edited by Carlo G. CERETI, Roberta GIUNTA

PRESERVATION OF CULTURAL HERITAGE OF THE KURDISH REGION IN IRAQ

Italian Cooperation Project in Iraqi Kurdistan (2009-2010)

IsIAO

This volume was funded by the Directorate General for Development Cooperation
of the Italian Ministry of Foreign Affairs in the framework of the project
"Safeguard, Management and Promotion of Cultural Heritage of the Kurdish Region in Iraq".

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Table of Contents

Preface

It is with great pleasure that I present this publication, which gathers the results of the activities of the Italian Cooperation Project, *Preservation of Cultural Heritage of the Kurdish Region in Iraq*, entrusted to this Institute by the Ministry of Foreign Affairs and concerning an area in which IsIAO has great scientific prestige and credibility, earned over many years of hard and demanding work. IsIAO is in fact since a long time involved in the field of archaeological research in many countries of the Middle and Far East, in collaboration with universities and cultural institutions of Italy and of the host countries, also thanks to the financial support provided, through specific contributions, by the Directorate General for Development Cooperation of the Ministry of Foreign Affairs.

The scientific skills and experience gained in this field have also been offered to the Directorate General for Development Cooperation and to the Directorate General for the Mediterranean and Middle East Countries for the elaboration and implementation of programs of technical assistance in the fields of preservation and enhancement of Cultural Heritage and training of local staff.

This Cooperation Project was carried out in accordance and collaboration with the institutions of Iraqi Kurdistan in charge of preservation of Cultural Heritage, in particular the MoTh (Ministry of Tourism and Heritage), now Ministry of Municipality and Tourism, and the HCECR (High Commission for Erbil Citadel Revitalization).

During more than 18 months of work many activities and initiatives were implemented, in the fields of documentation, urban planning, design and development of GIS projects, restoration plan, archaeological surveys, cataloguing and valorization of the Museums' property and, above all, scientific and technical training of local experts. All activities aimed at providing a contribution for a better management and fruition of the Artistic and Cultural Heritage of the Kurdish Region in Iraq and the strengthening of its institutions.

This publication, edited by the two co-directors of the Project, Prof. Carlo G. Cereti and Dr. Roberta Giunta, offers all the fundamental information to understand the interventions carried out and the results achieved. And this edition is particularly convenient: the experience can be taken as a guideline for other realities, to straighten a field – that of Cultural Heritage – of great importance, in which the intervention programs have the prevalent aim of preserving and enhancing, as in this case, the important artistic patrimony of the area. The final aim was also of contributing to generate phenomena of sustainable development and therefore tangible improvements of both social and economic nature.

Gherardo Gnoli

President of Istituto Italiano per l'Africa e l'Oriente (IsIAO)

The support to the rehabilitation and the valorization of the cultural heritage of a Country where civilisation was born several millennia ago, and spread from there for centuries in other parts of the world, is a crucial aspect of the Italian engagement for the reconstruction of Iraq, according to a long Iraqi-Italian tradition of joint activities in this field.

The awareness of such heritage is a fundamental element of national identity and Nation building. And at the same time its recovery and viability are strong factors of economic and social development through their beneficial effects on tourism and on a wide range of job creating cultural activities and other related sources of employment.

Along with the support from Italy to the Iraqi museal system, notably in Baghdad, Nassiriya, Diwania and Najaf, the project implemented in Kurdistan by IsIAO with local counterparts for the Erbil Citadel with the support of the Italian Ministry of Foreign Affairs and of the Regional and Provincial Administrations in Erbil is a major component of this action, together with other initiatives conducted since few years in the Region, like the studies on the Paikuli tower carrying two inscriptions, the surveys at Sulaymaniya area, and the cataloguing at the Sulaymaniya, Erbil and Dohuk Museums with the view of their rehabilitation and development.

This book documents the work done by the Italian scholars and experts, remarkably led by Carlo Cereti and Roberta Giunta, together with their Iraqi colleagues. It describes the activities on the Erbil Citadel, the oldest urban site in the world continuously inhabited, and in particular the topographical survey, cartography and photogrammetry, the design of the restoration of one of its most beautiful buildings, the Rashid Agha *diwan khanah*, the preparation of the archaeological investigation and the establishment of a Geographic Information System of the site, as well as the work done on the numismatic collections of the Kurdistan Region Museums and the Cartography of the Paikuli area. The exchange of experiences among colleagues of both sides and training on the job are a key feature of the project.

It is certainly the beginning of a work which will continue, together with UNESCO and other partners, and which will further strengthen a solid experience of cooperation between Italy and Iraq in this field, with the awareness of the contribution that their peoples have given along the centuries to the history of Mankind.

Maurizio Melani
Director General for the Country Promotion
(Economy, Culture and Science)
in the Italian Ministry of Foreign Affairs
and Former Ambassador of Italy to Iraq

When in February 2009 the High Commission for the Recovery of the Citadel of Erbil asked Italy to finance a project aimed at the preservation and enhancement of the site, our Country accepted the proposal with enthusiasm. The experience and skills gained by Italian experts in that field made however Italy the natural partner. To this was added the desire to expand the already extensive cooperation between Italy and Iraq in the cultural and archaeological fields, in which our Country since many years performs high value operations. They are a priority of our contribution to the reconstruction of Iraq, whose renaissance also passes through the rediscovery and enhancement of its own Historic and Cultural Heritage.

The Erbil Citadel is one of the earliest urban sites of history. One of the first things I did after taking the charge of Ambassador of Italy to Iraq was to visit it. I was greatly impressed, not only by the majesty and beauty of the ruins, but also by the passion of the experts, Italians and Iraqis, who were working there. It's not a coincidence that, in addition to the recovery and revitalization of the Citadel, the Italian team focused heavily on the training, in order to ensure the sustainability of the interventions and to set the basis for an effective "follow-up".

Thanks to the skills of the experts of IsIAO who were responsible for the implementation of the Project it was possible to develop a restoration plan for one of the most significant, from the point of view of the historical and artistic value, Houses of the Citadel, also among the most heavily damaged. Working in close synergy with the Kurdish authorities, the Italian experts have laid the premises so that the masterpiece may return to the earlier glories and shape, through coordinated interventions at multiple levels: from the topographic survey of the subsoil exploration with the most innovative radar technology, from the graphic processing of the ancient structure to the studies on the consolidation of the foundations.

But the aim constantly pursued by Italy in this Project was not only that, yet essential, of contributing to the restoration of the Citadel. The ultimate goal, medium and long term, was the development of an integrated system able to protect and enhance the Historical and Artistic Heritage of the Kurdish Region and of the rest of the Country. In the same perspective may be explained the interventions, supported by our Country, focused at the valorization and cataloguing of the findings of the Museums of Erbil, Dohuk and Sulaymaniya, with particular regard to the remarkable numismatic heritage conserved in the three Museums. Again, the IsIAO researchers worked closely with the local authorities, transferring their knowledge to experts who will soon be able to perform these tasks independently.

Projects such as this here presented remind us of the benefits resulting from a serious international cooperation, focused and, above all, agreed between donors and beneficiaries. The rest is due to the excellent and increasing relations between Italy and Iraqi Kurdistan, as well as to the passion and proficiency of our archaeologists, our researchers and our experts.

Gerardo Carante
Ambassador of Italy to Iraq

This publication presents a summary of the major results achieved during the previous 18 months of work of the Italian Cooperation Project in Iraqi Kurdistan, which mark an important passage in the history of the collaboration between Italy and Iraqi Kurdistan, being the first phase directly sponsored by Italian Cooperation. The collaboration between the two parties began five years ago, in 2006. IsIAO was among the first institutions to begin a project in the Kurdish region of Iraq after the fall of Saddam Hussein's regime, thanks to an intuition of Amb. Riccardo Sessa, then Director for the Mediterranean and the Middle East of our Ministry of Foreign Affairs, and the active support of Prof. Gherardo Gnoli.

The first phase of the activities was run under the supervision of Amb. Gianludovico de Martino, who was at that time the Head of Task Force Iraq. A very important role was played by H.E. Baker Fattah Hussein, the present Ambassador of Iraq to Brazil, who helped us to organize our first inspections in Iraq. At that stage, our efforts were focused on the recovery of the Sasanian tower

of Paikuli, not far from the town of Darband-i Khan, about 100 km south of Sulaymaniya, and on a cooperation with the Museum of Sulaymaniya. Our aim was also to assist the local authorities in preserving the significant Cultural Heritage of the northern provinces.

In 2008, while designing the latter phase of the project, we had long talks with our Embassy in Baghdad, chiefly with Amb. Maurizio Melani, and with the Italian Cooperation led by Min. Elisabetta Belloni, who both suggested to include the Historical Citadel of Erbil in our project. Given the importance of the site, our team accepted this proposal with great enthusiasm.

Through consultation with the different institutions involved, we were able to devise a very ambitious project, whose organization was possible thanks to the precious support of Couns. Bellelli, Head of Desk Iraq at Italian Cooperation. The structure of this program included the participation of the three provinces building up Iraqi Kurdistan, Erbil, Sulaymaniya and Dohuk, and entailed two major lines of intervention:

1. Understanding and exploring the Cultural Heritage of the region and its potential of valorization:
   a. study of the territory (cartography of the area around Paikuli)
   b. study of the museums' collections (catalogue of the numismatic property of the museums of Sulaymaniya, Erbil and Dohuk).

2. Study and restoration of Erbil's historical Citadel:
   a. graphic and topographic documentation (Erbil Citadel, Rashid Agha *diwan khanah*)
   b. restoration project of the Rashid Agha *diwan khanah*
   c. archaeological investigations on the Erbil Citadel.

Thanks to the continuous and close cooperation with the local authorities, all the goals of the project have been achieved, though each to a different extent. If the Cooperation Project will have further steps – as we sincerely hope – more accurate results will certainly be earned for several of these activities.

We want to thank all those who have made this project possible. First of all H.E. Amb. Saywan Sabir Mustafa Barzani, Prof. Gherardo Gnoli, Min. Elisabetta Belloni, Amb. Maurizio Melani, H.E. Amb. Gerardo Carante and Couns. Massimo Ernesto Bellelli, who have all constantly sponsored our Project. The Kurdish partners, Arch. Dara Talaat Mohammed Ali al-Yaqoobi, Arch. Ranan Khasraw Tawfiq, Dr. Abubaker Othman Zendin, Dr. Kamal Rasheed Raheem, Dr. Hashim Hama Abdullah, Dr. Payadar Abdulmuhsen Muhammed, Dr. Haydar H. Husayn, and Dr. Hassan Ahmed Qasim Barwary, who allowed us to complete our activities. All the numerous local specialists with whom all we have had the pleasure to collaborate.

Finally, we would like to thank all the Italian specialists involved in the Project, as well as Dr. Antonella Martellucci, Sara Mattarozzi and Federico Franci, who have worked hard behind scenes. Last but not least, we wish to thank Arch. Anna Maria Ceci, who carried out the major part of the back stage work at the Ministry of Foreign Affairs, helping us to better define the Project both conceptually and from an administrative point of view.

Carlo G. Cereti
Full Professor, "Sapienza" University of Rome
Roberta Giunta
Full Researcher, University of Naples "L'Orientale"

Topographic Survey and Cartography in the Ancient Center of Erbil

1.1

Sven Stefano Tilia

The Citadel is certainly the element that most characterizes the city of Erbil and affects its whole urban plan. The development in concentric circles and radial disposition of the road network is a clear indication of such an organization, because the hill on which the Citadel stands – almost circular in shape – functions as a geometric and ideal fulcrum. The extraordinary continuity of life of this area emphasizes the important role that this site also plays in a rapidly evolving modern urban setting. It is therefore fundamental to have a cartography able to describe both the actual state and the buried evidence.

The first step, in any project concerning the topographical mapping of large scale areas, led to the acquisition of the maps used to integrate the new surveys. In collaboration with the HCECR and its technicians, all the available cartography was explored, choosing the map that had the detail to represent the town in all its components, and a scale sufficiently large to clearly distinguish every single structure. However, the most appropriate map was obtained processing an aerial image (probably satellite), certainly georeferenced but without proper perspective corrections. It was clear that a cartography with careful dimensional features was not available, much less in the scale required by the present project. It was therefore decided to create a new one, on the basis of satellite images, acquired through new generation satellites, suitable for a stereo-photogrammetric restitution process and appropriate software.

In the meantime, the surveying activity in the Citadel initially focused on covering two needs: the detail mapping of the Rashid Agha *diwan khanah* and the creation of a system of geo-referenced stations useful for other surveys in the area. For this purpose, we placed a fixed point on the roof of the house (also visible from the sky through an appropriate highlighting signal), whose function was to work as a basis for all the subsequent surveys and a control point for satellite mapping. The position of this point was measured with a single GPS antenna, obtaining the differential correction thanks to a US NGS (National Geodetic Survey) CORS station (Continuously Operating Reference Station) placed in the city of Erbil (hence at a perfectly useful distance): the necessary data were gained through a simple web download. After this first reference station, others were placed and all the points, necessary for the different planned surveys, were subsequently measured with a Total Station.

