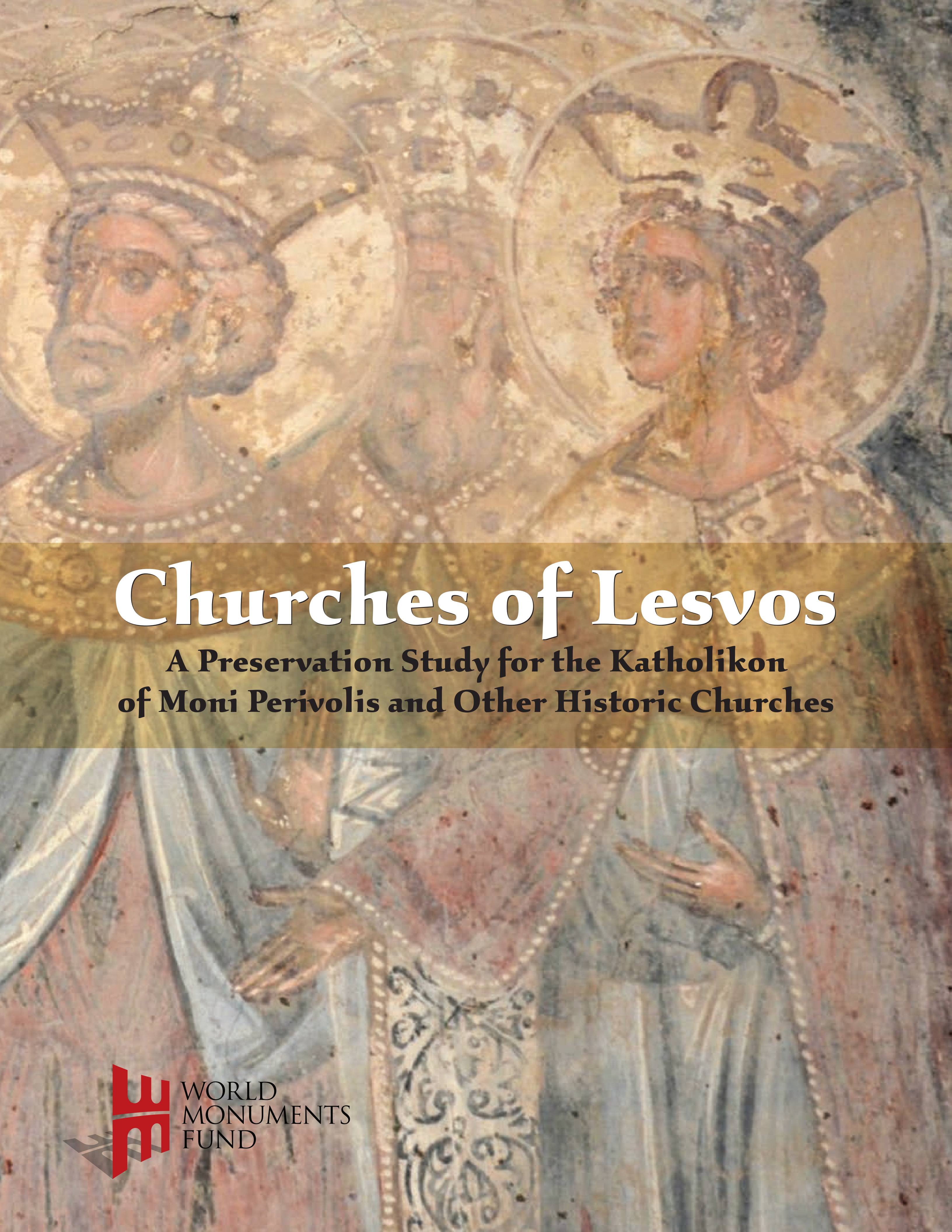

Churches of Lesvos

A Preservation Study for the Katholikon of Moni Perivolis and Other Historic Churches

WORLD MONUMENTS FUND

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Since 1965, World Monuments Fund has worked with local communities, governments, and affinity organizations to preserve cultural heritage around the globe. WMF has engaged in over 600 projects in more than 90 countries, seeking to advance innovation in the field, to forge international collaboration, and to ensure sustainable stewardship of the world's most treasured places. For more information about WMF and its programs, please visit www.wmf.org.

FIGURE 1 Detail from Oikos 14 of the Akathist to the Theotokos, on the west wall of the narthex at the Katholikon of Moni Perivolis

COVER Wall painting in the narthex of the Katholikon of Moni Perivolis

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Acknowledgments

This project was undertaken by World Monuments Fund (WMF), with support from the Robert W. Wilson Challenge to Conserve our Heritage and an anonymous donor. The WMF project team included Lisa Ackerman, Executive Vice President and Chief Operating Officer; Erica Avrami, Director of Research and Education; and Ioannis Avramides, Program Assistant.

The Churches of Lesvos, Greece, were first brought to WMF's attention by preservation architect and educator Pamela Jerome, a part-year resident of Lesvos. Ms. Jerome, in cooperation with local heritage conservation and church authorities, nominated twelve of the churches to the 2008 and 2010 World Monuments Watch. Ms. Jerome also helped to secure local arrangements for the project.

The 2011 field season was directed by Michael Devonshire, Director of Conservation for Jan Hird Pokorny Associates and Adjunct Assistant Professor at Columbia University. Adrian Heritage, Professor of Wall Paintings Conservation at the University of Applied Sciences Cologne, served as the wall paintings specialist. The 2011 team included Ioannis Avramides and three graduate students in Historic Preservation from Columbia University: Tony Baragona, Alison LaFever, and Sarah Morrison (Figure 2). The 2010 field season was directed by wall paintings conservator Constance Silver. The 2010 team consisted also of three graduate students from Columbia University: Reba Ashby, Sarah Sher, and Neela Wickremesinghe (Figure 3).

The 14th Ephorate of Byzantine Antiquities has responsibility and oversight over all Byzantine and Post-Byzantine monuments on Lesvos. This agency and its director, Athina-Christina Loupou, are strongly dedicated to the preservation of Moni Perivolis and offered enthusiastic support for the project. The 14th Ephorate generously provided scaffolding for the investigation of the wall paintings in the summer of 2010. The staff of the Ephorate also made available copies of studies about the monuments included in the World Monuments Watch that have been completed in recent years.

Figure 2 **Some members of the 2011 team at Moni Perivolis. From left to right: Tony Baragona, Michael Devonshire, Vangelis, the caretaker of Moni Perivolis, Alison LaFever, and Sarah Morrison.**

Figure 3 The 2010 team during a visit to Moni Ypsilou. From left to right: Pamela Jerome, Constance Silver, Delphine Lucas, a volunteer, and historic preservation graduate students Neela Wickremesinghe, Reba Ashby, and Sarah Sher.

Plaster samples from Moni Perivolis were examined and analyzed by Jamie Martin of Orion Analytical in Williamstown, Massachusetts, and by Dr. Christine Bläuer of Conservation Science Consulting Sàrl in Fribourg, Switzerland. Mortar samples were analyzed by Lisa Sauer, graduate student in Historic Preservation at the University of Massachusetts Amherst.

The support of the supervising priest of Moni Perivolis, Father Leonidas, was invaluable to the success of the field campaign. His decades-long, personal commitment to the preservation of Moni Perivolis, as well as his strong interest in its future as a religious site, offer the strongest hope for the success of preservation efforts. During both field seasons Father Leonidas offered daily support and encouragement, and demonstrated enthusiastic interest in the findings of the two teams.

Ecclesiastical authorities on Lesvos also provided extensive support. In 2010, the two bishops of Lesvos, Metropolitan Iakovos of Mytilene and Metropolitan Chrysostomos of Methymna, visited the project and engaged the researchers in discussion about the church and its wall paintings. Metropolitan Iakovos took a personal interest in the project and escorted the team to other historic churches on Lesvos. Metropolitan Chrysostomos and members of the diocese attended a presentation of findings at the conclusion of the 2010 field season.

The project would not have been possible without essential in-kind support. The community of Antissa provided housing for all team members during the 2010 and 2011 field seasons. In particular, the efforts of the president of the community of Antissa, Kyriakos Karamichael, were an important contribution to the success of the field campaign.

Local businesses supported the project by providing discounts to the team, and in 2010 a local mason volunteered to help make probes to the structure. Lastly, community members provided great moral support, by expressing their high interest in the project and by the kindness shown to the team. During the team's work on the site Moni Perivolis was visited daily by men and women from Lesvos and from the Lesbian diaspora who did not fail to express their concern about the condition of the church and its wall paintings, and also their excitement and support for the preservation efforts.

Introduction

The island of Lesvos, Greece, contains a large number of historic churches, which represent a continuum of ecclesiastical architecture beginning in the Early Christian period and continuing through the late nineteenth century. Many of these churches are notable for their associated artwork, especially their fine sacred iconography.

In 2008 and 2010, a group of twelve churches on Lesvos were included on the World Monuments Watch. Launched in 1996 and issued every two years, the World Monuments Watch is the flagship advocacy program of World Monuments Fund. The World Monuments Watch calls international attention to cultural heritage around the world that is at risk from the forces of nature and the impact of social, political, and economic change. The twelve churches were identified by the Watch nominators as the most endangered Christian monuments on the island. The group includes churches dating from the Early Christian, Byzantine, and Post-Byzantine periods, from the fifth to the nineteenth centuries. They include monastery churches, or *katholika*, as well as other small village and rural churches.

After inclusion on the World Monuments Watch, WMF supported a summer field program on Lesvos for graduate students in historic preservation. Providing such opportunities to professionals-in-training is a key aspect of WMF's educational mission. These on-site learning experiences complement university curricula and prepare students for work in the field. They also impart to the next generation of heritage professionals an important understanding of international issues in conservation and of cross-cultural collaboration (Figure 4).

The scope of work of the Lesvos summer field program was to assess conditions at one of the churches and to undertake a rapid, preliminary survey of the other eleven. In two field seasons, in the summers of 2010 and 2011, two teams studied the Katholikon of "Perivolis" convent, or Moni Perivolis, in the west of the island. In addition to Moni Perivolis, the teams of students conducted a preliminary survey of the eleven other churches included on the World Monuments Watch.

Figure 4 Historic preservation graduate student Tony Baragona demonstrates documentation to Father Leonidas, Athina-Christina Loupou, Director of the 14th Ephorate of Byzantine Antiquities, and Pamela Jerome.

Project Aims and Methodology

The aims of this project were twofold: to provide a useful resource to the stewards of the Lesvos Churches in the form of a conservation study, and to provide training in historic building documentation and assessment skills for graduate students in historic preservation.

Goals and Scope

The Katholikon of Moni Perivolis was the primary focus of two summer field programs in 2010 and 2011. Eleven other churches included in the World Monuments Watch were also surveyed. These monuments are:

1) Agios Andreas Early Christian Basilica, Skala Eresou
2) "Afentelli" Early Christian Basilica, near Skala Eresou
3) Agios Stephanos Church, near Mantamados
4) Katholikon of Moni Taxiarchon, near Kato Tritos
5) Katholikon of Moni Damandriou, near Polichnitos
6) Metamorphosi Soteros (Transfiguration) Church, Papiana
7) Agios Georgios Church, Anemotia
8) Agios Nikolaos Church, Petra
9) Graveyard Church of Moni Ypsilou, on Mount Ordymnos
10) Agios Ioannis Church, Kerami
11) Taxiarchon Church, Vatousa

The five-week 2010 field season focused on establishing a basic understanding of Moni Perivolis and its wall paintings, to investigate the causes of deterioration, and to suggest future steps for the site. The team identified the following areas for further investigation:

- Possible moisture infiltration at the upper portions of the façade walls
- Roof performance
- General weatherization and waterproof performance of the building envelope
- Site drainage

The 2011 field season followed on the 2010 findings and included an assessment of all conditions relevant to the long-term preservation of the Katholikon of Moni Perivolis, an analysis of the potential impact of building envelope conditions on the interior wall paintings, and the development of recommendations for the design of repairs by local partners. In the cases of the eleven other churches, the scope was limited to a simpler, rapid assessment of their condition and to suggestions for further work. The result was the study of a single monument in great detail, as well as exposure to the pressing conditions of many traditional buildings of a common cultural heritage.

Specific learning objectives were identified as integral to the investigation and overall project, including:

- Documentation of a building constructed using traditional local vernacular stone masonry techniques
- Identification and analysis of field conditions
- Establishment of a preliminary scope of appropriate remedial intervention
- Introduction to the interrelationship of building conservation and wall paintings conservation.

To fulfill these learning objectives and the goals of the project, the following were produced and compiled in this report:

- Written field assessment and results of the investigation, recommendations for remedial action, and an outline of specifications for remedial work
- Photographic illustrations of site and building conditions
- A set of measured drawings, including: a site plan, building plan, exterior and interior elevations, and sections

Documentation Tools and Assessment Methods

Thanks to the accomplishments of the 2010 field season, team members were able to familiarize themselves with the site and the building prior to the start of the 2011 campaign. The 2011 season consisted of three weeks in the field, from June 11 through July 1, and three weeks of documentation and report preparation. Nearly all of the investigative work at Moni Perivolis was completed in the first week, with the remaining time used for investigations at the other churches on the island. The first day on-site was spent on general site orientation and on a visual review of construction methods and salient conditions in the interior and exterior of the building (Figure 5). During the first two days, the inspection and photography of the wall paintings was undertaken (Figure 6). Remaining days at Moni Perivolis were spent gathering first a broad understanding of the church building and the overall site, then gaining an understanding of specific modes of deterioration and their results, and finally coordinating the information in formalized format. The weather during the field investigation period was fair, with only a brief period of precipitation. Temperatures ranged from 20–30°C (70–90°F).

The following tools and methods were used to gather additional information during the 2011 season:

- Field measurements were taken using common measuring devices
- A perimeter datum was determined using a line level
- Photographic documentation was completed using digital cameras
- Thermographic images were collected using a FLIR b40 thermal imaging camera
- Moisture level readings were taken using a Delmhorst BD-10 meter
- Two stone bench flags were removed for inspection of the bench construction
- The wall paintings were examined from the ground level using a handheld halogen lamp to provide raking light

Testing of samples of the building stone was undertaken on site using (1) full immersion water absorption and (2) RILEM testing. Small samples were taken of different kinds of mortar found at Moni Perivolis. Twelve samples of clay-and-lime setting mortar, lime-and-sand pointing mortar, and hydraulic cement mortar were removed and visually examined. Two of these samples were analyzed further (see Appendix 2).

Following the completion of other field work, a field mock-up was undertaken to determine the feasibility of altering moisture levels within the masonry benches along the building exterior, and consequently inside the façade walls. The mock-up involved removing hydraulic cement from the mortar joints and the seat-rear cant, replacing it with a lime-and-sand mortar, and improving the water-shedding properties of the benches by resetting the seat flags to pitch away from the building. Information regarding the field mock-up is found in Appendix 3.

Figure 5 Inspection of the roof of the Katholikon of Moni Perivolis

Figure 6 Inspection and photography of the wall paintings at Moni Perivolis

Figure 7 The enclosure of Moni Perivolis from the Northeast

Moni Perivolis: An Overview

History

Moni Perivolis is a site typical of small-scale Eastern Christian monasticism, away from the large and well-known monastic centers such as the mixed natural and cultural World Heritage Sites of Mount Athos and Meteora in Greece (Figure 7). Though insular and self-sustaining, monastic communities like Moni Perivolis have always commanded high esteem among the devout local peoples as places of great spiritual strength. Architecturally, monastery katholika are some of the finest monuments in the region.[1]

Moni Perivolis was a dependency of the nearby Moni Kreokopou, a monastery for which the oldest known reference dates from 1331.[2] This male monastery was reconstituted sometime during the mid-sixteenth century, and a new katholikon was built in 1605. Moni Kreokopou struggled under a large financial burden brought about by poor management, and it closed in 1821.[3]

The earliest known mention of Moni Perivolis is in a *firman* (decree) of the Sublime Porte that dates from 1590. It was issued in response to a petition from several monasteries on Lesvos, including Moni Perivolis, requesting protection from abuse of power by local Ottoman officials, like the *subaşi* (military superintendent).[4] Attempts have been made to date the complex to the Byzantine period, including the claim of Metropolitan Iakovos of Mytilene (1907–1987), a prolific historian, that the Katholikon of Moni Perivolis is one of four surviving Byzantine churches on the island.[5] A hand-written sign at the site similarly dates the Katholikon to the thirteenth century for the benefit of modern visitors. Nevertheless, some recent researchers do not credit this hypothesis, and little is known about this island of the northeast Aegean Sea during the Byzantine era. The island flourished under the Genoese, who controlled it from 1355 until it was conquered by the Ottomans in 1462, nine years after the Fall of Constantinople. The English travel writer Richard Pococke (1704–1765) briefly mentioned Moni Perivolis in his description

1 Charalampos Bouras, *Byzantine & Post-Byzantine Architecture in Greece* (Athens: Melissa Publishing House, 2006), 238.

2 Panos Frankellēs, "To Monastēri tou Kreokopou," *Lesviaka* 3 (1959): 82-91.

3 *ibid*.

4 Stauros Karydōnēs, *Ta en Kallonē tēs Lesvou Hiera Stauropēgiaka Patriarchika Monastēria tou Hagiou Ignatiou Archiepiskopou Mēthymnēs eis Merē Dyo* (Constantinople: Patriarchikon Typographeion, 1900), 100-01.

5 Iakōvos G. Kleomvrotou, *Mytilena Sacra, vol. 2: Naoi—Keimēlia (A-M)* (Thessalonikē: [Iakōvos G. Kleomvrotou], 1974), 9.

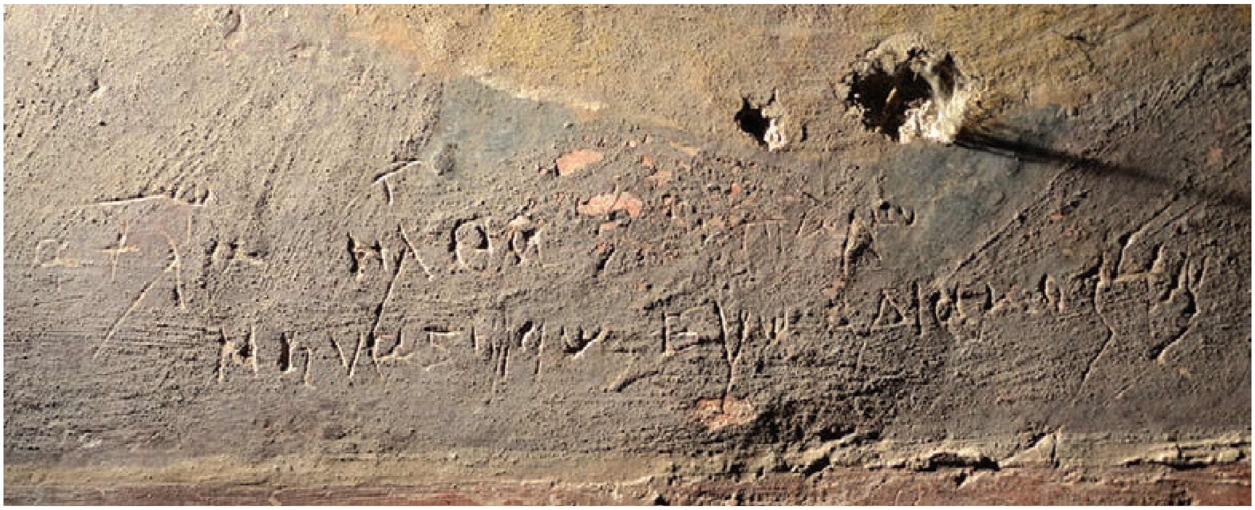

FIGURE 8 A scratched inscription at Moni Perivolis by a visiting deacon is dated to year αψλα', or 1731.

of Lesvos, which he visited in the late 1730s:[6] "We came to a large village of Turks called Telonia [modern Antissa]; there is a nunnery about two miles to the east of it, at a place called Peribole, in which they have a manufacture of stuffs made of silk and flax." Today, some scratched inscriptions can be seen on the wall paintings dating from the eighteenth century (Figure 8). More than a century later, in an 1898 report to Patriarch Constantine V, the abbot of Moni Leimonos mentioned that four nuns resided at Moni Perivolis, sustained by income from the flour mill of the convent and from additional support offered by Moni Ypsilou and Moni Leimonos.[7] According to oral tradition, at its peak the convent housed as many as 30 nuns.

The Katholikon of Moni Perivolis is dedicated to the Entrance of the Theotokos into the Temple. The church is a small, rectangular, single-story building with dimensions of 14 × 9 meters (46 × 30 feet). The walls were built using rubble and dressed stone masonry, and are very thick. Entered from the west, a shallow narthex opens into a single space consisting of the nave and a narrower aisle. The aisle is separated from the nave by a two-arch arcade. The Sanctuary, the liturgical east end of the nave also known as the bema, lies behind an iconostasis and terminates in an apse covered by a semi-dome. Every interior wall surface contains wall paintings, in a rich and diverse iconographical program.

The church was designated as a historic monument (Διατηρητέον Ιστορικόν Μνημείον) in 1938.[8] A large-scale conservation campaign began in 1962, focusing on the structural stabilization of the wall paintings.[9] This campaign was completed in 1973.[10] The church has been endangered from flooding of the nearby river many times in its history, and most recently in 1985, when flood control measures were constructed. Another major repair took place in 1995, when the roof was replaced. According to the priest, before this repair water entered the interior through the roof, running down over the wall paintings and pooling on the floor. In 1999, a study of the conservation of the wall paintings of Moni Perivolis was carried out for the 14th Ephorate of Byzantine Antiquities.[11] Although the complex has stopped functioning as a convent, it has continued to be used for weddings, funerals, baptisms, and on feast days. The church is open daily for visitors between May and October, and on a more limited basis during the rest of the year.

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6 Richard Pococke, *A Description of the East, and Some Other Countries. Vol. II. Part II. Observations on the Islands of the Archipelago, Asia Minor, Thrace, Greece, and Some Other Parts of Europe* (London: Printed for the Author, by W. Bowyer, 1745), 18.

7 "Anekdotē Ekthesē tou Hēgoumenou tes Monēs Leimonos," *Lesviaka* 3 (1959): 92-95. p. 93.

8 Ephēmeris tes Kyvernēseos tou Vasileiou tēs Hellados, 373, October 14, 1938. 2469.

9 *Archaiologikon Deltion*, 18 B2 (1963), 271.

10 *Archaiologikon Deltion*, 29 B2 (1973-74), 22.

11 Iōannēs Verroiopoulos, Konstantinos Nikakēs, and Vasileios Panagiotopoulos, *Meletē Syntērēsēs Toichographiōn Katholikou I. Monēs Perivolēs Lesvou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn, 1999).

Summary of Observations

The following site and building elements are discussed in more detail in the discrete report sections. It is anticipated that the information gathered as a result of the 2011 building envelope survey project and this report will, in combination with the wall paintings investigation, result in the implementation of appropriate remedial responses to the existing conditions, ensuring the longevity of this very important site.

Site

As mentioned above, the location of the monastery, in the flood plain of the Voulgaris River, appears to have resulted in site flooding problems in the past. However, the construction of man-made embankments and water-diversion channels has protected the building complex from seasonal vacillations in water level more recently. But unlike surface water, ground water appears to be a persistent issue—a result of the siting of the buildings in a low-lying plain. The sandy soil on which the buildings are located is relatively porous and absorbent, resulting in a condition of soil dampness, which in turn creates a chronically damp condition for the building, even in drier months. The extant traditional site drainage system is performing well. However, changes in paving at the immediate building perimeter have created drainage deficiencies that will warrant intervention.

Roofing

Roofing at Moni Perivolis has been very problematic in the past. Previous roof conditions related by Father Leonidas are alarming, and were a primary cause of deterioration of the wall paintings at the upper registers. The present roof is adequate, providing a multi-layer system of water protection, but nevertheless, it is not without some problems. Reuse of older terra cotta tiles within the new system, an admirable approach to the preservation of historic material, has resulted in some damage, and will likely do so in the future. The tiles, laid in a bed of hydraulic cement and with an application of cement at each lower end, rather than the traditional method of fastener attachment, are restricted in their movement (thermal and moisture-related expansion and contraction) by the cement, and, being of smaller compressive strength, are likely to fracture. This condition is ameliorated by the additional layers of protection beneath the tiles, but still creates a path for water to enter the system, which will likely worsen with time.

The replacement of the traditional corbelled-stone rafter plate with a new concrete ring beam does not appear to have negatively affected the structural integrity of the walls in any manner. While it is visually somewhat unsightly, the beam has performed appropriately. Nevertheless, the method of construction of the beam, including internal iron reinforcing rods, appears to be problematic. At several locations the rods were installed too close to the surface of the concrete, within the depth of moisture absorption, and are now corroding, and causing the concrete to spall at these locations. As this chronic condition persists unchecked, more iron will corrode resulting in more spalling concrete. The unfortunate result will be that the beam will require replacement, a process that, unless undertaken with considerable care, could result in additional damage to the painting on the interior. Partial repairs would be very invasive and likely to cause vibration damage to the frescoes.

Walls

Considering the issues that appear to have plagued the roof system, the walls beneath have performed admirably. Although the stone masonry was set in a relatively weak clay-and-sand setting mortar, the traditional lime-and-sand pointing mortar, in combination with appropriate maintenance and a sacrificial exterior limewash, appear to have generally protected the walls well from the elements. Failure of the previous roof system, which permitted significant amounts of water to enter the wall masonry from above, resulted in only moderate damage. Rising damp is a chronic condition at the church, as it would be for many structures built with similar materials in similar conditions. When surveyed, the lowest register of the walls, to a height of about one meter, exhibited a relatively uniform pattern of rising damp. The middle and upper registers were relatively dry, with only some minor heightened moisture readings around the perimeters of openings. The poor condition of the interior face of the apse walls is alarming, and appears to be attributable to the elevated ground level at the east end of the building, which is exacerbating the rising damp condition.

The condition most detrimental to façade wall longevity, and hence that of the interior paintings, is the presence of the exterior masonry benches on the south, west and east facades. Repointing efforts on the benches included the use of materials that are abetting high moisture conditions and rising damp. Remedial action at the benches may be the least invasive intervention that would achieve the greatest compensation.

Windows and Doors

No original windows or doors survive on the building exterior. Existing doors and windows are generally in fair physical condition, but lack suitable weather-tightness. Exterior doors exhibit considerably more deterioration—a result of contact or near-contact with grade or surfaces that are regularly washed with runoff. A moderate amount of remedial action is warranted in order for doors and windows to provide proper building envelope performance.

Interior

Interior masonry walls, separating the narthex from the nave, and the nave from the aisle, exhibit similar rising damp conditions to those of the exterior façade walls. The relatively recent addition of a new concrete floor section within the nave, while very likely lessening the amount of moisture evaporating into the interior volume, has most certainly resulted in an amplified level of rising damp in the walls.

Both Father Leonidas, and Vangelis, the caretaker, indicated that the building is unheated in the winter months because of sporadic use. Considering this state, and the general lack of air exchange between interior spaces and the exterior, it is safe to conclude that the interior volume contains a considerable amount of moisture-laden air, a condition that warrants, if time permits, thorough monitoring.

A considerable amount of the interior finishes are of wood: the door separating the narthex from the nave, which appears to be a very early, if not original, element, the new ceiling, the iconostasis, as well as furniture pieces and picture frames. All of these elements exhibited elevated moisture levels when tested during the field survey, and many exhibited indications of deterioration.

Wall Paintings

Most of the wall paintings have survived in remarkably good condition, even close to the ground. This indicates that ground moisture is not a major factor affecting the wall paintings. The paint layer is in variable condition, and on close inspection areas suffering from various deterioration processes can be detected. There is ongoing mechanical damage to the paint and plaster caused by the back-rests of benches and chairs in the nave and aisle.

The most critical conservation problem affecting the wall paintings as a whole is the lack of adhesion of the plaster in the wall paintings of the Sanctuary. This problem could easily lead to further significant loss and requires both emergency and longer-term stabilization interventions.

Throughout the church, much of the surface is affected by a whitish or grayish coating, which impedes the legibility of the wall paintings to a great degree. Removal of this material, which possibly contains gypsum and should be investigated, is not the most pressing conservation issue at Moni Perivolis. Nevertheless, it is important for the surface material to be properly identified and eventually reduced, if not removed, using an appropriate method.

Figure 9 The Katholikon of Moni Perivolis from the Northwest

Assessment of Building and Wall Paintings

Site

Moni Perivolis is sited near the bottom of a ravine located roughly 5 kilometers (3 miles) from the village of Antissa on the western side of the Greek island of Lesvos. It is situated at the foot of a hillside, on a flood plain roughly 50 meters (150 feet) from the south bank of the Voulgaris River. These facts play heavily into many of the conditions found during the team's assessment of Moni Perivolis, which focused particularly on understanding if and how water was infiltrating the Katholikon, and thus potentially affecting the wall paintings on its interior surfaces, the preservation of which is, as mentioned in the Executive Summary, a central goal of this study.

The compound of Moni Perivolis is enclosed by a tall wall, with a single entrance marked by a bell tower. The stone masonry wall is capped with terra cotta copings, and encloses an area of roughly 1,350 square meters (14,600 square feet). Approximately a third of this area, or 400 square meters (4,300 square feet), is devoted to buildings. The church occupies 135 square meters (1,450 square feet), a latrine occupies 15 square meters (150 square feet), and a dormitory building occupies 250 square meters (2,700 square feet). The rest of the area is either "hardscape," including the open bell tower and a fish pond, or "softscape," in planters. While the area around the compound slopes generally from south to north (as noted above) the courtyard area additionally slopes from west to east. The church is situated in the east section of the courtyard and thus both surface water and presumably ground water are pulled by gravity in its direction (Figure 9). The arrangement of a free-standing katholikon in the center of a courtyard, with subsidiary structures along the surrounding walls, is typical of Eastern monastic architecture.[12] Its positioning close to the eastern wall allowed for a large enough area in front of the church to contain crowds of the faithful on feast days.

The enclosed compound is paved with a sophisticated traditional system of stone work that can be observed throughout Lesvos. This system is composed of random-shaped flat (sedimentary) stone pavers, tightly placed with very small gaps between stones that allow some seepage between stones, through the sub-surface soil, roughly 15 centimeters (6 inches) deep into porous volcanic bedrock below. Paving surface drainage is achieved within the compound by the linear alignment of stone joints, acting to direct the surface flow. These rivulets are spaced evenly at

12 Anastasios K. Orlandos, *Monastēriakē Architektonikē* (Athens: Hestia, 1927), 16-17.

precise intervals throughout the courtyard, as shown in the Site and Drainage Plan (Appendix 1), and lead to centerline drains on either side of the church, which in turn flow out of the compound through openings in the perimeter wall (Figure 10). These drainage openings occur at two points on the east wall of the compound, carrying the flow of water from the site, from the exterior low points just mentioned to a drainage channel outside the walls that is an average of 6 meters (20 feet) from the compound wall. The northern drain flows beneath the crawlspace of the dormitory building before exiting the compound (Figure 11), while the southern drain exits from underneath the bell-tower stairs.

Both drains empty into the channel that runs along the exterior wall and that also serves as a drain for a spring emanating from the hillside across the driveway, as well as for water flowing along the driveway. The channel then leads to a corrugated steel pipe through a storm-berm toward the nearby Voulgaris River, near the northwest corner of the compound (Figure 12). Plant growth can be seen along the drainage channel.

Prevailing winds (at least at the time of this study in June) are channeled down the ravine from West to East towards the ocean, roughly 5 kilometers (3 miles) away. While the site is far enough away from the hillside to receive day-long sun-exposure, there are numerous trees inside of the compound walls that shield the church throughout most of the day, most notably a large walnut tree directly across from the southwest corner of the church and a large pine tree directly in front of the main entrance to the church at the west wall. Notable hardscape in the immediate vicinity of the church includes a 3 × 10 meter (10 × 30 foot) stone masonry-enclosed planter between 1.5 and 5 meters (5 and 15 feet) to the south (it is roughly 22° off the plane of south wall of the church), the large pine tree to the west, planters abutting the dormitory building to the north, and a terraced area to the east of the church that runs between Sanctuary wall and the apse, and the courtyard wall. This raised area is of particular concern in terms of water intrusion

Figure 10 Drain on the exterior of the perimeter wall of the compound

Figure 11 The northern drain flows beneath the dormitory building.

