WHAT COMES TO MIND WHEN YOU HEAR MOSAIC? CONSERVING MOSAICS FROM ANCIENT TO MODERN

PROCEEDINGS OF THE 13TH CONFERENCE OF THE INTERNATIONAL COMMITTEE FOR THE CONSERVATION OF MOSAICS, BARCELONA 15-20 OCTOBER 2017

edited by

Roberto Nardi and Montserrat Pugès i Dorca

ICCM Foundation
INTERNATIONAL COMMITEE FOR THE CONSERVATION OF MOSAICS

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The 13th conference of the International Committee for the Conservation of Mosaics

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Organising committee

The conference was organised by the ICCM in collaboration with and under the auspices of the Servei d'Arqueologia de Barcelona, a municipal body of the Institut de Cultura – Barcelona City Council.
The members of the organising committee were:
Roberto Nardi, President of ICCM, Centro di Conservazione Archeologica, Rome
Carles Vicente, Director of Memòria, Història i Patrimoni - Institut de Cultura de Barcelona (ICUB)
Stefania Chlouveraki, ICCM Vice-President, Athens University of Applied Sciences (TEIA)
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On cover
Mosaic del Pla de l'Os, Las Ramblas, Barcelona, by Joan Mirò, 1976.

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AS A FOREWORD

Dear Roberto,
We are coming to the end of the conference now so the time has come to write the foreword for the minutes.
And I'm wondering, in fact I'm asking you, how you think we should do it. In short, should we highlight what we believe was the most relevant contribution, the work that will mark a before and after… How do you think we should steer it? Thoughts are whirling around my head so I'm going ahead without waiting for your reply. I don't feel like it much, let me tell you, but I need to write down other things more related to feelings, emotions, and sensations. Everything that we have experienced and that we have not written down – yet – anywhere.
So, breaking with conventions, and with the illusion of bringing together what were a few days lived intensely, I propose doing a kind of game where I remember and you do too. If you want, you can shorten or expand it, but above all, let's try to share, once again, the doubts, fears, uncertainties but also hopes, complicity, challenges. Sharing all that with the conference attendees, now transformed into readers, is a debt that we have. Once it has been settled, we can definitively close the 2017 conference in Barcelona.
To begin with, I just have to go to Alghero. There I saw you and Andreina, smiling, radiating happiness as always, like when we met, restoring Etruscan sarcophagi in Fregene. Suddenly, with a glass of wine in hand, we got excited saying that we would celebrate the next conference in Barcelona. As if I could decide that. But there is nothing like intensely wanting something and fighting for it until you get it. You were sure I would do it. Me, not so much.

And Barcelona, after returning from the Alghero conference in 2014, did not make it easy. A City Council does not organise these things, they told me. And it was an election year and when it seemed that we had them convinced, the politicians changed. So then, it was back to square one. You came repeatedly to see if your snake charmer skills worked. The first time I called you at the Old Sant Pau Hospital. And then you liked Barcelona even more and we were talking about mosaics. What else would we talk about in a city that has them everywhere? And you let me propose it to you, months later when we already had the City Council convinced and the money to get the conference committed, you then convinced the ICCM Board. I didn't have a great time that day at the ICCROM, although I think I hid it quite well. I wanted to make Barcelona seduce them and make its mosaics enter into the association's ideas. To protect them. To preserve them.

And from there, everything went smoothly. Well, not everything. Do you remember that press conference in El Born – in the place where we would later hold the conference – that not a single journalist came to? I was so ashamed, so disappointed. Many things happen in this city every day, Roberto, too many things. And the mosaics, unfortunately, are a thing of a few crazy people who see the world in pieces. But nothing set us back. And we started to team up, with Monica de Manners and her professional know-how; Kusi, always enthusiastic and thoughtful; Josep who seems to say yes to everything, the volunteers, and, little by little, everything started to take shape. Everything happened as if by magic.

You told me one day that this should be a special conference because the ICCM would be 40 years old in Barcelona, that we had to dance and that birthdays should have a cake. And we didn't just dance at the end, we started dancing – although we were sitting down – the first afternoon of the conference. My fondest memory is always fixed on the first afternoon of the conference. Sunday 15 October at the Pedralbes monastery. I had designed that reception of the conference attendees with all my heart set on the participants from the Arab countries. I was afraid that perhaps they would feel uncomfortable, even accused, with what had happened during the summer, when on 17 August there was the terrorist attack in La Rambla – on the Joan Miró mosaic (!) And even today I find it hard to believe how months before I met that group of musicians called *Mosaico del Mediterráneo*, whom we asked, how else, to accompany us; in the second piece, everyone clapped and shifted in their chairs. And on top of that, the icing on the cake was Manuel Forcano with his speech in seven languages. Fantastic, second to none. I saw faces of happiness, sincere smiles, expressions of brotherhood. That did look like a good to start the week.