For the architectural survey of the Rashid Agha *diwan khanah* an adequate number of stations was positioned, for the measurement of all the points necessary for the realization of the plans, sections/prospects, and of the markers needed as control points for the terrestrial stereo-photogrammetry through the Menci system (Fig. 1).

Starting from the reference point described above, using the Total Station, we proceeded to the materialization of additional stations placed in appropriate positions to map the reference points – already placed by a local topographical company (Avaland Surveying and Engineering) on behalf of HCECR – in order to create a topographical network over the entire area of the Citadel. Such measurements allow, now and in the future, the integration of the data collected by the Italian

Fig. 1. Rashid Agha diwan khanah. Point acquisition and resulting plan view

Project with the existing and future ones.

In 2010, GPR (Ground Penetrating Radar) surveys were carried out as an additional task, not planned in the initial program. These surveys were to be placed within the topographic system that was gradually developing to better assess the position and extent of any possible anomaly in relation to the existing buildings. The base stations already in place have been particularly useful in the central area of the Citadel (close to the offices and the big flag), right where it was decided to start the GPR acquisition campaign. Such measurements were the detection of the 4 vertices of each investigated area (usually of rectangular shape) in order to fix their position inside the topographical grid; the height of the 4 vertices provided then the reference for assessing the depth of the anomalies found. The coverage of the entire main road (north-south) was not a problem since all the points to measure were visible, thus easily detectable with the Total Station placed on the already known stations. The necessary stations were added where it was not possible to map the investigated areas, as in the areas on the left and right of the South Gate, in the North Gate, in the narrow streets that are the direct branches of the main road (e.g. the one between blocks B43, B21 and B19), in the area south of the block B24 and between blocks B3 and B4 (both near the Rashid Agha *diwan khanah*). Using the station on the roof of the *diwan khanah* as a fixed base, direct measurements using differential GPS were taken in RTK (Real Time Kinematic) mode in all the areas where it would be too laborious to extend the topographical grid. This methodology was possible thanks to the reduced distance between the fixed base and the points to measure, and to the availability of the radio connection for real time calculation. On one occasion it was not possible to measure the points with the GPS directly because the areas to be surveyed were located inside a building (B18). In this case we used a mixed technique: materialization (with GPS) of two stations (reciprocally visible) on the roof of the examined building; positioning of the Total Station on one of these; orientation on the second and creation of a polygonal able to get inside the building and to allow the placement of a station for measuring of all the points necessary to define the areas of the GPR survey.

The sites of the coring carried out by the HCECR were located in addition to the survey areas. The exact location and height of departure of these cores will be useful in the analysis and calibration of the GPR results. Although we lacked an adequate cartography, all of these measurements were placed (with a certain degree of approximation) within the existing map (Fig. 2).

The mapping of the activities aimed at creating a possible new cartography of the Citadel began in the meantime. As mentioned above, the strategy consisted in obtaining satellite images, useful for a stereo-photographic restitution, with the highest resolution possible, in order to distinguish the individual structures in the urban context. Currently there are two products able to provide a level of detail higher than any other commercially available product: the sensors WorldView-1 (panchromatic only) and WorldView-2 (panchromatic and multispectral), belonging to the

DigitalGlobe company and to the GeoEye-1 (panchromatic and multispectral) of the homonymous company, both of which provide a resolution of 0.5 m (measured on the ground) per pixel. The choice between these was based on the availability of the product within the deadline of the project itself, rather than by its technical features. The GeoEye-1 images, while requiring a smaller number of GCP (Ground Control Points) would have taken one year of delivery! Therefore, the choice of the WorldView-2 images was obliged.

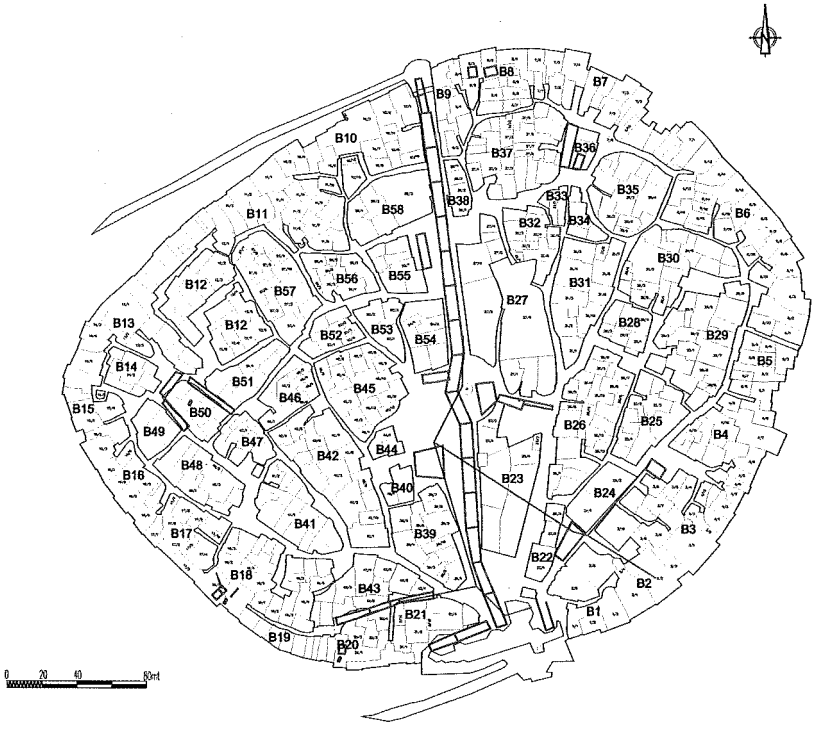


Fig. 2. Map of the Citadel. The red poligons indicate the GPR prospected areas, and the blue lines the topographic traverse

These satellite images were delivered in late 2010 in the form of a stereo-pair covering an area of 15 x 14 km. The vastness of the acquired area, compared to our needs, is due to the commercial type of the WorldView-2, that does not allow the purchase of smaller areas, in particular for products aimed at the stereo-restitution. This gave us the possibility of mapping the whole urban and suburban area of Erbil.

The software of digital stereo-restitution used in this project is the application suite called INPHO (Trimble), equipped with all the fundamental tools of inner orientation, relative and absolute, aerial triangulation (combination of a large number of stereo-pairs within a single project with a minimum number of control points), automatic generation of DEM (Digital Elevation Model) and subsequent editing of it, creation of true-orthophoto, creation of radiometrically corrected photo-mosaics (color uniformity between adjacent slides), and finally the possibility of using more traditional stereo-photogrammetric techniques for feature collection, through the independent module Summit Evolution (DATEM). In our case, however, the decisive feature was the possibility, through the exploitation of the RPC (Rational Polynomial Coefficients), to use images obtained from satellites such as Quickbird, Ikonos, Worldview (1 and 2) and GeoEye in the process of stereo-restitution. In particular, the last two sensors provide the opportunity to acquire

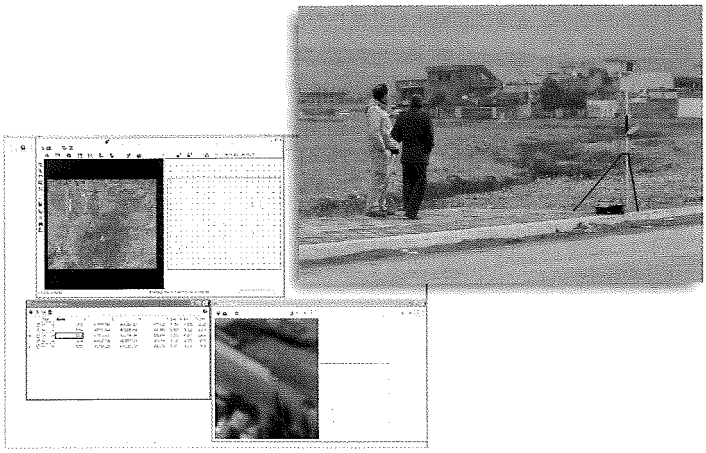


Fig. 3. Collecting the GCP (Ground Control Points) with differential GPS measurements

a product already developed for the use in stereophotogrammetry through images of the same subject obtained from different points of view in the same orbit (minimum time difference between the images). Remains anyway the need to acquire, through topographical surveying instruments, the GCP (Ground Control Points) for georeferencing the images.

The latest activities in Erbil were indeed devoted to the acquisition of the GCP (Fig. 3). Through an examination of the images, specific areas were identified (at the 4 corners and along the 4 sides of the images, as well as in the center, coinciding with the Citadel) inside which to look for elements on the ground that can be easily and clearly recognized in the images themselves. The methodology was difficult because some of these areas were not accessible (e.g. the airport area, occupying the entire north-west sector of the stereo-pair and a vast military zone along the west side) and we had to search for points in adjacent areas, even if not ideally positioned. With the acquisition of the GCP the next step of the stereo-restitution could be carried out. For now, the partial restitution of certain aspects of the Citadel is planned, and it would allow a better definition and positioning of the analyses performed therein, such as the profile of the buildings as a background in the representation of the sections illustrating the GPR surveys. It was not possible to complete the phase of production of the actual cartography in this first year, phase that we hope will continue next year (Fig. 4).

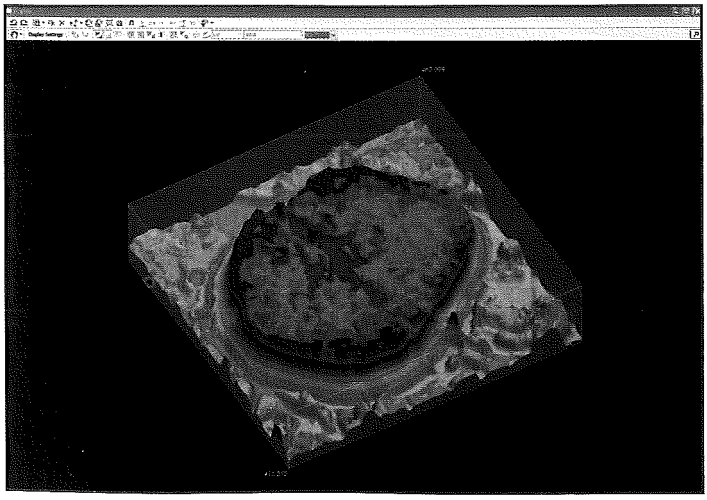


Fig. 4. Vertically exaggerated solid elevation map of the Citadel

The final product will be, as well as a digital cartography, a Geographic Information System, viewable and searchable in various ways and able of producing additional cartography, depending on the layers selected during the consultation.

The Graphic Documentation of the Rashid Agha *diwan khanah*

1.2

Angela Bizzarro

The graphic documentation (plans, prospects and sections) of the Rashid Agha *diwan khanah* is part of a wider georeferenced system concerning the Erbil Citadel. All the activities of topographic, photogrammetric and detail surveying were coordinated by the writer, with the involvement of Alessandro and Sven Stefano Tilia and the collaboration of Daniela Citro, Giolj F. Guidi, Rossana Nicolò and Bafreen Abdulqader Ali.

The restoration project of the building, coordinated by Giuseppe Morganti, will be planned on the basis of this careful survey (Fig. 1).

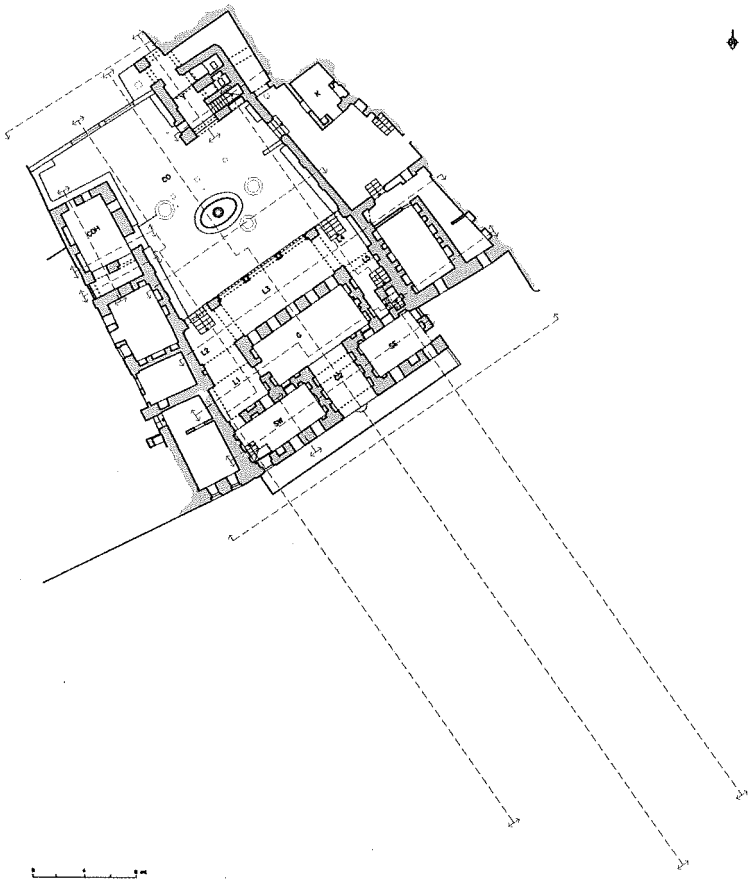


Fig. 1. Plan of the main floor, with the localization of sections and prospects

The first steps of the process were the positioning and survey – through differential, double frequency GPS (LEICA GX1230 GG) – of a datum point (identified by a nail) on the *diwan khanah* roof, with the aim of associating its position to the survey of other appropriately placed

points in the Citadel and creating a series of "baselines". These "baselines" were used both for georeferencing the archaeological evidence in UTM coordinates (WGS84), and for combining the plans of the *diwan khanah* with the other documentation of the surrounding structures (Fig. 1). A topographical traversal net was created with the use a LEICA TCR1205 total station. It comprises 59 stations and more than 7,400 measured points for detail-scale documentation.