Figure 12 The drainage channel flows through a pipe into the Voulgaris River.

and its effects on wall paintings in the apse (Figure 13). Of additional concern are the benches attached to the exterior of the church on every side except the east (Figure 14). For more details on the effect of the benches see the section on Walls, below.

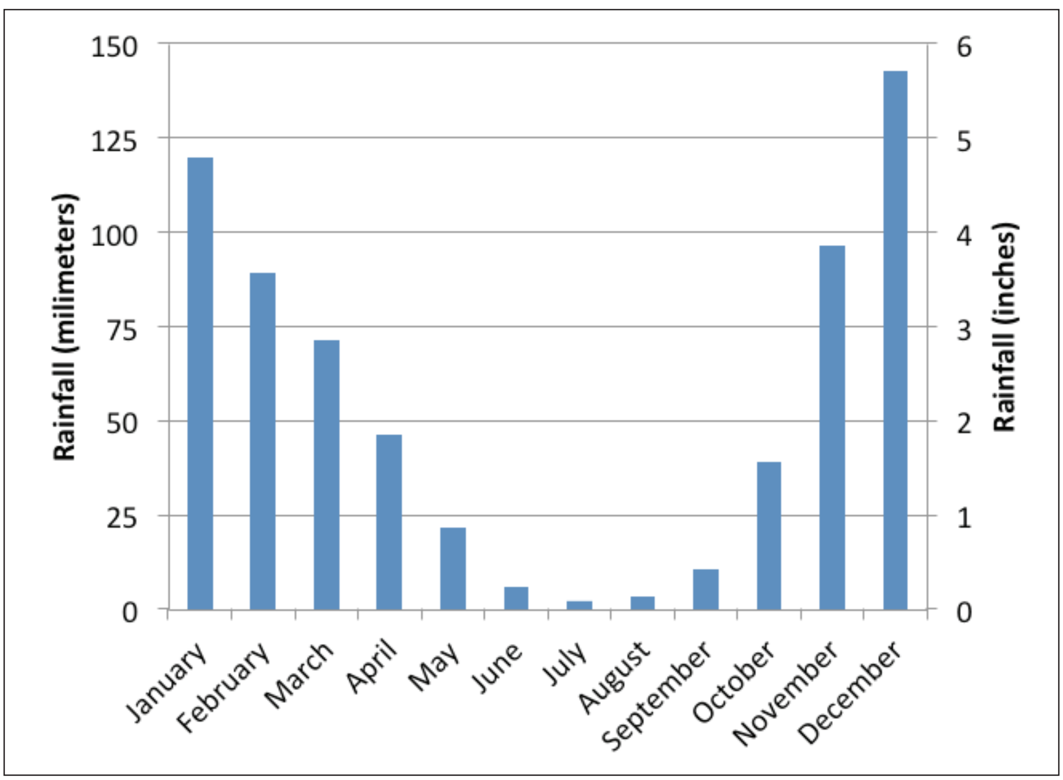
Figure 13 Stepped terrace at the east end of the church

Figure 14 Northwest corner of the church with exterior bench

Site Conditions

In general, the site of Moni Perivolis is maintained in excellent condition, due in no small part to the efforts of the local priest, Father Leonidas, and the site caretaker, Vangelis. One or both of them is on-site every day to inspect the buildings and make the site accessible to the public, maintain plantings, and see to the day-to-day business of the monastery. The site is kept clear of debris, from the terra-cotta roofs to the paving of the courtyard, both of which are important factors in ensuring that the church and its wall paintings are not exposed to excessive amounts of moisture from the outside environment above the ground level.

As mentioned previously, there was only a brief period of precipitation during the 2011 field season. The summer months on Lesvos are very dry, but rainfall is considerable during the winter and early spring, as is shown by the following diagram of average monthly precipitation:[13]



13 The rainfall data were collected in Mytilene over a 42-year period (1955-97). Source: Hellenic National Meteorological Service (www.hnms.gr).

The rivulets in the paving system stones that are aligned long edge to long edge appear to be performing properly during rain events (Figure 15). One adverse condition in the drainage system is the blocking of some of the channels in front of the main entrance with a layer of hydraulic cement (Figure 16).

Although not observed during the site review, it can be reasonably hypothesized that this blockage causes water to pool at the front door at either side of the blockage, and more prevalently on the south, or uphill, side. Additional problems arise at the main and side entrances, where recently hydraulic cement slabs have been laid outside of the building. Not only do they partially block the drainage system, they are within 1 centimeter (½ inch) of the height of the door thresholds and finish floors of their corresponding doors, creating a path for water flow towards the interior (Figure 17).

Continuing through the drainage system, the drainage channel immediately outside of the courtyard wall has been partially filled with silt and vegetation (Figure 18). These three conditions warrant remedial action to keep the system fully performing.

Perhaps of greater impact on the longevity of the interior wall paintings are two other exterior conditions mentioned above: the benches on three sides of the church, and the raised terrace around the apse of the Katholikon. The interior surface of the walls that correspond to these conditions exhibit some of the more serious levels of moisture related deterioration, corresponding directly to the heights of the benches and the marked grade difference between the interior floor and the exterior terrace level at the apse. The problem of the benches is addressed in greater detail in the following section on the exterior walls. Regarding the east end terrace, there is the possibility that the raised area is blocking subterranean water flow coming from the hillside as it is near the line that would flow from a known spring toward the creek. At a minimum, the higher soil levels against the apse area are creating a more damp environment in the portions of the apse that are below grade at this point, a condition corroborated by moisture meter readings and thermographic imaging at this location. These two conditions are also to be addressed in the section on Site and Building Recommendations.

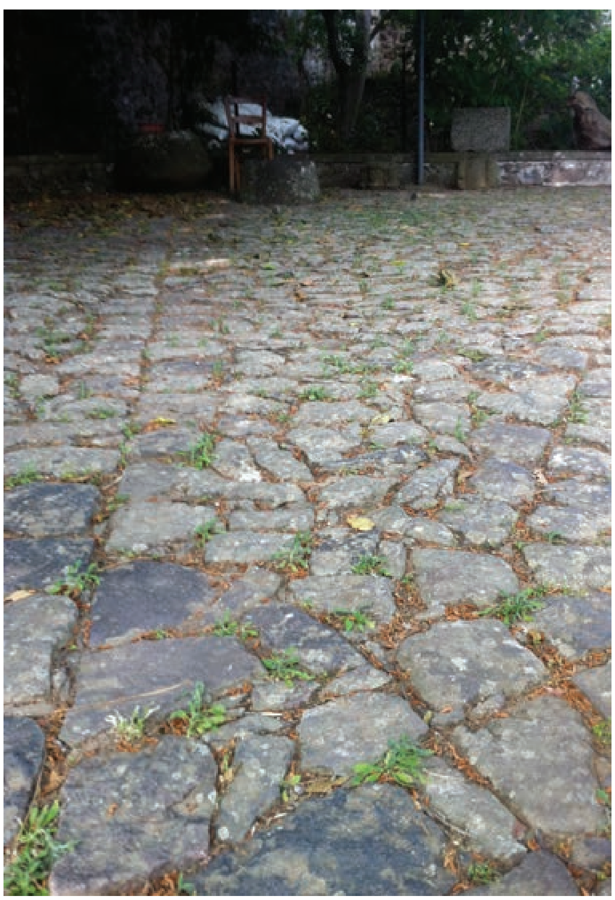


Figure 15 Traditional surface drainage system

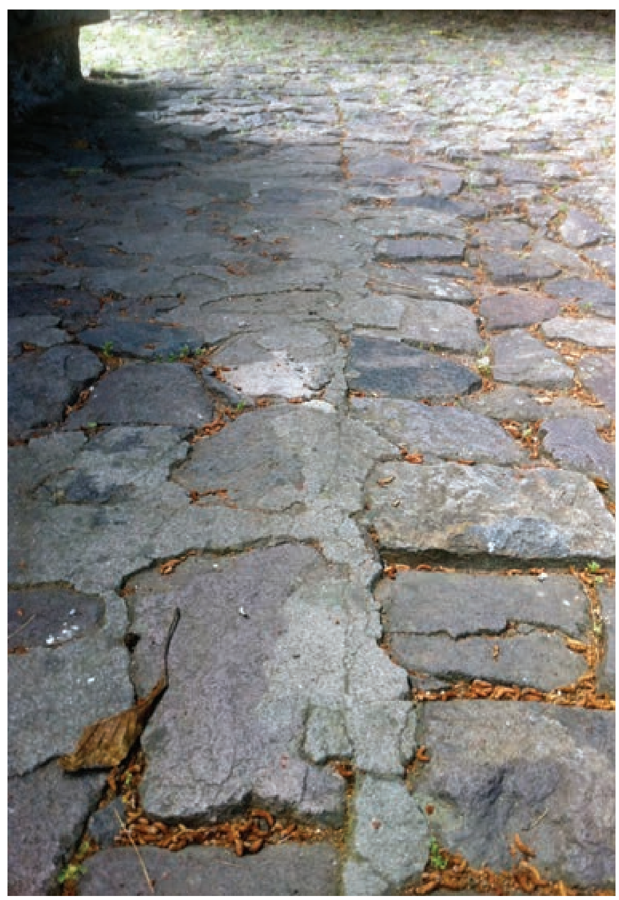


Figure 16 Open joints between the stone pavers filled in with hydraulic cement

Figure 17 Cement slab at the threshold of the main entrance door

Figure 18 Plant growth in the drainage channel

Exterior Walls

The Katholikon of Moni Perivolis is roughly rectangular in plan, with the longer side running approximately east to west (Figure 19). The dimensions of the plan are 14 × 9 meters (46 × 30 feet). A semi-circular apse projects from the east end of the building, to which a small ossuary is attached. The principal entry is located at the west end and leads into a narthex. The exterior façade eave walls and the west end wall are approximately 2.5 meters (8 feet) high at the exterior face and vary in thickness (see wall sections, Appendix 4). The east gable end wall is approximately 5.5 meters (18 feet) high at the gable peak.

The walls are surmounted by a relatively new 10-centimeter (4-inch) thick continuous reinforced concrete "ring beam" installed in the 1960's. This beam likely supplanted an original corbel of the traditional type, which acted as a rafter plate for the prior roof structure. This new plate projects horizontally beyond the outer masonry wall surface, forming a soffit overhang at each wall extending approximately 25 centimeters (10 inches) from the wall surface.

Figure 19 The building is rectangular in plan, with the longer side running east to west

Investigative probes revealed that the walls extend at least 40 centimeters (16 inches) below grade, and appear to rest directly upon the soil substrate (Figure 20). Probes were performed on interior faces of the west exterior wall within the narthex, and within the Sanctuary, at the wall separating the Sanctuary and the narthex.

The walls are constructed of a mix comprising random-coursed rubble and dressed stone masonry from nearby sources. The exterior surfaces of the façade walls have received numerous applications of whitewash, an annual procedure that generally conceals the masonry. The interior surfaces of the walls have been finished with Orthodox wall paintings on plaster.

Close visual examination of stone samples from the walls reveal that the principal wall construction stone is andesite, a volcanic igneous rock, of the type found and used as building stone in the surrounding area. Wall construction generally includes rubble and dressed stones of varying sizes, and employs larger dressed stones at façade corners to provide structural connections between walls. Stones are set in a mortar of clay, lime, and sand, and joints are finished on the exterior face with a pointing mortar of lime and sand, tooled to a slightly inverted "V" profile. Mortar joints vary in width—a result of the use of varying stone sizes with uneven surfaces (Figure 21).

While the south and east façade walls were constructed relatively plumb, the north and west walls are "battered" on the exterior surface, a building method more typically found in dry-laid stonemasonry walls (Figure 22). Anecdotal information has suggested that the battered surface of the north and west walls is a later intervention, constructed to prevent wall collapse. This information was not confirmed by investigative probes, and this condition does not appear to affect the condition of the walls of the structure.

Figure 20 Walls penetrate the ground at least 40 centimeters, but lack footings

Figure 21 Local andesite stone was used for the walls of the Katholikon of Moni Perivolis

Figure 22 "Battering" of the stone masonry walls suggests dry-laid stone construction

Figure 23 The rose window on the east façade has been filled in

Figure 24 A former door opening on the south façade has been filled in

Figure 25 A hydraulic cement cant at the bench edges entraps moisture. Note the typical gap at the rear upper edge, a result of differential expansion and contraction.

Figure 26 Walls lacking exterior benches meet the ground with a hydraulic cement cant

Exterior walls are penetrated by four window openings: two on the south façade, one on the north façade, and one within the apse. Seven dressed segmented arch stones at the east gable end of the building just above the apse roof are likely to be the extant remains of a surround for a window opening at this location that was never installed, or was later removed and filled in (Figure 23).

There are presently three door openings, although the ghost of a fourth former opening is visible near the west end of the nave on the south wall (Figure 24).

The rose window and the south door opening, now infilled, are the only such features within the walls that utilize large stones for the surrounds—the door opening at the south façade featured a large stone lintel, remaining in situ, to support the masonry above the head of the opening. With the exception of the main door opening, which is arched and constructed with a surround of dressed stone, other door and window openings are finished with unadorned jambs, with stone above the masonry openings supported by wood lintels.

At the bases of the north, west and south walls, stone benches have been constructed extending the length of each wall. The benches vary in height between 40 and 60 centimeters (16 and 24 inches) in height, and project 40 to 50 centimeters (16 to 20 inches) from the wall surfaces. Constructed of rubble stone and filled with smaller rubble set in a mortar of clay, lime, and sand, the benches are capped with 10-centimeter (4-inch) thick stones, averaging 60 centimeters (24 inches) in length. The mortar joints in the benches have been repointed with hard cement mortar, and large cement cants have been applied where the bench seat flags adjoin the exterior wall surfaces (Figure 25). At the east wall, where no benches have been installed, a similar massive cement cant has been fabricated at the base of the wall, presumably to direct runoff away from the building (Figure 26).

Exterior Wall Conditions

Generally, the performance of the façade walls of the building has been satisfactory. Even previous issues with the roof deterioration and failure did not result in wholesale failure of the walls. In fact, it appears that most of the damage to the walls has occurred as a result of roofing repairs and the placement of the concrete rafter plate.

Although the walls lack a spread footing or other foundation elements that are now considered standard practice, there appears to be only very minor subsidence, and the resulting small cracks observed variously on each wall may possibly be seasonal in nature. Both horizontal and diagonal small cracks were observed in the whitewashed finish, but their insignificance is no cause for alarm.

The whitewash finish revealed a few *lacunae* in the mortar system on the exterior, but this condition too appears to be isolated and easily repaired (Figure 27).

The lime and sand pointing mortar, in conjunction with the annually applied whitewash coating, has generally been adequate to protect the masonry from mortar erosion or other deterioration. The stone of which the walls are constructed is minimally absorbent. A standard laboratory water absorption test was performed on a sample of façade wall andesite for 48 hours. The test indicated that the rock is anhydrous and non-absorptive. RILEM tests also revealed no absorption.

Because the stone used for the construction of the façade walls is anhydrous, the path for moisture into the walls is provided by the use of the clay and sand setting mortar for the masonry. It appears that a clay and lime mortar mix, similar to that used on the exterior, was used on the interior surface as a finish mortar as well, serving as a substrate for the finish plaster system, upon which the fresco decoration was applied. The clay and lime mortar is, unfortunately, quite absorbent, and appears to be transmitting ground water with great facility, through capillary action (or "rising damp"), upward into the walls, resulting in deterioration of the plaster finishes. Infrared thermographic images taken of the perimeter walls confirm the rising damp condition at the bases of the exterior walls, a condition exacerbated at the east wall where the ground level is stepped up at the terrace, reaching an apex near the center of the apse wall (Figure 28).

Moisture meter readings taken at intervals near the bottoms of the exterior walls, in the courtyard a few feet outward from the walls, and in the foundation test pits, revealed nearly identical amounts of moisture in the soil and in the setting mortar at the lower portions of the wall. The probes penetrated 30 centimeters (1 foot) into the walls. Infrared thermograph images of the

Figure 27 Small *lacunae* in the exterior lime finish are easily repaired. Exterior finishes are in good condition

Figure 28 Although the interior floor level remains constant, the raising of the exterior grade at the east façade is very damaging

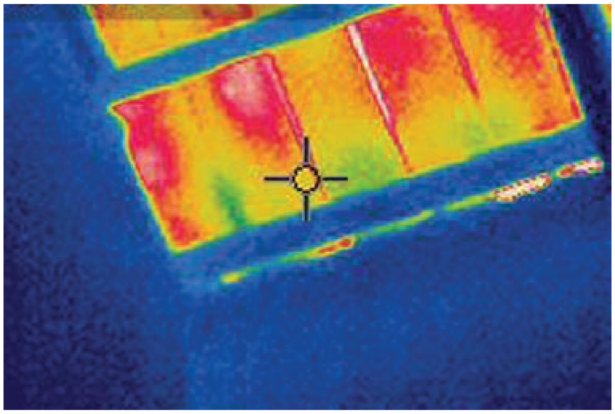


Figure 29 Infrared image of the top of the south wall. Note that the moisture content of the wall (blue) is quite even

Figure 30 Hard hydraulic cement mortar at benches entraps water, exacerbating wall deterioration

Figure 31 Interior wall damage resulting from previous deterioration and subsequent repairs

upper portions of each wall revealed little or no moisture content within the upper portions of the walls (Figure 29).

Contributing to the rising damp, and raising considerable concern, is the construction of the benches at the perimeter of the building. The benches were constructed using the original construction technique, with a clay and sand setting mortar and a lime and sand pointing mortar. While this was initially adequate, it is almost certain that the amount of ground water present, and the tendency of "splash back" from the roof runoff impacting the ground-level pavers, resulted in significant and frequent mortar loss on the bench fronts and sides. As a consequence, more recent repointing of the benches has been accomplished using hard cement (Figure 30). The same cement type has been used to form the cant at the east end of the building where the wall meets the ground. The unfortunate result of the use of this cement is that it is very impervious, and thus entraps any moisture that is in the masonry system. At Moni Perivolis, the cement on the joints of the bench face traps the rising ground water, which passes through the considerable mass of the wall's clay and sand mortar, migrating toward the interior face of the wall, and resulting in moisture-related damage to the interior wall surfaces. Extremely high moisture levels were recorded within all of the benches.

Also contributing to the rising damp condition at the walls is the partial replacement of the original interior floor pavers with a concrete slab. This moisture-impervious barrier prevents ground moisture from evaporating into the interior volume, resulting in the moisture migrating toward the walls, exacerbating the rising damp condition and resulting in damage to the interior plaster and paintings.

Interior plaster finishes at the upper portions of the walls have been damaged and subsequently repaired. Thermographic documentation of upper wall sections revealed no presence of unusual moisture, suggesting that the damage to finishes at this location is likely related to previous roof failure, and as mentioned, construction of the concrete rafter plate ring beam (Figure 31).

Roofing

The roof of the church is a hybrid of a hip (west end) and gable roof (east end) (Figure 32). The gable ridge runs in an east-to-west orientation, and an iron cross is located at each of the two ridge ends. A lower, partial conical section roof covers the semi-circular apse, and the adjacent ossuary (which is not accessible from the interior) is covered with a simple shed roof. All roof structures share a similar method of construction and date from the mid-1960s, according to Father Leonidas.

The main roof structure consists of four heavy timber king-pendent trusses. Diagonal struts extend from the king posts to the principal rafters which form the upper chords of each truss. Smaller purlins, on approximate 60-centimeter (2-foot) centers join the rafters and support the wood sheathing. Roughly square straining beams extend between the rafter ends. With the exception of the wood sheathing, all of the roof framing is handworked and appears to be either original construction or a near-original modification. Access to the roof framing was limited and close inspection was not possible (Figure 33).

The roof construction consists of unglazed terra-cotta tiles set in a mortar bed, with both barrel and pan tiles being curved, instead of flat pan tiles. The tiles are not attached with fasteners, but rather adhere to the roofing substrate entirely by means of gravity and mortar. Below the tiles and mortar is a bituminous waterproofing membrane which rests upon a reinforced concrete deck which terminates at the eaves and gable ends in a 10-centimeter (4-inch) thick ring beam which acts as a rafter plate or soffit. This non-original construction replaces what was likely the traditional brick or stone corbel. The reinforced concrete ring beam appears to have been used to build up the walls of the church to level them out in preparation for receiving the new roof. The roof tiles project approximately 10 centimeters (4 inches) beyond the outer edge of the soffit, providing an adequate drip edge. The roof membrane is supported by a series of wood king-post trusses within the building. Beneath the trusses rests the ceiling framing of the church.

The re-roofing project created a hipped roof form, from what had been a combination of a standard gable roof over the nave combined with shed roofs covering the aisle and the narthex. The effect of this is to create the illusion that the hip roof is truncated on the south side, when in actuality, it extends further to the north to cover the aisle while maintaining the same slope (between 3-3.5 to 12) and accommodating the change of ceiling height from nave to aisle (Figure 34). The narthex is similarly roofed, but the slope is slightly steeper, and closer to 4 to 12 (or 1 to 3). Thus the central ridge is plumb despite the fact that that interior ceiling heights range from 2.6 meters (8.5 feet) in the narthex to 4.7 meters (15.5 feet) in the Sanctuary, which is lower relative to the exterior finish grade and, unlike the nave, does not have a dropped ceiling that extends 1 meter (3.5 feet) below the interior roof ridge framing.

Figure 32 Hybrid roof at Moni Perivolis

Figure 33 Main roof wood framing

Figure 34 Roof profile from the West

Figure 35 Cracking and deterioration due to rusting rebar

Roofing Conditions

The authors of the 1999 report expressed their concern about the water tightness of the then-recently replaced roof and recommended that it be professionally inspected. Today the roof is, in general, well-maintained (there was no accumulation of leaves or plant growth at the time of the survey) and does not appear to be leaking. The roof lacks a drainage system for carrying runoff away from the building. Roof runoff presently drips onto the ground or onto the benches at the building perimeter. This detail is problematic on the north side of the building, where the bench seats are pitched toward the façade wall, encouraging water penetration at the building façade. Framing, viewed within the "attic" above the dropped wood ceiling of the nave, appears to have been modified in the past, but remains in serviceable condition. There is no water staining at the interior walls of the church, nor did moisture readings or infrared thermographic images indicate that there was water accumulating in the walls at this level. It is theorized that damage to the wall paintings in this area occurred either before the building was re-roofed or in the process thereof. Since metal fasteners were not used to attach the roof tiles, it can be safely assumed that the waterproof membrane has not been punctured by nails or other fasteners, including from the inside given the presence of the concrete slab.

Only a few of the roof tiles are cracked—a condition that may be attributed to the somewhat moisture-absorbent tiles expanding as they are wet, and fracturing under pressure (a result of differential expansion) from the adjacent moisture-impervious hydraulic cement. It was indicated to the survey team that when the roof tiles were previously replaced, a significant number of older tiles were reused on the new construction. These older tiles are readily identifiable, and are likely to be significantly more absorbent than the newer tiles, and thus more likely to be damaged by differential expansion and contraction. The tiles that were found to be cracked were all older.

The area of greatest concern for the roof of the church is the deteriorating condition of the concrete ring beam soffit. The ferrous reinforcement was placed close to the surface of the slab at several locations—less than the current industry standard, and now is corroding, causing oxide jacking and spalling of the adjacent concrete as a general condition, rather than in a few cases (Figure 35).

Although the failure can be observed to be below the waterproof membrane (as shown in Figure 35), there is danger that the corrosion eventually will becoming severe enough to affect the structural integrity of the slab, and the performance of the roof in general. Recommendations for mitigating this condition can be found in the section on Site and Building Recommendations.

Doors

There are three exterior doors at Moni Perivolis, leading into the narthex from the west, north, and south. In this report and in the accompanying drawings they are labeled D1, D2, and D3 respectively. An interior door, labeled D4, separates the narthex from the nave.

West / Main Entry Door (Door D1)

The main entry doors on the west façade are contemporary double-leafed board-and-batten doors that open inward, with an astragal on the north-side door (Figure 36). These doors date from the mid-twentieth century and are made of wide-plank chestnut, planed by hand, rusticated to appear older, and painted brown. The door opening lacks a wood trim surround, but is instead framed on the exterior by an arched doorway. Each door is held together by three horizontal steel batten straps that are attached to the wood boards with flat-headed screws, a few of which have been replaced with contemporary steel screws (Figure 37).

Each door is also supported by L-shaped steel brackets at the top and bottom. The doors are hung from steel plates, approximately 45 centimeters (18 inches) long by 5 centimeters (2.5 inches) wide and ½ centimeter (¼ inch) thick that are bolted into the lintel beams. Steel pins that are attached to the L-shaped brackets fit into the steel plates above and the stone threshold below. The pins serve as the doors' hinges.

The door hardware consists of a stamped sheet-metal thumb latch and plate mounted on the southern door that fits into a wrought-iron strike on the inside of the northern door. There is also a small surface-mounted lockset on the northern door.

Door D1 Condition

The doors are in fair to poor condition. On both doors, the bottom has been exposed to significant amounts of moisture, which has resulted in rotting of the lower 15–20 centimeters (6–8 inches) of each vertical board (Figure 38). This deterioration is particularly serious just above the bottom L-bracket on the exterior of both doors. A significant amount of checking of the boards has occurred at the lower ends. Where the deterioration is particularly bad and pieces of the door are missing, small sheet steel repair plates have been added. The deterioration at the door bottoms has resulted in significant gaps beneath the doors, which in extreme weather very likely permit water infiltration by driven rain. In addition, the doors are not weather-tight at the perimeters, eliminating any possibility of isolating the interior of the building from inclement weather conditions.

There are four hand-hewn wood lintel beams supporting the door opening extension on the building interior. The beam closest to the door has been cut and is thinner on the south end. The wood appears to be sound, but it exhibits some evidence of powder-post beetle infestation.

Figure 36 West /Main Entry Door (Door D1), from the exterior

Figure 37 Door D1, from the interior, showing steel batten straps

Figure 38 Wood deterioration from moisture at the bottom of Door D1

Figure 39 North Door (Door D2), from the exterior

Figure 40 Door D2, from the interior, showing wood battens

Figure 41 Wood deterioration at the bottom of Door D2

North Door (Door D2)

The door on the north façade leading into the narthex is a contemporary board-and-batten door, most likely installed in the late twentieth century (Figure 3). The door is composed of seven vertical beaded wood boards, each approximately 10 centimeters (4 inches) wide, and three horizontal wood battens with beaded outside edges. The battens are attached to the interior face of the door with modern wire nails, clinched on the interior face (Figure 40). The door opening also has a contemporary frame and trim, machine-planed with mitered corners. The trim is detailed with a quirk-and-bead detail to match existing historic trim on the south side windows. The door, frame, and trim have all been painted brown.

The hardware consists of a surface-mounted lock attached on the inside and a stamped sheet-metal key hole on the outside. There is also a steel slide bolt attached on the inside. The door is hung from three mortise hinges.

The lintel of Door D2 is of olive wood, and possibly original to the masonry opening. There is an extant rebate at each jamb, where the original frame may have been attached. At the left end of the lintel beam a painted wood block has been placed in the rebate. Square hand-wrought nails can still be seen in the lintel. Mortar has been added to the stone threshold where the new frame meets it. In the interior, the lintels are concealed by a thin sheet of painted particle board. A small portion of the front lintel is exposed where the plaster and wall paintings have detached, and the wood appears sound. The interior door frame is sound, but hydraulic cement has been added between the interior wall and door frame.

Door D2 Condition

While the top portion of the door is sound, the lower door is in poor condition. The bottom of the door and the bottom and the underside of the door frame are rotted along a third of the door height (Figure 41). The lowest horizontal member is loosely attached and there is a large hole in the door where the bottom section of a vertical board is missing below it. The hole in the door and the moisture in the rotting wood render the interior more vulnerable to insect infestation and damage.

Seen from the exterior, the door frame is loosely attached on the bottom left, and on both sides near the bottom holes and frass from insect infestation can be seen. On the upper left side of the frame pieces of wall plaster have detached. On the upper right side of the frame, the cement mortar likely holds moisture behind it and is causing the frame to rot further. Because it is concealed, the condition of the rest of the door frame below the existing trim, or the condition of the underside of the olive wood header could not be determined. The sheet of particle board covering the lintel beams is deteriorating and in poor condition. The header above the door opening is made of three contemporary painted machine-planed boards, each approximately 15 centimeters (6 inches) wide and 1 centimeter (½ inch) thick. These cover thicker wood support members underneath. Those structural headers are possibly olive wood that have been white-washed on the exterior. All of this system appears to be in good condition.

Figure 42 South Door (Door D3), from the exterior

Figure 43 Door D3, from the interior, showing wood battens

Figure 44 Wood deterioration at the bottom of Door D3

South Door (Door D3)

Like the north door, the south door leading into the narthex is a contemporary board-and-batten door, most likely installed in the late twentieth century (Figure 42). The door is made of four wide vertical wood boards, beaded and painted, each approximately 14 to 22 centimeters (5½ to 8½ inches) wide, and three horizontal wood battens with chamfered ends and corners rounded with a 1 centimeter (⅜-inch) filet (Figure 43). The door opening has a contemporary wooden frame and trim, machine-planed with mitered corners. A small projecting drip cap surmounts the door frame head. The trim is detailed with a quirk-and-bead around the outside edge. The hardware on the door consists of a simple stamped sheet metal thumb latch on the exterior and a steel slide latch on the interior. The door is hung from three hinges.

In the interior, the large wood lintels are covered with a thin particle board sheet, as in the north side, attached to the lintel beams with round headed nails.

Door D3 Condition

The door frame and trim are in good condition, although the door is more highly deteriorated than the north door (Door D2). The bottom end of the door has been exposed to weather and is deteriorating (Figure 44). The boards are checking at the grain and the rot was seen to affect the bottom 5 centimeters (2 inches) of the door. Wood is missing from the bottom of each board, creating a large gap between the door and threshold. This gap is temporarily covered with a clay roof tile on the exterior and a wood board and piece of carpet propped against the door on the interior. The rest of the door is sound.

On the exterior, the wood door trim is surrounded by soft mortar that is delaminating. In the interior, the left side of the door frame has been patched with a white plaster compound. Here, a bit of brown door and trim paint is touching and partially covering the wall paintings in areas.

Interior Nave Door (Door D4)

The interior doors separating the narthex from the nave are a pair of raised and fielded 8-panel double doors, made of chestnut (Figure 45). While it was not possible to determine the exact age of the doors, the joinery and surface treatment suggest that they are at least 300 years old. There is an ornamental astragal on the narthex side of the south door. The raised panels on the side of the narthex are more detailed and the moldings are more refined than the other side. The wood-work of the panels on the side of the nave is simpler (Figure 46). On this side the panels themselves retain the same chamfered carvings, but the rails and stiles do not. The narthex side of the doors is painted, whereas the nave side is unpainted.

Wrought iron straps support the bottom of each door from the inside hinge at the corner. The doors are hung, like the main entrance doors, with pins at the outside corners at the top and bottom. At the top of the door, the pin is of wood and turns in a hole in the wooden lintel above. At the bottom of the door, an iron pin is attached to the iron strap that fits into a hole in the stone threshold below. The doors swing inward toward the nave.

Door D4 Condition

Door D4 is in a very fragile condition. The lower third of both leaves is highly deteriorated, presumably from moisture-related causes. Several panels are separating from the rails and stiles, where the tenons holding the joinery in place have rotted (Figure 47). The bottom two panels of each door are deteriorating—exhibiting severe biological deterioration—and are fully detached from the horizontal rail above. The inside faces of the doors, which are unpainted, exhibit numerous insect holes and there is frass in some places, evidence of insect infestation (Figure 48).

The iron straps and fasteners at the bottom of the doors are rusted and detaching from the door. An iron pin at the bottom of the stone jamb is exposed where the iron has rusted and a piece of stone has broken off.

The wood lintel above the door on the nave side is exposed. There is an angled rebate in the center with two holes where fasteners were once attached, possibly from an earlier door configuration. The lintel is in fair condition except for a few insect holes and frass at the two ends.