We did a lot of work inside El Born and it was very well done. Themed sessions, round tables, stalls, coffees and pastries, visiting nights, and a day trip to see a little of the country. I wanted to show you that there are other realities that perhaps you did not know about because history often hides them from us and the maps do not draw them. And outside the Born, there were sad days, days of decapitated liberties that perhaps you will remember.

Probably Barcelona received you with little pomp and luxury. Politicians did not come to open or close the conference. Only the necessary authorities. We are like that, no pretense, simple, we do not like solemn acts or artifices too much. But we are passionate and vital too. We are sanity and madness. And I think this also sums up what the conference was.

Anyway, I just wanted you to know because Roberto, the conference was also this, right?

Dear Montserrat,

In your letter, you refer to the fact that on several occasions I have said that the strength of the ICCM lies in the sense of familiarity and friendship that bonds the members of the Foundation, as well as its professional competence. Indeed, it is this that is behind the success of this organisation whose work is supported by volunteers and by their passion and enjoyment. I fully agree with everything you wrote and the example of the conference in Barcelona is emblematic: you are right to remember that everything started with our surprise meeting during the XII conference in Alghero, 35 years after that Etruscan tomb restoration site. From that moment, an idea that was sparked in a moment of enthusiasm has gradually become a reality.

You may not know that my first reaction to the idea of organising a conference in the Iberian Peninsula was less than enthusiastic given that the ICCM has already held three conferences in that region: Soria in 1986 and Palencia in 1989, both titled "In situ conservation" and Conimbriga in 1993, titled "Conservation, Protection, Presentation". However, having examined and discussed it, the geographical value that up to then had guided the ICCM in its decisions on where to hold conferences has given way to new interests that have been gaining relevance in our sector over the years: chronological position and work materials.

For some years now, a few sparse presentations on mosaics of the "non-archaeological" era have been making a timid appearance on the list of works presented at the ICCM conferences: a very small number of talks given in a quiet voice stood out due to the significant interest they attracted from among the participants. For years, public and private clients have been growing increasingly aware of the fact that tiling works involving tiles of various sizes and materials "other" than marble and glass can play a role in portraying the artistic and cultural expression of a community, with equal worth given to the antique mosaic and its right to be valued and conserved by qualified persons.

All of a sudden, your proposal to organise the XIII conference in Barcelona, the home of Gaudí, the city where mosaics are the dominant characteristic of its heritage from ancient to modern times, seemed like the opportunity the ICCM had long been waiting for. Barcelona, the city where, the way you, Montserrat, have written in the conference presentation, "from tesserae of the early Roman period to tiles of Antoni Gaudí, Barcelona is an open field of study of several, diverse and complex forms and techniques of mosaics in public or private spaces with significant historic and usage value. Within the framework of mosaic production, in addition to fine examples of the Greek and Roman mosaic tradition, such as the Empúries archaeological site or the recently excavated Roman mosaics in la Sagrera, in the city of Barcelona, in Catalonia there is a large range of Art Nouveau mosaics dating from the early 20th century. In Barcelo-

na, one can find mosaics in the most unexpected corners of the city. Examples include the Santa Creu I Sant Pau Hospital and the Palau de la Música with an extensive collection of top-level Art Nouveau mosaics. Moreover, various mosaic works, which demonstrate a wide range of materials and techniques, can be found in shops, residences, markets, or other public and private buildings".
There was enough to attempt leaping: use Barcelona and its mosaic heritage to break down the temporal barrier of antiquity in the objectives of interest to the ICCM and fully promote the various forms of modern and contemporary tiling to scholars, conservators, administrators, and planners. Put more simply, in the field of interest to the ICCM.
This explains the title for the meeting: "What comes to mind when you hear mosaic? Conserving mosaics from ancient to modern". With this question, we wanted to discuss the materials and techniques of a functional and artistic expression that has been incorporated into various forms of architecture: flooring, murals, roofing, both internal and external. We have found mosaics used as a decorative technique in an extensive variety of contexts which we wished to explore and share at the conference.
We highlighted the modernist mosaics, which incorporated the *trencadís* technique, and other less well-known mosaics. We also discussed the use of materials produced in the XX century - natural and Portland cement - the production of hydraulic mosaics or Nolla mosaics among others. Easy to say: I remember the surprise on your face during the board meeting in Rome at the ICCROM when you realised that what for you seemed obvious and a given, was not so in reality. Only with your refined political capabilities, you were able to gradually make it clear which path needed to be followed. After your passionate speech, everything became clear: a well-defined path that we all followed, satisfied in the knowledge that we were opening up a new horizon which would benefit the whole profession in the years to come.
It was an ambitious challenge of the kind that ICCM readily rises to and, thanks to the extraordinary heritage of Barcelona, the generosity and efficiency of the group of colleagues that you put together, and the tireless support of the Vice President of the ICCM Stefania Chlouvera-