The technical devices available today allow an integrated survey capable (depending on each case) of combining information gathered through different methods: in the present case-study the traditional mapping systems were associated with topographical survey, surface scanning and digital photogrammetry. The great amount of digital graphic restitutions obtained from the archaeological evidence under examination focused on the drafting of different aspects of the restoration project: from the structural and architectonic one to that related to wall surfaces, building techniques and analysis of decoration elements.

The methodology here presented implies a very careful survey, with a high metric precision. For the detail-scale documentation of the actual state of conservation of the *diwan khanah* a great number of plans (the main floor – including the eastern area and the harem in the west – the underground floor and the roofs), prospects and sections/prospects were created.

All the decorated wall surfaces were documented through the use of the Menci ZScan system (3D models and true orthophotographs), which allows the creation of 3D models of surfaces. The processing of such models made it possible to create mosaics of metrically corrected and measurable orthorectified images (Figs. 2-3).

The ZScan system is a useful tool for the acquisition of point clouds by using a high-resolution digital SLR camera with fixed lens, calibrated in the Menci Software laboratories, a precision slide with a recirculating ball bearing carriage and software based on an algorithm of multifocal analysis of images. Each 3D model is created using 3 images taken from fixed positions along the precision slide.

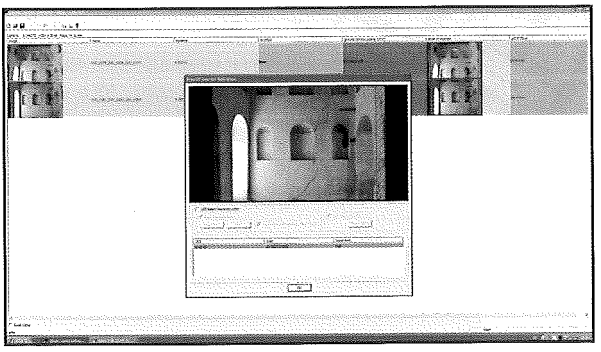


Fig. 2. Definition of the 3D models based on triple images

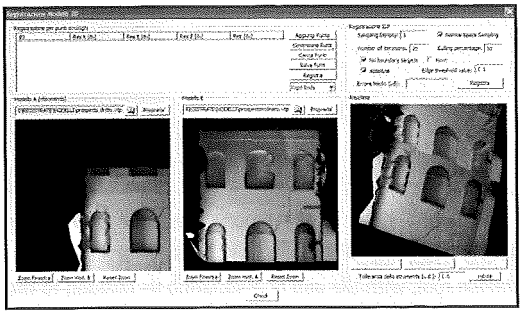


Fig. 3. Referencing of the different surfaces and creation of the actual ortophoto

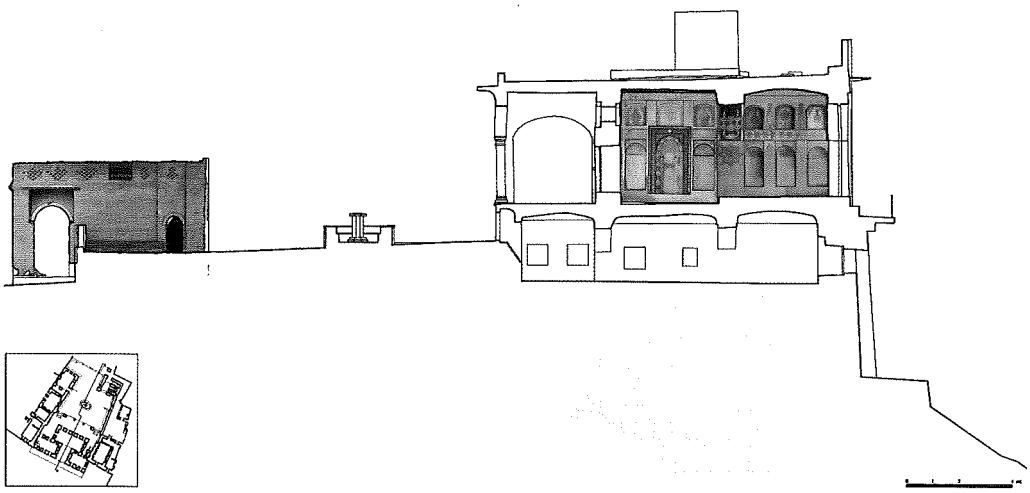
The point clouds obtained with this system show colors with photographic accuracy, and it is possible to visualize the related raster texture on every 3D model.

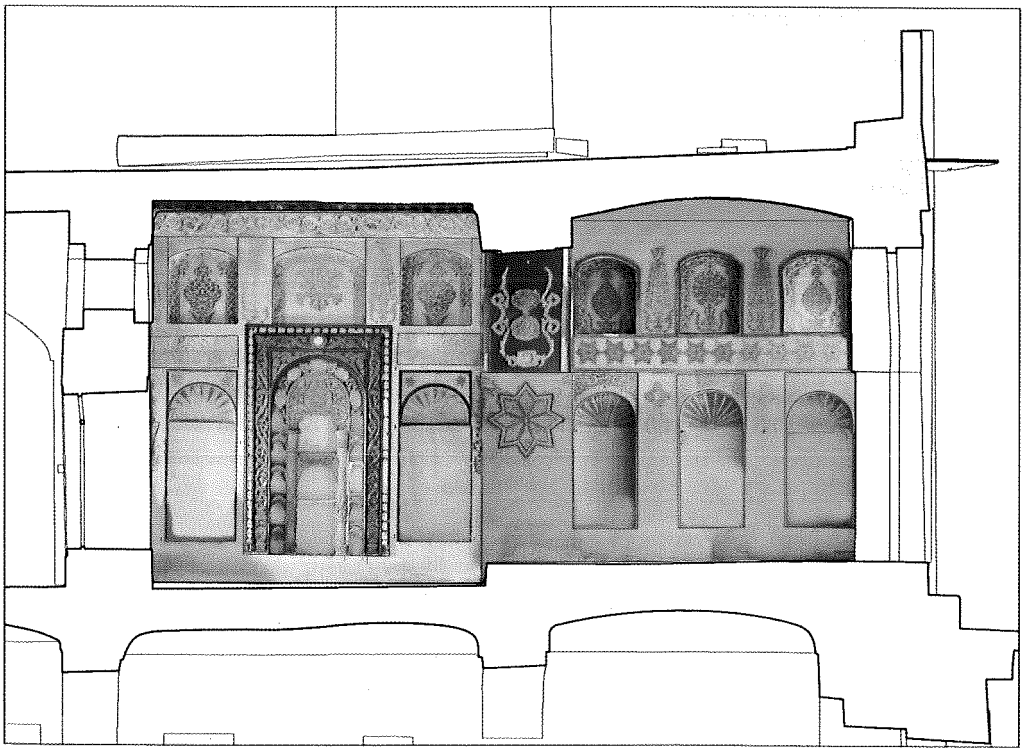
The post-processing of the cloud points (editing, merging, creation of orthophotos, exportation) were performed through the ZMap software, produced by Menci Software.

Unlike the usual photographic images, the digital documentation obtained through this methodology allows multiple output applications, such as a digital draft of the decorations or the definition of layers of the different states of preservation of the walls (Figs. 4-6).

Fig. 4. Longitudinal section L2a (above)

Fig. 5. Longitudinal section L2a, detail of the diwan *(below)*





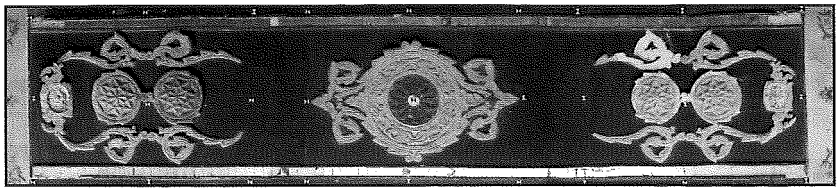


Fig. 6. Arch of the diwan: the surface of the intrados developed as a plane

In collaboration with Julian Bogdani, this complex system of data acquisition, closely connected thanks to the geographic reference of the data, is managed through a Geographical Information System (GIS) in which different kind of information are contextualized with all the related analyses, from the general to the detailed plan, to the sampling areas (Fig. 7).

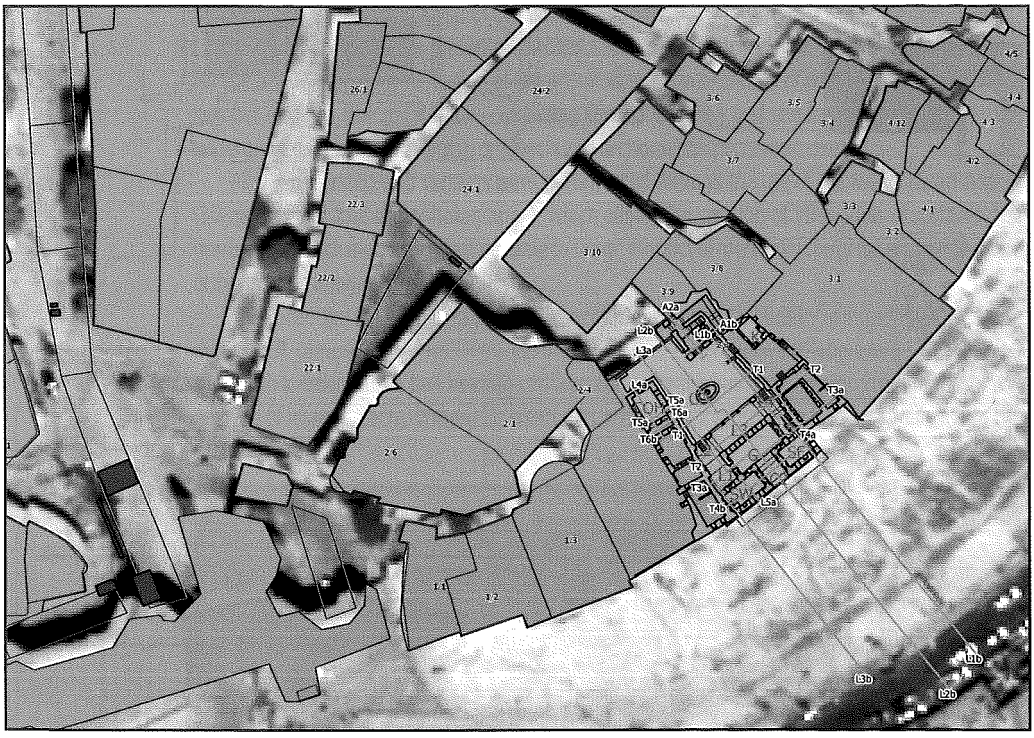


Fig. 7. View of the GIS system with the Rashid Agha diwan khanah and the surrounding areas of the Citadel. The red lines cover the geophysical surveys (in blue, the detected anomalies)

Project Methodology and Historical Profile

2.1

Giuseppe Morganti

In May 2010 Jerry Podany[1] asked Giorgio Torraca[2] to express his opinion on the topicality of the theme of 'Heritage Conservation: past, present and future'. One of the questions was: 'Why are we (or why we should be) interested in conservation?'. In response, among other things, Torraca noted: 'In studying ancient materials and deterioration processes, I had invariably found that the most refined analysis always raised more problems than those they solved. This was exactly what humanity has been set up to do: achieve infinite knowledge through an infinite amount of data measured and shared by an infinite number of people. Conservation would then be an infinitesimal part of the human attempt to know everything about the present and about the past, in order to foresee the future and achieve the power we attribute to the gods, like omniscience and immortality'.

These words powerfully express a sort of metaphysical motivation of the restoration activity. In other words – conscious of the human nature and our responsibilities towards works of art – it may be said that the purpose of preserving the historical heritage is to pass on the set of values, preserving the meaning and avoiding damage. The historical and artistic heritage helps to define the identity of any place and any community. It is a fundamental expression of cultural richness and diversity; an irreplaceable testimony of the past, whose protection and preservation, in all latitudes, represents a common value for all Nations that have the responsibility to work together in order to transmit this heritage to future generations.

However, the term under examination implies a deep comprehension of the importance of the historic building and its changes over time, and therefore a careful consideration of the values – both historical and contemporary – to assign to the building to be preserved. It should also be noted that the importance of the site can lie in both the original and the latest phase, and in any transformation. If it was deliberately destroyed in the past, even this may be an important factor for understanding its meaning, as it is the history of its preservation and restoration.

Any assessment of the importance of a historic building should thus be based on an appropriate program of research, surveys and analysis, aimed at conservation. The restoration project of the Rashid Agha *diwan khanah* is designed to fit coherently into this methodological framework.