Figure 45 Interior Nave Door (Door D4), from the side of the narthex

Figure 47 Deterioration from rotted tenons

Figure 46 Door D4 from the interior

Figure 48 Evidence of insect infestation on the unpainted side of the door

Windows

There are four window openings on the exterior walls of the church building: two on the south façade, one on the north façade, and one on the east, at the apse. One previous opening, a rose window above the apse, has been infilled. No original windows appear to remain on the building.

North Façade (Window W1)

The window on the north façade, in the exterior wall of the aisle, is set within a splayed jamb opening in the stone masonry. The masonry above the window opening is supported by wood lintel beams. The window is a one-over-one light wood casement sash that opens toward the interior (Figure 49). Window W1 is finished with machine-planed wood casing trim, with mitered corners and a chamfered edge. In the interior, the sash rests within a simple frame that lacks decorative trim. Radial metal thumb-latches attached to the frame secure the window when closed.

While the existing window sash and the trim are contemporary, portions of the frame appear to be older. The upper portion of the window frame retains larger, possibly hand-wrought iron fasteners (Figure 50). There are also two rectangular holes in both the top and bottom of the window frame that likely held vertical security bars in front of the sash at an earlier time.

Window W1 Condition

The window sash rests skewed in the opening and is not tight within the frame, creating a gap at the top left side of the window. The painted wood sash and trim are in good condition. However, there is no glazing compound on the sash, leaving the sash elements vulnerable to water or UV deterioration and the glass insecure within the sash.

In the interior, a lintel of three wood members supports the masonry above the opening (Figure 51). The timber exhibits some evidence of insect infestation (Figure 52).

Figure 49 Window W1, in the north wall of aisle, exterior

Figure 50 The upper portion of the exterior window frame shows iron fasteners and rectangular holes

Figure 51 Interior recessed window opening

Figure 52 Detail of lintel showing insect flight holes

Figure 53 Window W2, in the apse, from the exterior

Figure 54 Detail of plaster on sash

Figure 55 Hydraulic cement patching on the top right corner of the stone lintel

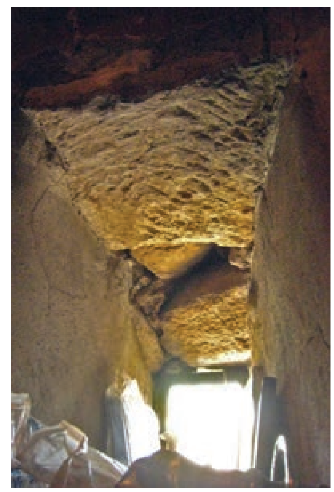


Figure 56 Stone lintel above the recessed window opening, view from the interior

Apse (Window W2)

The small window in the apse is an inoperable painted steel sash with a single glass light (Figure 53). The sash rests within a small opening in the wall above a stone sill. A plaster or cement setting/glazing compound secures the glass to the sash (Figure 54).The window sash is nearly flush with the exterior face of the wall.

Window W2 Condition

The steel sash is in good condition. The right end of the stone still is broken. Above the sash, a large section of the stone lintel is missing on the right side and has been patched with hydraulic cement (Figure 55). Some fissures in the stone at the window head may be permitting water infiltration, and a gap between the window head and surrounding masonry is problematic.

On the interior, the window is recessed deep into the narrow wall opening. The sash is not tight in the stone opening and daylight and air are infiltrating. A large stone lintel supports the masonry above the opening and appears to be in good condition. The window is supported by two stone lintels. The lintel closest to the exterior wall is broken; the innermost lintel appears to be stable (Figure 56).

Figure 57 Window W3, in the south wall of the Sanctuary, exterior

Figure 58 Trim and sill detail at the bottom left corner of Window W3 from the exterior

Figure 59 Detail of loose lime-based mortar around window trim, view from the exterior

Figure 60 Interior sash detail

Figure 61 Lintel, view from the interior

South Façade, Sanctuary (Window W3)

The window on the south façade, in the exterior wall of the Sanctuary, is similar in size and condition to the north façade window (Window W1). This window is a one-over-one light wood casement sash in wood frame that opens to the interior (Figure 57). The window opening is high on the wall, above eye level, with the top of the sill 2.4 meters (7.75 feet) above the ground. The window surround on the exterior is made of machine-planed wood, with mitered corners and a quirk-and-bead detail on the outside edge, suggesting a relatively recent origin (Figure 58). The upper portion of the window frame retains larger, possibly hand-wrought iron fasteners.

Window W3 Condition

Window W3 is in good condition, with minor exceptions. All of the wood members are sound, but the trim components and the sill are worn and separating at the joints. The trim is surrounded by a soft, lime and sand mortar that is loose and very friable (Figure 59). There is some patching with a harder, hydraulic cement mortar on the bottom left of the window trim.

The window is inverted, with the face of the muntins that holds the glazing compound on the inside (Figure 60). There is no glazing compound on the muntins and the glass is loose within the sash. The sash retains historic "wavy" glazing, and the upper glass pane is cracked. In the interior, the wood lintel above the window opening is in good condition, with no evidence of insect infestation (Figure 61).

South Façade, Nave (Window W4)

The window on the south façade, in the exterior wall of the nave, is a six-light double-leafed wood casement sash that opens to the interior. Each sash has three lights of equal size separated by horizontal muntins 1 centimeter (½ inch) wide. The sash is set in a wood frame constructed with mortise-and-tenon joinery (Figures 62, 63).

Two round-headed iron fasteners at opposite corners of the jamb hold the sill and head into the stone masonry. There are three rectangular holes in both the sill and head that may have held vertical security bars on the exterior face of the window at an earlier time (Figure 64). Additionally, there are four smaller square holes in the sill only, suggesting another set of bars or possible support for stained glass cames. There are no corresponding holes in the head or the jambs, which suggests the sill is the older extant element and the rest of the frame has been replaced.

The window is surrounded on the exterior with wood trim that is machine-planed, with mitered corners and a quirk-and-bead detail on the outside edge.

Window W4 Condition

Window W4 is in a good condition. The sash is sound and fits securely within the frame. There is no glazing compound on the sash—the glass is held in place by small iron nails (Figure 65). Where the compound is missing, the interior side of the wood muntin lacks paint and is exposed and left vulnerable to deterioration from the weather and ultraviolet radiation. The muntins are also showing some signs of deterioration. The sill is sound but not smooth. The wood is separating at the joints and erosion from ultraviolet radiation, prior to the most recent repainting, is evident. The central pane of glass in the western sash is cracked (Figure 65). The surround trim is set in a soft lime and sand mortar that is loose and friable, similar to Window W3.

On the interior, three wooden lintel beams span the window opening (Figure 66). There are several insect holes, showing evidence of insect infestation, and frass was found on a book in the opening, showing that the insects are currently active.

Figures 62, 63 Window W4, in the south wall of the nave, from the exterior and the interior

Figure 64 Detail of iron fasteners and rectangular holes on window frame, view from the exterior

Figure 65 Exterior sash detail, showing missing glazing compound and cracked glass

Figure 66 Lintel, view from the interior

Flooring

The floor of the narthex is covered with fired, glazed clay tiles, set on a soil substrate (Figure 67). The floor slopes very gently from the higher southern wall to the lower northern wall. In the northern section of the narthex, the tiles are 30 × 40 centimeters (12 × 15 inches), with the longer segment oriented north-south, and aligned. The grout between tiles is lime-based. In the portion of the floor between the main door and the entrance to the nave—a heavily trafficked area—the tiles are 40 × 40 centimeters (15 × 15 inches), most likely later replacements. These tiles are set in a soil substrate. The tiles at this location are heavily worn and cracked. Patches of hydraulic cement have been used to repair the cracked tiles and areas of missing grout.

The tiles in the aisle are also of fired clay and appear to be of a similar composition to those in the narthex. These tiles are roughly 30 × 40 centimeters (12 × 15 inches) and laid in staggered courses set in a soil substrate. The grout is lime-based and, as in the narthex, repairs have been made using hydraulic cement. Along the northern wall, a strip of possibly original stone flags remains. The grout is also lime-based.

In the nave, a c. 1950s concrete floor slab roughly 8 centimeters (3 inches) thick has replaced the probable original tile (Figure 68). The slab is decorated with a an 8-centimeter (3-inch) tinted red border and central medallion. Along the southern perimeter, a 75-centimeter (30-inch) strip of concrete lays roughly 3 millimeters (⅛ inch) above the slab. Similarly a 60-centimeter (24-inch) concrete patch flanks the entrance to the north. Measured at the center, the slab is 2.5 centimeters (1 inch) higher at the Sanctuary than at the door. The floor slopes imperceptibly downward from the South to the North. The slab does not extend to the South underneath the Bishop's throne (Figure 69).

The concrete slab stops abruptly at the iconostasis and a 10-centimeter (4-inch) patch of soil is exposed adjacent to the tiles in the Sanctuary. In the Sanctuary, the floor is covered with stone flags, which are most likely original. The flags are 30 × 40 centimeters (12 × 15 inches), oriented horizontally, and aligned in the northern 7 courses. The flags change direction in the remaining

Figure 67 Floor tiles and soil substrate in the narthex

Figure 68 Concrete floor slab in the nave

Figure 69 The concrete floor slab does not extend underneath the Bishop's throne

Figure 70 An earlier finish is preserved on the stone flags in the Sanctuary

Figure 71 Very high moisture levels could be recorded underneath the carpet in the Sanctuary

courses: the northern 7 courses are laid with the long edge oriented north-to-south while the remaining tiles have an east-to-west orientation. The floor was whitewashed and painted red at one point, however, most of this finish remains only under carpeted areas, where it has been protected (Figure 70). The grout between stones is lime-based. From the iconostasis to the eastern wall, the floor slopes downward almost 4 centimeters (1½ inch). The floor drops 2.5 centimeters (1 inch) in the apse alone.

Flooring Conditions

In general the flooring is in good condition, with the exception of the broken tiles mentioned near the entry. In addition, the tiles are uniformly laid and fairly level, except in the Sanctuary. But the use of concrete in the nave and of hydraulic cement as a patching material and grout is incompatible with the historic nature of the materials used originally at Moni Perivolis. The cement-based materials may also contribute to damage the clay tiles. In the Sanctuary some of the tiles are loose and may present a tripping hazard. The lack of a proper setting bed for tiles within the narthex is problematic and warrants remedial action. As moisture levels in the soil change, the tiles can be damaged by soil subsidence.

It would be reasonable to surmise that the concrete slab in the nave contributes to rising damp in the church walls. Nevertheless, the near-complete state of preservation of the wall painting near the bottom of the south wall does not corroborate this concern.

In general, a considerable amount of soil-borne moisture is migrating into the building, and presumably a considerable amount of this is in contact with the floor system. In the Sanctuary, especially, the use of carpets is contributing to the moisture retention, as it appears to be "wicking" moisture. When touched, the carpet covering the exposed dirt at the iconostasis was extremely damp. A moisture reading taken from a sill set in the dirt at this location revealed extremely high moisture levels (Figure 71).

Woodwork and Ceiling

Interior woodwork, while arguably of secondary importance to the decorative wall paintings, are nonetheless of significance not only to the decorative scheme of the church, but very much integral to the liturgical iconography at Moni Perivolis. Principal wood elements encompass ceiling construction and the iconostasis, supports at masonry openings, windows and doors, as well as other various smaller moveable elements, in addition to furniture.

There are two ceiling types: the exposed underside of the deck boards in the narthex, aisle, and Sanctuary, and a somewhat more decorative ceiling within the nave.

The ceilings of the aisle and the narthex consist of flat tongue-and-groove boards resting on the roof support purlins, which are in turn supported by the rafters. The boards are oriented with the length following the roof slope. The spaces between board edges are covered with small wood battens, and the entire assembly is painted (Figure 72).

In the nave the ceiling boards are fastened to the lower face of horizontal joists that span between the south wall and the interior wall separating the nave from the aisle. They are joined at the wall ends to perimeter plates. The joists run between and parallel to larger collar ties which are set at the ends into the same masonry walls. The ceiling joists are supported at the mid-span by transverse beams that extend between the collars (Figure 73). The nave ceiling is painted on the visible face, unfinished on the reverse.

The iconostasis is one of the most important interior features of the Katholikon, screening the nave from the Sanctuary (Figure 74). It is finished with painted and faux marble and wood finishes on the principal face. The framing members in the rear are unfinished (Figure 75). The iconostasis consists of five bays with ogee arches, flanked by slender turned wood columns decorated with simple capitals. The central bay contains the "holy doors", or Beautiful Gate, and the northernmost bay contains veiled "deacon doors." One leaf of the Beautiful Gate appears to be original, or a very early replacement. The other leaf is a contemporary replacement. The architrave and arched openings of the iconostasis are formed from fret-sawn wood boards, and the architrave is capped with a simple cornice. Above the cornice the assembly is completed by a decorated wood fascia with a decorative carved scroll and a central cross.

Figure 72 **The exposed underside of the roof deck in the narthex**

Figure 73 **The ceiling structure in the nave**

Figure 74 The iconostasis at Moni Perivolis

Figure 75 The rear of the iconostasis with unfinished framing members

Figure 76 Evidence of deterioration at the cornice of the iconostasis

Woodwork and Ceiling Conditions

The ceiling elements within the church are all in serviceable condition and require no immediate intervention. However, the unfinished upper face of the flat ceiling above the nave is heavily laden with dust and debris. This material collects ambient moisture from the room, and thus may contribute to moisture-related deterioration of the wood.

The general condition of the iconostasis is serviceable, but it exhibits signs of many years of wear, in spite of generally attentive maintenance. The painted faux finishes are covered with soot, as are most of the remaining painted finishes. The unfinished framing and cladding sections on the rear face registered high moisture levels when tested. Most problematic is the base of the iconostasis where in contact with the floor. At this location evidence of insect damage was noted, and very high levels of moisture were recorded in wood elements. Minor deterioration was noted as well at the cornice level, where previous roofing failures contributed to water-related deterioration issues (Figure 76).

Additional testing of wood frames attached to the iconostasis and framed elements around the interior all registered very high moisture levels, thus supporting the hypothesis of high atmospheric moisture levels due to evaporating ground water within the building.

Wall Paintings

Every interior wall surface at Moni Perivolis contains sacred wall paintings, in a rich and diverse iconographical program (Figure 77). These wall paintings are part of Orthodox worship, and they carry dogmatic significance in their form and style. The figures depicted are ennobled and transcendental, while the scenes are removed from natural reality in order to convey timeless spiritual truth. A study of all the surviving Post-Byzantine wall paintings of Lesvos was published in 1997 in a volume by the Archaeological Society at Athens.[14] In addition to the Katholikon of Moni Perivolis, this report includes studies of the following six monuments: Moni Leimonos (including the Katholikon, the old monastic cells, the cemetery church, and the chapel of the monastic annex of Agioi Anargyroi), the Church of Agios Nikolaos in Tzithra, the Katholikon of Moni Damandriou near Polichnitos, the Katholikon of Moni Taxiarchon near Kato Tritos, the Metamorphosi Soteros (Transfiguration) Church in Papiana, and the Church of Agios Georgios in Anemotia. The last four of these monuments, along with Moni Perivolis, make up five of the twelve churches listed on the World Monuments Watch in 2008 and 2010.

At Moni Perivolis the semi-dome in the apse depicts the Theotokos enthroned, holding Christ as a child and flanked by two angels (Figure 78). In the apse, beneath the semi-dome, is Christ as the Lamb of God, flanked by St. John Chrysostom, St. Basil the Great, St. Gregory of

14 Geōrgios G. Gounarēs, *Metavyzantines Toichographies stē Lesvo* (Athens: Hē en Athēnais Archaiologikē Hetaireia, 1999).

Figure 77 View of the nave and aisle of the Katholikon of Moni Perivolis

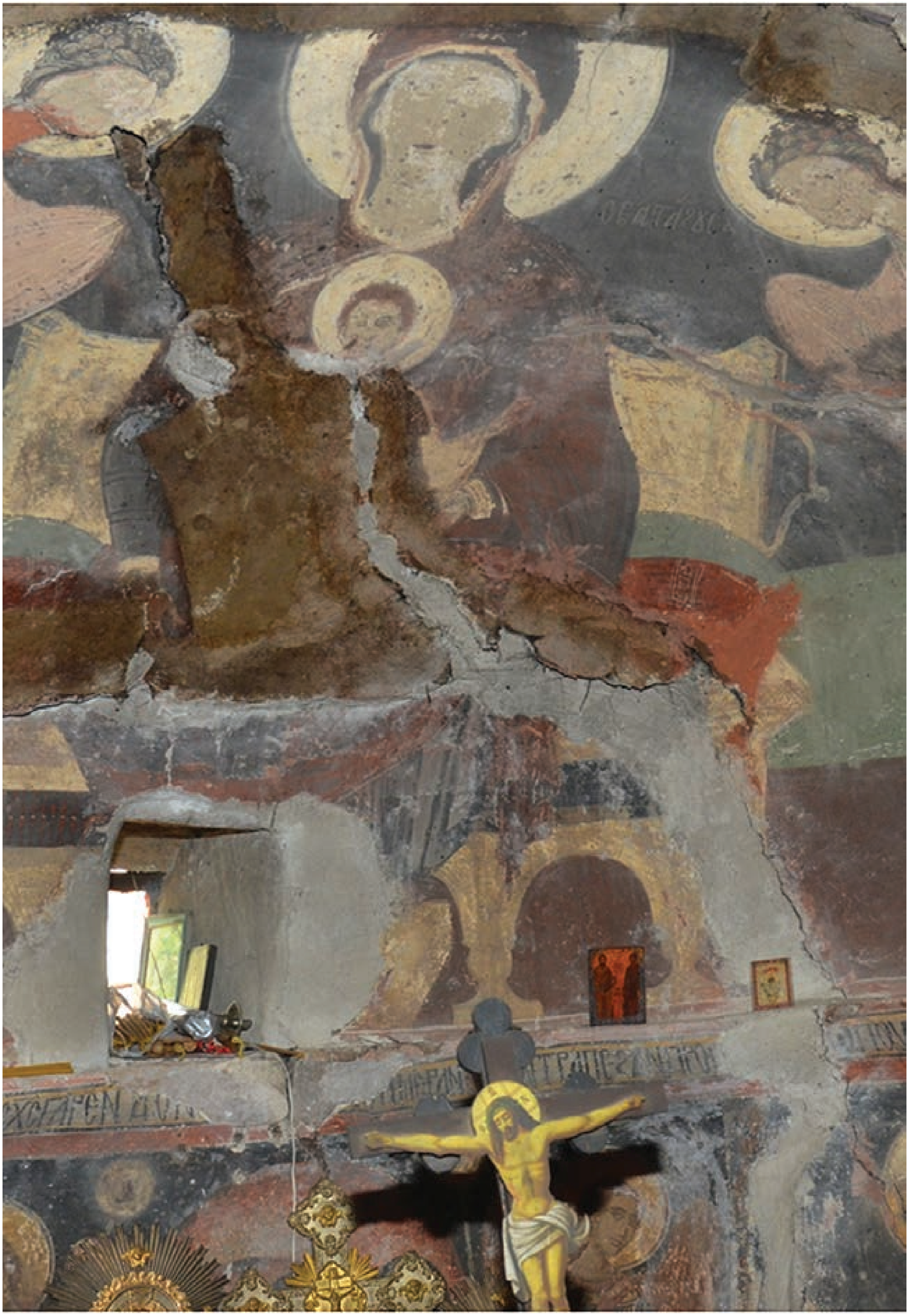


Figure 78 Wall paintings in the semi-dome of the apse at Moni Perivolis

Nazianzus, and St. Clement I (Figure 79). The prothesis niche, to the left of the apse, depicts Christ as the Man of Sorrows. The upper section of the east wall in the Sanctuary depicts the Pentecost. The side walls of the Sanctuary contain depictions of Melchizedek, the Vision of St. Peter of Alexandria, the Healing of the Blind, and the Ascension of Jesus on the north, and the Nativity on the south.

The upper registers of the north and south walls of the nave contain more scenes from the Life of Christ. On the south wall, the Nativity, inside the Sanctuary, is followed outside the Sanctuary by the Presentation of Jesus at the Temple, the Baptism of Jesus, the Transfiguration of Jesus, the Raising of Lazarus, Palm Sunday, the Last Supper, and the Betrayal of Jesus. The north wall contains the Lamentation at the Tomb, the Harrowing of Hades, the Myrrhbearers at the Tomb, the Appearance to the Myrrhbearers, the Incredulity of St. Thomas, the Healing of the Paralytic, Christ and the Samaritan Woman at the Well, and terminates with the Healing of the Blind and the Ascension of Jesus inside the Sanctuary. On these two walls, as in the long walls in the aisle, the upper and lower registers are separated by a row of saints on medallions. The lower registers contain life-size depictions of standing saints. The west wall of the nave contains, in the upper registers, the Crucifixion and the Descent from the Cross, in the middle registers, the Nativity of the Theotokos and the Entrance of the Theotokos into the Temple, and in the lower registers, standing saints.

Throughout the church are depictions of the 24 scenes of the Akathist to the Theotokos, the famous sixth century hymn consisting of 24 stanzas, each known as an *oikos*. The first eight *oikoi* are depicted in two sets of four on the intrados of the two arched openings between the nave and the aisle. The following seven are depicted in the upper registers of the west wall of the narthex, an unexpected choice given that the rest of the iconographic program in this space is almost entirely dedicated to the Second Coming of Christ. The last nine are depicted in the upper registers of two walls in aisle, six on the south wall and three on the west wall.

In the narthex, the paintings depict an imaginative vision of the Second Coming of Christ and the Last Judgment. The central composition, depicted on the east wall, has not been preserved. The south wall depicts Paradise as a verdant, walled garden. The north wall depicts personified figures of the Earth and the Sea yielding the dead, as well as the Ladder of Divine Ascent of St. John Climacus.

Extended iconographical programs like this are common in monasteries, fitting the long hours of prayer required of monastics.

It is possible to confirm that the wall paintings are not coeval with the original building. Painting over a blocked doorway on the south wall of the nave provides conclusive evidence for this (Figures 80, 81). In the opinion of the team the wall paintings—in the narthex, nave, aisle, and Sanctuary—are contemporaneous. The wall paintings were most likely executed after a significant remodeling of the building which included the addition of the narthex. It is not clear whether the earlier building remained undecorated prior to the remodeling. However, no physical evidence of an earlier scheme of paintings was found at least during this initial inspection.

In his book, Gounares implies that the wall paintings all date to the sixteenth century, but nevertheless is explicitly willing to entertain the hypothesis that the wall paintings were executed in two different campaigns. In this he agrees with an earlier study by Konstantinos Kalokyres. It has been speculated that the second campaign coincided with a 1630 repair of the building, mentioned in a seventeenth century codex. The wall paintings in the narthex would thus postdate the rest of the program by several decades.

Figure 79 St. Clement I in the apse of the Sanctuary

Figures 80, 81 Wall paintings on the south wall of the nave. Under raking light (right) a blocked doorway can be seen.

Wall Paintings Conditions

The following observations are based on a close naked-eye inspection of the wall paintings from the point of view of physical condition. As mentioned above, an iconographic and stylistic interpretation and a very brief technical discussion are provided by Georgios Gounares in *Post-Byzantine Wall Paintings on Lesvos*.[15]

The first impression on entering the church is that most of the wall paintings survive throughout the building in a relatively good condition given their great age. The paintings on the south wall of the nave are particularly well-preserved. Remarkably the wall paintings, which were painted in four registers, survive even very close to the ground level (Figure 82). The survival of large areas of non-figural dado painting near the ground level contradicts the view that ground moisture is a major factor affecting the survival of the wall paintings. Nevertheless, flooding events could have caused intermittent damage to the wall paintings in the past. Much useful progress has been made in 2011 regarding the assessment of the building fabric and its performance in its environmental context, described elsewhere in this report.

The paint layer is in variable condition, and on closer inspection various deterioration processes can be identified on many areas. The most critical problem is the lack of adhesion of the plaster in the Sanctuary (Figure 83). The severe delamination of the plaster from its support could lead to further significant loss and requires both emergency stabilization and longer-term stabilization interventions. This issue could not be investigated in 2010 because of restricted access to the Sanctuary. Permissions for conservators to undertake the work may be sought from the priest in the future.

Much of the surface is affected by a whitish or grayish surface layer, which impedes the overall legibility of the wall paintings (Figure 84). It is likely for this reason that a 1994 travelogue about Moni Perivolis published in the literary journal *Nea Hestia* described the wall paintings as "ash-gray" (τεφρόφαιες).[16] According to some community members, the wall paintings have not been clearly visible in living memory. Analysis of samples taken in the 2010 field season indicates that this obfuscating material is not a crust but rather an organic coating. The coating contains some gypsum, but not in the form of a coherent layer or crust. It is important for this coating material, and any contaminant materials to be properly identified, and to confirm whether the samples removed in 2010 are representative of the general situation throughout the building. Nevertheless, notwithstanding the problem caused for the visibility of the wall paintings, this is not the most pressing conservation issue at Moni Perivolis, as described in the previous paragraph.

Significant areas of the original plaster and wall painting are lost on the upper registers of the aisle, on the north and east walls (Figure 85). This appears to be a result of alterations or the replacement of the aisle roof. There is ongoing mechanical damage to the paint and plaster caused by the back-rests of benches and chairs, especially along the east-west walls in the nave and aisle. These have been repeatedly pushed up against the walls and have caused damage by mechanical scraping (Figure 86).

A large quantity of chaff, or chopped straw, is present in the plaster layer, a practice which has ancient origins in the region. This has led to widespread pitting in the surface of the paintings as a result of hygroscopic expansion, and this deterioration process is ongoing (Figure 87).

No evidence of dampness near the top of the interior walls as was reported in 2010 was observed. This appearance of "dampness" could have been caused by the behavior of surface hygroscopic salts, which is dependent on the prevailing Relative Humidity. In the case of nitrate salts, this would have potential implications for the conservation methodology. Alternatively, the observed dampness could have been the result of liquid water infiltration following heavy rainfall.

15 Geōrgios G. Gounarēs, Metavyzantines Toichographies stē Lesvo (Athens: Hē en Athēnais Archaiologikē Hetaireia, 1999).

16 Dēmētrēs Nikoretzos, "Stē Monē tēs Perivolēs," Nea Hestia, August 15, 1994: 1053-61.

Figure 82 On the northwest corner of the pier of the arcade, the painted surface survives to the ground without any losses.

Figure 83 Lack of adhesion of the plaster in the Sanctuary is the most critical problem facing the wall paintings

Figure 84 A surface layer covers and obscures the wall paintings, seen here on a detail of the figure of Archangel Michael, on the south wall of the nave

Figure 85 Much of the original plaster has been lost on the upper registers of the north wall of the aisle. Paint drips from painting the ceiling can be seen on the wall paintings

Figure 86 Mechanical damage to the paint and plaster on the north wall of the aisle caused by movable furniture

Figure 87 Detail of deterioration from the expansion of chaff included in the plaster

Site and Building Recommendations

The goals of this study included the assessment of conditions relevant to the long-term preservation of the Moni Perivolis structure, an analysis of the potential impact of building envelope conditions on the historic interior wall paintings, and the development of recommendations for the design of maintenance and repairs.

To assist in the conservation of both the building and the wall paintings, it is recommended that additional research be undertaken to compile a timeline for both from published, unpublished, and oral sources. These should include a chronology of historical references to Moni Perivolis, together with more recent building history, from archival material on alterations, repairs, and on the restoration and documentation of the wall paintings.

The following outlines physical interventions that can be taken to improve the condition and performance of the site and building, so as to preserve this historic structure and to ensure a stable, protective environment for the wall paintings.

Site

- Clean out all grade level drainage troughs at east site perimeter wall. Clean the main drainage trough outside of site perimeter to ensure proper drainage of site runoff. Ensure that the crawlspace beneath the dormitory building remains unencumbered with silt, soil or debris. Provide cyclical maintenance for all site drainage elements.
- Remove concrete slabs at west and north exterior entry doors, and replace with stone pavers similar to the extant courtyard pavers, to improve perimeter drainage at these locations.
- Consideration should be given to lowering the hardscape grade at the east end of the building—i.e., removing at least one, or preferably two, of the upper step levels at this location, thus removing a significant source of moisture at the walls of the apse at this location. This work should only be undertaken if it can be determined that the steps are not part of original construction, however, through archaeological investigation (See additional intervention under "Façade Walls," below).

Façade walls

- Carefully remove existing hydraulic cement from all perimeter "bench" masonry, including but not limited to seat flags, sides, ends, and at juncture with building façades. Remove, label and store all bench seat flags. Repoint all joints in stone masonry using lime-based mortar to match the original installation and the existing configuration and tooling (Appendix 2). Reset and repoint seat flags to pitch slightly to direct water from the building façades to facilitate proper drainage. Apply new limewash coating to "bench" faces.
- Fill all existing *lacunae* in façade wall masonry with lime-based mortar and apply new limewash coating to match existing.
- Remove hydraulic cement cant strips at the base of east façade wall and apse, and replace with new lime-based mortar strip.

Roofing

- Remove all broken roof tiles and replace with new tiles to match existing.
- Apply appropriate biocide to remove existing biological growth from roof tiles. Consider the installation of a sheet zinc flashing strip beneath the central ridge tiles, exposed slightly on either slope at the ridge tile ends—runoff flowing over the strip will slowly rinse tiles below with mild biocide, reducing the amount of biological growth on the roof.
- Clean, prepare and repaint iron crosses located at main roof ridge.
- Monitor roof tiles periodically to detect broken or slipped tiles. Provide repairs as necessary.
- Monitor concrete roof corbel soffit for indications of severe corrosion of the reinforcing rods. Carefully expose, clean and repaint the corroded reinforcing rods as necessary, and patch existing concrete corbels.

Doors

- Remove existing original doors separating the narthex from the nave. Remove existing paint coatings on the narthex side. Restore deteriorated original panels and replace inappropriate later panel replacements. Apply new clear finish to both faces of doors and reset in existing hardware.
- Replace the missing vertical board elements in the door on the north façade leading into the narthex (Door D2).

Windows

- Provide mortar fill or paintable sealant at all gaps at window frame perimeters that have lost mortar. Where hydraulic cement has been used as filler, remove and replace with lime-rich mortar and apply new lime wash coating.
- Replace all broken or missing window glass.
- Replace glazing compound on all windows and repaint windows to match existing color.
- Document and remove Window W2 in apse wall. Replace with appropriate operable wooden frame and casement sash window.
- Monitor all wooden window opening supports for insect infestation. Treat as necessary.
- Ensure that casement sash in all windows is properly operative, and that all hardware operates properly.

Flooring

- Remove carpets that are presently left on the floor in the Sanctuary and store until they are needed, to prevent continual "wicking" of moisture into the absorbent material from the floor and to alleviate general moisture retention.
- Replace all broken floor tiles with new tiles that replicate the existing.
- Install floor tiles on appropriate substrate at all areas where soil is exposed.
- In general, flooring tiles are set on a clay and sand substrate, which is subject to moisture-related expansion and contraction. Consideration should be given to re-flooring the interior: removing all floor tiles and the concrete floor section in the Sanctuary; resetting the existing and new floor tiles on new appropriate substrate, placing the historic floor tiles in areas that receive lesser amounts of foot traffic.

Woodwork

- Remove all debris and dust from the upper surface of the nave ceiling, to eliminate moisture retention.
- Apply a clear non-glossy finish to the rear unfinished face of the *iconostasis* elements to reduce absorption of atmospheric moisture.
- Apply liquid borate solution to bottom portions of iconostasis elements in contact with ground to eliminate possible insect and biological deterioration. Insulate any elements in contact with ground (see "Flooring" section).
- Monitor all wooden elements at interior for insect infestation on periodic basis.

Other

- Install temperature and humidity monitors within the church to determine annual humidity and temperature fluctuations (see: Environmental assessment and monitoring under Wall Paintings Recommendations).
- Provide stands or bases of moisture impervious material to support all paintings and other art work presently resting on the floor, to prevent moisture-related damage.
- Provide temporary ventilation to ensure air movement within the nave and the Sanctuary; this can be accomplished with portable fans, etc., set in window openings.