ki, the outcome was a great success. Indeed I would like to add that the efficiency and spontaneous generosity of our Catalonian friends and colleagues are perhaps what surprised me most: characteristics that elsewhere often do not coincide and are, indeed, antithetical, in Barcelona are expressed always as two sides of the same coin.
The ICCM will never be the same after Barcelona. The profile of the mosaic conservator/restorer will also not be the same. The Barcelona conference with its plenary sessions, visits, and cultural events represented a milestone that marks a turning point in the profession, and all those who contributed, from our Catalonian friends to members of the ICCM board and all the participants are proud of the work done. It amazes me to think that it was four days from when we first talked about this idea to when you gained the support of the municipal authority which confirmed the nomination of Barcelona as the location for the conference. Particularly if we compare this timeframe with the impact that the results of this conference will have in years to come.
Speaking of memories, the other challenges that we added to the list of conference objectives in Alghero over a glass of wine come to mind. I recall, for example, the idea of exceeding in Barcelona the 350 participants that attended the conference in Palermo in 2008. Through no fault of our own, we did not achieve this goal. Although I am sure that we would have far exceeded this number for the strict rules imposed by the fire service that limited the number of people admitted to the multipurpose room in El Born where the event was hosted to 250. We can console ourselves with the fact that in the cultural events and taking into account the coming and going of different participants, the goal of 350 was effectively far exceeded.
We can also be satisfied with the ever-increasing number of countries represented: 34. Albania, Algeria, Germany, Austria, Belgium, Brazil, Bulgaria, Canada, Cyprus, Costa Rica, Egypt, Spain, United States, France, Greece, Hungary, India, Israel, Italy, Jordan, Libya, Republic of North Macedonia, Montenegro, Morocco, Palestine, Poland, Portugal, United Kingdom, Serbia, Switzerland, Syria, Tunisia, Turkey, and the Vatican City have all contributed to the work.

I recall another challenge that was posed at the Barcelona conference, based on an idea of Theocharis Katrakatzis, Treasurer of the foundation: to use videos in the conference as a means of communication to facilitate the promotion of conservation work and to connect groups by leaping language barriers through the use of more direct communication means such as images and sound. This is how the video review entered the program of future ICCM conferences. The main topics covered during this session were manufacturing, art, and significance, conservation, presentation, education, and conservation good practices. 11 videos from 8 different countries were screened during the conference in two rooms next to the conference hall. The members of a dedicated commission gave a prize for the best videos. The winning videos were selected based on the originality of the idea and the strength of the narration. I would like to mention the prize-winning videos because in a certain sense they represent the pioneers of this further legacy of the Barcelona conference that the ICCM will take forward in future years to be used and enjoyed by the entire professional community:

- 1st Video Award, *"MCC Mosaic Conservation Course – 2016 Ephesus On-site Project"*, Gian Mario Porcheddu (Italy), https://www.youtube.com/watch?v=eawBTyYT0Jc
- "Coup de Coeur", *"Refugee Community Mosaic"*, Gertrud Mülle (Brazil), https://www.youtube.com/watch?v=rd61uIJOXnc
- Special Mention, "*A Learning and Teaching Adventure in mosaic conservation: the Um Ar Rasas Project"*, Christos Xourgias & Giorgos Agavanakis (Greece), https://www.youtube.com/watch?v=-jqUGIsgDbk
- Special Mention, *"A New Mosaic from Philippopolis, Syria"*, Maher Jbaee & Moutaz Al-Shaieb (Syria), https://www.youtube.com/watch?v=L5dLPl_q9eU
- Special Mention, "*The Conservation Project of the Mosaics of Eshmun, Saida, Lebanon"*, Myriam Ziadé (Lebanon), https://www.youtube.com/watch?v=2dNNeKD8V7A