The restoration activity must meet the aesthetic, historical, spiritual and social heritage, taking into account both the physical integrity of the object and the context to which it belongs. The products, materials and procedures used should not damage the works of art and, likewise,

[1] 'The project was meant to encourage a dialogue between those who have given so much to the profession over their long years of service and those who have just entered the field. But what his words offer is, like Giorgio Torraca himself said, a gift to all of us' (see www.iiconservation.org/index.php).

[2] The Italian conservation scientist Giorgio Torraca, who died on September 25th, 2010 of complications from pneumonia, was a brilliant chemist and teacher who devoted his career to the preservation of historic buildings, monuments and archaeological sites. He helped co-ordinate international responses to the flooding of Florence in 1966, was consultant from 1992 for the cleaning of the Sistine Chapel in Rome, and was a member of the committee for the stabilisation of the Leaning Tower of Pisa (2004-09).

should not attempt on people and environment. The methods and modes of operation, as the materials used, should not prejudice – as much as possible – any future intervention, analysis or appreciation. That is why the project is inspired by the basic criteria of the correct and scientific restoration methodology, which also provides that any activity carried out on the monument must be compatible, reversible, recognizable and limited to the minimal intervention. For this reason, the project relies on the principles expressed in the main internationally recognized charters and guidelines.

An *appropriate program of research, surveys and analysis, aimed at conservation* should be the starting point of such a project, if we want it to be scientifically correct. The development of the project provides then historical, scientific and technical research and feasibility studies. These investigations are necessary to determine methodologies and aims of restoration: a diagnostic test of the building is essential in the process, because it allows the detection of the constituent materials of the object to be preserved, allows an assessment of the state of preservation, reports any previous alteration – nature, extent and causes – leading to the proper definition of the most appropriate treatment. One of the main research activities focused on the investigations to ascertain the architectural history of Rashid Agha *diwan khanah*.

The identification of the vicissitudes through which the architecture is created and develops – site, materials, cultural environment, functional purposes, ambitions of the client – is the necessary prerequisite for understanding the architectural organism. This survey also provides a fundamental guideline for the recovery and enhancement of every historic building, in order to find a use compatible with its vocations. Vocations that can be understood only by tracing the formative stages of the building in its context: in our case, the Rashid Agha *diwan khanah* in the Citadel, where it occupies an important position. In fact, it constitutes one of the most interesting and beautiful buildings both for its location along the outer perimeter of the walls, and the quality of the decorations.

The main source for the reconstruction of the historical phases of the building was, in the case of Rashid Agha *diwan khanah*, the observation and interpretation of the structure itself. Indeed, the historical documents referring to the earliest stages of the site and its origins are almost entirely absent. It was possible to identify with some reliability only the latest phases of reconstruction and expansion, almost exclusively through iconographic data and oral sources. In this context, the topographic survey, the stratigraphic tests and the direct observation were the basic methods to identify the later stages of construction and make hypotheses on the earliest phases.

A couple of examples illustrate the process used and explain the meaning of *observation of the structure* and *historical research on its development*.

In the first case, the observation of the building makes it possible to fix the exact date of the expansion of the building to the south, towards the edge of the hilltop. Studies carried out by the joint venture[3], commissioned by UNESCO to draft the Master Plan for the revitalization of the Citadel, state that 'there are only three dates recorded in inscriptions and only one house with a precise construction date provided by the family [...]'[4]. This corresponds to the Hashim Chalabi's House; Rashid Agha *diwan khanah* is one of the three buildings that preserve dating inscriptions inside. The inscription is on the marble architrave of the door that leads to the south-west *oda*: here we read the engraved dates 1321 and 1323 (of the Hegira), corresponding to the years 1903-04 and 1905-06,

[3] Consultancy for Conservation and Development; Huszar Brammah & Associates; EURONET Consulting.

[4] See *UNESCO Master Plan, Comprehensive Survey*, vol. I, p. 39.

respectively. As the room where the door gives access belongs to the enlargement that determined the present size of the house[5], these dates may be interpreted respectively as the beginning and end of this construction phase. Besides this, an examination of the topographical heights, allowed by the accuracy of the survey, permitted to reconstruct a reliable urban situation previous to the presence of the Rashid Agha *diwan khanah* as we see it today. In fact, the layers detected through the survey operations of the site highlight the possibility (quite obvious) that the altitude of the earlier buildings was lower than today. What is less obvious is that the earlier buildings, smaller and almost certainly with only one floor, became the underground quarter of the house built above. This conclusion can be drawn quite immediately by observing the longitudinal section of the house (Fig. 1), which shows that the level of the street in front of the entrance to the Rashid Agha *diwan khanah* is approximately the same of the present basement of the building.

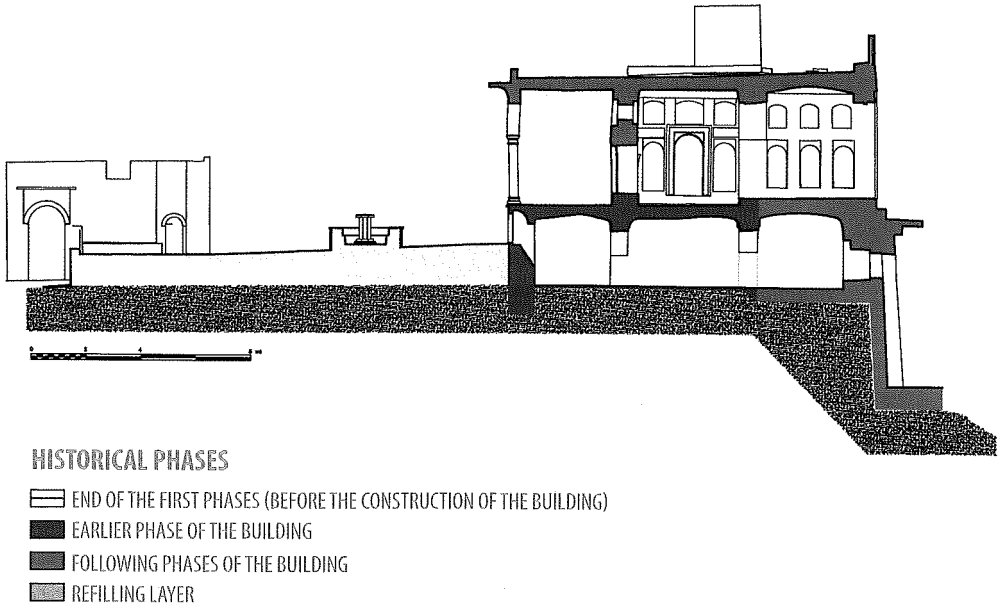


Fig. 1. Longitudinal section on the entry of the house

In the plan, a clear continuity is visible when connecting the walls on the sides of the Rashid Agha *diwan khanah* (Fig. 2) with an ideal line, to which the internal walls, parallel to the slope, also align. This suggests the possible trace of the earlier perimeter walls of the Citadel. These town walls were on the hilltop, and were subsequently incorporated within the outer buildings. The phase of the small structures with one floor, on which the Rashid Agha *diwan khanah* was superimposed, reflects this earlier situation. At this stage the house was greatly expanded, enlarged with one floor, and advanced beyond the line of the ancient town walls, with the outer portion resting in a very risky position, on the steep slope of the hill. One can deduce that the earliest part of the house kept the original foundations, insufficient in size and depth for the increased loads of the new building; the consequences are visible today and cause the current instability[6].

[5] Connected to that particular moment of the urban history of Erbil when all the urban plan outgrew the perimeter of the walls, occupying part of the slope of the hill (see *UNESCO Master Plan, Comprehensive Survey*, vol. I, pp . 14-15).

[6] See Santoro in this volume.

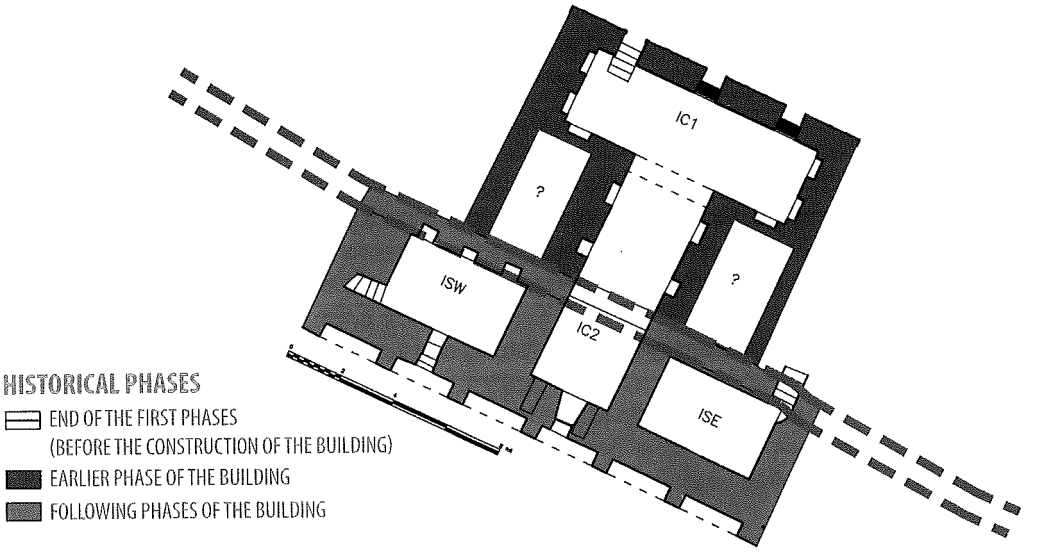


Fig. 2. Lower floor plan, with the indication of the probable profile of the ancient town walls

From the origin to its present configuration the Rashid Agha *diwan khanah* underwent several further interventions of reconstruction and modernization, testified – especially for the last thirty years – by a number of photographic documents (though, not always accurately datable), printed reports and articles[7].

The analysis and comparison of these data with those derived from the observation of the structure, and the contribution of the stratigraphic tests carried out on the walls, paintings and decorative surfaces (on the constitutive materials and products used during the restorations), led to the identification of the different interventions and construction phases, allowing the reconstruction of the chronological synthesis reproduced below (Fig. 3).

before 1903-1906	*(before the present structure of the Rashid Agha diwan khanah) a group of small, one-floor buildings, leant against the earliest town walls, on the hilltop*
1903-1906	*construction (perhaps in different phases) of the Rashid Agha diwan khanah, on top the small existing buildings that became the underground rooms of the new house. The construction goes forward in the direction of the slope, partly founded in the steep zone*
before 1958	*significant differences in the outer façade, changed during the recent works (after 1980)*
before the 1970s	*changes and enlargements of the street in front of the Rashid Agha diwan khanah, with alterations also to the perimeter fence, towards the town*
1980-1984	*first set of recent restorations, with the total reconstruction of part of the porch, the eastern perimeter wall and the entrance*
after 1990	*the house suffers damages as a result of the conflicts*
1994-1996	*second set of recent restorations, focused mainly on the decorative surfaces*
1998	*beginning of the abandonment and ruin*

Fig. 3. Synthesis of the recent construction phases

[7] I wish to thank Arch. David Michelmore (Consultancy for Conservation and Development), who kindly reported the printed documents.

Diagnostic and Conservation

2.2

Giolj F. Guidi

The evaluation of the state of preservation of the materials used in the construction of the Rashid Agha *diwan khanah* was carried out during the April-May 2010 campaign. All the rooms of the building, the materials used in its construction, in addition to those employed for the laying of the architectural elements, were taken into account for this purpose.

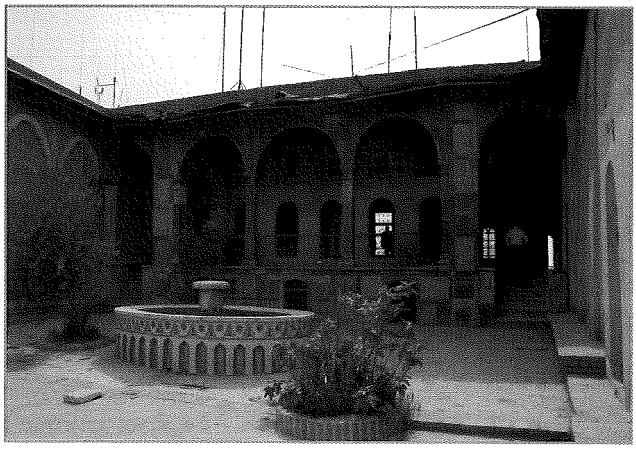


Fig. 1. The façade (view from the garden). NNW prospect

The façade looking on to the courtyard (Fig. 1) is the only one characterized by extensive use of stone, mainly consisting of polychrome marble, of colors variable between white and dark gray tending to black. The slabs, composing the vertical ashlars, are affected by splitting and detachments, especially in the joint areas, where the loss, although partial, of the cement mortar is clear. The slabs on the right and left of the windows with bars show, on the contrary, phenomena of surface corrosion, due to rainwater runoff. From the vestibule of access to the courtyard of the house, one can see, on the left of the façade, a brick wall (NE prospect) with false columns defining false blind arches (Fig. 2), which rises to the level of the upper terrace. On the right one can also see a wall of the same height, also in brick, but completely plastered (SW prospect), in which splitting and detachment of the plaster from the masonry below, due to the swelling caused by the seepage of rainwater, are evident. Moreover, the problem of seepage from the roof and the top of the perimeter walls of the court is particularly relevant because of both the disintegration of the cementitious mortar placed at their top, and the condition of complete decay of the wood shelter which certainly had a protective function, in addition to adorning the upper part of the outer walls of the house (Fig. 2).