Wall Paintings Recommendations

As noted previously, additional research and assessment are required to develop a detailed conservation program for the wall paintings. The preliminary objectives for such a program, subject to change as work progresses, include the emergency stabilization of all areas of loose plaster, an assessment of the original technique and present condition of the paintings, identification of past and current causes of deterioration, and the development and implementation of preventive and remedial interventions to ensure the long-term preservation of the wall paintings. The program should be iterative in its approach to the conservation of the site, building, and wall paintings, rather than linear or predetermined. At the end of this section a phased campaign is outlined.

Preparation for documentation

An important consideration prior to any future detailed survey of the wall paintings is the creation of base maps for graphic documentation. All documentation, including notes about technique, condition mapping, sampling locations, and test areas can be added to this structure.

It is preferable to use digital base maps, created from accurately scaled interior elevations with rectified wall photographs. The drawings of the building produced by the students in 2011 provide an excellent basis for these base maps (Appendix 1). Marking the conditions of the wall paintings to accurately scaled base maps will produce the first quantifiable data about deterioration and conservation needs. A simpler and less costly alternative is to use printed photos or photocopies, and to overlay those with acetate sheets or tracing paper. Nevertheless, accurately scaled interior elevations allow for the calculation of the surface area of a phenomenon, for estimating materials, labor, and time requirements for conservation, and for quantifying the amount of change that takes place by repeated mapping over a period of time. If this, preferable, method is used, it is advisable to map onto hard copies of the digital base maps, which can be digitized at a later time. In this way, an original hard copy record of the documentation is preserved, which is not the case with direct digital mapping (for example, using a laptop in the field).

Survey of original materials and technique

The material composition and characteristics of the wall paintings at Moni Perivolis must be known in order to guide the selection of conservation methods and materials. It is otherwise impossible to understand and predict the chemical and mechanical sensitivity of those centuries-old wall paintings. While it is sensible to consult the available conservation literature on similar Post-Byzantine wall paintings, this is not a sufficient basis on which to formulate a campaign of remedial treatment, or even to conduct cleaning tests in the field. We can see from a casual inspection that the artists varied in their selection of pigments and usage of preparatory techniques, for example, from the narthex to the nave. Therefore, even within the paintings at Moni Perivolis there is sufficient variation that may have a significant bearing on the choice of appropriate conservation materials and methods for their application. Without a proper understanding of the type, condition, and distribution of these materials (whether original, added, or altered), it is not possible to predict their response to mechanical cleaning, high or low pH, or aqueous or solvent treatments.

Likewise, depending on the treatment requirements, from grouting to aqueous cleaning, it would be prudent to acquire some qualitative and quantitative information on the types, amount, and distribution of soluble salts present in the paintings and in the walls. Prior to any future cleaning tests to remove or reduce the obfuscating veil or crust it is important for the material composition to be identified –if possible– and characterized. Some insight has been gained from the analysis of samples removed from Moni Perivolis in 2010, which is described in Appendixes 5 and 6. The requirement for further sampling in situ may arise during these subsequent investigations, particularly in respect to soluble salts and specific pigments that are not found in the extant samples. Permissions would need to be sought from the relevant authorities based on the production of a sampling strategy document outlining the technical questions and ethical justification for taking each sample, the size and location, and the type of analysis to be performed.

The survey should be supplemented with a visual glossary. The findings of this survey will also help to inform future scholarship in art history.

Condition survey

Similar to the original technique survey, the undertaking of a detailed condition survey is a prerequisite for determining further conservation interventions and for their sequencing. For example, the severe delamination of plaster in the Sanctuary needs to be assessed as a matter of urgency. The condition survey should be supplemented with a visual glossary.

There are two main avenues for non-invasive investigation of conditions:

- Environmental diagnostics (for example: Infrared Thermography).
- For original technique and condition surveys, imaging and non-invasive analysis to provide information on the painting techniques and materials, added and altered materials and their condition (imaging techniques, for example: UV fluorescence, IR Reflectography, False-Color IR, video microscopy; analysis techniques, for example: UV-VIS, XRF, FTIR).

These non-invasive techniques can be very useful to map phenomena, to provide initial indicators of surface or near-surface materials or characteristics, and, importantly, to inform sampling strategies. A great deal of relevant information is concealed from these techniques within the stratigraphy of the wall painting. Hence there is a need for invasive sampling and analysis to obtain this information.

Sampling and analysis

The material composition and characteristics of the wall paintings at Moni Perivolis must be known in order to guide the selection of conservation methods and materials. It is otherwise impossible to understand or predict the chemical and mechanical sensitivity of the centuries-old wall paintings. This requires the general characterization and identification of the original material composition of the individual layers of the wall painting stratigraphy, and any added or altered materials which may be present, such as salts or microorganisms. In addition, the composition of the obfuscating coating over the paintings should be identified, assuming that the material is present in sufficient quantity on available samples.

Based on the findings of the 2011 campaign, samples removed in 2010 were sent to Dr. Christine Bläuer for the following additional analyses:

1. A careful examination and description of the samples using a binocular microscope.
2. Further analysis using polarized light microscopy (e.g. in dispersion), microchemical tests, and FTIR analysis on microscopic particles of selected component materials (binder, pigment particles, possible salt crystals etc.) to provide further information on the inorganic and also organic components present.

The complete scope and rationale for the above analyses are detailed in Appendix 5, and the findings are presented in Appendix 6. On the basis of these initial findings, additional questions now arise. It might be necessary at a later stage to commission further analyses employing more sophisticated analytical techniques, particularly in respect to any organic components of the paintings (e.g. binders, additives, coatings), but perhaps also of the inorganic materials. For example, ion chromatography might be used to provide qualitative and quantitative data on any soluble salts which may be present; XRF, HPLC, etc. might be employed for the organic analysis and pigment analysis insofar as they are present in the samples.

Environmental assessment and monitoring

It would be useful to gain more information on the interior microclimate, and on the moisture content of the building materials, to complement the visual survey and surface moisture observations made in 2011. A phased environmental assessment would provide important information to assist in decision-making about the type and sequencing of preventive and remedial actions at Moni Perivolis, and would provide data that enable the efficacy of these actions to be assessed.

A modest monitoring program would ideally collect Relative Humidity and temperature measurements from the exterior and three locations in the interior (narthex, nave, and Sanctuary) for one year or longer. Nevertheless, even a shorter monitoring period would be preferable to collecting no data at all.

A further step would involve the examination of the walls through core-sampling from the exterior. This would provide very accurate information about the water content and its distribution through the thickness of the wall, and about salts present inside them. By repeating the core sampling over a period of time, especially following interventions to the building as described in Appendix 3, it is possible to accurately measure long-term changes on the water content. Without this supplementary information one is forced to rely on indirect indicators or, at worst, guesswork. The removal of these samples from the exterior would not damage the paintings, but it would be invasive and is not always feasible for rubble walls.

Art historical research

A fresh art historical assessment underpinned by any new technical evidence gathered from a hands-on survey would be useful and could add further insight to the substantial work of the late art historian Georgios Gounares on the iconography and style of Post-Byzantine wall paintings on Lesvos. These new insights can better inform us about questions such as the number of artists who worked at Moni Perivolis and the materials that they used. It would be preferable to include other churches with Post-Byzantine wall paintings on Lesvos, to provide comparative examples and to investigate the activity of workshops and individual artists across the island during this period. This would improve our understanding of the paintings at Moni Perivolis and in the wider context of Post-Byzantine wall painting on Lesvos and beyond its shores.

On these questions, Gounares has suggested that the wall paintings were executed by two experienced and skilled artists, positing that both painters worked together in the nave and the aisle, with one of the two being solely responsible for the work in the narthex. He saw no connection with wall paintings in other churches on Lesvos, and suggested that the artists were itinerant painters who possibly originated from the region of Macedonia. Much more remains to be learned about these intriguing questions and hypotheses.

Phased conservation program

The following steps outline a possible route towards achieving the conservation objectives described above. A number of tasks should ideally be instigated or accomplished in advance of Phase 1, the first major field campaign. These various preliminary tasks are grouped together under Phase 0, and should commence as soon as possible. The phased structure is based on yearly field campaigns. If sufficient funds are available, it may be preferable to undertake two campaigns per year, to promote continuity and to allow for closer monitoring of the wall paintings.

Phase 0—*Preparation of a conservation program proposal*

- **Conservation program proposal:** A preliminary stage is the preparation of a conservation program proposal for the wall paintings at Moni Perivolis. This would set out the various elements and a schedule for the phased program. The proposal should set out the interdisciplinary requirements for the conservation team and include the wall paintings, and their host building and site in its scope.
- **Base map documentation:** A rectified photographic base map needs to be prepared, on which all future graphic documentation will be mapped. This would need to be undertaken by members of the conservation team in advance of, or as part of, Phase 1. (See above: Preparation for documentation)
- **Environmental assessment and monitoring:** A liquid moisture survey and the installation

of an environmental monitoring system should be undertaken in advance of, or as part of, Phase 1. The environmental assessment could include core sampling to provide information on the moisture content of the walls, and qualitative and quantitative analysis of the salts and their distribution in the walls. (See above: Environmental assessment and monitoring)

Phase 1 (Year 1)—*Emergency intervention and detailed technical surveys of the wall paintings*

As stated above, the initial focus of a wall paintings program must be the stabilization of the plaster in the Sanctuary, above all other considerations. This requires preliminary emergency stabilization (edging repairs and facing), in advance of tests for grouting and the implementation of a grouting methodology for the Sanctuary and other locations in the building, if required. A further objective of Phase 1 will be to gather sufficient information to allow clear objectives for the subsequent conservation campaign to be formulated and followed up at later stages. In other words, refining and changing *mutatis mutandis* the provisional outline set out below. The elements should include:

- Emergency facing and repairs (for example in the Sanctuary using the minimal intervention necessary to stabilize the plaster)
- Art historical research (ongoing in future phases if required)
- Documentation
- Video microscopy
- UV Fluorescence imaging
- Original techniques and materials, added and altered materials survey (Including a non-invasive survey)
- Condition survey
- Sampling and follow-up analysis
- Environmental assessment and environmental monitoring
- Grouting, fixing, consolidation test, and small-scale mechanical cleaning tests

Following sample analysis and the initial mechanical cleaning tests, further chemical tests for reducing or removing the gray coating can be undertaken from Phase 2 onwards.

Phase 2 (Year 2)—*Testing*

- Further emergency treatment, if required
- Develop conservation strategies on the basis of Phase 1 findings (including preventive, passive measures, and testing for remedial treatments)
- Documentation and condition monitoring
- Test areas (grouting, fixing, consolidation, and possibly cleaning tests)
- Video microscopy and other imaging
- Sampling and follow-up analysis
- Environmental assessment and environmental monitoring

Phase 3 (Year 3, if required)—*Assessment of testing in Phase 2*

- Further emergency treatment, if required
- Further testing, as required
- Sampling and follow-up analysis
- Documentation and condition monitoring
- Environmental assessment and environmental monitoring

Phase 4 (Year 3 or 4)

- Larger-scale interventions, as required
- Sampling and follow-up analysis
- Documentation and condition monitoring
- Environmental assessment and environmental monitoring
- Devise maintenance plan

Phase 5

- Implement maintenance plan
- Determine requirements and intervals for future condition monitoring
- Environmental assessment and environmental monitoring, if required

Other Historic Churches

Agios Andreas Early Christian Basilica in Skala Eresou

Most of the Early Christian remains on Lesvos are found in and around Eresos and Mytilene, two of the ancient cities on the island. The Early Christian Basilica of Agios Andreas in Skala Eresou, the modern city at the site of ancient Eresos, dates from the first half of the fifth century (Figure 88). The original dedication of the church was changed in the eighth century to Andrew (Andreas) of Crete, a bishop who died en route from Constantinople to Crete and was buried at this site on Lesvos. The ruins of the ancient basilica are located to the east of the modern Agios Andreas church, which was constructed in 1936-52.[17] The ruins and the mosaic floor, the oldest on Lesvos, were first rediscovered in the late nineteenth century.

The rectangular plan consists of a narthex, a wide nave with flanking aisles, and the Sanctuary, which terminates in a single circular apse. The mosaic floor occupies the narthex and the nave and contains antique geometric motifs, epigraphs, and figures of peafowl, popular in Early Christianity (Figures 89, 90, 91).

Condition and recommendations

Portions of the nave and narthex walls and foundations remain intact, while little evidence of the apse and aisles exists. But it is the remnants of the richly detailed mosaic floor, with tesserae in seven colors, that give this site much of its significance. A conservation campaign took place in the 1960s, during which most surviving mosaic fragments were removed, embedded in cement slabs, and repositioned in place. This irreversible intervention has resulted in many conservation problems for the mosaic. An excavation and preliminary conservation campaign took place in 1999-2001, during which many of the problems began to be addressed. A study for the conservation of the mosaic floor was conducted by the 14th Ephorate of Byzantine Antiquities at that time.[18]

The site would benefit greatly from the construction of a shelter to protect the floor mosaic from future deterioration. Further remedial action should include the construction of a walkway and viewing platform at the perimeter of the basilica to protect the mosaic floor from abrasion from visitors' footsteps. It should also be noted that the archaeological museum next door is about to open, suggesting an increased tourist presence at the site in the near future and further emphasizing the need for protection of the fragile mosaic.

Additionally, trenches for investigative probes have been dug adjacent to the above-ground remains, and have not since been infilled (Figure 92). These openings retain water on the site and adjacent to the structure, and should be filled. At the time of the visit, the ground at the site was damp, and it is possible for the moisture to interact with the adhesive used to stabilize the mosaic and result in the development of the dark-colored biological growth that can already be seen in some locations.

The ground at the site is damp and is penetrating the slab. This moisture is interacting with the adhesive used to re-set the tiles, resulting in the dark-colored biological growth in areas. Lastly, artifacts from the site have been displaced in the school yard across the street.

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17 Iakōvos G. Kleomvrotou, *Mytilena Sacra, vol. 2: Naoi—Keimēlia (A-M)* (Thessalonikē: [Iakōvos G. Kleomvrotou], 1974), 165-70.

18 Ēlias Rokos. *Meletē Syntēresēs Psēphēdotou Dapedou Hag. Andrea Skalas Eresou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn).

Figure 88 View of Agios Andreas Early Christian Basilica from the South

Figure 92 Trenches on site adjacent to existing nave walls that retain water

Figures 89, 90, 91 Geometric motifs, epigraphs, and figures of peafowl have been preserved in the floor mosaic

"Afentelli" Early Christian Basilica near Skala Eresou

The "Afentelli" Basilica is an Early Christian site located west of Skala Eresou, at the foot of a large hill. It is known by the name of its locale (Afentelli), because its dedication is unknown. It is thought to date from the second half of the fifth century. The site was first excavated in 1928, and a second campaign took place in 1981-82.[19] During the second campaign the mosaic floor was removed, with very little documentation. The 14th Ephorate of Byzantine Antiquities documented this monument again after 2001. Little evidence of the building remains above ground (Figure 93). The T-shaped plan originally consisted of a long narthex, a wide nave with flanking aisles, and the sanctuary with flanking pastophories, while evidence of earlier construction phases has also been found. Extant marble fragments contain carvings like six-petalled rosettes or crosses.

Condition and recommendations

The site has yielded important archaeological information, but it is today overgrown since the last field campaign (Figure 94). Previous work at this site has concentrated on the safeguarding and conservation of the highly significant mosaic.

Exposure of the site to the elements is taking a toll on the remaining fragments. Marble pieces are deteriorating from exposure to airborne acidity (Figure 95). Some stones have become colonized by lichen (Figure 96). The metabolic processes of lichen produce acidic substances that break down the marble matrix, leaving the crystalline structure friable. Lastly, the architectural fragments are protected from the access road only by a low chain-link fence and face the risk of vandalism and theft.

Reburial or construction of a shelter have been proposed for this site. Both options will require technical expertise and material resources, and will need to be properly evaluated and designed.

Figure 93 View of the remains of the Afentelli Basilica from the East

19 *Archaiologikon Deltion*, 36 B2 (1981): 362-65.

Figure 94 Overgrowth at the site surrounding the architectural fragments

Figure 95 Marble block showing erosion and rounding

Figure 96 Marble column base with lichen growth

Agios Stephanos Church near Mantamados

Agios Stephanos is one of few surviving Byzantine churches on Lesvos, and one of the most important monuments on the island. It is located a short distance away from the town of Mantamados, near a small coastal settlement, and it is surrounded by an olive grove (Figure 97). The church was built out of rough blocks of the red volcanic tuff stone that is prevalent throughout Lesvos. It has a Greek-cross plan and a triconch east end. The original building was enlarged through the addition of a narthex, and a large porch was added closer to the present (Figure 98). This recent addition provides a large sheltered seating area in front of the entrance to the church. The north, south, and west façades are characterized by large blind arches and small wall openings. The original dome and parts of the adjoining vaults collapsed prior to the middle of the nineteenth century, and the openings were later inexpertly reroofed.

A study for the stabilization, restoration, and presentation of the monument was completed by an independent researcher for the 14th Ephorate of Byzantine Antiquities in 2010.[20] The author is able to date the church to the tenth century based on the morphology of the Sanctuary. Its antiquity makes Agios Stephanos an important link in the surviving historic record for the island. The scarcity of surviving Byzantine era churches on Lesvos has puzzled historians, and a satisfactory explanation has not yet been offered.

Condition and recommendations

The recently completed restoration study is very thorough and amply documented. Its phased implementation will benefit the church and the small nearby community that it serves today. The rest of this section describes observations made during a visit on 24 June, 2011 that corroborate the findings of the 2010 study.

Historic collapses and hasty repairs have resulted in displacement of structural elements and misalignment of the roof structure of the church. In addition, today most of the roof tiles are aged and deteriorating. For the roof, the 2010 study recommends reconstructing the arches and vaults along the arms of the Greek-cross plan and restoring the preserved pendentives, but without reconstructing the collapsed dome.

Located at an exposed coastal site in the North Aegean, the church has always been threatened by the elements. Today, the church has lost its exterior plaster finish, evidence of which can still be seen on the west façade, which is better protected by the porch. The loss of exterior plaster has revealed the underlying masonry structure and exposed the binding mortar, which has suffered considerable erosion. Some voids and cracks can be detected on the exterior, and the 2010 study recommends repairing them locally and also stabilizing the walls through mortar injection. Plant growth on the exterior also now threatens the building, since the roots of plants can widen joints and fracture masonry (Figure 99). To protect the openings of the church, Plexiglas has been installed over the unglazed and unshuttered windows of the triconch (Figure 100).

Interior walls are finished with a thick plaster coat, which follows the pattern of the underlying masonry. The author of the 2010 study noted a painted plaster fragment in the prothesis niche inside the sanctuary. The existence of surviving wall paintings hidden behind the plaster layer would need to be properly investigated. Localized failure of plaster suggests water intrusion from the exterior, which these repairs will arrest (Figure 101). The undersides of the vaults that survived the collapse have also lost most of their plaster, facilitating water infiltration into the building through the roof. Soot staining from oil lamps presents an aesthetic problem. In addition, the interior has become home to swallows and wasps (Figures 102, 103). These last three problems can be remedied by routine maintenance. Even if these are neglected, they do not pose a serious threat to the integrity of the church building.

Some recommendations for further study include carefully removing the interior plaster to complete the assessment of the condition of the masonry structure, as well as excavating along the north wall in order to ascertain the need for drainage improvements or for reinforcing the foundation. Lastly, the author of the study recommends reconstructing the front porch using a self-supporting design instead of leaning on the front of the church.

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20 Maria K. Tsitimakē, *Meletē Stereosēs & Anadeixēs Vyzantinou Naou Hagiou Stephanou ston "Palio" Mantamadou Lesvou* (Athens, 2010).

Figure 97 Agios Stephanos Church from the East

Figure 98 Agios Stephanos Church from the North

Figure 99 Plant growing on the north apse of the triconch

Figure 100 Plexiglas installed over unglazed window

Figure 101 Spalling plaster on the north wall of the church

Figures 102, 103 Swallow and wasp nests in the interior of Agios Stephanos

Katholikon of Moni Taxiarchon near Kato Tritos

One of the best-preserved Byzantine churches on Lesvos, the Katholikon of Moni Taxiarchon is located at a high elevation above the village of Kato Tritos, overlooking the Gulf of Gera (Figure 104). It is a compact domed church, built to a rectangular plan with dimensions of 6.5 × 4.5 meters (22 × 14 feet). The church is thought to have been a monastery katholikon, and in the surrounding area remnants of stone walls indicate the limits of the monastery complex. The walls are constructed of rubble stone set in a small amount of mortar. A small dome is supported on a drum pierced by five narrow windows. The dome and the gable roof are covered with red terra-cotta tiles. A small window in the apse of the church is the only opening in the walls of the building, but because of its exposed location the interior is very bright. Exterior structural repairs were completed in the first half of the twentieth century, when four buttresses were added on each of the north and south walls to reinforce the structure.

The interior of the church was adorned with wall paintings from three different campaigns, the earliest of which is thought to have dated to the Byzantine era.21 Gounares dates the second layer to the last thirty years of the sixteenth century, and the third layer to the seventeenth century. Today only a fraction of the third layer survives, in very poor condition, despite recent efforts to clean and consolidate the wall paintings (Figure 105). Gounares estimated that a scant fiftieth of the original painted surfaces has survived. Based on stylistic similarities and on their shared patronage by the same bishop, Gounares speculates that the second layer of wall paintings at this church and the wall paintings at the Katholikon of Moni Damandriou and at the Metamorphosi Soteros Church were all painted by the same artists.[22]

The monastery was traditionally thought to have been abandoned in the wake of the Ottoman conquest of Lesvos in 1462. Nevertheless, the presence of subsequent layers of wall painting and an iconostasis that has been dated to the sixteenth century suggest that the church remained in use in the Post-Byzantine period.[23] During the 1930s the iconostasis was removed to the Ecclesiastical Byzantine Museum of Mytilene and the surviving wall paintings were stabilized for the first time.

Condition and recommendations

Today, the exterior walls are in very good condition, even though the church was reported to be in a poor condition in recent years. A possible cause of interior degradation is suggested by substantial cracks that can be seen in the interior, but have been repaired on the exterior, indicating a past means of water ingress. Other moisture-related problems may originate from landscaping around the church, which is watered from a hose that is directly attached to the building (Figure 106).

Nevertheless, there are interior conditions in need of attention. This can be partly attributed to previous interventions. Some of the major issues include unrepaired voids in the masonry (Figure 107) and hydraulic cement patches (Figure 108), which should be appropriately repaired. The wall paintings have also suffered greatly, and stabilizing facings applied to them have not been removed (Figure 109).

Fragments of paint and evidence of earlier flooring suggest a history warranting further investigation.

21 Iakōvos G. Kleomvrotou, *Mytilena Sacra, vol. 2: Naoi—Keimēlia (A-M)* (Thessalonikē: [Iakōvos G. Kleomvrotou], 1974), 231-35.

22 Geōrgios G. Gounarēs, *Metavyzantines Toichographies stē Lesvo* (Athens: Hē en Athēnais Archaiologikē Hetaireia, 1999), 199.

23 Kleomvrotou, *Mytilena Sacra, vol. 2*, 231-35.

Figure 104 View of the church from the South with the Gulf of Gera in the background

Figure 105 Christ Pantocrator in the dome of the Katholikon of Moni Taxiarchon, part of the third layer of wall paintings

Figure 106 A spigot is attached to the exterior

Figure 107 Void in the masonry

Figure 108 Inappropriate repairs using cement

Figure 109 Wall paintings stabilized using fabric

Katholikon of Moni Damandriou near Polichnitos

Moni Damandriou is a small monastery near Polichnitos, a town on the east of the Bay of Kalloni. It is not known when the monastery was established, but it is thought that it originally formed part of a small village of the same name, references to which survive in archives in the region. The earliest reference to Moni Damandriou dates from the middle of the sixteenth century. The Katholikon is dedicated to the Dormition of the Theotokos. It was built out of stone into the hillside on a terraced site, and it has a gable roof (Figure 110). The rectangular building has dimensions 10 × 4.5 meters (33 × 15 feet) and consists of a narthex, a nave without aisles, and the Sanctuary. The exterior is today covered with stucco. The entrance to the church is centered on the west façade and is raised to the elevated interior floor level. It is accessed by a symmetrical double stairway, with a sacred spring at its base.

The monastery became defunct in the nineteenth century and was used for other purposes, but it has been reconstituted in recent years. It is now open to visitors, and it operates a small museum. The church underwent an extensive restoration in 2009-2010. The work was commemorated with a re-opening ceremony in August 2010.

The narthex has a flat wood ceiling and plastered walls, with a painting of Saint George on the south wall. More wall paintings survive in fragments in the nave, especially on the west wall (Figure 111). The wall paintings were first uncovered from beneath layers of plaster in the 1930s, when an early restoration campaign took place. Many of the wall paintings had been defaced in historic times, and subsequently covered with plaster. Based on their style, Gounares dates them to the second half of the sixteenth century.[24] As mentioned above, Gounares has speculated that the second layer of wall paintings at the Katholikon of Moni Taxiarchon and the wall paintings at the Metamorphosi Soteros Church were painted by the same artists who worked at Moni Damandriou.[25] At the east end of the nave, an intricately carved wood iconostasis separates the nave from the Sanctuary (Figure 112). It is thought to be a composite of fragments from abandoned nearby churches. The iconostasis is divided into five bays, two with openings leading to the Sanctuary and three which contain large icons. Wall paintings inside the Sanctuary are visible over the top of the iconostasis.

Condition and recommendations

During the recent restoration a trench was dug around the perimeter of the east end of the church, creating a physical separation between the church and the hillside (Figure 113). Prior to this intervention, seepage from a spring in the inclined hillside created a severe moisture problem in the interior of the church. Now, a perimeter channel allows water to drain properly and the walls to dry thoroughly.

A dehumidifier has also been installed to further alleviate interior moisture problems. Water from the dehumidifier is drained to the nearby spring through a new piping system. It is very important to note that the use of dehumidifiers can be very dangerous for wall paintings, since excessive drying can often trigger salt crystallization. The appropriateness of this device for the interior of the Katholikon of Moni Damandriou should be further investigated.

At the same time as the building restoration, the wall paintings were cleaned and possibly varnished. The edges of the wall paintings were stabilized with a pink plaster, while the rest of the wall surfaces were covered with plaster in a light brownish gray color. The iconostasis, which had been completely painted black, was also restored. The black paint was removed in order to reveal the wood's intricate carved details and applied colors (Figure 114).

The new stalls, or *stasidia*, along the walls are raised on stone bases to protect from moisture, and have been pulled a short distance away from the walls so as not to touch and damage the wall paintings (Figure 115).

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24 Geōrgios G. Gounarēs, *Metavyzantines Toichographies stē Lesvo* (Athens: Hē en Athēnais Archaiologikē Hetaireia, 1999), 83.

25 *ibid.*, 199.

Figure 110 View of the Katholikon from the West

Figure 111 Interior of the Katholikon with surviving restored wall paintings

Figure 112 View of restored iconostasis

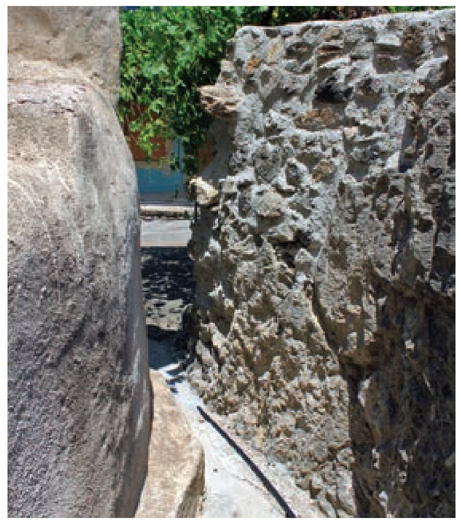

Figure 113 Separation trench between the east side of the church and the adjacent hillside

Figure 114 Detail of the iconostasis

Figure 115 Stasidia have been carefully positioned not to touch the wall paintings

Metamorphosi Soteros (Transfiguration) Church in Papiana

The Metamorphosi Soteros, or Transfiguration, Church is located in Papiana, a small settlement near the coast of the Bay of Kalloni. A long and narrow rectangular building, with dimensions of 16 × 5 meters (52 × 16 feet), the church sits within a large shaded courtyard (Figure 116). It is located at a lower grade than the ground in the courtyard and it is surrounded by a sunken walkway of stone pavers. The building is built out of stone and has a simple gable roof, although it is possible that the roof was originally vaulted. The church is entered through two doors on the long, south side, one leading into the narthex and one leading directly into the nave. The narthex and the nave are separated by a low wall. A painted iconostasis defines the Sanctuary, which terminates in a single apse. The iconostasis sits on the stone pavers of the Sanctuary, several inches above the main floor. Painted a red-orange, it is divided into five bays. According to a painted inscription, the church was built in 1600 (Figure 117).

The interior surfaces of the walls were painted (Figure 118). In general, a wide band at the top and bottom of the walls has been lost. According to Gounares, the iconography includes saints who are not commonly depicted in religious wall paintings in Greece.[26] As was mentioned previously, Gounares has hypothesized that the same artists were responsible speculates that the second layer of wall paintings at the Katholikon of Moni Taxiarchon and the wall paintings at the Katholikon of Moni Damandriou were painted by the same artists.[27]

Condition and recommendations

Recently many repairs and replacements have taken place at the Metamorphosi Soteros Church. These include the replacement of the roof after a partial collapse. Between 2010 and 2011 the walls were repointed using a traditional lime and sand mortar and a stucco frieze, measuring roughly 50 centimeters (20 inches) high, was added. In addition, the old wooden doors were replaced. During these works, the wall paintings were covered and shored using timbers, which have since been removed.

Over time the wall paintings have been stabilized through the application of a facing material on the painted surface. Many of these remain, as conservation work on the wall paintings has progressed over the years. In addition, the wall paintings have been edged and varnished.

Not all of these recent interventions are successful. The roof was replaced using modern terra-cotta tiles, but without adding a waterproof membrane. Modern wooden doors with shiny new hardware were substituted for the original doors. The new doors are incompatible with the aesthetic of the historic exterior. The old olive wood doors are leaning against an exterior wall, uncovered and unprotected. Repair patches have been applied to the façade masonry using hydraulic cement, most problematically at the entrance. In addition, issues of maintenance warrant action. In the sunken walkway surrounding the church, for example, leaves and other debris are collected that can potentially contribute to water retention on the site (Figure 119).

It is highly recommended to remove the hydraulic cement and replace it with traditional materials. A waterproof membrane should be added to the roof, and, when possible, the roof tiles should be replaced with a more historically accurate kind, of appropriate size and shape. The sunken walkway around the church should always be kept clear of debris. Lastly, the recently removed doors should be stored properly as evidence of traditional craftsmanship and of the history of the building.

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26 Geōrgios G. Gounarēs, *Metavyzantines Toichographies stē Lesvo* (Athens: Hē en Athēnais Archaiologikē Hetaireia, 1999), 151.

27 *ibid.*, 199.

Figure 116 The long south façade of the Metamorphosi Soteros Church

Figure 117 Painted inscription over the entrance to the church

Figure 118 Detail from the Pentecost on the east wall of the Sanctuary at the Metamorphosi Soteros Church

Figure 119 Leaves in the sunken walkway contribute to water retention near the church

Agios Georgios Church in Anemotia

Once the main church for the village of Anemotia, the seventeenth century Agios Georgios Church is located off the main square of the village, in a leafy courtyard (Figure 120). The building consists of a single nave and has dimensions 12.5 × 5.5 meters (41 × 18 feet). The walls were constructed with rough volcanic rocks and a lime mortar, and the east wall has been reinforced with battering on the exterior. A covered porch in front of the entrance to the building is supported on rough-hewn timbers with visible saw marks (Figure 121). The timber shows evidence of insect infestation, which, nevertheless, does not appear to be ongoing. The building is surrounded by a concrete walkway at its base (Figure 122).

The interior walls are covered with wall paintings. According to Gounares the wall paintings were executed in two campaigns, the second of which is dated by a painted inscription to 1702. Evidence of earlier wall paintings dates the church to the first half of the seventeenth century. The iconographic program includes a cycle of scenes from the life and martyrdom of Saint George, to whom this church is dedicated. A painted wood iconostasis raised on a soleas separates the Sanctuary from the nave.