Finally, I would like to talk to you about the significant participation of the representatives of the countries of North Africa and the Middle East, a significant legacy of the Mosaikon project. As everyone knows, Mosaikon was an initiative of the GCI, ICCROM, and ICCM funded entirely by the Getty Foundation, and represents a revolutionary chapter in the field of mosaic conservation and management. Over a decade, following training courses, field projects, publications, and direct and indirect support for the ICCM through the provision of study grants to participate in ICCM conferences, this project created a new generation of professionals able to operate autonomously in countries responsible for the conservation of the richest mosaic heritage in the world. The enthusiastic and fruitful participation of former members of the Mosaikon project was a source of inspiration and joy. The lifeblood of an organisation that needs to continuously regenerate. An example of all, the mosaic created during the conference with the signature of all the participants: a perfect seal for a perfect initiative.

Dear Roberto,
I have been moved by your praise and I only have thanks and a great feeling of peace for having done things as the heart dictates. But notice, Roberto, what should have been just a foreword has also become a summary of the conference and, even more interestingly, it is serving to explain something of the history of the ICCM, the "family secrets" that some of you have experienced and many of us do not know. From what should only have been personal memories of this conference, you are making a critical analysis of the conceptual evolution of the mosaics, of their consideration as a heritage asset, of the need to expand the field of study and work of the association. Because yes, all this came from afar and although it materialised in Barcelona, it was certainly a long time ago. Things do not come out of anywhere and it is clear that sooner or later ICCM had to take on new challenges, in line with the times we live in. Talking about the past is also talking about the present and the commitment made, as an association, from this conference. I think it is very important to make this clear and in writing. Until next time, then.

Roberto Nardi, Montserrat Pugès i Dorca

PREFACE

The presentation of the proceedings of a congress is always a source of satisfaction, because it means that we're finishing what we started, keeping to the commitments we made, and moreover, leaving a written record of the fact. Things which may seem obvious and unproblematic are not always so simple within a city council, and even less so in the case of a city like Barcelona. We often have the feeling that it's difficult to bring issues to completion; we put out one fire and then another one breaks out, and it's back to square one.
And this has been the case with this 13th International Congress on the Conservation of Mosaics. We welcomed you to Barcelona to spend a few days exchanging experiences, working together and organising those always necessary debates, and although it's now over, you've left your mark. Your stay here is a part of all those mosaics that we've discovered since then.
When we received the proposal for the joint organisation of this event, we asked the Archaeology Service what the congress would bring to the city, and what its overall impact would be on citizens - which is the main concern of any public administrative body.
It's true that we're continuing to collect mosaics via citizen participation through our own programme, initiated in 2017 and called "Mosaic in my Neighbourhood". And in this way we came to understand how the city needs to discover itself, get to know itself, and learn to love itself. And so the wheels started to turn, and other needs were generated. All of this reveals the fact that the people of Barcelona have seen in the recent work on the

conservation of the mosaics that are part of our heritage values that haven't been taken sufficiently into account.
Together we've taken a fresh look at the word "heritage", questioning the boundaries between the public and the private, to what degree private institutions or individuals can be granted the authority to damage what can be considered a part of our joint heritage. Because heritage, whether public or private, needs to be conceptualised within the framework of the city where it is to be found, as a part of the city's history, and as a way of transmitting a culture that is constantly evolving. We need to make the necessary tools available to ensure that we don't lose what we have, what we feel is our inheritance and that we want to transmit. We're now learning that we are just a very small tile in a much bigger whole.
For many people the mosaics are a source of inspiration, not only for what they represent in artistic terms, but also because of their capacity - as a set of little things well organised and beautifully joined together - to form an outstanding and monumental work. This is the spirit that characterises us as human beings, and our ability to create and to renew ourselves. I encourage you to continue with your task, as preservers of our heritage so that we can go on enjoying it, and go on rethinking who we are as human beings. Thank you so much for coming, and for all that you've taught us, and thank you for keeping the wheels turning!

Joan Subirats i Humet
Deputy Mayor of Culture, Education, Science and Community
Barcelona City Council

ICCM AWARD 2017

Gaël de Guichen is a French chemical engineer. He started his career in conservation as a scientist at the Lascaux Caves in France. Gaël de Guichen is an indisputable international reference in Preventive Conservation for his pioneering work in this field and for having contributed decisively to its statement as a disciplinary matter.