Fig. 2. Façade, NNW prospect (view from the roof). Degradation of wooden shed

The paving of the raised floor of the loggia, covered with the same marble used in the façade, appears in a fairly good state of preservation, except for a few steps of the two access staircases from the garden that are partially damaged. All

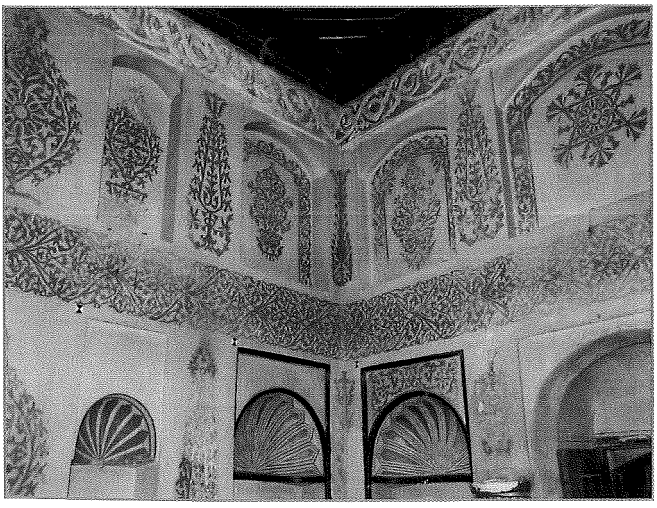
Fig. 3. Damage caused by water seepage on the SW wall, adjacent to B1-1/3 building

plastered walls of the loggia, instead, are generally very compromised as a result of the seepage of capillary rising water, revealed by dark spots and disintegration of the plaster (Fig. 3).

The *diwan*, characterized by a wooden lacunar ceiling and walls decorated with vegetal motifs in blue (Fig. 4), and stucco bas-reliefs painted with pigments of different colors (light green, emerald green, dark green, brown and gold), introduces directly to a side room (*oda*) that leads to a wide balcony overlooking the modern city. These rooms are in fairly good state of preservation, except for problems of rainwater seepage from the upper terrace, which caused in particular the partial loss of the blue pigment. The gates to the *diwan* and the adjacent room (small *oda*) are decorated with an architectural motif with an inlaid arch, made in Mossul stone (characterized by the specific dark gray color), which is in good condition except for the scratches and marks, probably of anthropic origin. The typical phenomena of superficial alteration of the plaster, resulting from the seepage of water from both the roof and for capillary rising humidity from the rooms below, are also evident in the case of the small *oda*. The underlying masonry is very damaged and the bricks are completely broken up in the areas where the plaster is completely missing.

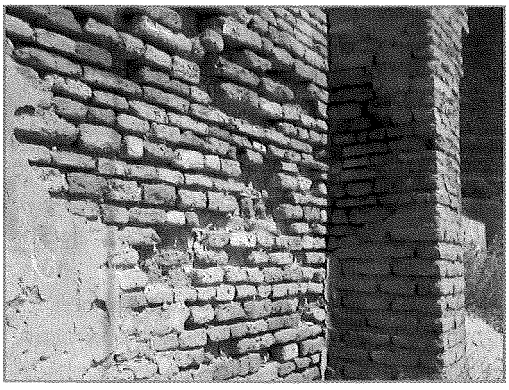
As for the underground rooms, the larger one, typically "T" shaped, and the second one (with a rectangular shape) are in bad condition because the bricks and, above all, the plaster are degraded, as a result of the seepage of water for capillary rise. In this second room, in addition, the frieze that defines the upper perimeter band and the one located in the center of the ceiling are severely compromised both for the dissolution, as a result of seepage of water, and for the presence of gaps and lacunae. Finally, the back façade of the house, made of non-plastered bricks (SE prospect) is in sufficiently good state of preservation, except for some visible fissures and, at the bottom, large areas where the deterioration of the bricks is at an advanced stage because of water seepage and compression produced by the upper layers (Figs. 5-6).

Fig. 4. Diwan. Blue vegetal motif



Given the complexity and the large number of building materials used in the house, 50 significant samples of the following materials were collected in order to define their physical-chemical and mineralogical composition: marble,

pigments on stucco, stucco, bricks, saline efflorescence, mortar and plasters. The latter two were analyzed through: optical microscopy with polarized light on thin sections (Moreland 1968; Hutchinson 1974; MacKenzie, Guilford 1985; Zezza 1996), X-ray diffraction (Klug, Alexander 1954; JCPDS 1990; Bonissoni, Ricci Bitti 1998) and X-ray fluorescence (Seccaroni, Moioli 2002).



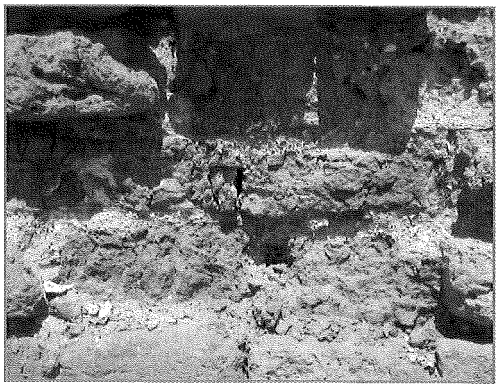


Fig. 5 (left). Lower portion of the back façade. SE prospect

Fig. 6 (right). Erosion of the bricks. Detail

The knowledge of the structure, the chemical, physical and mineralogical features of the material on which the cause acts, the type of manufacturing and construction, the environment, the degradation agents and the triggered dynamics were taken into account in determining the phenomena of alteration and degradation of the materials. These data make it possible to determine if the cause is contemporary or earlier, continuous, isolated or cyclic, ordinary or extraordinary. The relationship between causes, agents, dynamics and effects shows complex reasons for the different phenomena and degradation processes of the materials. Each cause can be the sum or the result of the interaction of more actions of decay produced by one or more natural or anthropic agents. It is possible that a single agent can cause different types of actions; the most significant case, observed in the Rashid Agha *diwan khanah*, is the presence of water, both meteoric and from capillary rise, evident in the most important degradation phenomena such as saline efflorescence, scaling, erosion, disintegration, exfoliation and detachment. On the basis of what has been explained above and the analytical results obtained from the chemical-physical and mineralogical methods of analysis, the following conclusions can be drawn.

1. Stone covering of the façade. The façade is characterized by a raised loggia with four columns made of parallelepiped-shaped blocks, and covered with mostly rectangular slabs. The pavement of the raised floor of the house and the moldings of the window (which give light to the *diwan*) are built with the same stone, set in a well-defined architectural motif, which is also visible in all the luxury houses of the Citadel. Their condition is, objectively, sufficiently good, except for the presence of small cracks and gaps, as well as phenomena of surface dissolution and saline deposition as a result of rainwater runoff. The chemical-physical and mineralogical investigations allowed the mineralogical and petrographic classification of this stones: they are all made of gypseous alabaster ($CaSO_4 \cdot 2H_2O$), some with homogeneous texture, with variable color from yellow to dark green, others with variegated texture, with color varying from white green to dark green. These stones come from the Mossul quarries.

2. Pigments. The only rooms that are decorated with vegetal motifs are the *diwan*, the great and the small *oda*. Blue is the predominant color, both on the upper and lower band of the three rooms,

while the stucco architectural motifs in low and high relief – also visible in the underground rooms – are painted with pigments of different colors. The analytical investigations revealed the use of modern pigments (purpurin with copper, zinc and iron basis).

3. Mortars. The mortars, especially those in the outer walls, appear in bad state of preservation, due to partial or total disintegration. The ones used as binder for the bricks in the walls are in better condition, with the exception of the underground rooms, where there are significant phenomena of capillary rising water. The chemical-physical and mineralogical investigations have detected the prevalent use of lime-based mortars, except in one case, where a plaster-based mortar is used.

4. Coring. The mortar extracted from the cores in the foundations is composed of lime and plaster.

5. Plasters. The plasters, usually gypseous, are most likely due to past restoration activities.

6. Stucco. The stucco, used for architectural friezes both in the *diwan*, and in the underground rooms, is mainly composed of plaster and sand.

7. Bricks. Generally most of the walls, especially those bordering the courtyard of the house, are made of bricks with different colors, from yellow to light brown that, in the most exposed areas, take a darker color due to aging (oxidation of the exposed surface). In many cases, the structure of the bricks shows traces of the straw used into the brick mixture. Furthermore, especially in the underground rooms, red, dark brown and (in scarce number) green bricks are visible. On average, their mineralogical composition is characterized by the presence of K-Feldspar ($KAlSi_3O_8$) and Plagioclase [$(Na,Ca)\cdot(Si,Al)_4O_8$] as main minerals, Quartz (SiO_2) and Hematite (Fe_2O_3) subordinates. Because there are also calcite ($CaCO_3$) and dolomite ($Ca, MgCO_3$), a firing temperature below 700°C is supposed.

8. Saline deposits. Surface saline deposits were sampled especially in the underground rooms, due to seepage of water (capillary rise) from the foundations. Those deposits were identified as chloride: Halite (NaCl) and Sylvite (KCl).

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The Knowledge of the Building as a Basis for the Intervention and the Restoration Plan Design

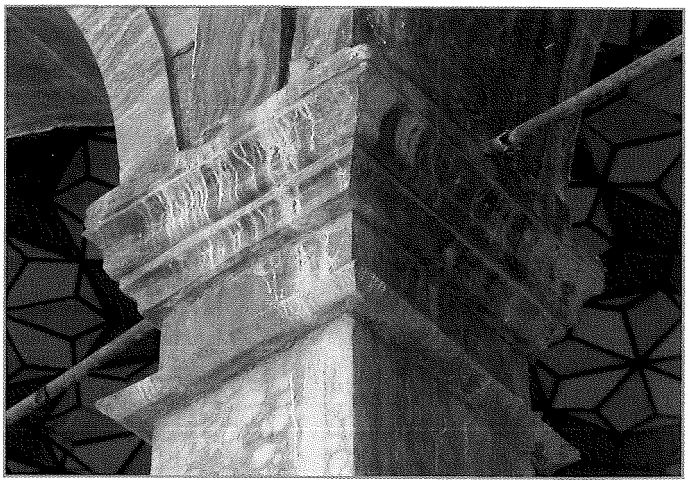
2.3

Rossana Nicolò

Knowledge is the first fundamental act of protection and the basis of a restoration project[1]. This operation is possible through the coexistence of investigations and experts working together and establishing the value of the monument. The systematic survey of the architecture, the analysis of the building materials and the degradation constitute the essential and fundamental means to understand the structure; the comprehension of the relationships between this data supplies a complex but clear outline of the problems and suggests the guidelines for the restoration of the monument. In this process, it is necessary to compare, through a continuous and fruitful reference between general and particular, the overall knowledge of the building with the punctual analysis, paying great attention to the broader context of the Citadel, its significant archaeological value and the traditional building materials and techniques used in adjacent structures.

The Rashid Agha *diwan khanah* consists of different elements that characterize it as a complex architectural structure: it has an external public façade on the perimeter of the Citadel, richly decorated representative rooms (that make it the one most valuable houses of the Citadel), a loggia and a courtyard with fountains and several rooms that overlook it, which reveal the importance given to public areas within the Citadel. The Rashid Agha *diwan khanah* is then a "permeable" building, through different openings, from the inside to the outside.

Fig. 1. Capital of the loggia pillar



The façade is visible along the southern perimeter of the Citadel, very close to the new gate built under the dictatorship of Saddam during the 1980s[2]; the brick front is characterized by the presence of substructures[3] with slightly pointed arches that hold the balcony, a series of windows and the upper masonry structured with a decorative motif.

[1] Carbonara 1996a, 1996b.

[2] The previous door was characterized by a smaller access, with pointed arch and a building, on the east side, with windows, loophole and crowned with flat-ended battlements.

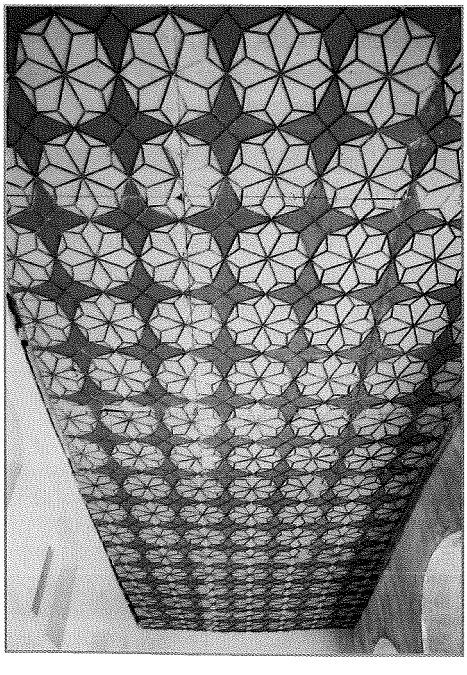
[3] There are a few façades on substructures along the entire perimeter of the Citadel. Among these, the Ali Pasha *diwan khanah* is particularly interesting and has deep arches with decorated lintel, two other simple round arches made of bricks (Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010, Annexes*, p. 426).