Condition and recommendations

The roof of the building has been recently replaced and appears to be functioning adequately. According to a 2000 study for the conservation of the wall paintings the roof was then in a "miserable" condition, with gaps in the roofing that were visible from the interior.[28] Skylights have been inserted in the roof, but it was impossible to determine whether they are water-tight. Today, there remains evidence of rising damp on the interior, which likely fosters the insect infestation on the woodwork. Contributing to the rising damp is the presence of the hydraulic cement walkway immediately adjacent to the building perimeter. Evidence of backsplash is visible at the bottom of the stone walls (Figure 122). In addition, the exterior walls have been repointed using hydraulic cement. It is recommended that the perimeter walkway be removed to diminish these water-related problems and that the walls be repointed using a traditional mortar.

The paintings in the Agios Georgios Church are obscured by a "milky" veil that creates a similar effect to that seen at Moni Perivolis. Strips of fabric have been widely employed as a temporary stabilization method (Figure 123). As at Moni Perivolis and other sites that were visited, the wall paintings have been damaged over time by abrasion from seating furniture (Figure 124). Deterioration was partly allowed for at Agios Georgios by way of a tall non-figural zone painted to imitate marble cladding, but today this zone should also be protected. Today the north and south walls are lined with newer stalls, which again threaten this zone. The stalls should be positioned at a distance from the wall, as they have been at the Katholikon of Moni Damandriou.

28 Iōannēs Verroiopoulos, Konstantinos Nikakēs, and Vasileios Panagiotopoulos, *Meletē Syntērēsēs Toichographiōn I.N. Hagiou Georgiou Anemotias Lesvou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn, 2000).

Figure 120 Agios Georgios Church from inside the courtyard

Figure 121 Underside of the covered porch

Figure 122 A concrete walkway surrounds the building

Figure 123 Strips of fabric are used to stabilize the wall paintings

Figure 124 Evidence of damage from seating furniture

Agios Nikolaos Church in Petra

The Agios Nikolaos Church in Petra is a low-rise building with a single nave. It rests on a site that is sunken below the surrounding churchyard. The main entrance is on the west façade, slightly off center, with two arched window openings in the gable above. In the last few years the church has been under restoration (Figure 125). The stone masonry of the exterior was repointed using a lime-based mortar with brick dust inclusions. In June 2011, work was underway to replace the roof. The roof tiles had been removed and deteriorated timber rafters and decking planks had been replaced (Figure 126). The original brick soffit will be retained (Figure 127).

The church interior contains two layers of wall paintings. The earlier layer is thought to date from the sixteenth century, and the later layer dates from 1721 according to an inscription. Because the site was undergoing restoration at the time of the visit, access to the church was not possible.

Figure 125 Agios Nikolaos Church under restoration in 2011

Figure 126 New timber rafters at Agios Nikolaos Church

Figure 127 Soffit capping the top of the walls of the church

Graveyard Church of Moni Ypsilou on Mount Ordymnos

Moni Ypsilou is a fortified monastery located at the top of Mount Ordymnos, overlooking western Lesvos from an altitude of 600 meters (2,000 feet). According to tradition, a monastery was established at this site prior to the ninth century. Nevertheless, the earliest known reference to Moni Ypsilou dates from 1593. A conflagration in 1967 destroyed the Katholikon, which was then reconstructed.

The graveyard church, dedicated to All Saints, is located a short distance from the monastery (Figure 128). The small graveyard of the monastery is located in front of the entrance to the church (Figure 129). A very small church with dimensions of 8 × 4.5 meters (26 × 15 feet), it consists of a barrel-vaulted nave with a small apse at the east end. A small ossuary is attached is attached to the east end of the structure. The walls of the church are of random coursed rubble stone masonry.

A carved inscription on the exterior appears to date the church to 1695, but a painted inscription in the interior dates the original layer of wall paintings to Anno Mundi 7192, or 1684. A second layer of wall paintings was added in 1924. According to a 2000 study for the conservation of the wall paintings, most of the original painted surface, which had faded, was painted over, either directly or on a thin layer of plaster, and largely in adherence to the original iconographical program.[29]

Condition and recommendations

All four façades have been recently repointed with hydraulic cement mortar. In addition, the south façade has been completely stuccoed using hydraulic cement, with a troweled and incised hexagonal render pattern. There appears to have been no attempt to reconcile this intervention with the traditional aesthetic of the older church, or of any church or other vernacular building on the island. More troubling than the visual appearance of this wall is its apparent effect on the paintings on the interior. Although less than a century old, they appear to be rapidly disintegrating. This moisture-related deterioration is presumably related to the impervious exterior stucco application. The paintings directly attached to this wall are in a far more advanced state of decay relative to other surfaces within the church.

The deteriorating roof was hastily replaced in 2004 after a tree limb fell on the church during a storm. Replacement was necessary to forestall water intrusion that was already damaging the interior wall paintings. The repair was successful in making the building watertight. Nevertheless, the modern terra-cotta tiles that were used now detract from the appearance of this historic building (Figure 130).

The deterioration of the newer layer of wall paintings now reveals fragments of the underlying earlier painted surface (Figure 131). Water intrusion continues to be a problem for this church, in particular around improperly sealed windows (Figure 132).

29 Iōannēs Verroiopoulos, Konstantinos Nikakēs, and Vasileios Panagiotopoulos, *Meletē Syntērēsēs Toichographiōn Koimetēriakou Naou I. Monēs Hypsēlou Lesvou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn, 2000).

Figure 128 The graveyard church of Moni Ypsilou from the Southeast

Figure 129 Monastery graveyard at Moni Ypsilou

Figure 130 Modern tiles detract from the appearance of the building

Figure 131 Fragments of the older layer of wall paintings have become visible at areas of deterioration

Figure 132 Deterioration around window opening on the south wall of the church

Agios Ioannis Church in Kerami

Constructed in 1737, the Agios Ioannis Church occupies a shaded lot in Kerami, a small settlement near Skala Kallonis (Figure 133). The church is simple in form, constructed out of local volcanic stone, and covered with a gable roof. The rectangular ground plan has dimensions of 13 × 6 meters (42 × 19 feet) and consists of a nave and a sanctuary with a shallow apse. The entrance is located in a sunken courtyard on the north side. The courtyard is covered by a lean-to porch with a tile roof. It is shaded by a row of cypress trees lining the northern edge of the lot (Figure 134). Today, the sidewalk next to the church is lined with café seating, making the historic church the background for social interaction.

The wall paintings in the interior date from 1773, and cover the top half of the long north and south walls. According to a 1999 study for the conservation of wall paintings, the bottom layer of mud and straw plaster is in very poor condition and has lost its adhesion to the masonry. For this reason, it was proposed that the wall paintings be removed, mounted on a new substrate, and reinstalled in the building.[30] Today they are held in place with strips of fabric. In the exterior, a niche above the main entrance contains a painting of Saint John the Baptist, and a shrine to the west of the entrance contains a painting of the Archangel Michael on a plastered wall.

A dropped wood ceiling is suspended in the nave. The design consists of a square grid with a polygonal rosette in the center. Heavily soiled, the ceiling appears to have been originally painted red. A carved and painted wood iconostasis screens the Sanctuary from view. Rare among these smaller churches on Lesvos, Agios Ioannis has a *gynaikonitis*, or women's gallery. The gallery is accessed by a spiral staircase in the northwest corner of the church and is supported by large beams, which show signs of insect infestation. The front side of the parapet of the gallery is painted very simply. A portion of a lattice screen survives on the southern half of the gallery. The flue for a wood-burning stove used to run through the east wall of the church, in the rear of the gallery.

Condition and recommendations

In the exterior, a large vertical crack on the south wall may indicate differential settling (Figure 135). On the west wall, a crack descends from the opening through which the flue of the stove runs (Figure 136).

Unfortunately, cement is used for repairs, and two bags of cement were found in the courtyard. The north wall has recently been covered with cement mortar, and the pointing is of very poor workmanship (Figure 137). The base of the west wall is also covered with cement. It is important for the preservation of the building that these mortars be removed and replaced with traditional lime mortar with volcanic pumice additive, known in Lesvos as "kourasani."

Much of the wood in the interior has been damaged by moisture. For example, the dropped ceiling is rotted at several locations. In addition, rising damp has caused wooden pieces at the bottom of the iconostasis to rot, and some moldings have been lost entirely. Apparent in most of the wood members in Agios Ioannis, the moisture has been conducive to insect infestation. For the iconostasis, it is recommended that the rotted wood at the bottom be replaced and that metal flashing be installed to prevent rising damp. The moisture problem is exacerbated by the presence of numerous cypress trees planted in the 1970s on the north side of the church. According to the caretaker, the roof of the church has been replaced twice within the last 15 years, each time necessitated by rotted wood elements. Evidence of biological growth in several areas of the roof is indicative of the continued presence of moisture. It is recommended that the trees in the courtyard be removed.

30 Iōannēs Verroiopoulos, Konstantinos Nikakēs, and Vasileios Panagiotopoulos, *Meletē Syntērēsēs Toichographiōn I.N. Hagiou Ioannē Keramiou Lesvou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn, 1999).

Figure 133 View of Agios Ioannis Church in Kerami from the Southeast

Figure 134 A row of cypress trees in the courtyard of the Agios Ioannis Church

Figure 135 A large crack runs through the south wall

Figure 136 A crack can be seen on the west wall

Figure 137 The north wall has been covered with cement mortar

Taxiarchon Church in Vatoussa

The Taxiarchon Church is a large cemetery church located at the western edge of Vatousa (Figure 138). The church, which was constructed in 1836, is a three-aisled basilica with dimensions of 15 × 11 meters (50 × 36 feet). It was built using rubble stone and brick masonry set in a lime-based mortar with brick-dust inclusions. Traditional mortar can still be seen on the south façade. The north façade is plastered, in contrast to the south façade, perhaps as a response to greater exposure to wind and higher risk of erosion. The roof is covered with flat tiles. Concrete walkways extend along the south and north façades, and gravesites are located to the south and the west of the church (Figure 139). A covered arcade extends along the west façade, and for a short distance along the north and south sides of the building. The spandrels in the interior of the arcade are finished in plaster.

The interior is richly ornamented with a rare decorative scheme that combines Ottoman and Baroque elements. The most prominent feature is the painted walnut iconostasis, which rises to a height of 10 meters (32 feet) and defines the Sanctuary on the east end of the church (Figure 140). The Bishop's throne, the pulpit, the *proskynetarion*, and the ceiling above the nave were painted using the same technique (Figure 141). The scheme is characterized by unusual bright colors such as ochre, green, light pink, and light blue. A study for the conservation of the painted wood elements of the Taxiarchon Church has been completed for the 14th Ephorate of Byzantine Antiquities.[31] The walls and the columns of the colonnades that define the side aisles are plastered, but the white plaster with light blue borders does not match the rest of the richly colored interior.

Condition and recommendations

The concrete walkways against the north and south walls are likely trapping ground moisture below the church walls. For this reason, it is recommended that a portion of the walkways adjacent to the exterior walls be removed.

Today, stones and mortar are missing at several locations on the exterior walls (Figure 142). The keystone of the arch above the main entrance has shifted. The finishes in the exterior arcade are in poor condition. The plaster finish is missing, or has lost adhesion in places. The original plaster coved cornice at the arcade ceiling perimeter is nearly completely missing and the plaster crest above the icon to the left of the entrance is damaged and in danger of collapse. The ceiling boards in the arcade are detaching in places.

The iconostasis and the other wood furnishings have suffered damage from wood-boring insects. Today paint is flaking and powdering, with more severe losses closer to the bottom of the iconostasis. Rotted pieces have recently been replaced. A membrane has been added at the sides of the iconostasis, where the structure meets the walls. The study that was conducted for the wood elements recommended a program of insect control for the church interior, cleaning, paint stabilization, in-kind replacement of rotted elements at the base, and protection with an appropriate coating.

The rest of the interior appears in good condition, with the exception of a few cracks in the plaster on the northern side of the parapet of the balcony. The mosaic floor has a visible slope toward the West. Ground moisture was detected below the floor, but it does not appear to be rising through the walls

31 Ēlias Rokos, *I. Naos Taxiarchē Vatousas—Meletē Syntēresēs Templou kai Tavaniou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn).

Figure 138 The cemetery of Vatousa and Taxiarchon Church seen from the West

Figure 139 View of the south façade of the church showing the concrete walkway and gravesites

Figure 140 The painted iconostasis of Taxiarchon Church

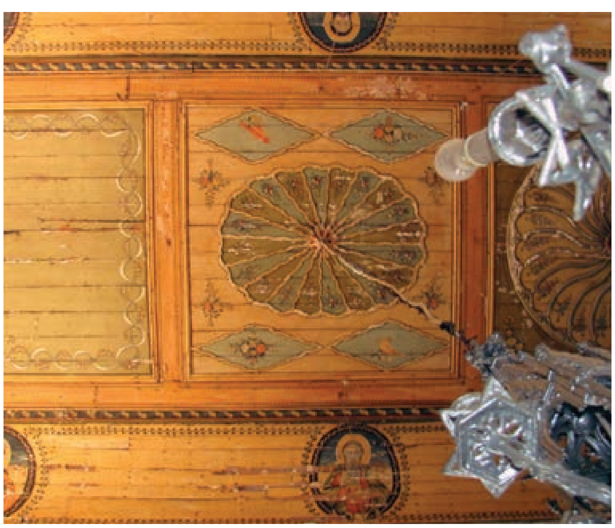


Figure 141 Ceiling above the nave with painted Apostles in medallions in the cove cornice

Figure 142 Deterioration of the exterior wall on the east façade

Appendix 1: Drawings

Sheet 01—Site and Drainage Plan

Sheet 02—Floor Plan

Sheet 03—West Elevation

Sheet 03A—West Elevation Conditions

Sheet 04—North Elevation

Sheet 04A—North Elevation Conditions

Sheet 05—East Elevation

Sheet 05A—East Elevation Conditions

Sheet 06—South Elevation

Sheet 6A—South Elevation Conditions

Sheet 07—Longitudinal Section

Sheet 08—Cross Section—Through Window 1, Looking West

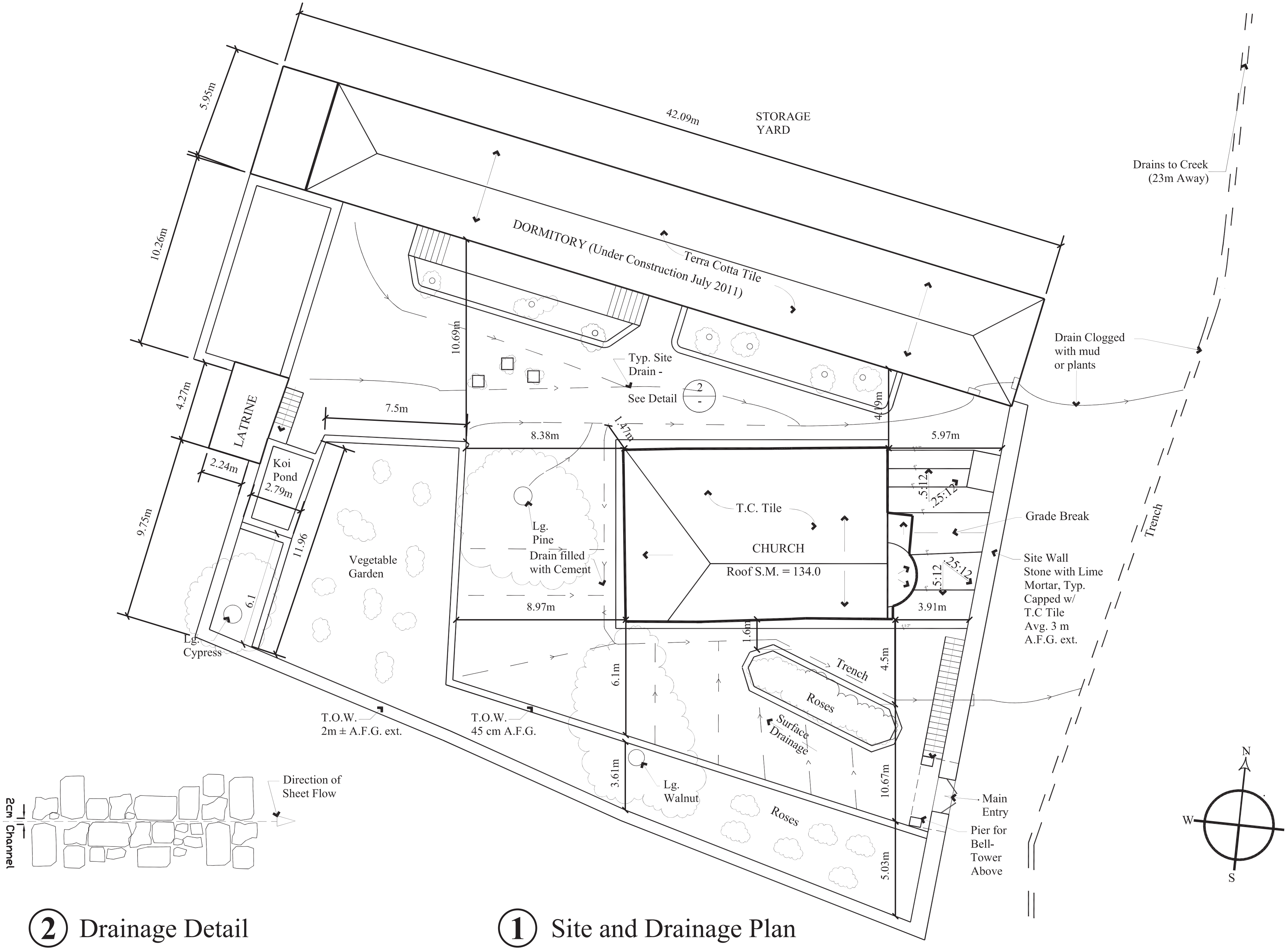
Sheet 09—Cross Section—Through Window 4, Looking East

Sheet 10—Cross Section—Through Door 2 & 3, Looking East

Sheet 11—Interior Elevations—Narthex

Sheet 12—Interior Elevations—Aisle

Sheet 13—Interior Elevations—nave/Sanctuary



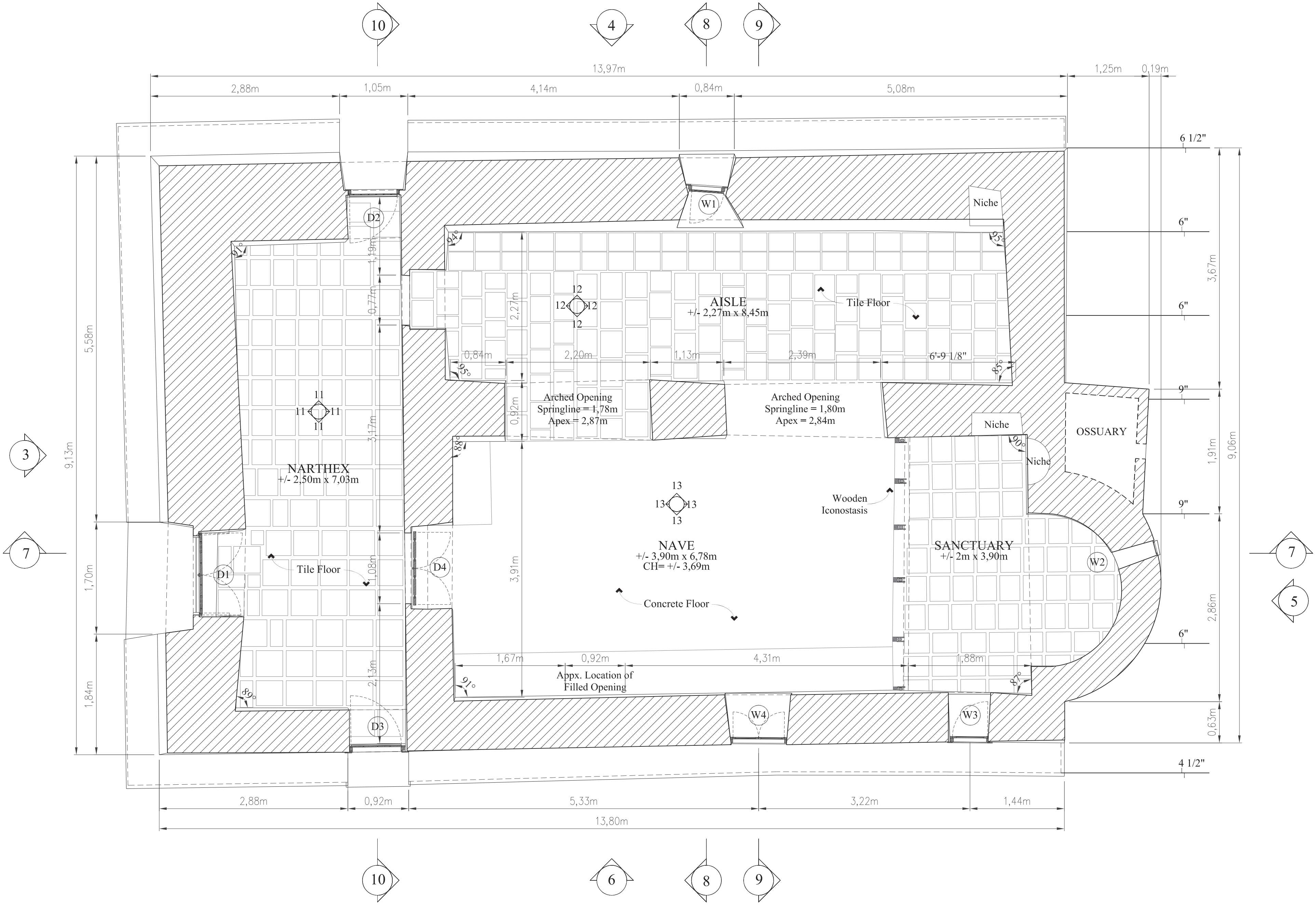
② Drainage Detail

① Site and Drainage Plan

WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 01
Site and Drainage Plan
Not to Scale, drawn by ajb



WORLD MONUMENTS FUND

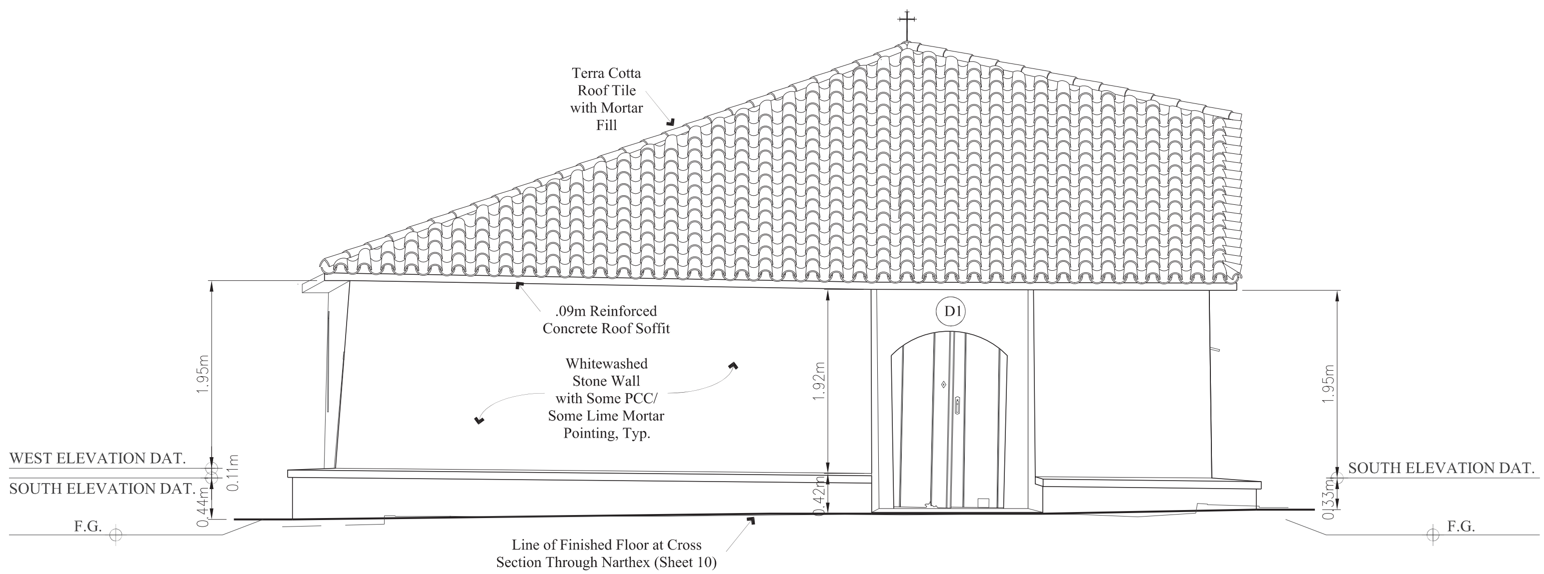
The Church at Moni Perivolis

Antissa, Lesvos, Greece, June 2011

Sheet - 02

Floor Plan

1:200 Scale, drawn by skm



WORLD
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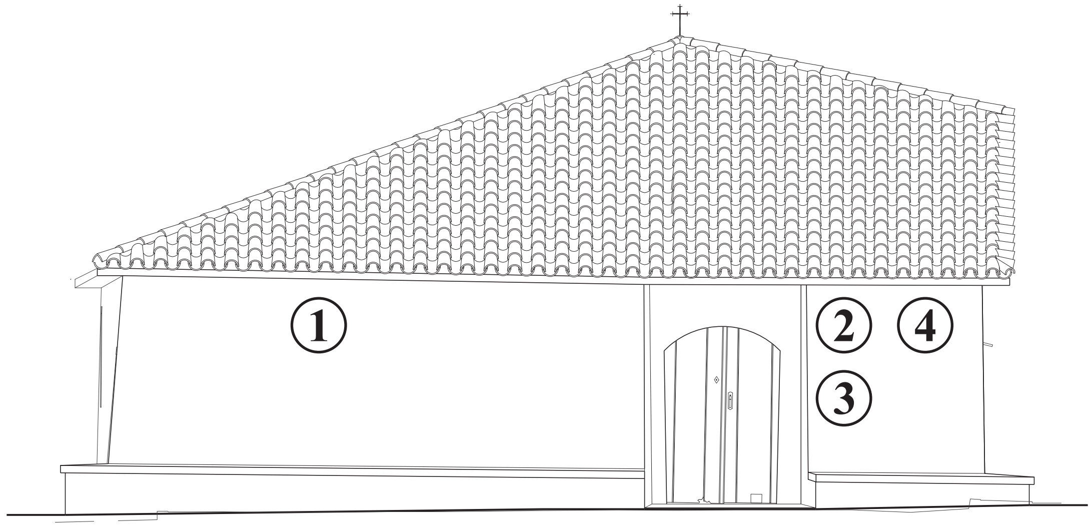
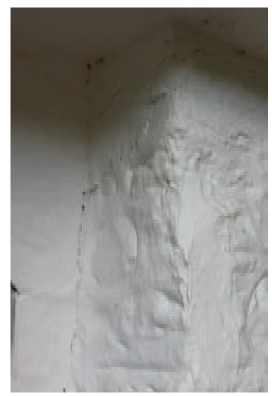
The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 03
West Elevation
1:200 Scale, drawn by skm



1

A separation crack between the concrete soffit of the new roof and the older wall. This general condition is found throughout the church.



2 3

Surface cracking between whitewash and pointing.

4

Rusting rebar is seen throughout the church in the soffit.

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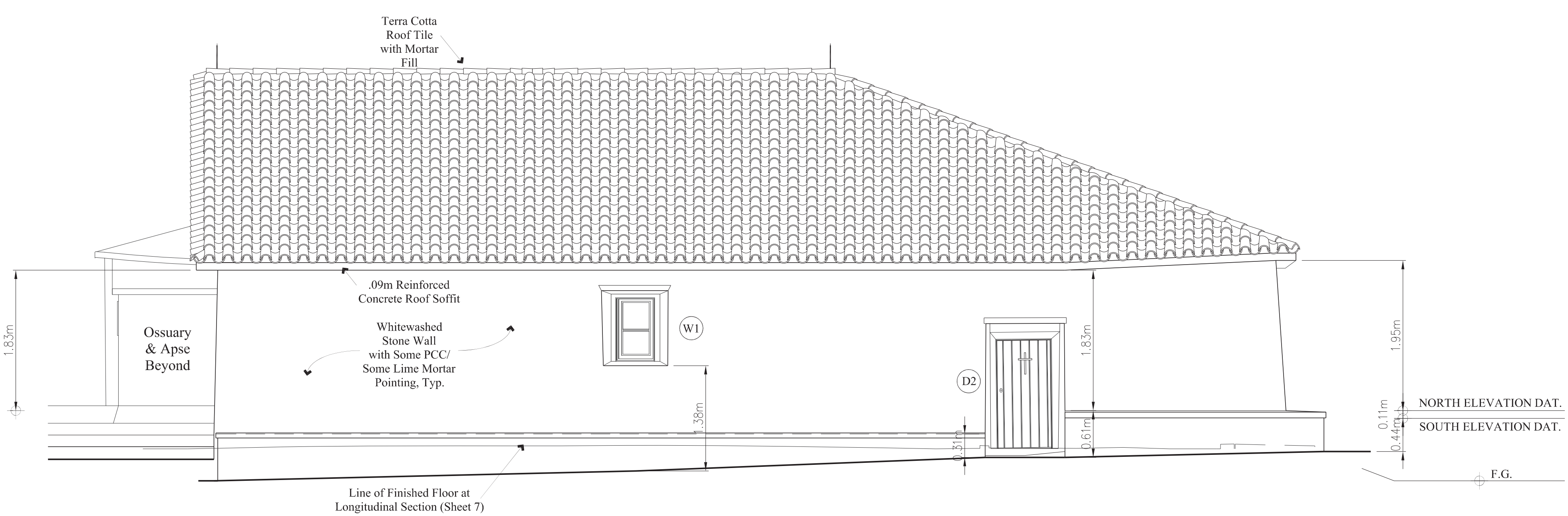
The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

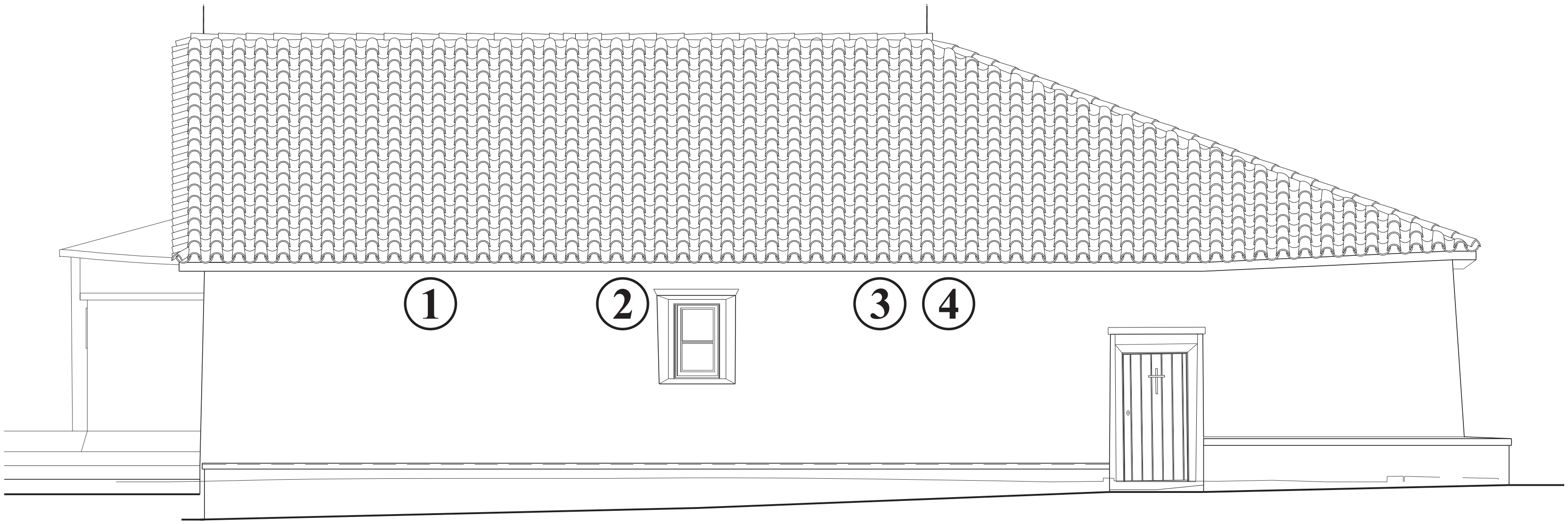
Sheet - 03A
West Elevation Conditions
1:200 Scale, drawn by ajb



WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 04
North Elevation
1:200 Scale, drawn by skm



1
While the rebar in the concrete soffit is causing cracking and spalling, the roof tiles can be observered to be in generally good condition.