One of his first achievements was the creation in 1975 of the first International Course in Preventive Conservation taught at ICCROM aimed at museum curators, conservators and, conservation scientists. In 1985 he launched "PREMA", Preventive Conservation in Museums of Africa, a vast program of the revitalisation of sub-Saharan African Museums. In 1989 he designed the International Course on the Safeguarding of Archaeological Mosaics.

His global vision of the necessity of Preventive Conservation as a long-term strategy for conservation of heritage led him to hold courses and conferences in more than 50 countries and to work tirelessly developing programs in this specific field.

He was among the first to strongly advocate for public understanding of the fragility of the heritage, the necessity of its engagement in heritage preservation and to recognise the importance of the media in raising awareness among the public. With these objectives in mind in 1991, he launched an international public awareness campaign called 'Media Save Art', which earned him the recognition of the IIC Keck Award in 1996. Since Gaël de Guichen first raised his concerns, public awareness and knowledge have increasingly become an integral component of preventive conservation strategies. Today

Gaël de Guichen receiving the ICCM Award 2017. In the photo Roberto Cassio, author of the mosaic plaque

Gaël travels the world to reorganise Museum storages in the framework of the RE-ORG campaign that he launched with ICCROM and UNESCO.
Gaël arrived in Rome in 1969 for a six-month scholarship at ICCROM. In 2020 he is still in Rome. This was a time of great cultural fervour, in which names of the calibre of Plenderleith, Brandi, Urbani, Torraca, Philippot, and Paolo and Laura Mora were discussing fundamental themes of conservation. Among these, the restoration and conservation of the mural paintings were finding a methodological codification that is still relevant.
Thanks to the contacts with his old friend Claude Bassier, a French mosaic conservator, Gaël was exposed to the problem of the fragility of the mosaic heritage. Discovering that 90% of excavated mosaics go lost in few years after the excavation, increased in him the need to create a platform that could awaken the attention of the professional world on this issue and generate a new awareness that may change things. This is one of the first preventive

conservation dedicated specifically to the conservation of the mosaic. This is how the International Committee for the Conservation of Mosaics was born in 1977, in Rome. Of ICCM, Gaël was the promoter, fundraiser, administrator, secretary, porter, driver, archivist, mentor, and, today, honorary president and founding member of the new Foundation. No one like him has linked his name to the conservation of the mosaics and ICCM. And no one like him has worked hard and incessantly without, due to his generosity, ever expecting recognition of thanks.

Therefore, after Federico Guidobaldi, Antonio Cassio, and Claude Bassier, the board of ICCM has unanimously decided to assign the 2017 ICCM Award to a person who deserves it the most while expecting it the least: Gaël de Guichen. Congratulations.

ACKNOWLEDGMENTS

The credits in a conference proceedings are the first thing that the reader encounters. However, in reality they are the last thing that authors write at the end of a long journey that starts with the organisation of the conference and ends with the publication of the report. They represent the final effort made by the authors who have the pleasure of thinking of all those who, through their institutional role, professional commitment or personal interest have contributed to the success of the operation that, in our case, has run its course over a period of six years. We will look back over this journey in order to thank those who contributed to the success of the conference and the publication of the acts.

There are many people, that we wish to thank for their collaboration and enthusiasm during the organisation and development of the conference. Starting with the members of the organisational committee external to the ICCM: Carles Vicente, Director of Memòria, Història i Patrimoni - Institut de Cultura de Barcelona (ICUB) and Josep Pujades, Head of Archaeological Interventions - Servei d'Arqueologia de Barcelona/ICUB for the significant work carried out "behind the scenes" in order to ensure the smooth passage of the conference through the various decision-making stages.

Ana Castellano-Tresserra, director of the *Reial Monestir de Santa Maria de Pedralbes* who offered us all kinds of facilities to enable the first meeting between the conference attendees and to Manuel Forcano, director of the *Ramon Llull Institute* who, with his short tutorial on mosaics and fraternity between peoples, we won't easily

forget. The *Institut Ramon Llull* itself welcomed us days later in an almost family session with the colleagues from the Middle East. Many thanks to them both and we also have a very special memory of our friend Jordi Carrió who with his "savoir faire" helped us to design the event. The venue where the conference was held was not chosen by chance. As lovers of archaeology, we brought you together throughout the week at the Born Cultural Centre, a place full of history, to discuss portions of history in the form of mosaics. We are very happy with all the support and backing we received from our colleagues in the Born and especially from its director, Montserrat Iniesta, who welcomed us during the opening ceremony and provided us with all kinds of facilities during the week to ensure that everything went well.