Fig. 2. Base of the loggia pillar

The position is one of the finest features of the building; the *diwan* and the lateral *oda* are dignified by the view of the surrounding landscape – now the modern city in constant urban development –, accentuated by the wide central opening[4] and the smaller lateral windows, which are arranged asymmetrically on both sides. The planimetric structure, with *diwan* and side rooms, and loggia on the courtyard, is similar to 19th century Ottoman houses and reproposes the common typological composition of prestigious residential architecture[5].

On the inside, the Rashid Agha *diwan khanah* opens on to a courtyard with a fountain through a loggia with arches on pillars, built in the so-called Mossul stone[6]. The decorative motifs recall the traditional architectural styles, albeit with simplified forms and technique: bases with torus and scotia and simple capitals with similar elements (astragal, band, cyma recta, listel and cyma reversa), now very damaged (Figs. 1-2).

Fig. 3. Loggia ceiling



The investigation dedicated to the surface finishes of the floors, walls and roofs detected the presence of valuable flooring (in stone) only in the loggia; other floors were recently rebuilt in ordinary materials. The stucco-covered walls with painted decorations are included in the decorative apparatus. The brick walls, in some portions, are decorated with geometric patterns obtained by changing the position of the individual bricks.

Particular attention was paid to the ceilings (both vaulted and wooden false ceilings): the masonry vaults in the side rooms of the loggia – some visible, some plastered – have a lowered geometrical shape, that makes them very fragile (for the shape, as well as for the presence of static instability); in the *harem* room there is a very low composite vault with octagonal shape and groins. The flat roofs are also valuable for the wooden false ceilings, with geometric decorations obtained through painted backgrounds; in particular, the one in the loggia shows circular and star-shaped patterns, reproduced by wooden sticks colored in black, almost alluding to a stained glass window (Fig. 3).

[4] The opening was different in 1958, consisting of a tamponed wall with three windows, as shown by some images in the Doxiados Archive in Athens.

[5] Kuban 2010, pp. 469-496, 475. Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010*, p. 69.

[6] Gypseous alabaster, see Guidi in this volume.

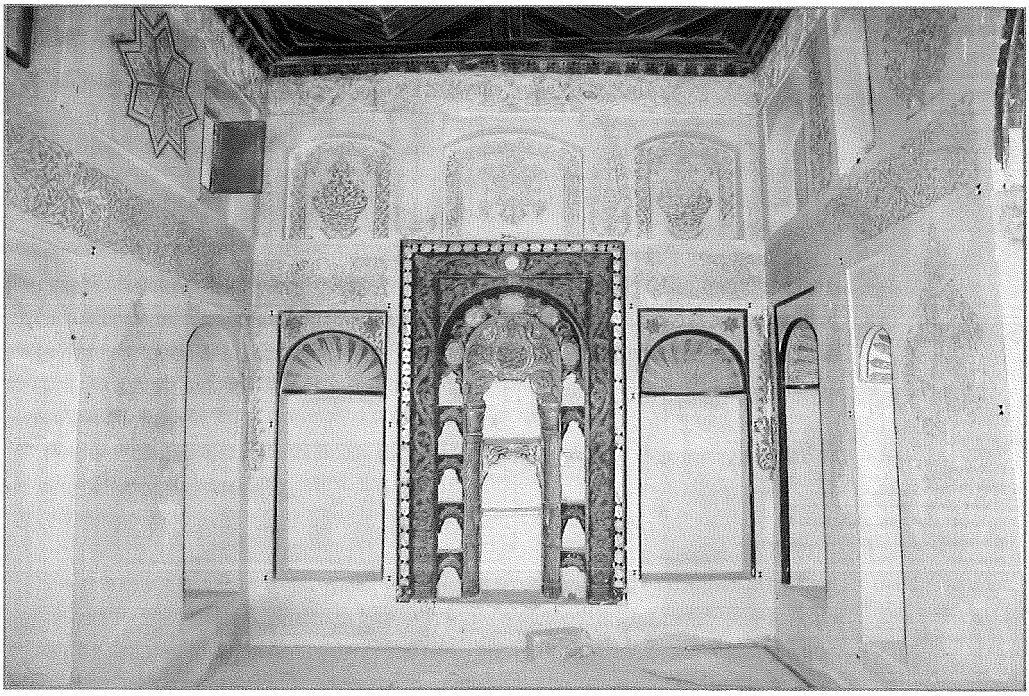


Fig. 4. Diwan, east wall

The Rashid Agha *diwan khanah* stands out in the Citadel for its decorative apparatus, although altered during the recent restoration[7], and for a number of significant features. The part of the *diwan* certainly has the more complex decoration, with walls covered with frescoes, an upper band of stucco and a decorative architectural element that evokes the shape of a *mihrab*[8] on the eastern wall (Fig. 4). The ornament inserted under the arch of the *diwan* was modified during recent restorations and has stucco inserts that are symmetrically disposed at the base in relation to an oval, from which two garlands with geometric and vegetal patterns diverge. At the center of the arch, a circular element with ramifications (with the shape of geometric and vegetal spirals) perfectly reproduces the decoration of the ceiling of the underground room.

The most interesting decoration, in fact, is in the south-west underground room. However, in addition to the stucco on the ceiling, repeated in the other decorative surfaces, there are a few fragments of vegetal frieze, set on a horizontal band at the height of the small openings that give light to the room. The stucco decoration is raised from the painted background, and the decorative pattern is symmetrical, though not rigid, with some slight variations probably due to the technique[9].

[7] See Morganti in this volume. The same information is also included in the report of the restoration project delivered to the Kurdish part at the end of the activities.

[8] Organized into bands with the central part excavated with niches and withdrawn towards the line of the wall. The upper part is flat-ended and frames the central portion, arched, with a central circular element with geometric star-shaped decoration, similar to the one on the arch of the *diwan* and in the stucco with geometric and vegetal spirals in the underground room.

[9] See Colombo in this volume.

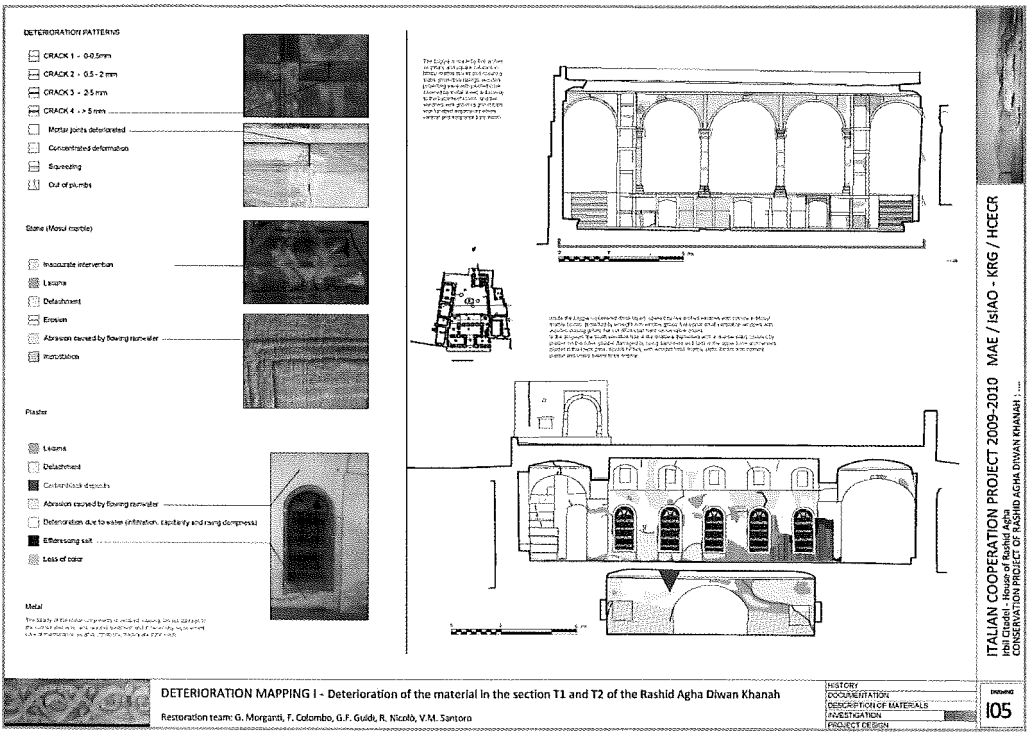


Fig. 5. Example of the degradation map of the materials

Degradation

The Rashid Agha *diwan khanah* shows a significant state of degradation[10], due to structural problems, together with numerous problems related to water, rising humidity that damages the walls, bad draining of the rainwater that has consumed significant portions of the stone façade of the loggia, both externally and in the floor, and deterioration of the wooden flat roofs.

The wide climatic variations in temperature and the strong solar radiation contribute to the erosion of the surfaces and the decay of the properties of the materials that sometimes do not present the chemical and physical qualities for the required tasks from the beginning.

Inappropriate interventions to solve these problems carried out during recent restorations represent another disturbing element for the comprehension of the figurative unity of the monument. For example, the cementitious plaster used in the lower floor to reduce the gaps caused by rising humidity and the cement integrations used to repair the architectural elements of the loggia (bases, ashlars of the pillars and capitals), damaged by the excessive load, show both deep material and visual breaks, and become cause of further deterioration. The lack of maintenance and the loss of windows frames and protection also have irreparably damaged the rooms and the decorations conserved inside, already severely compromised by poor reconstructions.

The features of degradation have been identified for the different materials, and are represented through appropriate layers on the geometric map of the building (Fig. 5).

[10] Fiorani 1996a, 1996b. For the definition of degradation see Normal I/88, *Alterazioni macroscopiche dei materiali lapidei. Lessico*. CNR-ICR, Roma 1988.

The Restoration Project

The restoration project aims primarily at preserving the artefact and recognizing its value[11]. This aim is pursued by limiting and correcting the conditions that foster both structural and architectural degradation, as well as the degradation of surfaces. These are topics that, in the present case, must be carefully evaluated due to the extent and seriousness of the situation. Secondly, it is necessary to provide an enhancement of the structure, to be achieved by choosing a destination profile coherent with the original vocation of the building. We suggest using the whole complex for representation purposes, with a small part as a museum, a space for a conservation laboratory (in the underground rooms), the decorated rooms (*diwan*) for conferences and ceremonies[12] and the terrace with panoramic view and a refreshment-room (Figs. 6-7).

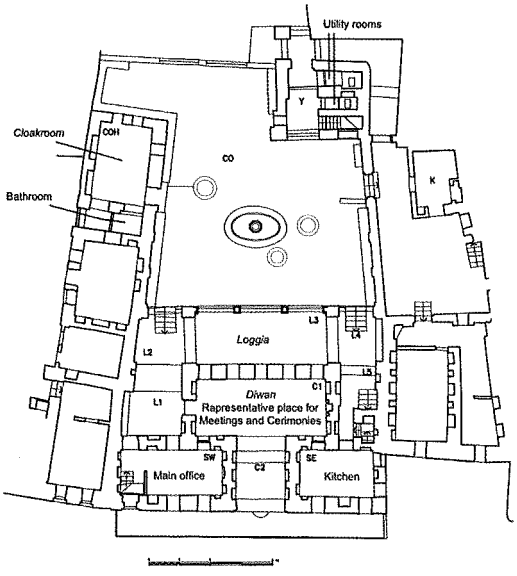


Fig. 6. Ground floor plan with functional destination

The restoration project is based on the principles of recognition of the value of the building, and respect for the traditional materials and techniques employed. It aims at bringing back the figurative palimpsest compromised by decay and partly irreversibly lost. The choice of the minimum intervention, which nevertheless employs the most innovative techniques for the restoration and static improvement – one of the crucial problems of the house[13] –, is suggested also in the restoration of the surfaces through the reintegration of the gaps according to the principles of reversibility and recognizability. Regards the architectural aspects, the choice of adapting the building to a VIP area allows to make a few measured interventions.

Some proposals are focused at reinterpreting, with a contemporary perspective, traditional materials and elements of the structure: the wooden shelters can be restored with the replacement of the deteriorated or permanently lost portions, using lamellar wood and marine plywood in place of the damaged one, improving the resistance to water with small technological devices. We will attempt to recover the lower decoration, consisting of colorful wooden elements. This reinterpretation with a contemporary perspective of the shelters is proposed as a guideline for other elements: a similar methodology will be applied in the restoration of the wooden roofs, the decorated and painted false ceilings. We will use the pattern of one of them, the one of the loggia, as the inspiration for the design of a panel that will form a glassy diaphragm (Fig. 8) into the south-west room (which will host the offices), with the stairs leading to the underground room, used as a restoration laboratory (because it retains the most valuable decoration).