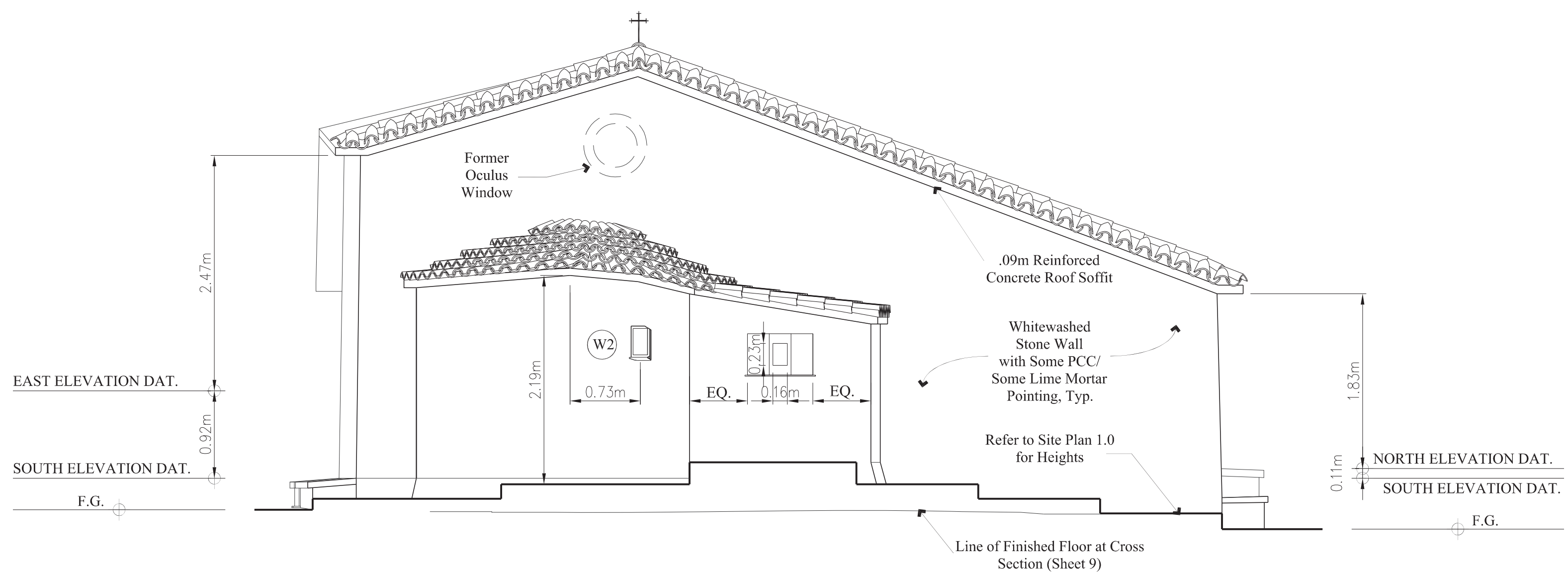
2
Surface cracking is also common at the interface between lintels or headers and the surrounding stone and mortar wall. There tends to be superficial cracks in the mortar or whitewash.

3 4
A spectacular example of rusting of the rebar. Also visible is the intact roof tile and modern bitumininous membrane. The roof is unlikely to be a source of leakage.

WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

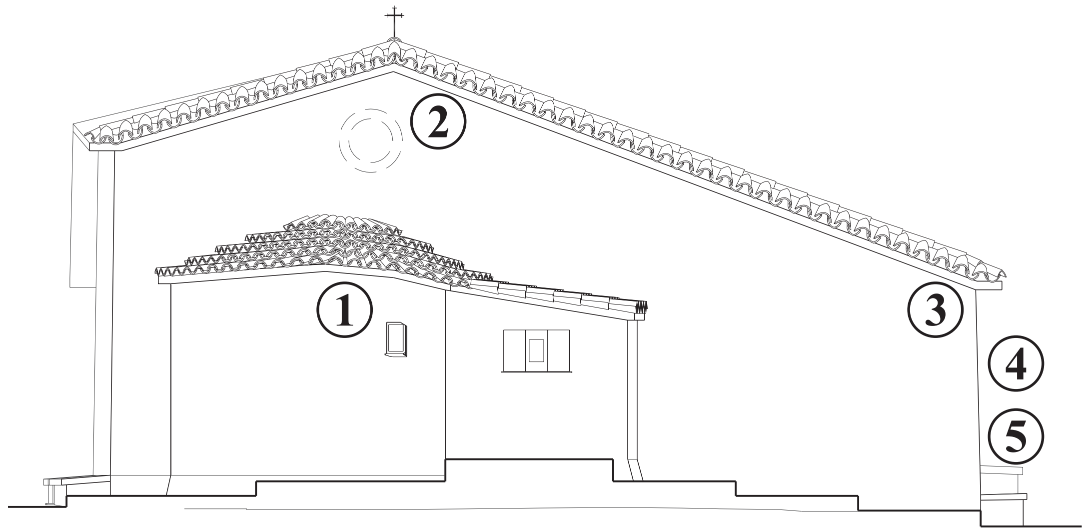
Sheet - 04A
North Elevation Conditions
1:200 Scale, drawn by ajb

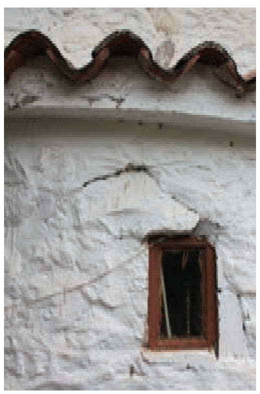


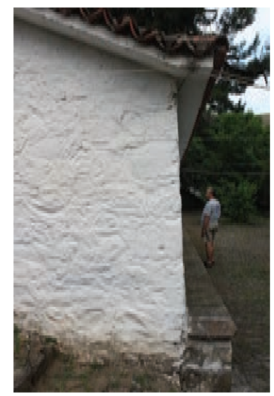
WORLD MONUMENTS FUND

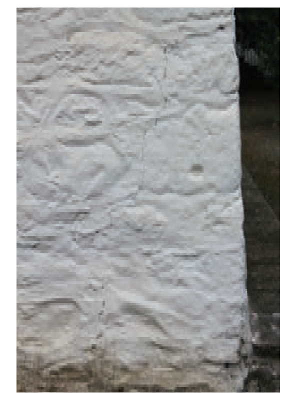
The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 05
East Elevation
1:200 Scale, drawn by skm









1 The apse is the area with the greatest loss of wall paintings. The multiple cracks and complex roof system contribute to the problem.

2 This cleary indicates the relation between shallow rebar and the cracks through the concrete soffit.

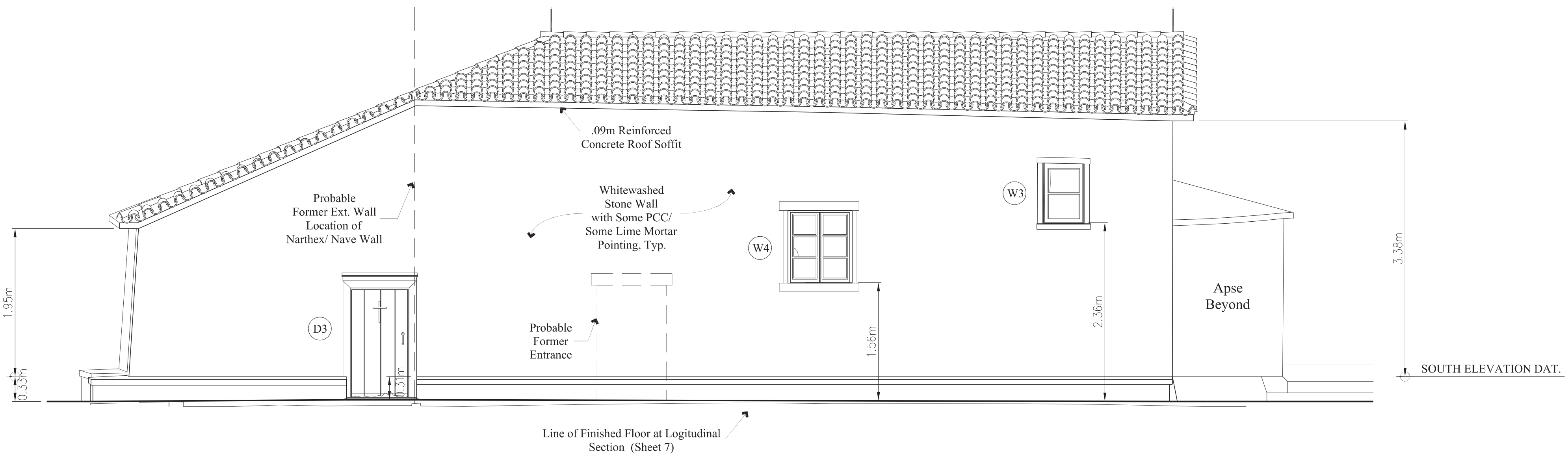
3 Utilizing the rusted rebar only exacerbates the deteriorating situation.

4 5 Both corners of the east wall exhibit cracks that could be caused by differntial settling.

WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

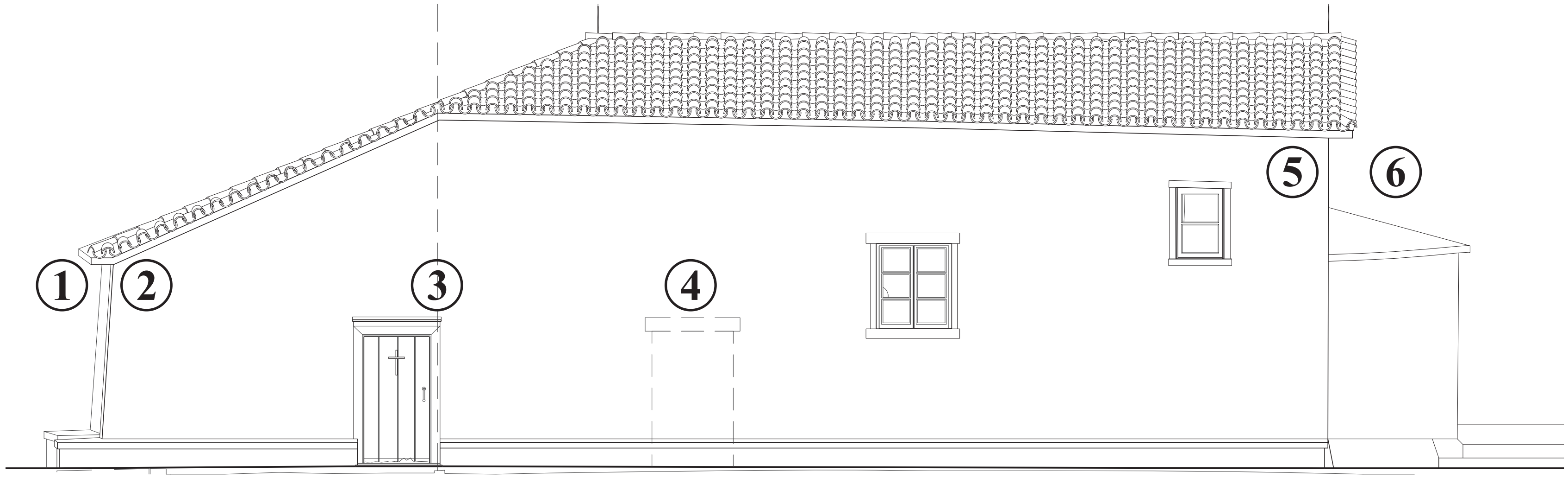
Sheet - 05A
East Elevation Conditions
1:200 Scale, drawn by ajb

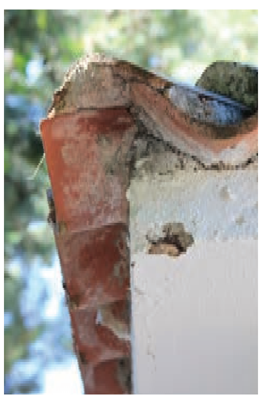


WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

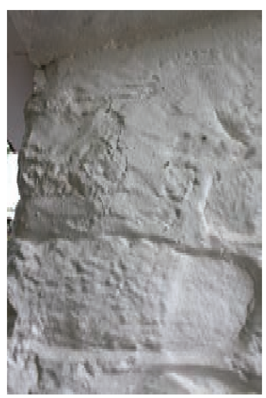
Sheet - 06
South Elevation
1:200 Scale, drawn by skm





1

Rebar placed close to the surface has oxidized and is causing spalling.



2

Portland cement-based pointing is detaching from wall surface, causing superficial cracking.

3

There is significant separation corresponding to the interior wall that separates the nave and narthex indicating the narthex is an addition.

4

An earlier entrance is visible. The joints and header are possible sources of water intrusion.

5

A deep crack may indicate differential settling of the apse.

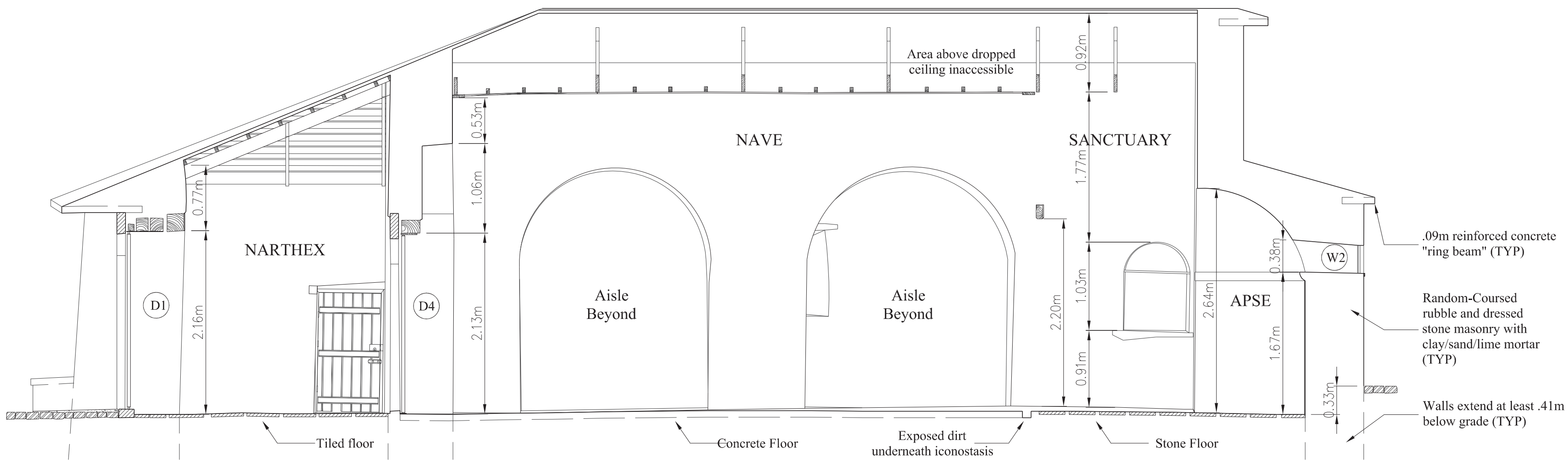
6

Additional rusting and spalling is evident.

WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

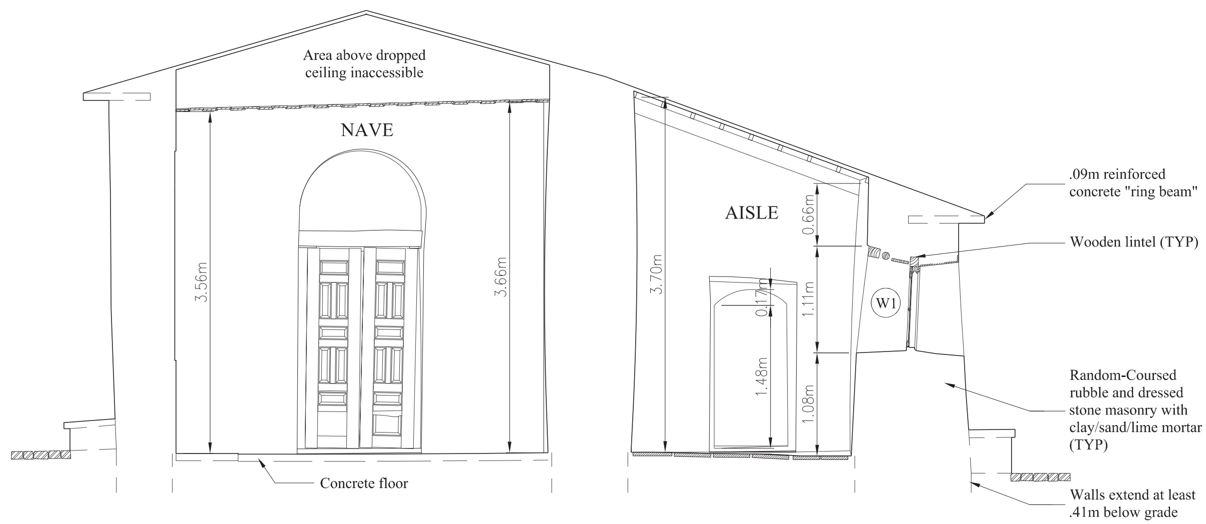
Sheet - 06A
South Elevation Conditions
1:200 Scale, drawn by ajb



WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

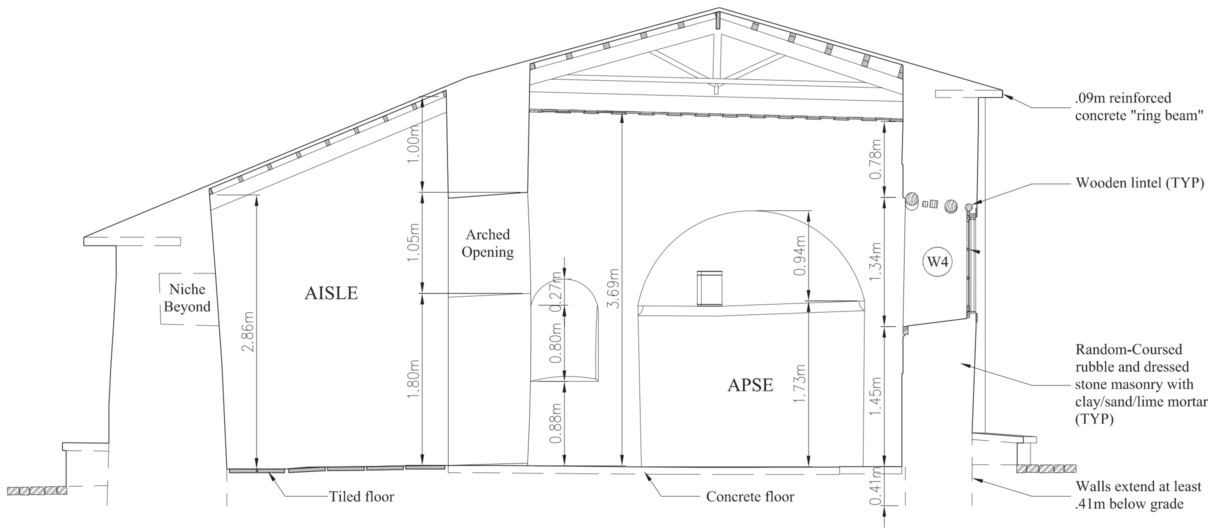
Sheet - 07
Longitudinal Section
1:200 Scale, drawn by skm



WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

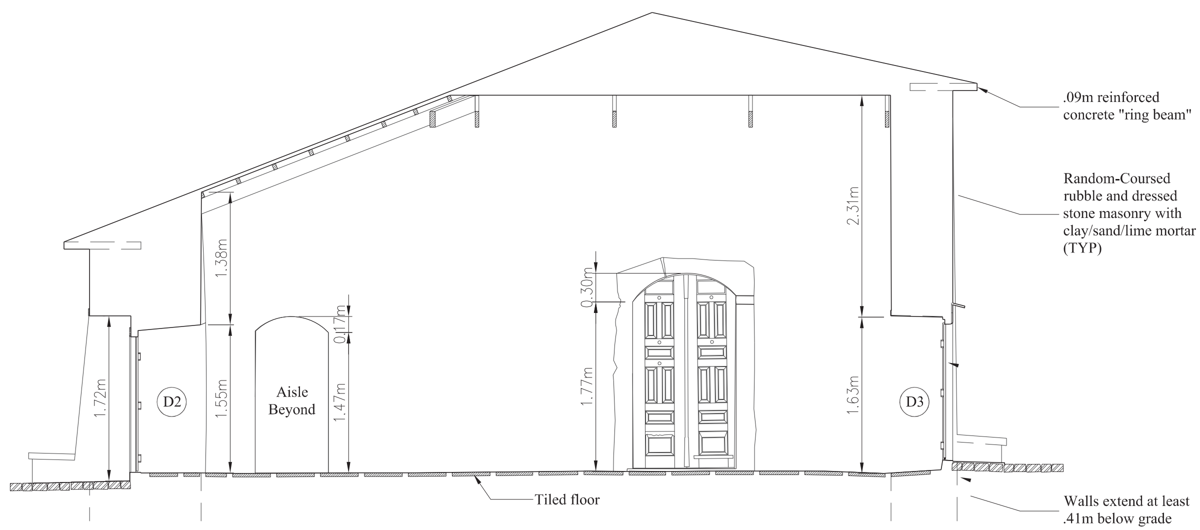
Sheet - 08 Cross Section
Through Window 1, Looking West
1:200 Scale, drawn by skm



WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

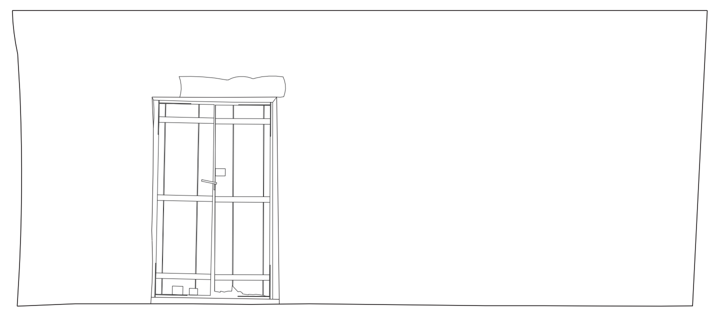
Sheet - 09 Cross Section Through Window 4, Looking East
1:200 Scale, drawn by skm



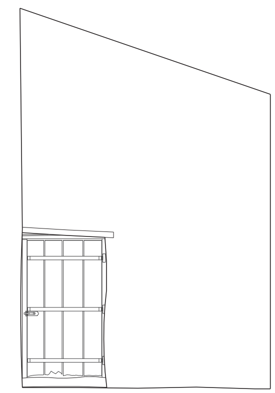
The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 10 Cross Section
Through Door 2 & 3, Looking East
1:200 Scale, drawn by skm

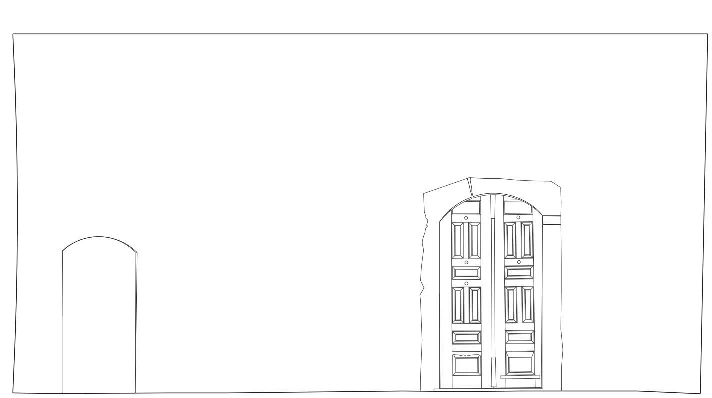
WORLD MONUMENTS FUND



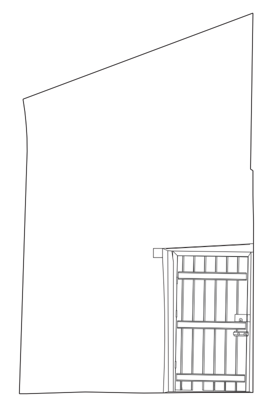
4 West Elevation



3 South Elevation



2 East Elevation

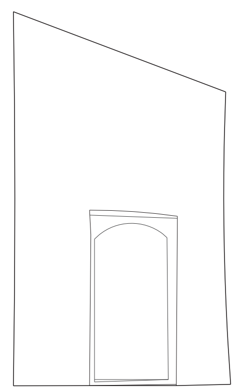


1 North Elevation

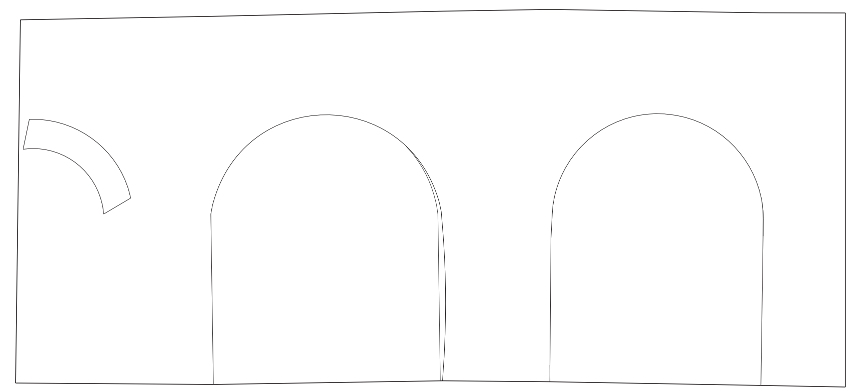
WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

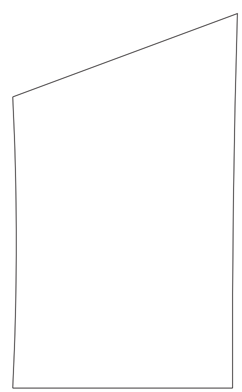
Sheet - 11
Narthex, Interior Elevations
1:200 Scale, drawn by skm



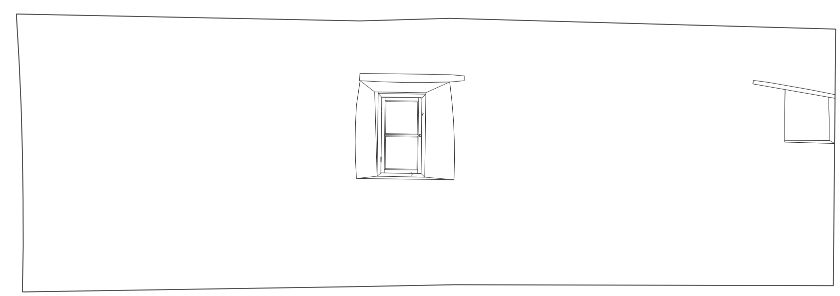
(4) West Elevation



(3) South Elevation



(2) East Elevation

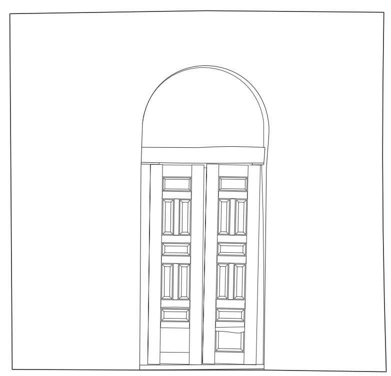


(1) North Elevation

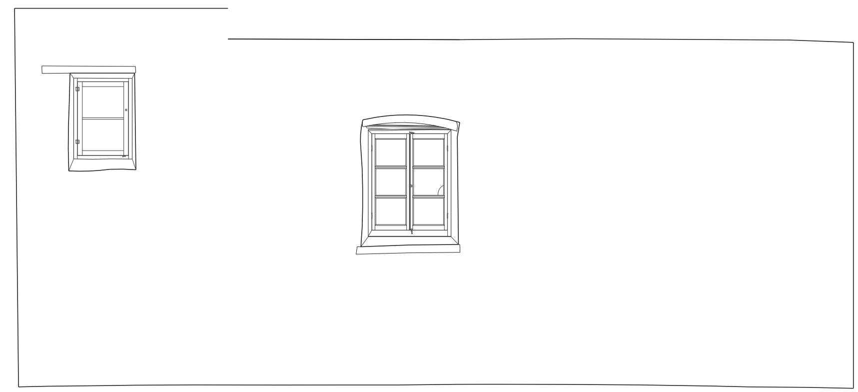
WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

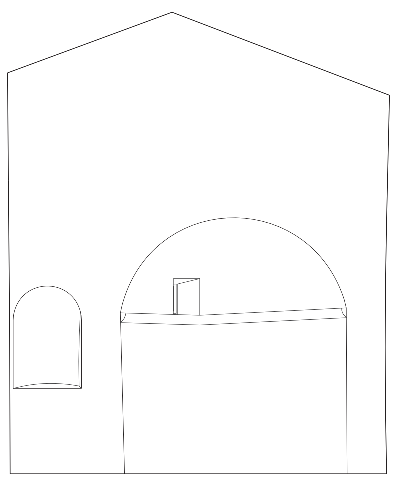
Sheet - 12
Aisle, Interior Elevations
1:200 Scale, drawn by skm



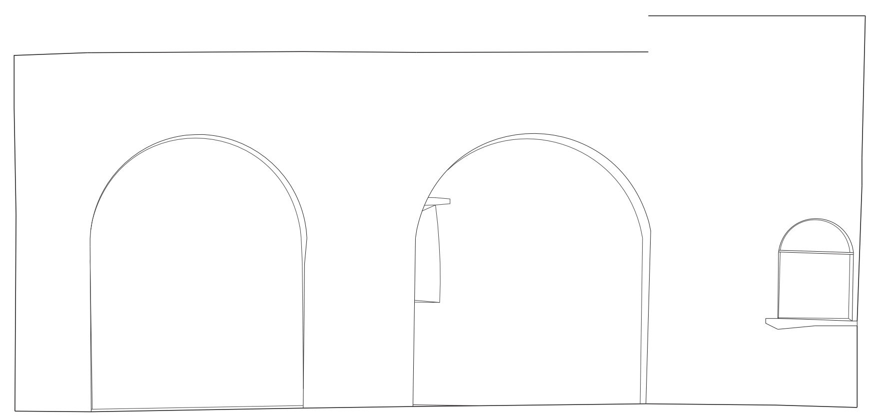
4 West Elevation



3 South Elevation



2 East Elevation



1 North Elevation

WORLD MONUMENTS FUND

The Church at Moni Perivolis
Antissa, Lesvos, Greece, June 2011

Sheet - 13
Nave/Sanctuary, Interior Elevations
1:200 Scale, drawn by skm

Appendix 2: Mortar Analysis

Purpose

The following is the result of wet chemical analysis performed on two samples of wall mortar from Moni Perivolis. The purpose of the analysis was to: (1) roughly determine the constituent materials in early, if not original, wall sections; (2) assist in determining what later modifications to the wall masonry may be deleterious; (3) assist in determining the dates of later accretions to the original construction.

Method

Sixteen mortar samples were removed from various locations on the building. For the purposes of this report, the two samples most likely from areas with extant original mortar were chosen. The following results are percent by weight designations.

Sample #1: Mortar from the wall above the bench on the north façade.

