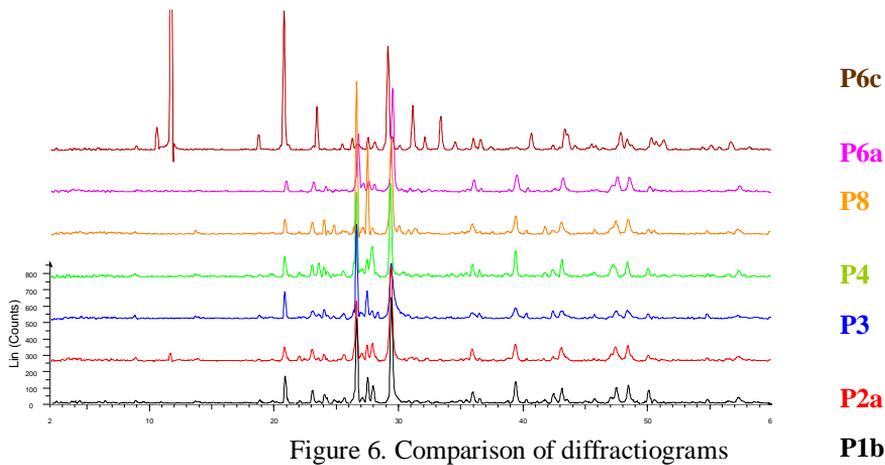


Figure 6. Comparison of diffractograms

As can be seen, all the samples, except for P6C, correspond to mixtures of calcite, feldspar and quartz.

A comparative study has been carried out between calcite and quartz samples, especially in the area of the diagrams in which they have their main peaks.

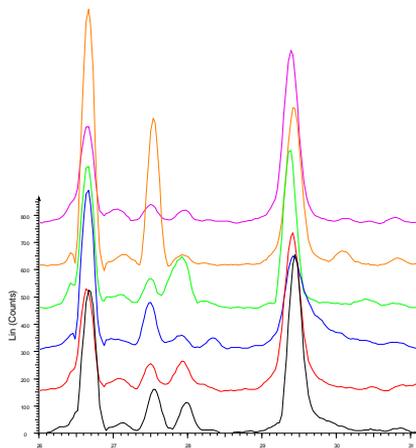


Figure 7. Detail of the area of main peaks of the diffractograms. A comparative study.

If the maximum diffraction of the samples is analyzed, these can be classified into two main groups:

- Group 1: Samples P1b, P2a, P4 and P6a. In this group, calcite is more abundant than quartz. In addition, in the P2 sample there are traces of gypsum.

- Group 2: Samples P3 and P8. In this group, quartz appears in greater quantity than calcite, although there are differences between the two samples since in the P8 sample there is more potassic feldspar than in P3.

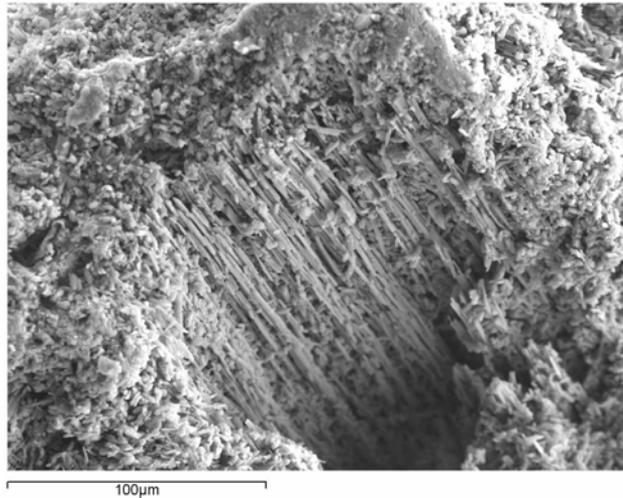


Figure 8. Electronic Microscopy ScannerPhotograpgh of sample p6C. There are gypsum crystals covering a hole of a possible earlier anhydrite. The sample corresponds to the joint mortar of the church.