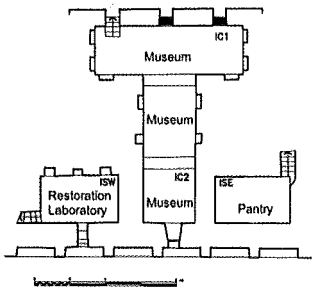


Fig. 7. Underground floor plan with target functional destination

The figurative reintegration of the images of the brick vaults will be implemented through the recovering of the joints. Such reconstruction is also suggested for the architectural elements of the loggia, bases and capitals, heavily compromised by improper interventions. The central underground

[11] Brandi 1977.

[12] Consultancy for Conservation – HBA – Euronet Consulting Joint Venture, *Conservation Master Plan 2010, Annexes*, p. 414.

[13] See Santoro in this volume.

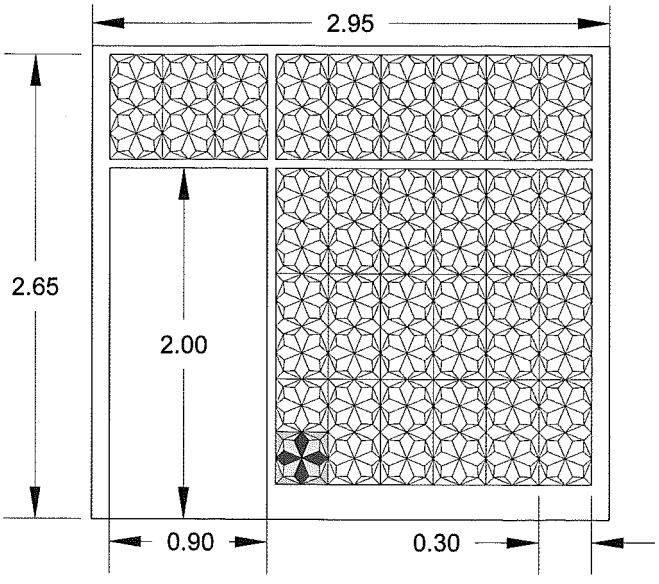


Fig. 8. Glassy diaphgram for the Main office

room, designed to become a museum, will be made more easily accessible by improving the functionality of the staircase; the interior restored by removing the concrete and applying plaster of adequate quality.

A reversible installation is also proposed to make the courtyard more usable, both in winter and summer: fabric curtains, to be anchored to elements distinct and distinguishable from the existing structure, will suggest a migratory and ephemeral dwelling, and recall the local tradition, particularly skilled in and appreciative of this kind of craftsmanship (Fig. 9).

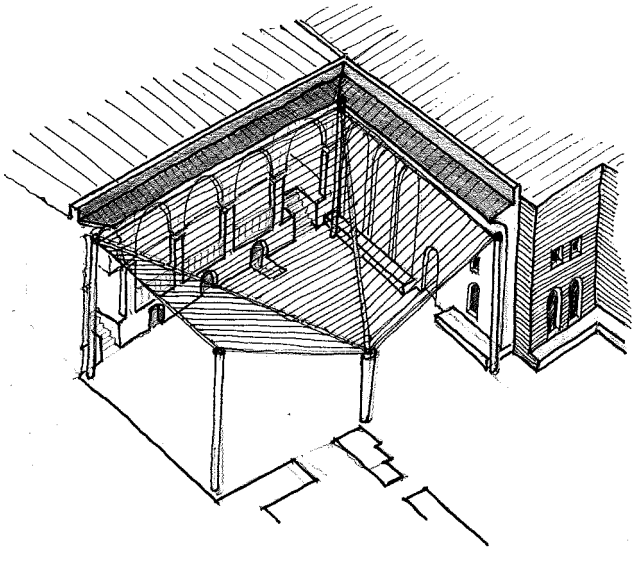


Fig. 9. Studies for the installation of a lightweight tented covering on the courtyard

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Restoration Project of the Architectural Elements

2.4

Fabio Colombo

About a year after the beginning of the operations, the investigations led to an overview of the steps for the development of a conservation and restoration project of the architectural elements of the house (Fig. 1).

Fig. 1. Detail of the painted decoration of room C1 (phases 2 and 3)

The need to identify the different historical phases of the house and its building materials involved the analysis of a large number of samples in order to obtain the highest degree of information. The study of the building techniques represented a very significant phase of the investigation because the results of the acquired scientific documentation were extremely useful for defining the choices to be implemented in the conservation work (Figs. 2-4).

For the paintings and stucco, and, more in general, for the partial rebuilding of the plaster, four distinct phases were found:

1. green and a neutral color painting;
2. green color painting, with vegetal decorations and stucco;
3. former rebuilding, with vegetal decorations obtained with a technique very similar to phase 2, and repainting of some stucco decorations;
4. second and last rebuilding, with blue color painting, geometric elements in purpurin.

In many cases, such as in the preparatory drawing of the first phase, engraved and finished with pencil, the overlap of the phases appeared particularly evident. Moreover, the presence of dust,

sometimes found between the two layers of painting, allows a number of possible hypotheses that require further study. On the basis of preliminary observation, it is reasonable to assume that the dust layer was formed by incoherent deposits accumulated on the wall surface before the drafting of the second – and now visible – preparatory layer. The difference in style and technique between the phases is also clear: in phase 2 there is a high degree of knowledge of the painting technique, while in later phases, there is clearly decreased meticulousness in the representation of the details.

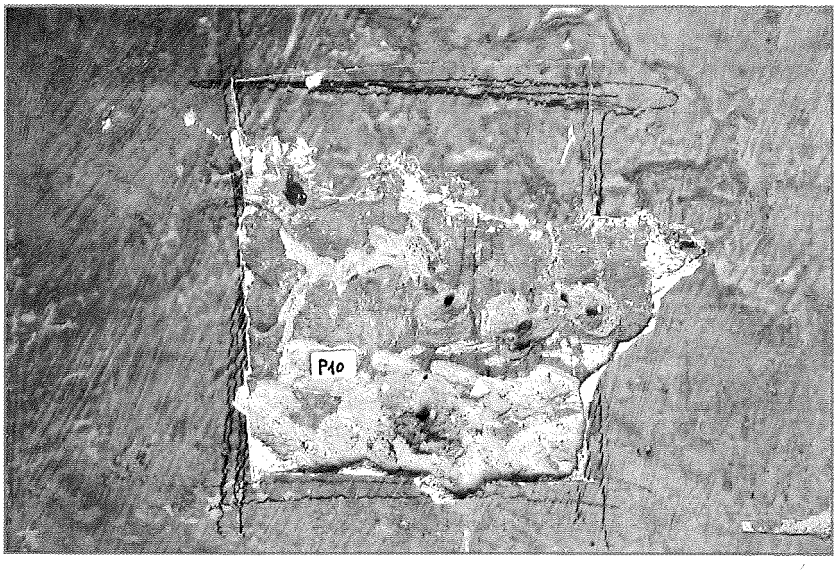

Fig. 2. Stratigraphic test in the SW room, south wall. Note the green painting of the phase 1

It will be especially important to decide the right period of the year to start the work: the Citadel of Erbil is in a region where temperature changes are significant; for this reason some interventions, in temperatures above 35° and below 6°, must be avoided, because outside of this range the behavior of the materials used for conservation is not reliable.

Fig. 3. Geometric decoration in purpurin (phase 4), performed on the vegetal decoration in blue (phase 3)

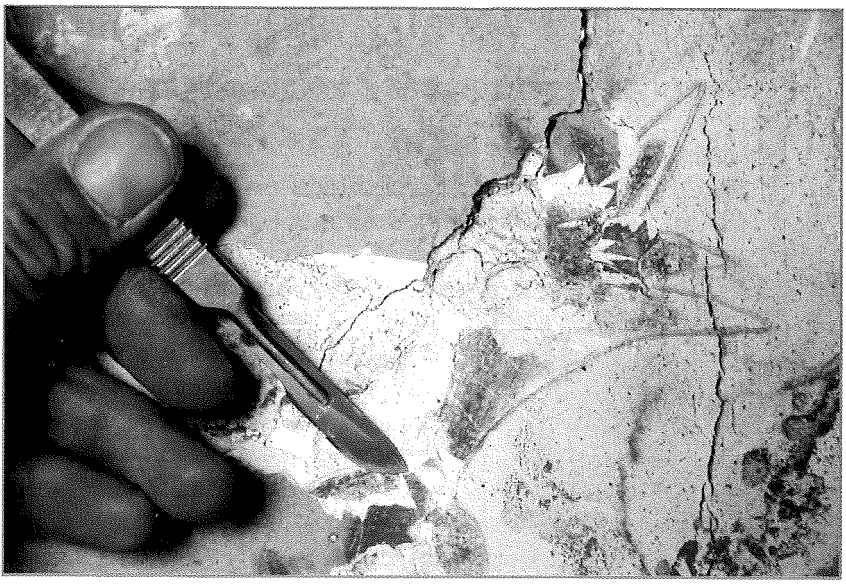

Fig. 4. The image shows a stage of the stratigraphic investigation carried out with the tip of a scalpel on a portion of the decoration in room C1. Note the overlap of phases 2 and 3, the preparatory incision, the drawing in graphite (pencil), the traces of dust between the two layers and the clear difference of the constituent pigments of the two pictorial phases

The materials composing the painted surfaces and stucco are highly sensitive to moisture; for this reason, dry methodologies, with non-aqueous solvents, should be preferred. For example, when cleaning the wall paintings it is conceivable to use sponges of Wishab type or neutral gum for dry cleaning of painted surfaces; compressed air is preferable to water for the removal of soft or incoherent deposits.

Moreover, to improve the economy of the preservation project, we plan to use, where possible, local materials and equipment, or from neighboring regions.

The intervention phases that we consider absolutely necessary for the development of a proper restoration and conservation project are the following.

- The intervention must be documented in every phase, through the appropriate graphic and photographic methodologies or in general visual surveys. Documentation will consist in collecting, recording and organizing all written and visual information on Cultural Property including its condition, treatment and measurements. It includes the justifications for conservation-restoration decisions. This documentation is integral to the Cultural Property and its conservation-restoration.
- Preliminary safety measures for all the areas involved in the consolidation interventions, by the temporary removal of some elements (floors) as well: application of layers of Japanese paper, gauze, pre-consolidation by means of resins and glue. These interventions are to be carried out in close contact with technicians and workmen in charge of the structural consolidation.
- Environmental remediation: making safe the unsafe areas and dismissed materials and equipment removal.
- Incoherent deposits removal: removing loose material (dust, sand, soil, animal waste) by means of soft-bristle brushes and vacuum cleaner.
- Biocide treatment: application of appropriate biocides by brush or atomizer. The application should be adopted only when opportune, and extended only where necessary.

- Disinfestations: extensive treatment in order to remove any form of biological pest colonies.
- Removal of obsolete equipment (pipes, cables, nails, plumbing): this phase of the work will be a highly critical point, having to face even the moving of original parts and their subsequent relocation.
- Efflorescing salt removal: the use of mechanical instruments such as scalpels, hard brush, small soft-bristle brushes and dental equipment (micro-explorers-drills) will be preferred instead of chemical products.
- Preconsolidation: application of resins and silicates by means of syringes, drip dispensers and atomizers.
- Surface consolidation: application of resins and silicates by means of syringes, drip dispensers, atomizers and brushes.
- In-depth consolidation: injections of natural lime flowing mortars through syringes fitted with extensions.
- Removal of cement fillets and fills: this operation will be mechanically implemented by means of automatic equipment such as micro-air drills.
- Concretions removal: paper pulp (laponite or sepiolite) packs will be used for concretions, stains and stain removal, using deionized or distilled water as the solvent, as well as mechanical methods in case of harder concretions.
- Recovering the original plaster layer: mechanical removal of non-original plaster layers.
- Surface removal of non-original paint layers: mechanical/chemical removing of recent layers of plasters or painted or protecting films.
- Rod insertion: in-depth reinforcement (of stone, plaster, stucco...) by means of rods, preferably fiberglass rods, because fiberglass is not subject to changes in volume as consequence of temperature changes.
- Walls brickwork reintegration: the lacunae of the walls will be reintegrated by the use of bricks, similar to the original ones, in order to make the reintegration visible only to close observation.
- Plaster fills and fillets: reintegration of plaster using natural lime mortars, similar to the original ones.
- Plaster and masonry micro-filler: reintegration of plaster and masonry micro-cracks using natural lime mortars, similar to the original ones.
- Final presentation (plastering, coating, protective layers drawing up): preparation of films consisting of watercolor painting or filleting, aimed both at the aesthetic presentation and surface protection.
- Metal features treatment: brushing, removal of the oxidized coating, anti-oxidant treatment.
- Reintegration/replacement of metal/wood/glass/ceramic elements/features.
- Cleaning: this is a very delicate working phase. The interventions will be highly selected and diversified according to specific materials and their condition. This phase will be described in a specific chapter in detail.

Technical Proposal for Restoration, Strengthening and Reinforcement Design

2.5

Valter M. Santoro

Strengthening and Reinforcement Implementation of the Conservation Project of the Rashid Agha *diwan khanah* in Erbil will allow the recovery of the lost safety levels of the building (Fig. 1).