Fines:	3.0%
Aggregate:	87.1%
Binder:	9.9%

Sieve Test

#8	9.1%
#16	31.8%
#30	26.1%
#50	18.2%
#100	11.4%
#200	3.4%

The above suggests a lime-rich mortar mix, with a minimal amount of fines, possibly clay.
This could be very early mortar.

Sample #2: Mortar from the window on the south side of the Nave (Window W4)

This sample was darker, nearly rose in color, very soft, with very few inclusions.
No reaction to hydrochloric acid (HCl).

Fines:	5.6%
Aggregate:	88.8%
Binder:	5.6%

Sieve Test

#8	6.3%
#16	9.5%
#30	11.1%
#50	36.6%
#100	28.6%
#200	7.9%

This sample appears to be a relatively recent, cementitious mortar.

Appendix 3: Repoint Mock-up

Background

In order to determine the possible efficacy of removal of the non-original hydraulic cement pointing mortar as a means of reducing the entrapment of moisture within the façade walls of the Katholikon of Moni Perivolis, a removal test and sample repointing was undertaken and completed. The area of the sample was the northeast corner of the building, on the North façade. This area exhibited typical degradation of the limewash exterior finish due to biological growth. The bench construction at this location included the hydraulic cement cant found at the rear of the seat, adjacent to the wall, and clay-and-sand mortar for setting of bench stones. Sedimentary stone flags were used for the seat—at this location the seat stone inclined slightly toward the building, a condition that directs rain runoff toward the building, rather than from it. Because the hard newer repointing mortar lacks the flexibility and coefficient of expansion of the surrounding stone assembly, the repointing mortar has lifted from the bench at several locations.

Prior to the implementation of the work, moisture meter readings were taken within the bench masonry, after removal of the seat stone. Readings were at the high end of the meter capacity.

Mock-up bench prior to the implementation of work. Note the ungainly cement cant at the rear of the seat, and biological growth.

Completed repointing with reduced cant, new limewash on adjacent wall, and new mortar joints

Implementation

Work was completed in the following manner:

1. The cement cant at the rear of the seat was removed using hand tools and the bench seat was removed by hand.

2. All hydraulic cement from the mortar joints on a portion of the North face and on the East end of the bench was removed by hand. All mortar joints were cleaned to expose the clay-and-sand setting mortar. The existing limewash finish was brushed to remove all biological growth (lichen) on the bench and on the adjacent façade wall. The entire mock-up area was rinsed lightly with fresh water.

3. New pointing mortar was mixed, consisting of slaked lime putty, premixed and aged on-site, mason sand from a nearby supply yard, and potable water.

4. The new mortar was mixed at an approximate 1:3 lime-to-sand ratio, and water was added to achieve the proper consistency.

5. The mortar was hand-troweled onto the top of the bench.

6. The rear surface of the seat stone was wetted with fresh water.

7. The bench seat was set in the new mortar so that the seat sloped slightly to the front of the seat, to achieve proper drainage. A new smaller cant was applied to the rear edge of the seat.

8. The mortar joints were repointed in two lifts, and after a short amount of time were tooled to match the adjacent joint tooling, with a slight "ridge" at the center of the joint.

Results

After permitting the mortar to set for 24 hours, moisture meter probes were inserted into adjacent joints in the bench, and the reduction in moisture (even following rinsing of the bench) was appreciable. The effect of this repair can be tested even more thoroughly by drilling core samples to provide information about the moisture profile of the wall at various heights, before and after the intervention.

Because there was inadequate time to allow the mortar mix to "rest" following mixing and application, there was some minor shrinkage on the broader expanses of new mortar. This condition would be eliminated by proper "resting" of new mortar mix.

The impact of this intervention on the wall paintings from drying is unlikely to be detrimental. Indeed, one would expect that the reduction of additional liquid water into the building fabric will be beneficial in the long-term. Nonetheless, for added caution it may be prudent to phase these modifications over a number of campaigns.

It is crucial that this intervention be implemented by workers trained in restoration masonry who will adhere to the specification of using a limited amount of water and slaked lime.

Appendix 4: Specifications for Masonry Restoration

Environmental Requirements

- Use materials only within manufacturer's or supplier's recommended temperature ranges.
- Cold Weather Pointing and setting: Do not perform stone masonry restoration when air or masonry temperature is below 5 °C (40 °F), or when it is expected to drop below 5 °C within 48 hours of mortar application.

Conditions

- Minimize dissemination of dust to greatest extent possible. Use all means necessary to prevent dust from entering the church.
- Provide all precautions necessary to protect the building, site, site features, air, water, and other elements of the environment from damage or deterioration caused by this work.

Quality Assurance

- **Qualification of Personnel:** Personnel performing the restoration work shall meet the following requirements:

  Foreman: Work shall be directly supervised by a full-time foreman who has at least ten years' experience preparing joints and pointing masonry and supervising the pointing and setting of masonry similar to the type of masonry pointing required on this Project and has, within the past five years, been foreman on at least three successfully completed projects with work similar in type, size, scope, and complexity to the work required by this Specification for this project on buildings designated as landmarks. The foreman shall be on site daily for duration of this work. The same foreman shall remain on the project throughout work unless the owner or architect deems his performance unacceptable.

  Mechanics: Work shall be performed by skilled mechanics who have at least five years' experience preparing joints and pointing and setting masonry similar to the type of joint preparation and pointing work required for this project and have, within the past five years, performed work requiring the same skills and of the same type and complexity as the work they are performing on this project on buildings designated as landmarks. In acceptance or rejection of work of this section, no allowance will be made for workers' incompetence or lack of skill.

  Workers removing mortar from existing joints: Each person proposed for use in removing mortar from existing joints to be repointed shall be required to successfully complete joint preparation samples specified below in presence of the architect prior to beginning work on the project. Unsuccessful performance in completing these samples will be grounds for rejection of this worker for this job.

  Hand Raking Joints: Six linear feet without damage to stones.

Field mockups

- **General:**

  Before beginning general stone masonry restoration work, prepare mockups to provide agreed-upon standards for work of this section. Do not proceed with stone masonry restoration until architect and owner have approved mockups.

  Locate mockups as directed by the architect.

  The architect will monitor mockups.

  Use workers for the mock-ups who will execute the work, and follow requirements of this Specification.

Approved mockups will represent the minimum acceptable standard for stone masonry restoration work. Subsequent work that does not meet standard of approved mockups will be rejected.

Protect the approved mockups to ensure that they are without damage, deterioration, or alteration at time of project completion—approved mockups in undamaged condition at time of completion may be incorporated into the work.

- **Mockups:** Provide the following mockups:

  Rebuilding top portions and repointing of perimeter seating:
  1-meter (4-foot) length of seating section, resetting seat flags, repointing to depth of loose masonry, applying new cant at rear seat edge.

  Pointing of joints in rubble stone masonry:
  One panel including at least 3 linear feet of joint.

Documenting stone masonry

- **Document existing stone masonry** to be restored with photographs keyed to drawings showing locations. Overlap or stitch views in photographs to thoroughly and clearly show every stone.
- **Identify** each stone to be removed and reinstalled on drawings.

Removing stone seat flags

- Remove mortar from joints between units to be removed without damaging units.
- Carefully remove stones or flags and salvage for reuse. Remove topping slabs first at seats. If any rubble fill is found, remove to location determined by Architect. Do not damage surfaces or any arrises of stones, where they exist. Handle carefully to prevent breakage. Store stones on site at location indicated by architect or owner. Dispose of rubble fill at owner's request.
- Label stone flags for seats to indicate identification and orientation on surface that will be concealed in finished work.
- Clean stones free of all mortar

Installing stone seat flags

- **General:** Install salvaged stone units in original locations and orientations. Reinstall incorrectly pitched stone to provide pitch from building façade.
- **Installation:** Apply solid bed of approved mortar to substrate. Set flag and tap gently into place. Mortar shall be squeezed out of joints when block is set. If mortar is not squeezed out of joints, remove flag, apply additional mortar, and reinstall. Rake joints for pointing and final finishing.
- **Location:** Install stones in locations as determined by supporting walls and as directed by architect. Ensure that tops of stone flags are flush to one another.

Pointing

- **General preparation:**

  Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of work. Do not proceed until unsatisfactory conditions have been corrected.

  Provide mortar mix that replicates lime-rich traditional mix as determined by mortar analysis.

  Before removing mortar using hand methods that generate airborne dust, erect dust impervious barriers and take other measures necessary to prevent dust from traveling beyond work area and/or into the monastery or surrounding buildings.

- **Mortar removal:**

  Use hand tools only to remove mortar from all joints.

  Rake mortar from joints using a blade or cutter made for this purpose. Cutter may be used with or without aid of a hammer.

  Sharpen any chisels periodically to minimize chipping.

  When using chisels, do not apply chisel to surface of mortar where there is no void into which mortar can be driven.

- **Protection of masonry being pointed:**

  Use all necessary care to protect existing masonry from damage during the work. Take special care in removing existing mortar to ensure that no stones are damaged, chipped, or broken. Replace in-kind or repair any masonry damaged by the work as directed by and to complete satisfaction of the owner and/or architect.

- **Protection from rain:**

  Protect all pointed joints from direct rain or other precipitation for at least 24 hours after mortar has been applied.

Mortar

- Mortar for pointing Stone Masonry: Mortar for each location shall match existing lime-based mortar as determined by analysis and approved by the architect.

Joint preparation on existing masonry

- Remove mortar from joints to a depth of 2-1/2 times joint width, 3/4 inch, or to sound mortar, whichever is greater. In all cases remove all deteriorated, weathered, and loose material.
- Do not damage faces and arrises of stone masonry in any way during joint preparation.
- Joint preparation shall cease if, in Architect's judgment, Contractor's methods are damaging masonry units. Work shall not resume until tools, technicians, and methodology have been corrected to meet quality standard of approved mockup.
- Remove completely mortar from surfaces of masonry units adjoining joint to allow new mortar to bond directly with masonry.

Mixing mortar

- Measure ingredients carefully so that proportions are controlled and maintained throughout all work periods.
- Mix mortar in an approved type of power operated batch mixer. Mix for time required to produce a homogeneous plastic mortar but not for less than five minutes: approximately two minutes for mixing dry materials and not less than three minutes for mixing after water has been added. Finish tooled joints to match original adjacent mortar joints.
- Use minimum amount of water to produce a workable consistency for mortar's intended purpose.
- Mortar for Pointing must be as dry a consistency as will produce a mortar sufficiently plastic to be worked into joints.
- Mortar may be mixed by hand in clean wooden or metal boxes prepared for that purpose provided that architect approves mixing boxes and methods of mixing and transferring mortar.
- After mixing, mortars for pointing masonry and mortars for setting masonry shall rest for 20 minutes prior to use to allow for initial shrinkage. Mortar shall be placed in final position within one hour of mixing. Re-tempering of partially hardened material is not permitted

Mortar application

- **Wetting:**

  Carefully wet masonry 24 hours prior to and again immediately before pointing. Let surfaces dry slightly. At time of pointing, surfaces must be damp, so that they do not rapidly absorb moisture, but free of standing water (saturated, surface dry).

- **Failure to Properly Wet Substrate:**

  Evidence that masonry being pointed or masonry previously pointed as work of this section has not been properly dampened to prevent too rapid absorption of water from mortar will be cause for rejection of pointing work. Rejected pointing shall be carefully removed and replaced after substrate has been properly prepared as specified.

- **Pointing:** Point joints as follows.

  Using a pointing trowel, tightly pack mortar into joints in layers not exceeding 1/2 inch thick to fill joint to match original sound joints.

  Begin by filling areas from which mortar is missing to a depth greater than 3/4 inch in 3/8-inch-thick layers to within 3/4 inch of wall surface to provide a uniform substrate for final pointing. Fill final 3/4-inch-depth continuously and uniformly in 1/4-inch-thick layers.

  Firmly iron each layer to compact mortar to ensure full bond between mortar and stone masonry and a firm, solid joint.

  Allow each layer to reach thumbprint hardness before applying succeeding layer. Do not let previous layer dry out before applying succeeding layer. Construct uniform joints.

  Finish mortar at surfaces to match original adjacent mortar, or original samples.

  When stopping work at end of each day or for other reasons, stagger layers of mortar so that there will be no through joints in pointing. Stagger joints in layers so that joints are at least 3 inches from each other.

  Where one day's work joins that of previous day, dampen previous work to ensure good bond.

- **Joint tooling:**

  Tooling: Tool joints after final layer of mortar is "leather hard."

  Profile: Tool joints flush. Solidly compress mortar so that it adheres well to masonry on both sides and forms a dense surface. Premature or late tooling will result in unacceptable finishes, which will be rejected.

  Overworking: Do not over tool joint surface. Excessive tooling will draw excess binder to the surface. Excessively tooled joints must be redone.

- **Curing:**

  Keep newly pointed joints damp for at least 48 hours after mortar has been inserted by protecting pointed surfaces with moisture retaining cover. Do not apply water directly to pointed joints. Attach cover without fastening to masonry or in any other way damaging masonry.

  Ensure masonry temperature remains as required by specifications until mortar is thoroughly cured.

- **Cleaning and repair of mortar joints:**

  Water washing:

  Wash pointed masonry with clean filtered water to remove mortar debris from masonry surfaces.

  Wash within 48 hours following completion of pointing.

  Use rough towels along with water to remove mortar debris. Remove remaining mortar with stiff non-metallic fiber bristle brushes that will not damage mortar or stone units. Do not use wire brushes. Do not use chemical cleaners.

  Repair of pointed joints:

  As cleaning progresses, examine joints to locate cracks, holes and other defects. Carefully point up and fill such defects with mortar to match adjacent. Where necessary in opinion of Architect, cut out joints and refill with pointing mortar exercising extreme care to ensure that color matches that of adjacent pointing. Exposed joint surfaces shall be free from protruding mortar, holes, pits, depressions, and other defects.

  Corrective measures:

  Should mortar in any joint fail in adhesion or cohesion or should a crack occur in any joint surface, cut out mortar and repoint following requirements of this Section to architect's satisfaction.

  Should architect determine that any masonry pointing work does not equal or exceed minimum standard established by approved mockup, remove mortar to a depth of 2 centimeters (3/4 inch) and repoint following requirements of this Section to architect or owner's satisfaction.

Appendix 5: Wall Paintings Analysis—Background

Learning from previous analyses

The major focus of concern at Moni Perivolis is the coating obfuscating the wall paintings. While a number of cleaning agents and methods have been proposed and investigated, a greater understanding is needed of the components and material constituents of the wall painting stratigraphy, as well as any added or altered materials and phenomena. This should precede any testing of cleaning or conservation methods, and aggressive options, such as the chelating agent EDTA, should be avoided.

In 1999 conservators recommended cleaning with a mixture based on ammonium bicarbonate known as AB57.[32] It is not clear whether they undertook analysis and confirmed the presence of gypsum, and this should be investigated further. The report also recommended that a barium hydroxide treatment be undertaken. The barium hydroxide method was developed in Florence over forty years ago as a mineral consolidation treatment for fresco paintings affected by gypsum (which is a sparingly soluble salt and can be highly damaging), and has been used widely on many important wall paintings. The application methodology and the chemical reactions are complex, but essentially it consists of two steps. In a first-stage treatment using ammonium bicarbonate, the calcium sulfate dihydrate (gypsum) forms ammonium sulphate, as well as calcium carbonate and water. In a second treatment using barium hydroxide, the ammonium sulphate reacts to form barium sulphate, which is an insoluble salt. If the treatment is not undertaken with care, the insoluble products of the various reactions involved (including barium sulphate, calcium carbonate, and barium carbonate) can form an insoluble white veil on the surface of the wall painting.

Therefore, the recommendation of a barium treatment indicates that the conservators considered that the salts mentioned in their report were calcium sulphate. T his is not stated explicitly, and no references to any analytical results were made to confirm this. Nevertheless, the barium treatment is very salt-specific. It is only effective in treating problems of sulfation, and, moreover, in the presence of nitrate salts, barium hydroxide can form barium nitrate, a damaging salt that can lead to further salt-related deterioration. An amount of approximately 3-4% (by weight) of nitrates is the limit for barium treatment. The methods proposed in the report have been applied selectively to some of the world's most important wall paintings. The Arezzo and Brancacci chapel frescoes were treated with the barium method, although it is important to note that the Sistine chapel frescoes were not, owing to the significant amount of nitrate salts present. However, the Sistine chapel frescoes were treated with ammonium carbonate as part of the AB57 cleaning method. There are further issues which may argue against the use of the barium method (ammonium carbonate/barium hydroxide):

- *Organic binding media:* Although some proteinaceous binding media, such as egg tempera, can tolerate the alkalinity of barium hydroxide, most organic binding media can be severely damaged.
- *Presence of copper-based pigments:* Treatment with barium hydroxide can cause changes to the chemical structure of copper pigments, especially those of small particle size.
- *Presence of previous conservation fixative:* The presence of a coherent layer of fixative might inhibit the consolidation of friable material using barium hydroxide.
- *Inadequate porosity:* Since successful application depends on effective capillary suction of the aqueous reactants, only materials of appropriate porosity are suitable.

Further analyses

Sampling from Moni Perivolis

A series of samples were removed from Moni Perivolis in order to advance knowledge about the original technique and the present condition of the wall paintings.

During the 2010 field season, three very small samples were dispatched to Orion Analytical in Williamstown, Massachusetts, for a rapid, preliminary analysis to inform ongoing activities in

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32 Iōannēs Verroiopoulos, Konstantinos Nikakēs, and Vasileios Panagiotopoulos, *Meletē Syntērēsēs Toichographiōn Katholikou I. Monēs Perivolēs Lesvou* (Hypourgeio Politismou, 14ē Ephoreia Vyzantinōn Archaiotētōn, 1999).

the field. Infrared spectroscopy (FTIR) revealed the presence of gypsum, a hydrated form of calcium sulphate, on a "gray coating" in each of the three samples that were examined. The coating was described as lacking in cohesive strength and powdering on contact. In one of the samples, which was taken from the area of a small cleaning test conducted during the 2010 season, discontinuous islands of the gray coating were observed (see text of the report from Orion Analytical at the end of this Appendix).

In addition, nine small samples were removed for microscopic examination. Details about these samples and the locations from which they were removed are shown below:

Sanctuary

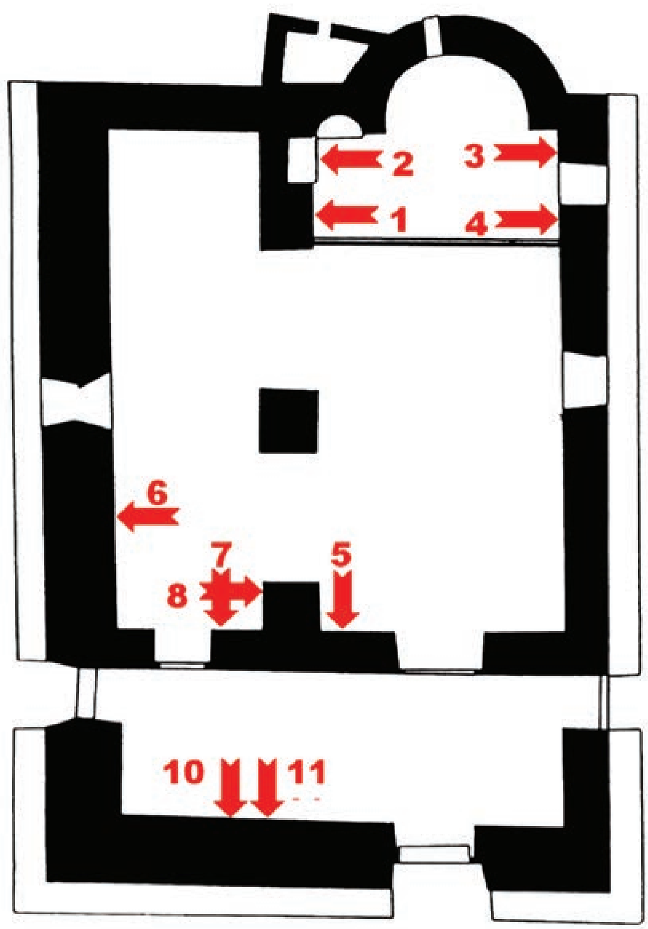
1.	North wall	Saint in medallion, far left, from damaged edge of neck
2.	North wall	Upper register, Ascension of Jesus, from hole in garments of left-most figure
3.	South wall	Lower register, left figure (St. Cyril of Alexandria), from hole in beard
4.	South wall	Lower register, center figure (St. Athanasius of Alexandria), from red diamond on garments

Nave and Aisle

5.	West wall (nave)	Upper register, north side (Descent from the Cross), from figure to the right
6.	North wall (aisle)	Lower register, second figure from left (St. Sava), from the hole in the scroll
7.	West wall (aisle)	Lower register, south of doorway (St. Zosima), from hole in the face
8.	South wall (aisle)	Saint in medallion, from hole in hair

Narthex

10.	West wall	Red border, before cleaning
11.	West wall	Red border, after cleaning.



Lastly, a larger sample was removed from a location of non-figural painting near the bottom of the west wall of the nave. This sample was analyzed by Dr. Christine Bläuer of Conservation Science Consulting Sàrl in Fribourg, Switzerland, to answer a series questions discussed below. It is important to note that this sample may not be representative of the entirety of wall paintings at Moni Perivolis. In particular, because of its location near the bottom of a wall it may vary in aspects of original technique and it likely has undergone a different physical history than the paintings in other areas. The sample also likely may not exhibit deterioration processes that can be observed elsewhere.

The goal of the analyses is to identify an appropriate methodology for conserving the wall paintings. Important objectives are to establish the suitability of aqueous or non aqueous treatments, and the sensitivity of the wall paintings to high pH treatments. Whether an ammonium carbonate or ammonium bi-carbonate treatment followed by a barium treatment is appropriate for these wall paintings, as suggested in 1999, or whether an alternative methodology should be adopted, should also form part of the inquiry. Specific questions and rationales for the analyses included the following:

Surface Gypsum

The intention is to find out whether the gray coating is a gypsum deposit, and if so, whether it is present only as a discrete layer.

- Can gypsum be identified elsewhere in the stratigraphy, and if so, is gypsum present in the plaster layers as part of the plaster matrix or otherwise?
- What other materials are present in the gray "coating", for example calcium carbonate, or barium even? (This may lead to the requirement for further analysis, for example by the Jäger's laboratory).
- Is there a dirt layer above and/or below the gypsum?
- What evidence is there regarding the potential source and formation process of the "coating" (possible past conservation treatment, sulfation due to pollution), and whether this source and process is ongoing or historic?
- If the gray "coating" is lacking in cohesion, to what extent can the gypsum be removed mechanically?
- How best is this layer described as a "coating" or "crust"?

Other salts

The intention is to find out whether nitrates are present in the plaster, in order especially to inform a potential treatment with barium.

- If nitrates are present, what is the quantity and distribution of nitrates through the stratigraphy? (This quantitative analysis is a second step, and would require more sophisticated analysis (e.g. ion chromatography). This is important in respect to the problems associated with a barium treatment where nitrate salts are present. If nitrates are present and near the surface perhaps the levels can be reduced (if a barium treatment were to be undertaken).
- Is barium present already (possible past conservation treatment)?
- Are other soluble salts present in the samples? If yes, is it necessary to undertaken additional quantitative analysis using ion chromatography?

Plaster layers

The aims here are to establish whether a consolidant is required for the plaster, and, if yes, whether barium could provide sufficient consolidation and/or whether grouting would be required to improve the adhesion of the plaster layers. The main problem is likely to be the adhesion of the "arriccio" plaster to the rubble/earthen support, which is not part of the samples.

- Can two (or more?) distinct plaster layers be identified?
- Is there any evidence of the rubble/earthen support on the underside of the "arriccio" ?
- Do the different plaster layers differ in their composition (binder, aggregate, additives)?
- Do they differ in their coherence?
- Are any, or all, of these plaster layers lacking in cohesion (i.e. requiring consolidation)
- Are the layers poorly or well adhered to one another?

An aim for the two following questions, is on the one hand, to question whether a consolidation treatment could be beneficial in reducing the hygroscopicity of the organic inclusions, or whether this is too risky and one should rely on preventive measures. On the other hand, answers to these questions can give information about the risks of activating and accelerating the deterioration process by using aqueous treatments.

- Can the organic inclusions best be described as chaff, or straw chaff, or can its source material be otherwise identified and described? [As mentioned above, these hygroscopic organic inclusions have led to many small losses in the surface of the paintings, and this deterioration process is ongoing].
- What other inclusions are present within the stratigraphy (organic and inorganic)?

Paint layer/layers

- Is there more than one paint layer?
- Is there evidence of a discrete layer of organic material on top of the paint layer? Could this be an original varnish? Conservator Connie Silver observed a yellow-brown oily residue on the painting (under the gray "coating") during the summer of 2010.
- To what extent are the paintings executed in fresco and/or a secco. Is there any evidence for this?
- Can a binding medium for the paint layer be identified? (Possibly requiring further analysis)
- Is there any evidence of a ground/sealant/imprimatura/or dirt layer below the paint layer?

If an original organic binding medium is present, or any pigments sensitive to pH, the question is to what extent the paint layer would be susceptible to damage from high pH treatments, for example, an ammonium carbonate/barium treatment.

- What is the pH sensitivity of the paint layer(s) (pigments, binding media)?
- What is the sensitivity of the paint layer(s) to liquid water?

An aim here is to determine whether consolidation —or fixing— is required and whether the dispersant should be solvent or aqueous. To better determine the efficacy of different consolidants insofar as they can alter the porosity of the paint layer/plaster, and to what extent this would be beneficial or otherwise.

- How good is the cohesion within the paint layer/s
- How good is the adhesion of the paint layer to the "intonaco" ?

The following section (Appendix 6) contains the results of an analysis of samples from Moni Perivolis. The analysis was performed by Dr. Christine Bläuer of Conservation Science Consulting Sàrl in Fribourg, Switzerland, based on the background and questions discussed above.

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July 22, 2010

Connie Silver
310 Riverside Drive, #1001
New York, NY 10025

Re: Orion Project No. 1646
Via: email as a PDF to c.s.silver@worldnet.att.net

Dear Connie,

Thank you for asking Orion to assist your study of samples from Lesvos:

- Sample 1, St. Andrew red drapery before cleaning
- Sample 2, green drapery not cleaned
- Sample 3, red drapery after cleaning

Methods

Orion examined the film canisters using a research stereomicroscope and selected visually representative sub-samples of the samples for analysis of chemical composition using infrared microspectroscopy (FTIR).

Observations and Results

Visual examination of each sample using a stereomicroscope revealed relatively thick, nearly continuous gray coatings on the surface of samples 1 and 2, and a thinner, discontinuous islands of gray coating on the surface of sample 3.

Removal of samples revealed that each gray coating lacked any significant cohesive strength. In other words, the gray coatings powdered on contact.

Visual examination of FTIR samples in the course of analysis revealed scattered colored and black particles. FTIR analysis of each gray coating sample showed the presence of gypsum (calcium sulfate dihydrate). FTIR spectra of the gray coatings on samples 1 and 2 also show calcite and weak carbon-hydrogen and carbonyl stretching bands, which likely point to an oily or fatty material. The FTIR spectrum of the gray coating on sample 3 shows kaolin (clay) and stronger carbon-hydrogen and carbonyl stretching bands, plus additional bands that point to the presence of metal soap(s). The frequency of the carbon-hydrogen and carbonyl stretching bands points to fatty/oily material(s).

Please let me know if you have further questions or would like additional analyses of the samples.

Very truly yours,

James Martin

Orion Analytical, LLC
By James Martin

Appendix 6: Wall Paintings Analysis—Findings

R.0214.01

GR – LESVOS, MONI PERIVOLIS, MEDIAEVAL MONASTERY CHURCH

PLASTER SAMPLE ANALYSIS

Client
Prof. Adrian Heritage ACR
Cologne University of Applied Sciences
Fachhochschule Köln
CICS - Cologne Institute for Conservation Sciences
Institut für Restaurierungs- und Konservierungswissenschaft
Ubierring 40
50678 Köln

Image: Big fragment of painted plaster. Image width ca. 10 cm

Abstract:
One plaster sample was examined and described using a binocular microscope. Additional tests were performed using polarising light microscopy (e.g. in dispersion), microchemical tests and FTIR analysis on microscopic particles of selected component materials (binder, pigment particles, possible salt crystals etc.) to provide further information on the inorganic and also organic components present.
The plaster contains probably of two layers of lime mortar, with the main difference of plant fibers in the lower layer and maybe a small amount of hydraulic material in the intonaco. Both mortar layers seem to contain water soluble salts consisting of calcium, magnesium, nitrates, sulfates and probably chlorides.
The gray, sticky surface coating on the paint layer contains as well some gypsum as organic materials.
Further investigation will be necessary to answer the additional questions.

Date: Fribourg, 29.11.2011
Distribution: See list at the end of the report

Person in charge:
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Content

1 Introduction

Preliminary observations were made of the Moni Perivolis church during the summer of 2010 by C.S. Silver.[1] During this campaign several samples were taken to be analysed.[2] Three more samples were analysed by ORION analytical LLC.[3] They did find gypsum as well as organic material, oily or fatty, by means of FTIR analysis.

Prof. Adrian Heritage was then commissioned by the WMF to provide an assessment of the wall paintings at the church of Moni Perivolis, Lesvos, Greece.
He suggested the following preliminary investigation of the material composition of the existing samples:

1) a careful examination and description of the samples using a binocular microscope;

2) further analysis using polarising light microscopy (e.g. in dispersion), microchemical tests and FTIR analysis on microscopic particles of selected component materials (binder, pigment particles, possible salt crystals etc.) to provide further information on the inorganic and also organic components present;

3) thin section analysis could be commissioned to provide further information on the plaster layers a) if this is physically possible (given the condition of the samples); and b) if it is required (on the basis of questions either not answered or arising from parts 1 & 2)

Here we report on the results of the first two of the suggested points.

2 Questions to be answered

The questions to be answered, were formulated by Prof. A. Heritage. They are listed in chapter 6 together with the answers that are so far possible to give.
Here only the topics the questions consider are given:

- Surface coating including gypsum
- Other salts
- Plaster layers
- Paint layer/layers

3 Samples

According to the 2010 preliminary observations, only one plaster sample was taken. Probably because its fragility it has broken into three parts. When arriving here the three parts were named big, small and crumbly sample respectively (see images in the annex chapter 7.1 of this report).
Further 10 samples and their cross sections were sent to our laboratory (sample number 1 to 8, 10 and 11). Some of these samples were briefly looked at but not included in this study. From the short examination it can only be stated, that the cross sections look professionally done but would need polishing before they could be properly examined.

[1] All information on the church, the sampling, and the so far executed studies stated here derive from the preliminary observations of the 2010 field season, under the direction of Constance Silver, hereinafter referred to as “2010 preliminary observations”.
[2] Sample locations are provided in **Appendix 5** of the WMF Lesvos report.
[3] The report from July 22, 2010 is provided in **Appendix 5** of the WMF Lesvos report.

4 Analytical procedure

The samples were first photographed (see appendix chapter 7.1) and examined using a binocular microscope with a magnification of about 70x.
Then small particles from the individual layers were selected for the diverse analysis (see figures 7.1.4 and 7.1.5).

Microscopic analysis of dispersions:

Selected particles are slightly crushed on an object slide and immersed in a blue light hardening resin (refractive index of the polymer of n = 1.527) covered with a covering slide and analysed by means of polarized light microscopy.[4]

Mainly inorganic constituent can be identified by comparing their optical properties with known materials (known from experience and from published tables).

Dissolution behaviour in cold 2-molar hydrochloric acid (= HCl 2M):

Lime (calcite) is dissolved very quickly with strong effervescence;

Dolomite and other carbonates (e.g. magnesite) are only dissolved very slowly or even not at all.

If the sample contains calcite ($CaCO_3$), an additional sulphate content can be observed by the crystallization of gypsum ($CaSO_4.2H_2O$) upon drying of the solution.

Mica, quartz, feldspars, clay minerals and ochre pigments remain mainly unchanged.

Micro-chemical test for Magnesium with Titan Yellow[5]:

This can either be done on a drop of the water extraction of the material or on the material dissolved in 2M HCl. In the first case only the water soluble Mg is detected. In the case of the water extraction the solution is acidified with little HCl 2M. Then a drop of Titan Yellow solution[6] is added to one or two drops of the acid sample solution. Then some caustic soda solution 2M is added to the test drop.