Because ICCM conferences are both work and leisure, time and spaces shared with people are united by enthusiasm, often a passion for mosaics. And Barcelona has been a city of mosaics for many years, as we have been able to see by walking around it, but also thanks to the different specialists who have helped us with the visits to museums and heritage buildings.

It is difficult to describe the involvement, effort and prior dedication of all the institutions and museums that have collaborated to show their precious mosaic work. The preparation of special visits in the *Palau de la Música Catalana* or in the *Antic Hospital de la Santa Creu i Sant Pau* have been an unbeatable source of knowledge in order to appreciate the Modernista mosaic treasures they contain. Many thanks to Joan Oller and Montserrat Carulla, director of the *Palau de la Música Catalana* and president of the foundation, respectively, and to Marta Grassot, documentary film maker, with whom we have shared the pleasure of showing you the Palau and its mosaics, convinced that we would fall in love with them. Also thanks to Isabel Basseda, Head of Spaces and Institutional Relations of the *Sant Pau-Recinte Modernista*, with whom we started the negotiations and from whom we received all kinds of facilities in order to visit the building complex and understand its artistic, historical and social value.

A sincere thanks to the colleagues from museums and institutions that have helped us: to staff of the *Museu d'Historia de Barcelona*, who we would like to thank especially for their interest and dedication in opening the different venues during the conference: Joan Roca, Lidia Font – director and restaurateur respectively – thank you very much. To our colleagues at the *Museu d'Arqueología de Catalunya* (MAC) in Girona and Empúries, where we spent a whole day offering you a little sample of this country. To Marta Santos and all her team for their welcome in Empúries where the magnificent work prior to the visit was revealed with a special exhibition dedicated to mosaics. To the director and technical staff of the MAC of Girona, Ramon Buxó, for the visit to *Sant Pere de Galligants* and Silvia Planas, director of the *Museu d'Història de Girona*. A very special recognition for the restorers Sílvia Llobet and Laura Lara for their constant and silent work, done with the rigour and enthusiasm in a way that characterises them.

Thanks also to the volunteers, always attentive to our whims and requests: Lucía Martínez, Elena Morera, Carla Roig, Paula Solé, Andri Tsiouti, Mario Vazza, Irene García, Martí Puig, Anna Bertral, Nuria Ramón, Emma Clapés, Ana Montemayor, Caterina Fiol, David Holguera and Silvia Soler. It has been a pleasure to have you!

During the preparation of the conference, there were other people and institutions too that helped us in one way or another, either by contributing their experience, knowledge and support, or simply through their enthusiasm. Thank you everyone: Mónica Borrell and Pilar Sada (MNAT) Tarragona, Roser Vilardell (MEL), Antoni Vilanova (AADIPA), Xavier Laumain and Angela López Nolla Ceramic Research and Dissemination Centre (CIDCEN), Faculty of Fine Arts University of Barcelona, Higher School of Conservation and Restoration of Cultural Property of Catalonia, Catalan Association of Conservationists-Restorers (CRAC). We would also like to remember and especially thank the invaluable help of colleagues from other areas of this great Barcelona City Council: David Listar from the Directorate of Global Justice and International Cooperation Services and Jordi Cortés from the Directorate of International Solidarity

and Cooperation Services without whose intervention we would not have been able to count on the presence of so many colleagues from all over the Mediterranean. Josep Lluís Alay too, for believing that we could do it, and Xavier Domènech for making it possible.
The conference also found moments for us to speak in a relaxed atmosphere, to laugh and share a table. In that regard, we would like to thank Elvira Cabot from Barcelona Provincial Council for letting us use the space on the magnificent Escola Industrial campus to share the dinner offered by the GCI. The long-awaited celebration of the ICCM's 40th anniversary, with dinner, a *gralla* dance and *l'Escribà* cake, was possible thanks to the use of the gardens at the *Museu Agbar de les Aigües*, in Cornellà de Llobregat. Sonia Hernández and team, thanks for making it so easy. This farewell has already become part of the ICCM's festive history.

