



***“NDT prospection in the study, implementation and monitoring of the rehabilitation of the Holy Aedicule of the Holy Sepulchre in Jerusalem within the Scientific integrated governance”,  
presentation of a collective work by Professor A. Moropoulou, NTUA***

The Holy Aedicule in the Church of Resurrection in Jerusalem has undergone many building phases throughout its history. The latest building phase was implemented by architect Kalfa Komnenos in 1810 after a destructive fire. This latest Aedicule has, however, sustained significant damage and deformations in the last two centuries that need to be addressed in order to ensure the structural integrity and sustainable preservation of this unique monument. An interdisciplinary study was conducted by the NTUA team for the Protection of Monuments, after invitation by his Beatitude, Patriarch of Jerusalem, Theophilos III, in order to diagnose the prevailing decay factors and to assess the state of preservation of the Aedicule. According to the results achieved, appropriate and compatible restoration and conservation materials and interventions were proposed and planned.

The study indicated that the observed buckling at the lower parts of the Aedicule is mainly attributed to the swelling of the masonry at its lower level and the degradation of mortars. A historic cause of the swelling was the water precipitation through the open oculus of the dome above the Aedicule, until 1870. Thereafter, as investigated by NTUA, the main source of humidity is the uptake through capillary rise from the surrounding water canals and underground voids. Thus, it was decided to rehabilitate the Aedicule and ensure its structural integrity, to address the humidity problem, to preserve the values of the monument and achieve a state of sustainable preservation, while fulfilling the requirement that the monument be accessible to pilgrims throughout the duration of the works.

The works follow a strict procedure. First the marble panels were disassembled and the slabs were removed and transferred to the Conservation Laboratory. Behind the slabs, the Komnenos filling mortar, which was found in a bad state of preservation, was removed. The inner masonry of the structure was revealed and the joints were cleaned of disintegrated or loose mortars. The compatible and performing restoration mortar, as selected during the study, was applied to repoint the masonry. Poorly constructed parts of the masonry, which posed a risk to the structural integrity of the structure and the preservation of the Holy Rock, were repaired, even reconstructed, where needed, using the restoration mortar and new-cut compatible and performing stones. The dislocated columns are being reset.

Preparations for the grouting of the masonry involved many interconnected projects in order to ensure the control of the grouting process, while preserving the values of the monument: partial removal of internal facings in order to obtain visibility of the Rock; measures in order to protect the Arcosolium interior during the grouting process; interventions in the interior staircases and the Chapel of the Angel; interventions regarding the conservation and protection of wall paintings; interventions to protect metal elements in the masonry; detection and sealing of underground canals and voids. When the grouting is completed, the slabs will be repositioned and each anchored with titanium elements to the masonry; the reset columns will also be secured to the masonry with titanium anchors and an appropriate filling mortar will be applied between the marble panels and the masonry.

After the completion of the above, the exterior scaffolding of iron girders, installed by the British Mandate in 1947, will be removed, cleaning and protection interventions regarding the stone slabs will be completed and the works will conclude with an underground intervention aiming to reverse the humidity uptake of the masonry through a complete conservation of the pavement.

The diagnosis and continuous on-site monitoring of the works, connected with the implementation study conducted by the NTUA interdisciplinary team, has verified the NTUA study conclusions. Non Destructive multispectral prospection comprised by Ground Penetrating Radar, Infra-Red Thermography, Fiber Optic Microscopy and Ultrasonic investigations prevails in:

- the documentation of the construction phases,
- the diagnosis of decay and pathology
- the monitoring of:
  - o The historic layers of the Holy Aedicule's internal structure.



- The compatibility and performance of the planned and implemented materials and rehabilitation interventions.

Scientific monitoring and documentation is operational regarding all issues at the center of the implementation project, as described above. In this direction, scientific monitoring is opening new research themes and demands the cross-fertilizing synergies amongst scholars and Christian communities at an international level. The findings and issues that arise deem continuous decision support as mandatory in the specific project, as the Holy Aedicule is the most important monument of the Christian World, with a rich history and many construction periods.

Meanwhile, a three-year monitoring period will occur, in order to assess the thermo-hygric performance and structural, dynamic and static health of the structure by planning and installing a proper network of sensors. Furthermore, the effect that the high flow of pilgrims has on the structure will be monitored as well. For an integrated documentation and the continuous monitoring of the works and research evolution, an innovative Information System is currently under development that can serve current or future needs with respect to data archiving, retrieval and analysis. In particular, based upon the geometric documentation of the monument, an optimized spatial database for storing and querying data that represent objects defined in a geometric space, will not only allow the spatial and time-data registration, assigned to multi-layer deformations, but will also enable optimal data querying. Thus, the various researchers from different disciplines will be able to register their data directly to the location and/or area where the measurements were made.

This innovative project is of great value and importance and at its completion, as well as during the three-year monitoring period, the Holy Aedicule will become a center of innovative applications, research and education. Key points are the interdisciplinarity among the different disciplines and the multi-interface interactions between the scientific teams, the working groups, the Technical Bureau of the Patriarchate and the three Christian communities, all under the authority of His Beatitude, Theophilos III. The Common Agreement of the Status Quo of the three Christian communities responsible for the Holy Sepulchre provides the statutory framework for the execution of the project. This project was initiated, became possible and is executed under the governance of His Beatitude, Theophilos III. Contributions from entities and persons all over the world secure the project's funding, the Mica Ertegun's donation through World Monuments Fund prevailing.

The rehabilitation of the Holy Aedicule is not only a structural issue or choice, but a choice to preserve the values of the monument. The Holy Rock is the initial structure, the core of the Holy Aedicule at the center of the Holy Sepulchre and the symbol of Christianity. It exists both as a physical entity and as a symbol and provides the archetypal meaning to the word Aedicule. The manmade structure was put in place after the destruction of the Holy Rock in order to complete and protect it. In addition, the preservation of the Holy Rock is intertwined with the preservation of the underground structure and the pavement.

This project is highly interconnected with the values of mutual communication and understanding, between different countries and different people with different religious backgrounds.