If Mg is present a red precipitate is formed.

Micro-chemical test for Calcium with 1M sulphuric acid[7]:

One drop of 1M sulphuric acid is added to the sample solution.

If the sample solution contained calcium, gypsum($CaSO_4.2H_2O$) is formed upon drying.

Micro-chemical test for Sulphates with calcium chloride solution[8]:

One drop of $CaCl_2$-solution is added to the sample solution.

If the sample solution contained sulphates gypsum($CaSO_4.2H_2O$) is formed upon drying.

Detection of nitrates by means of Merckoquant®-test strips:

A few drops of demineralised water are added to a material particle, the test strip is briefly dipped into this solution, excess water shaken off and the result can be seen in a colour change or not after 1 minute.

Infrared spectroscopy (FTIR):

Some very small particles were analysed by means of Fourier-Transform-Infrared spectroscopy (FTIR) (instrument: Bruker ALPHA-P; preparation technique: diamond ATR; measuring region: 4000 - 375 cm^{-1}, number of scans 24, resolution 4 cm^{-1}).

The produced measuring curves can be interpreted in comparing with spectra of known material.

The detection limit is about 2%.

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[4] Microscopy of mortars according to Bläuer, C. & Küng, A. (2007). "Examples of microscopic analysis of historic mortars by means of polarising light microscopy of dispersions and thin sections." Materials Characterization 58 (2007), 1199-1207. Microscopy of salts according to Bläuer Böhm, C. (1994): "Salzuntersuchungen an Baudenkmälern." Z. Kunsttechnologie und Konservierung, 8/1, 86-103.
[5] Thiazol yellow G; $C_{28}H_{19}N_5Na_2O_6S_4$; see: http://de.wikipedia.org/wiki/Titangelb
[6] Titan Yellow solution = 10mg/10mlH_2O; according to: https://www.uni-rostock.de/fakult/medfak/biochem/materialien/praktikum/med/zahnhartgewebe_speichel.pdf
[7] According to Bläuer Böhm, C. (1994) in note 5

5 Results

From the macroscopical investigation and the observation using a binocular microscope it seems, that the mortar consists of two layers (figure 7.1.1).
The ground layer of the plaster contains plant fibres. Its binder is beige to white. Very rarely, extremely fine, sometimes coloured aggregate particles can be observed. The mortar contains some small spherical pores, that look like air bubbles.
The top layer, it is called here intonaco, is a few millimetres thick and seems to have a very similar composition to the ground layer, but it does not contain any plant fibres and only the intonaco layer contains some extremely small, reddish, granular particles that look a bit like brick particles.
In the samples analysed here the paint layer(s) on top of the intonaco is dominated by reddish colours (see figures on title page and appendix 7.1).
For the further analysis of the plasters some particles already fallen off the small sample were selected (figures 7.1.4 and 7.1.5). In the dispersions of both layers the binders look very similar. It forms brown, fine grained aggregates with medium to high birefringence. In the dispersion samples of both layers no aggregate grains could be observed. In the dispersion of the intonaco a few isotropic grains with refractive indices of about 1.54, interpreted as halite (NaCl), could be observed.
Both the ground layer and the intonaco dissolve very quickly in HCl 2M. Only very little insoluble material in form of small crystalline grains remain untouched by the acid.
In the samples of the both mortar layers calcite ($CaCO_3$) is the main constituent (see FTIR-spectra in figure 7.2.1). From the same FTIR-spectra it can be seen that the samples probably contain some hygroscopic water (peaks in the 3500 cm^{-1} region) and probably silicate minerals (small peaks in the 1100 cm^{-1} region).
The sample of the ground layer contained nitrates, traces of chlorides, calcium and magnesium in the water extraction.
The sample of the intonaco (lower part of the sample in figure 7.1.5) contained nitrates, calcium and magnesium in the water extraction. Although halite (NaCl) could be observed in the dispersion, the test for chlorides was negative.[8]
The painted surface of the particle in figure 7.1.5 with about 0.2 mm of the under laying intonaco was separated mechanically. In the FTIR-spectra of the painted surface traces of gypsum as well as organic material could be found. The same sample was then dissolved in 2M hydrochloric acid. Upon drying some rare gypsum crystals did form. Sulphates could only be detected within the painted surface and not in the lower part of the same sample particle and neither in the tested ground layer particles.
The painted surface of the big sample is at places covered by a gray coating (figures on title page and figures 7.1.6 and 7.1.7). In the sample this coating has a greasy, sticky touch. It can be scratched off with a scalpel, however not completely removed by this method as it seems to stick to the underlying paint layer.
The FTIR-analysis of the outer surface of a splinter of the paint layer of the big sample or of the scratched off coating show as only difference a little amount of gypsum in the first type of sample. Both sample preparations indicate organic material (peaks around 1640 and 1730 cm^{-1}).
External surface and back side of the maybe 0.2 mm thick surface of the particle in figure 7.1.5 were analysed with quite different results. Only the external surface showed detectable amounts of gypsum, the backside showed a nearly pure calcite spectra (figure 7.2.3).

[8] It is not possible to use exactly the same sample for both the micro-chemical analysis and microscopy. The particles used for the micro-chemical testing was extremely small.

6 Questions[9] and preliminary answers

6.1 Surface gypsum

• Can gypsum be identified elsewhere in the stratigraphy, and if so, is gypsum present in the plaster layers as part of the plaster matrix or otherwise?

So far not really and only very little gypsum in the coating.

• What other materials are present in the gray “coating”, for example calcium carbonate, or barium even? (This may lead to the requirement for further analysis, for example by the Jäger’s laboratory). For example, olive oil and wax from lamps and candles, other dirt and debris?

There is most likely organic materials present, proteins ? oils? A Ba-content cannot be analysed with the methods accessible to us. It could e.g. be seen with the XRF of Jägers’ Laboratory.

• Is there a dirt layer above and/or below the gypsum?

It is not a uniform gypsum layer, but a layer that has a greasy, sticky touch and which contains maybe at places gypsum; the layer is not everywhere the same thickness and even absent at places.

• What evidence is there regarding the potential source and formation process of the “coating” (possible past conservation treatment, sulfation due to pollution), and whether this source and process is ongoing or historic?

Not enough gypsum, I do not even know if gypsum is the main problem.

• If the gray “coating” is lacking in cohesion, to what extent can the gypsum be removed mechanically?

Unfortunately in the samples it seems to stick quite well on the surface.

• How best is this layer described as a “coating” or “crust”?

In the samples it is definitely a coating

6.2 Other salts

• Particularly in respect to a potential barium treatment, are there any nitrates present?

Yes, plenty of nitrates and the water soluble cations are mainly Mg and Ca.

• If nitrates are present, what is the quantity and distribution of nitrates through the stratigraphy? (This quantitative analysis is a second step, and would require more sophisticated analysis (e.g. ion chromatography). This is important in respect to the problems associated with a barium treatment where nitrate salts are present. If nitrates are present and near the surface perhaps the levels can be reduced (if a barium treatment were to be undertaken).

In the samples analysed here, nitrates could be detected in the intonaco as well as the ground layer of the plaster.

• Is barium present already (possible past conservation treatment)?

Cannot be answered here. Needs further analysis with specialized equipment.

[9] The questions are listed here as formulated by Prof. A. Heritage

• Are other soluble salts present in the samples? If yes, is it necessary to undertaken additional quantitative analysis using ion chromatography?
Difficult to decide; if salt damage is visible – yes; if salts hinder treatment yes; profiles in depth to know distribution (and source) at several levels above ground?

6.3 Plaster layers

• Can two (or more?) distinct plaster layers be identified?
To me it looks like two;
1. What is called here "intonaco", without plant material, a few millimeters thick;
2. A ground layer with a lot of plant material, might be wood, might be straw, I cannot tell.

• Is there any evidence of the rubble/earthen support on the underside of the "arriccio"?
Not in the samples provided.

• Do the different plaster layers differ in their composition (binder, aggregate, additives)?
No, apart from the plant material in the ground layer and some supposed brick in the intonaco, they seem to be very similar.

• Do they differ in their coherence?
Cannot be said here.

• Are any, or all, of these plaster layers lacking in cohesion (i.e. requiring consolidation)
From the samples it looks as if yes, but have they ever been stronger?

• Are the layers poorly or well adhered to one another?
Very well, not easily distinguishing layers.

• Can the organic inclusions best be described as chaff, or straw chaff, or can its source material be otherwise identified and described? [As mentioned above, these hygroscopic organic inclusions have led to many small losses in the surface of the paintings, and this deterioration process is ongoing].
Maybe the best thing to do, would be to look (measure) whether the plant materials are actually hygroscopic (in the climate at Moni Perivolis).

• What other inclusions are present within the stratigraphy (organic and inorganic)?
Very little very small sized sand grains.

6.4 Paint layer/layers

• Is there more than one paint layer?
Sometimes it looks like it sometimes not see images.

• Is there evidence of a discrete layer of organic material on top of the paint layer? Could this be an original varnish? Conservator Connie Silver observed a yellow-brown oily residue on the painting (under the gray "coating") during the summer of 2010.
No answer can be given so far.

• To what extent are the paintings executed in fresco and/or *a secco*. Is there any evidence for this?
No answer can be given so far.

• Can a binding medium for the paint layer be identified? (Possibly requiring further analysis)
There are organic materials present near/in/on the surface; further tests might be worthwhile.

• Is there any evidence of a ground/sealant/imprimatura/or dirt layer below the paint layer?
Not until now, but….?

• what is the pH sensitivity of the paint layer(s) (pigments, binding media)?
Further analysis needed to answer that or need for in situ tests.

• what is the sensitivity of the paint layer(s) to liquid water?
No answer can be given so far.

• How good is the cohesion within the paint layer/s
No answer can be given so far.

• How good is the adhesion of the paint layer to the “intonaco”?
from the samples it looks as if it was very good.

Fribourg, 29.11.2011

Conservation Science Consulting, Sàrl

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Mineralogist

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7 Appendix

7.1 Sample photographs

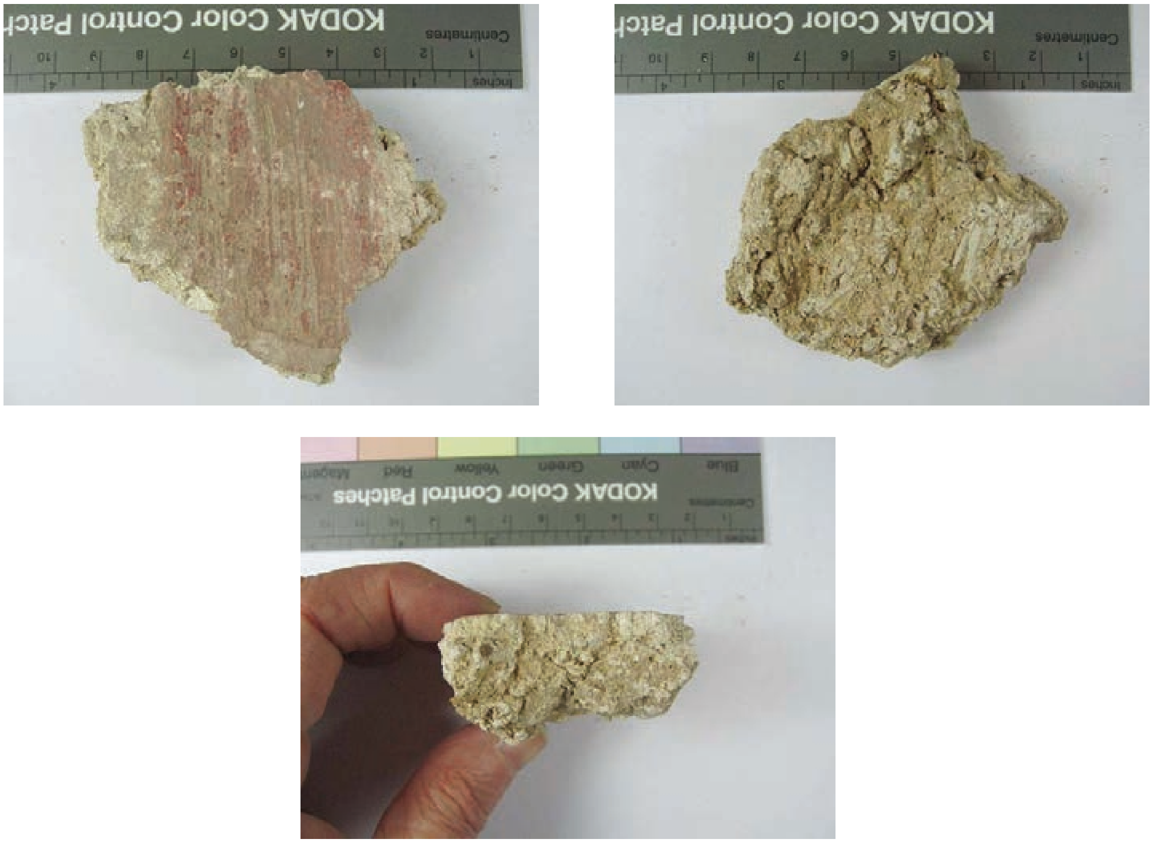

Figure 7.1.1: Big Sample. Top right: outer surface; top left: back side; below: side view. Image widths ca. 11 cm.

Figure 7.1.2: Small sample. Right: outer surface; left: back side. Image width ca. 11 cm.

Figure 7.1.3: Crumbly sample. Image width ca. 11 cm.

Figure 7.1.4: Particle used for the analysis of the ground layer

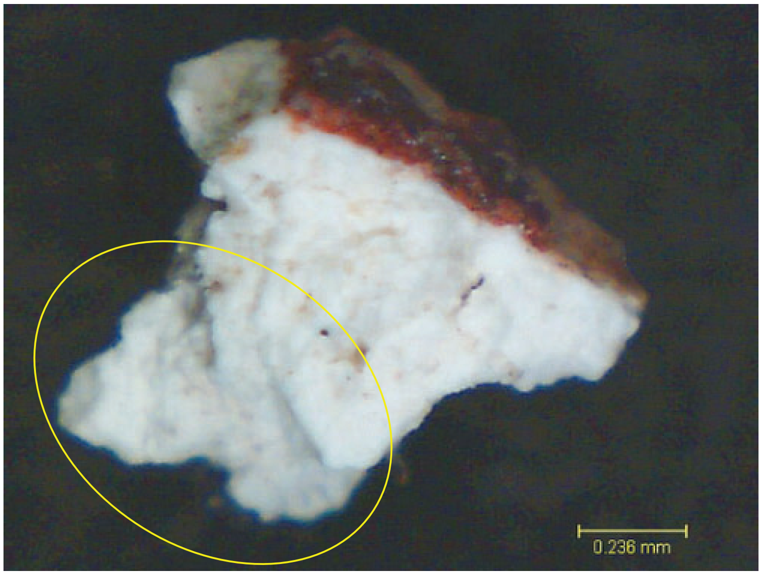

Figure 7.1.5: Particle used to analyse the intonaco from the small sample with red paint layer. Part in yellow circle used for microchemical testing of salts

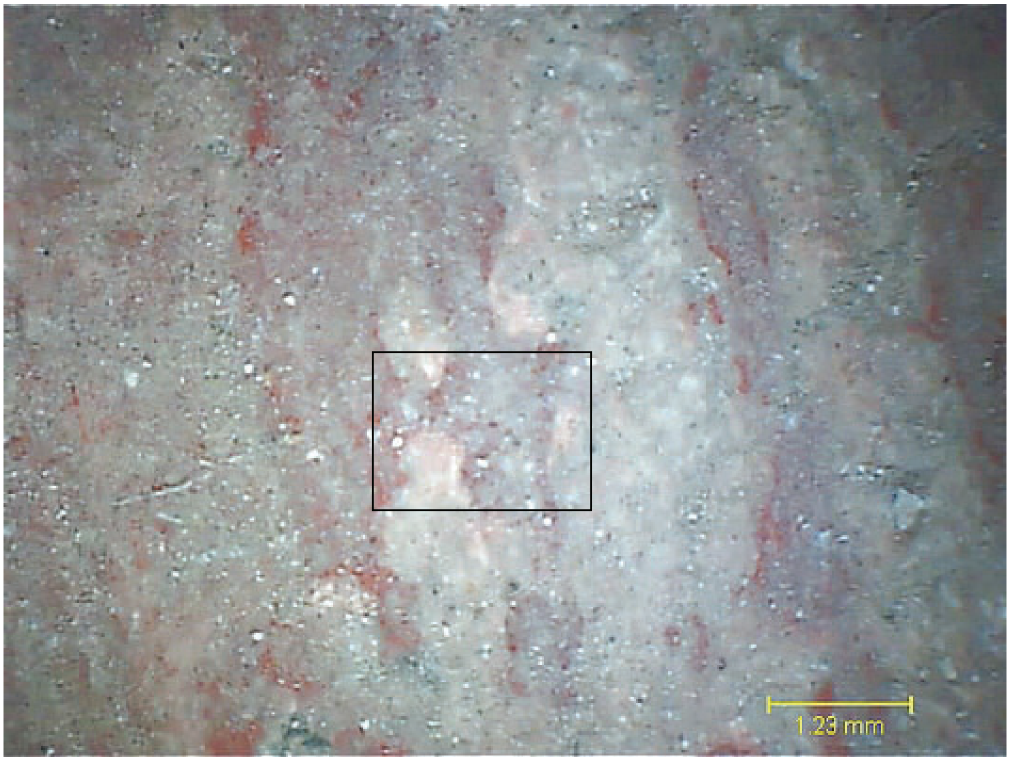

Figure 7.1.6: Macroscopic view of the painted surface of the big sample. The frame in the middle indicates the emplacement of the image below.

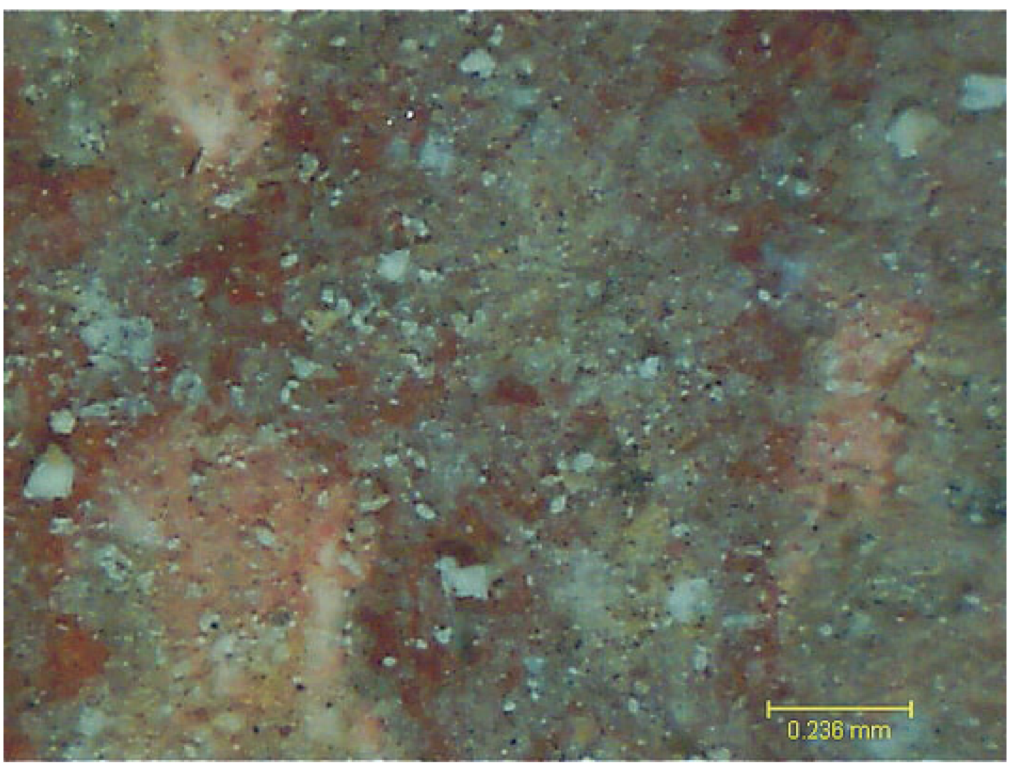

Figure 7.1.7: Macroscopic view of the painted surface of the big sample.

7.2 FTIR-spectra

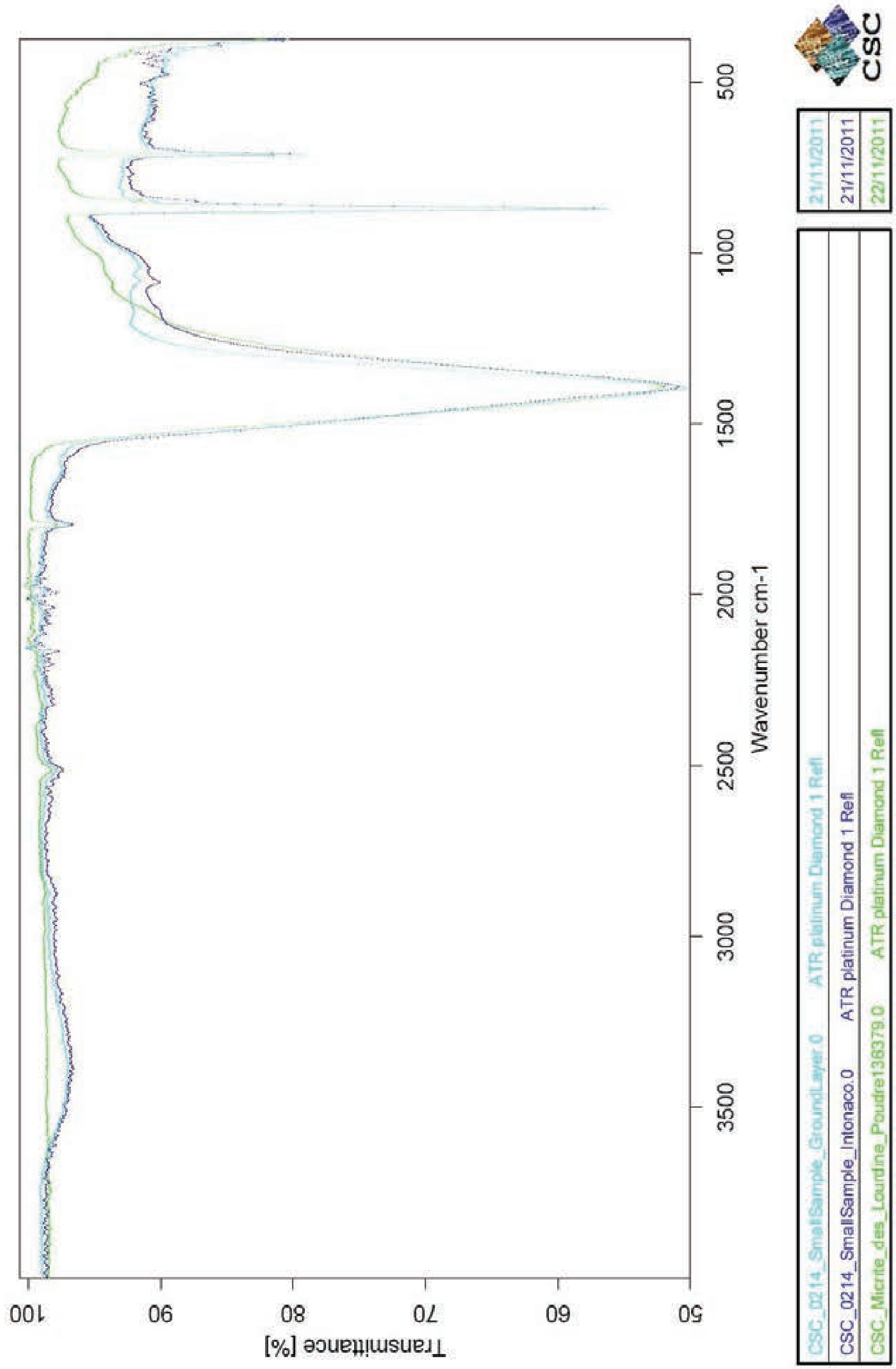

Figure 7.2.1: FTIR spectra of the two mortar layers (without the plant material) compared to a limestone (micrite) containing nearly only Calcite ($CaCO_3$)

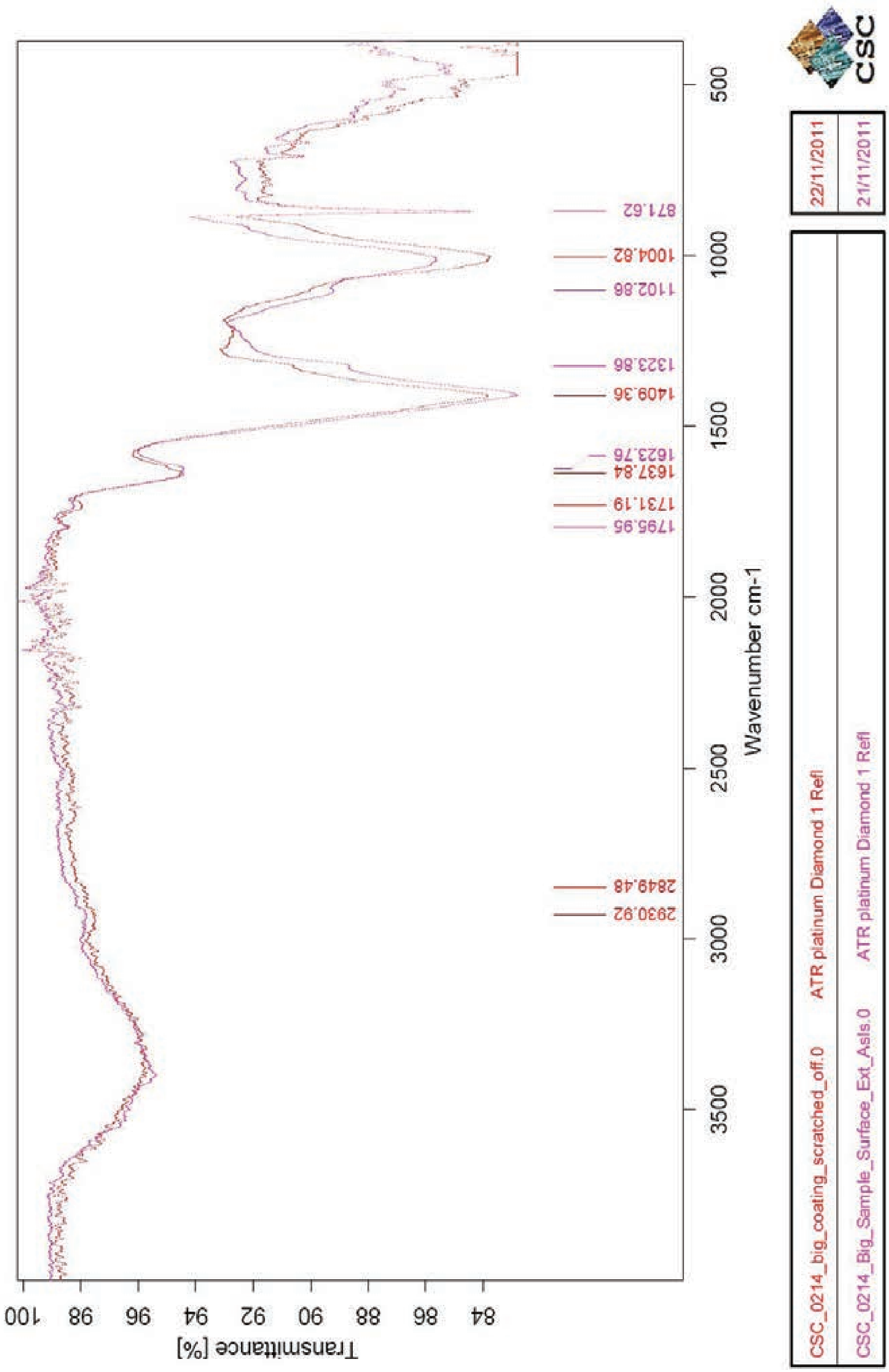

Figure 7.2.2: FTIR spectra of the surface coating of the big sample. Red coating separated with a scalpel; magenta: coating side measured as is.

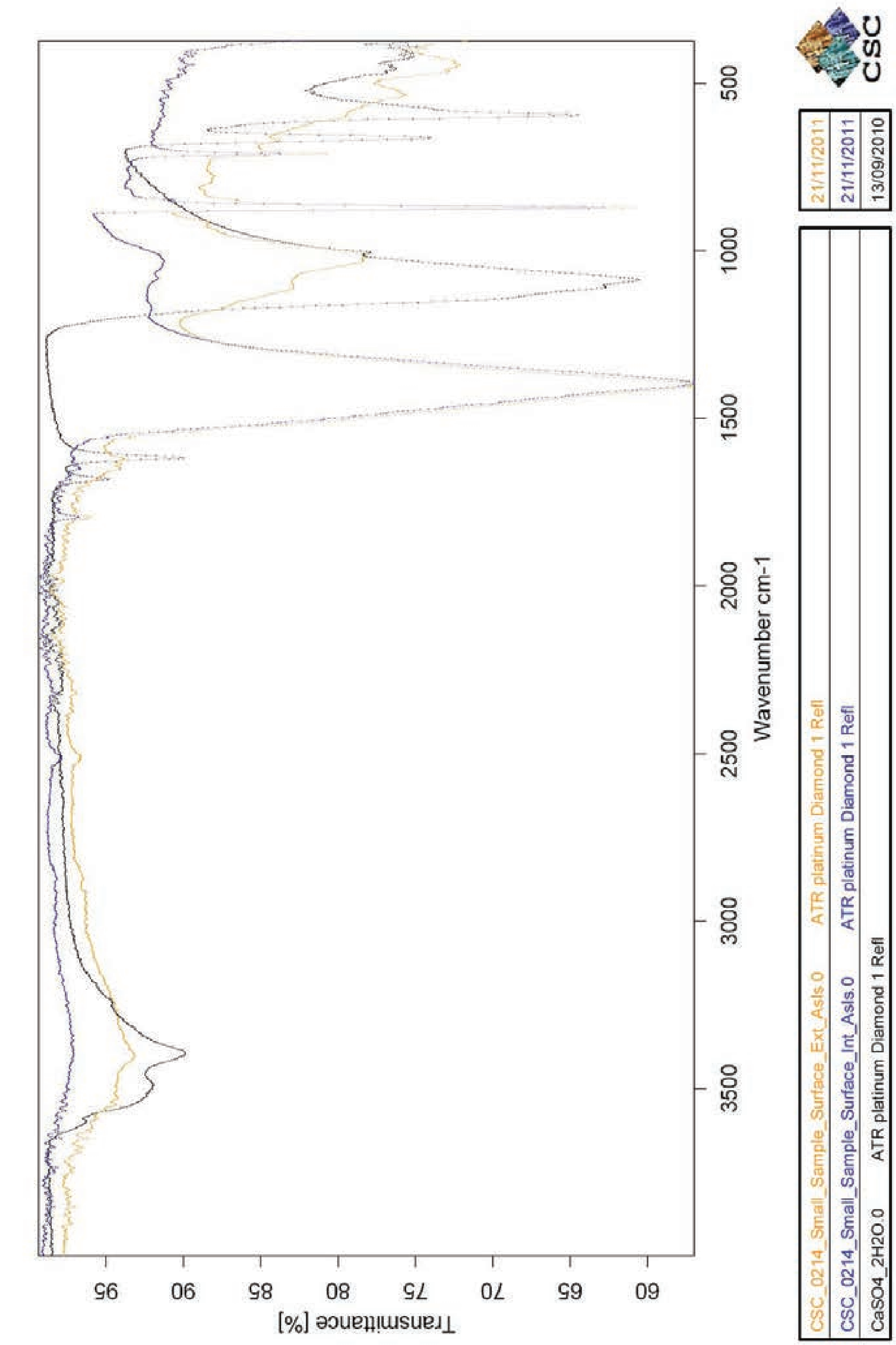

Figure 7.2.3: FTIR spectra of the surface coating of the big sample. Red coating separated with a scalpel; magenta: coating side measured as is.

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