With regard to the content of the conference and of this publication, we would like to thank Joan Weinstein, Director of the Getty Foundation for the financial support provided to the ICCM over the last ten years; for supporting for the third time the participation of forty participants of the Mosaikon project in an ICCM conference; for sustaining the publication of this volume and for her skilled and passionate contribution to the professional and organisational aspects.
We would also like to thank all the members of the scientific committee for their astute selection from among the 160 proposals received from 35 countries around the world of the contributions included in this report: Gaël de Guichen, Demetrios Michaelides, Anne-Marie Guimier-Sorbets, Stefano De Caro, Jeanne Marie Teutonico, John Stewart, Evelyne Chantriaux, Aïcha Ben Abed, Alessandro Lugari, Hicham Rguig, Komait Abdallah, Kusi Colonna-Preti, Sílvia Llobet. Stefania Chlouverachi, vice president of the ICCM, and Theocharis Katrakazis, treasurer of the Foundation together with being part of the scientific committee, deserves special thanks for their direct support in the organisation and management of the conference. In addition, Theocharis conceived and managed the video showcase, with an award

for the best presentation, an exciting new development in the ICCM's current and future activities.
A mention must be made of Zaki Aslan, Director of ICCROM-*ATHAR* Regional Conservation Centre in Sharjah for having supported the participation of 5 grant recipients from Arab countries. We would like to thank Roberto Cassio for producing the "ICCM Award" and the Madaba mosaic school for creating the coral mosaic of all the participants of the Barcelona conference.
We would also like to thank Neil Putt for his work on the translation and standardisation of the texts.

Finally, for alphabetic reasons and because she was deeply involved in the editorial process, we must mention Chiara Zizola for her tireless and important work proofreading the texts, without which this Volume would never have been produced in its current form.

OPENING SPEECH FROM THE PRESIDENT

Since its founding in 1977, the ICCM has regulated its life with a view to the three-year deadline of the international conference. It was at the first international conference in Rome, in 1977, that the participants founded the ICCM, and here in Barcelona we have arrived at the 13th such event. For the professionals and institutions in the mosaic conservation sector, this is our moment for discussion, exchange and debate, within the international network that the ICCM has done so much to develop.

The triennial conferences have multiple functions, leading in turn to multiple results.

Among them:

– Updating on the state of the mosaic heritage and interventions, taking an international point of view;
– Exchange and assessment of technical and methodological information;
– Sensitisation of policy-makers, administrators and media within the host countries. These are chosen in the logic of a precise strategy, which over 40 years has seen the conferences held in all parts of the Mediterranean region.
– Maintenance and development of a professional network, based on personal relations and mutual respect;
– Welcoming new generations of students and technicians to the profession from all countries, including through scholarships focused on the events of the conference itself;
– Publication and dissemination of the new knowledge contained in the conference papers and posters, developing a series of volumes that now represent a large part of the technical and theoretical literature for our field.

The triennial conferences are also the moment for an essential act of ICCM governance: the organisation of the Members General Meeting, during which the representatives to the ICCM board are appointed and roles and tasks are identified. During the 12th international conference, held in Alghero in 2014, the committee members elected the new board, confirming me as one of the representatives. Immediately afterwards the board members elected the officers for the triennium: John Stewart as treasurer, Jeanne Marie Teutonico as secretary, Stefania Chlouveraki as vice-president, and Roberto Nardi as president. As the first act of our new mandate, I proposed that we recognise Demetrios Michaelides as President Emeritus, in consideration of all his great work during the six preceding three-year terms. The entire board and all ICCM members extend our warmest thanks to Demetrios for the quality of his services and his devotion to the committee over the years.

As ICCM President, I believe that the publication of this volume, which describes the "state of the art" of the profession, is also a valuable opportunity to provide a retrospective of the three years of activity just concluded, and of the results achieved. Indeed, I hope that this practice will become standard practice so that through the publication of the proceedings we can record the life of the ICCM Foundation, trace the history of its activities, and observe the results. For the current report I proceed in chronological order, summarising the results from the work of a group of colleagues and friends – the ICCM Board – supported by our members, partners and sponsors. To all, I extend my heartfelt thanks.