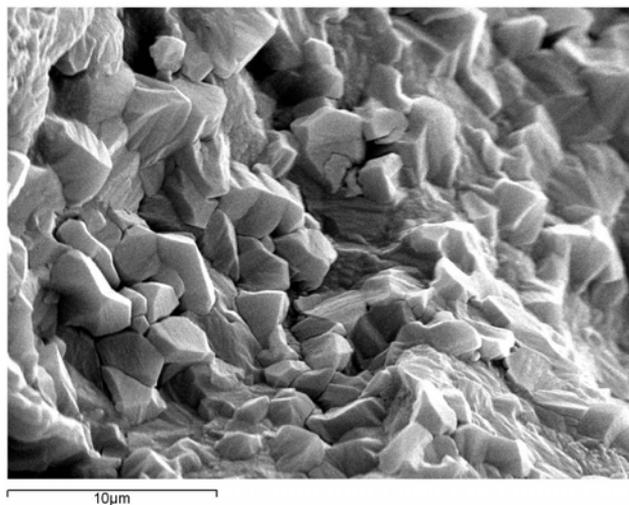


Figure 9. Sample of calcite crystals corresponding to the foundation joint mortar of the church. The sample belongs to Group 1 of the analysis.

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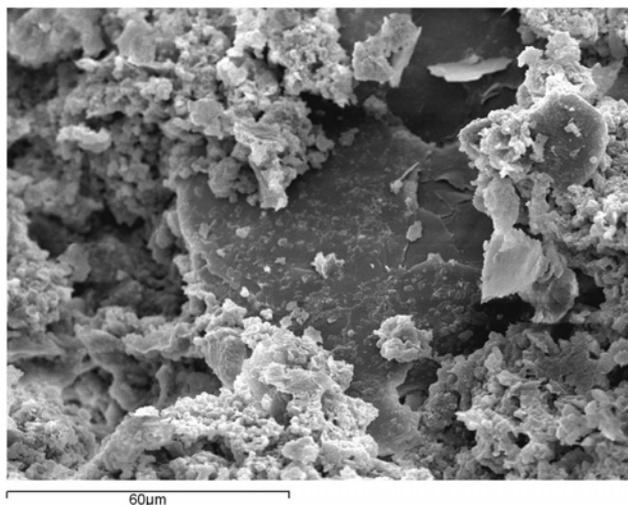


Figure 10. Joint mortar representative of the tower structure located South-east of the building group. This mortar corresponds to Group 2 of the analysis.

## CONCLUSION

The comparison and crossing of data obtained from the documentary-historical survey and those from the archaeological excavations together with the characterization works and material (mortar) testing has led to a key interpretation of the place and has helped to create a proposal of the chronological-constructive sequence.

We have observed the presence of sand mortar, without binding agent, in one of the walls in the sample test 4. This sample test has also provided interesting information; since there is a slight inclination in the orientation of the structure regarding the present orientation of the church, it can be interpreted as the remains of the prior medieval church, above which the actual one was built in the 17<sup>th</sup> century. It is important to notice that the masonry used is also different from the one found for the interior foundations and therefore it is possible to consider it a structure used and levelled to serve as settlement to the new masonry in this part of the building. Thus, this foundation masonry would be the remains of the well documented medieval church of Polvoranca.

Therefore, the lime and sand mortars observed can be divided into two groups with different proportions: the ones with lower proportion correspond to the areas identified as the oldest from the temple (primitive foundations observed in test sample 2) and with those from the prior tower of the old palace, situated at the SE side of the building group. The mortars with higher proportions correspond to constructive elements –mainly foundations–, of the 18<sup>th</sup> century building.

The other mortars studied are the masonry joint mortars and that of the interior plastering. All of them are made of gypsum and belong to the constructive period of the 18<sup>th</sup> century. They are well preserved; especially the joint mortars and they correspond to the constructive Madrilean tradition of the 17<sup>th</sup> and 18<sup>th</sup> centuries.

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