The main features of the interventions are based on the hinge principles of the modern Italian approach to the Restoration Project, that are:

- non invasive techniques of implementation,
- respect for the original architecture and building materials, in order to maintain its authenticity,
- respect for the potential archaeological sites,
- compatibility of the added materials from all mechanical, physical, chemical and thermal point of view,
- reduced impact of the new works on the architectural context.

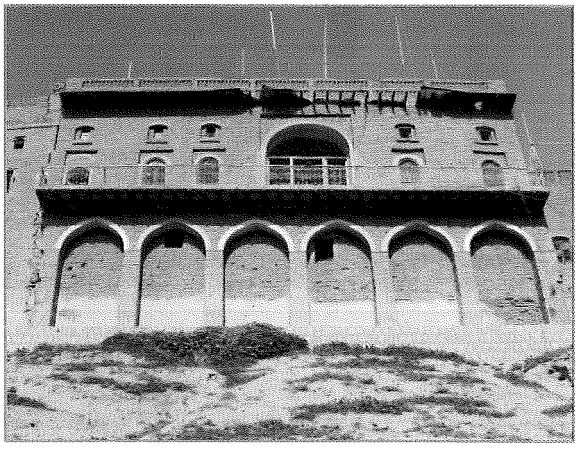

Fig. 1. General view of the Rashid Agha diwan khanah from downhill

Following those guidelines, the structural project was addressed to eliminate the causes of damages, originated, as recognized during the phase of study, by the inadequate bearing capacity of the foundation of the structures, and to reduce the hazard of new damages consequent to potential seismic events (Fig. 2). The result would be a general improvement, even though not a complete retrofit (that would cost more impacting activities).

The possible interventions for the foundation set up were addressed to reduce or, hopefully, to eliminate the risk of further deformation at the foundation level, due both to a limited bearing capacity – because of the local and geotechnical conditions – and to the seasonal variation in water content of the soil.

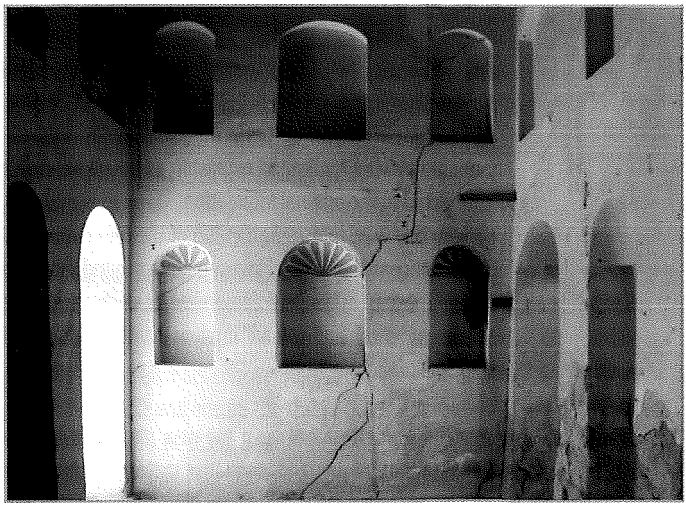

Fig. 2. Example of crack pattern of damaged structures

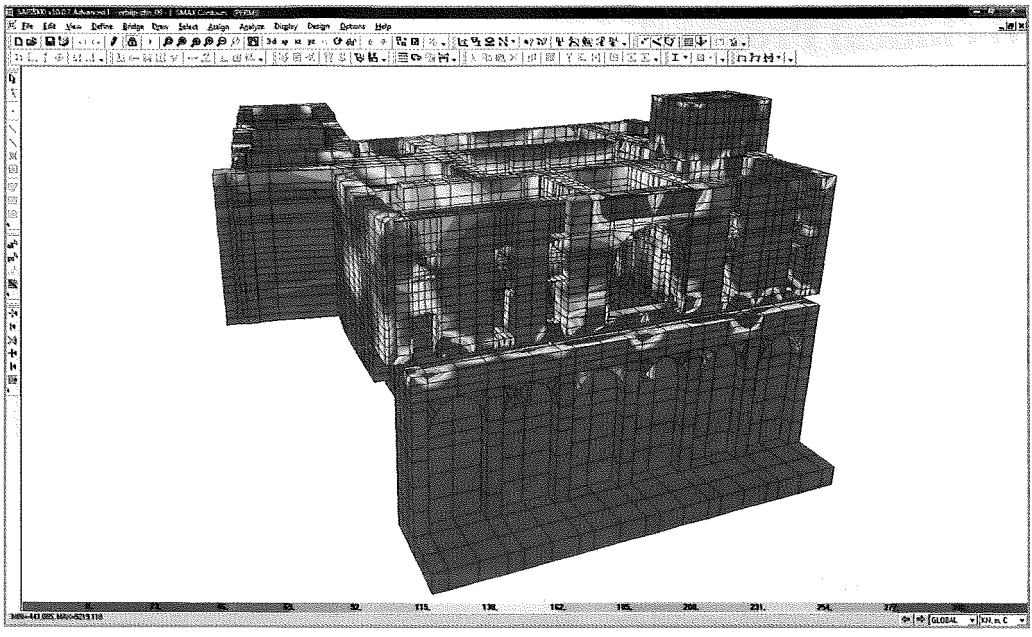

Fig. 3. Stress analysis of the whole building through a numerical structural model

During the phase of investigation, study and analysis, a three-dimensional numerical model was developed, for the evaluation of the stress condition on the structure of the building, related to the abnormal behavior of the foundation and to the response to the seismic actions (Fig. 3).

The visualization of the stress distribution shows the concentration of stresses into the walls, revealing high hazard conditions. Cross matching between the results of the theoretical analysis and the map of degradation, reported by the on site survey, shows good accordance, and validates the drawn hypothesis (Fig. 4).

The basic aims of the project of strengthening can be achieved reinforcing the wall foundations by means of a deepening of the bearing surface elevation and of an enlargement of the dimensions of the base. This can be performed through traditional excavation works, that must be carried out step by step for limited extension samples, building new brick masonry structures effectively connected to the original foundation.

By this way, the strengthening of the foundations is based on a technique that allows all the preliminary archaeological investigations around the existing foundations. In case of non subsistent boundaries, an effective enlargement or underpinning of the walls will build up. The technique, known as "check and spread" implementation, will offer further knowledge of the archaeological deposits of the site.

The connection between the new structures and the existing ones will be realized through advanced techniques and innovative materials, whose use is based on the aforementioned criteria. The connecting tie rods are of fiber glass type, and will be tensioned without any permanent device, transferring the pre-stress along the drilling shaft itself (Fig. 5).

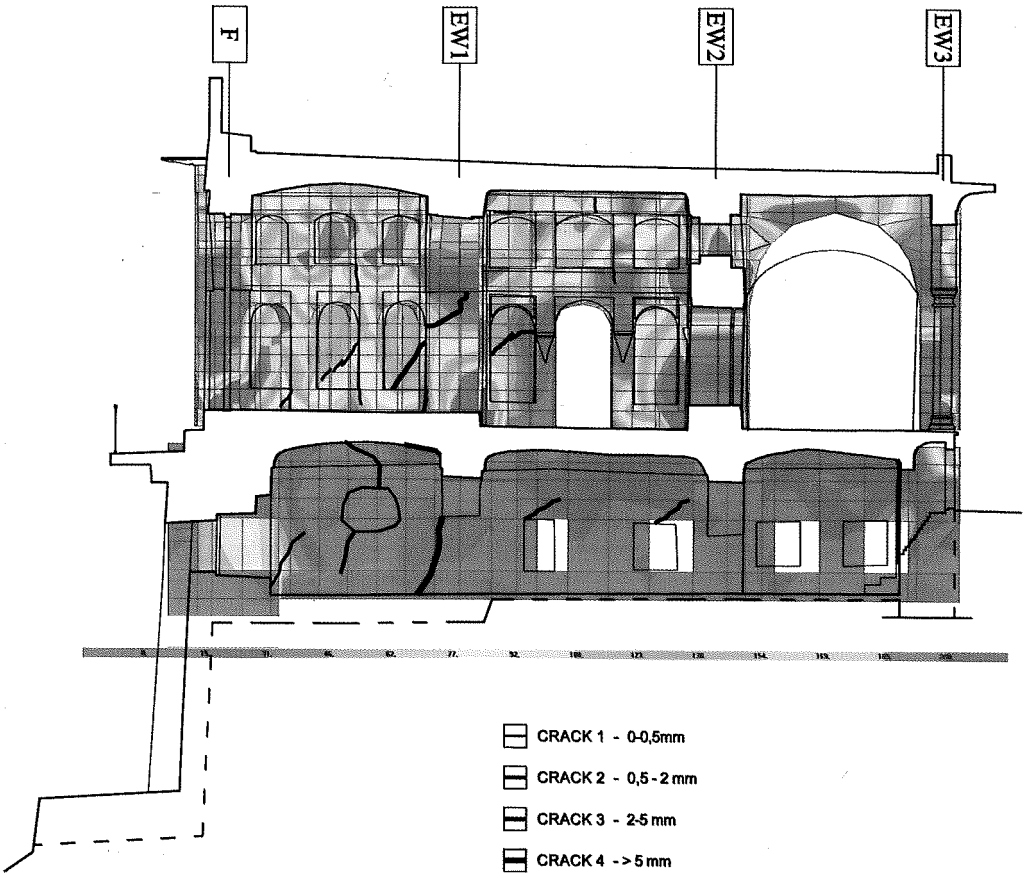

Fig. 4. Stress distribution from the numerical model for a longitudinal wall overlapping the crack pattern

The re-filling of the extra excavation volume will be carried out through a granular soil backfill wrapped in geotextile fabric, in order to provide an effective drainage against the raising dampness along the hypogean walls.

Similar procedure is foreseen for the chaining bars and rods at the two levels, where the lack of connections between the opposite walls can produce further damages.

Effective reconnections between the façade and the side and parallel walls will be also foreseen, in order to ensure the cooperation of structural function for all the reacting elements as compared to the static loads, to the coactions induced and to any seismic action.

A key role will be played by the tie rods and by the anchors connecting the downstream wall and the arched buttresses to the back top of the hill. These will ensure the stability of the boundary structures of the buildings against the overturning, both in static and seismic loading cases. In order to make it compatible with the archaeological characteristics of the backfill of the hill, special anchoring devices, called TFEG, will equip the bearing ends of the rods. They consist in a telescopic spikes that locally penetrate into the soil, avoiding, in this way, any cement injection of the shaft and consequently any contamination of the possible significant archaeological layers.

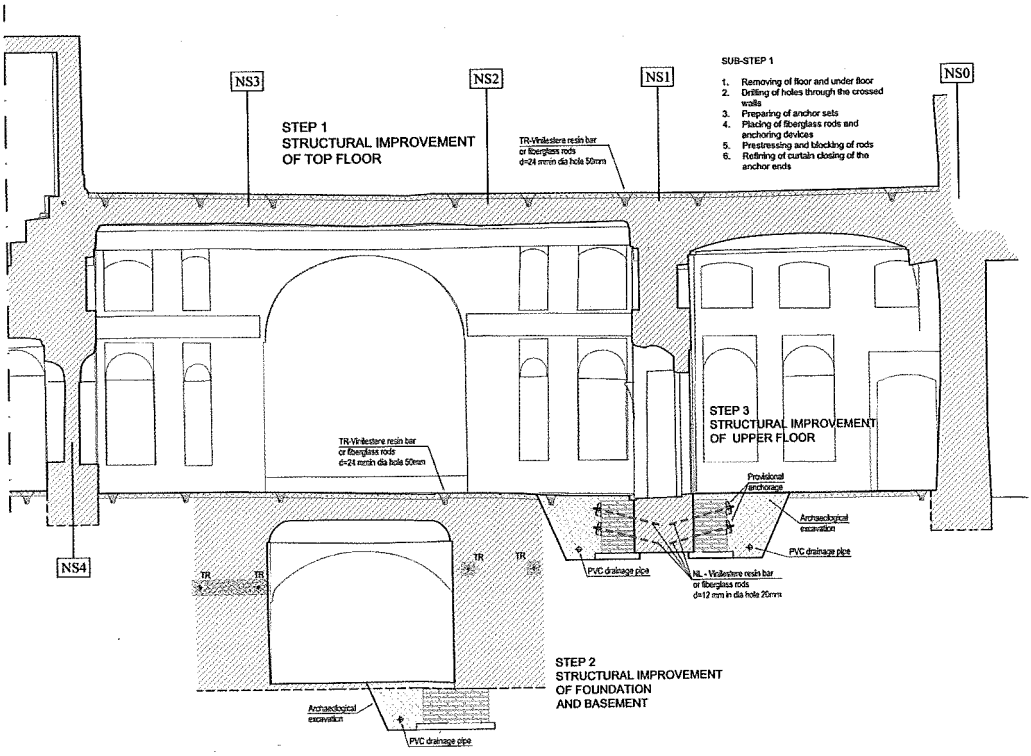

Fig. 5. Strengthening measures for the foundations of the walls

The slabs and vaults of both ground levels will be lightened and reinforced through new timber slabs, more suitable for the seismic response of the overall structure and for any inter-wall connecting function.

Special implementation are provided for the local damaged structures, walls and vaults, based on traditional technique, such as pointing, re-pointing, local grouting, stitching.