31 October 2014. I Board meeting, Alghero, Sardinia

One of the functions of the first international conference of 1977 was the election of the board of representatives. Since then we have renewed the board by election, at every triennial conference. Traditionally, the first board meeting has coincided with the conclusion of the conference, at which time the new officers are announced. The representatives elected to the board in 2014 were:

- Komait Abdallah, Director of Scientific Laboratories, Directorate General for Antiquities and Museums of Syria,
– Aïcha Ben Abed, Director of Monuments and Sites, Institut National du Patrimonie, Tunisia;
– Evelyne Chantriaux, Director of Atelier de Restoration de Mosaïques et d'Enduits Peints de Saint-Romain-en-Gal, France;
– Alessandro Lugari, Conservator-Restorer, Soprintendenza Speciale per i Beni Archeologici di Roma, Italy;
– Hicham Rguig, Conservator-Curator for the Archaeological Site of Chellah, Morocco;
– Jeanne Marie Teutonico (Secretary), Associate Director of Programs, Getty Conservation Institute, USA;
– John Stewart (Treasurer), Senior Architectural Conservator, English Heritage, United Kingdom;
– Stefania Chlouveraki (Vice-President), Technological Educational Institute of Athens, Greece;
– Roberto Nardi (President), Director of the Archaeological Conservation Centre of Rome;
– Gaël du Bouexic de Guichen (Honorary President), Advisor to the Director-General of ICCROM;
– Demetrios Michaelides (President Emeritus), University of Nicosia, Cyprus;
– Anne-Marie Guimier-Sorbets (ex-officio member as representative of the Association Internationale pour l'Etude de la Mosaïque Antique - AIEMA), University of Paris Ouest-Nanterre;
– Stefano De Caro (ex-officio member as representative of the International Centre for the Study of the Preservation and Restoration of Cultural Property - ICCROM), Director-General of ICCROM.

7 April 2015. Establishment of the ICCM Foundation, 2015-2016

On 7 April 2015, Roberto Nardi, President, and Gaël de Guichen, Honorary President, signed the "Memorandum of Creation of the International Foundation for the Conservation of Mosaics". With this, the International Committee completed its transformation as a "legal person", regulated by the Italian Civil Code, from its former status as a cultural association. One of the significant results from the achievement of this milestone is that as a

foundation, the ICCM can and must hold assets for the performance of its stated purposes.
As a body endowed with legal personality, the foundation has a life distinct from that of the founders and administrators. The foundation is governed by a Board of Directors, which may delegate powers to its members or other bodies, such as for the organisation of the triennial conference. The elections to the board take place at the conference. The foundation must appoint a qualified auditor or auditors, who report on the correct keeping of the accounts. The procedures for appointing the board and any other bodies are defined by the articles of the founding Memorandum. The president, elected by the board, is usually the legal representative. All of these characteristics enable the foundation to receive funds from external sources, and then allocate them correctly for the achievement and management of the statutory purposes.

The Memorandum, or "ICCM Statute", states that the foundation:

> has the primary objective of public good, to promote and enhance the conservation of ancient mosaics through the study of the technology of mosaics and of the techniques and theories on conservation, restoration, maintenance, protection, training and presentation of ancient mosaics. The Foundation also encourages the international exchange of information in the field of mosaic conservation ... through the organisation of Triennial Conferences, the publication of the proceedings of these conferences, the publication of periodicals and newsletters with contributions by specialists from all geographical origins, and the creation of a network of professionals who in various ways contribute to the conservation of ancient mosaics.

The foundation renews the work of the International Committee for the Conservation of Mosaic (ICCM), carried out since 1977, in a more institutional form, consolidating its decisive role in promoting mosaic conservation as a distinct discipline within the field of archaeological conservation. The ICCM can now base its operation on legally held assets, and benefits from a regulated structure, while still maintaining its purposes of social utility.

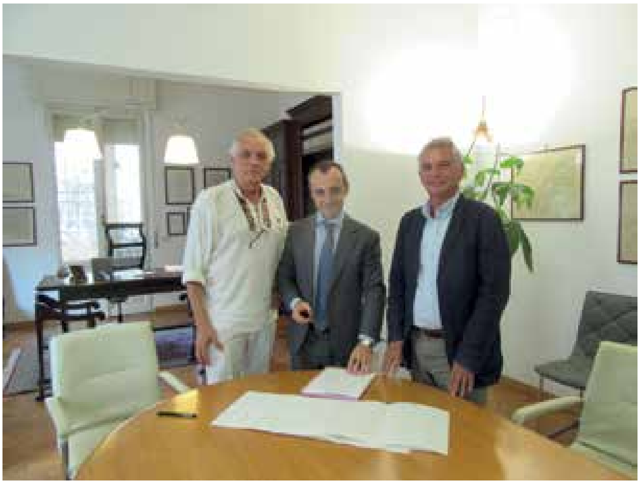

Fig. 1. On April 7, 2015, Roberto Nardi, President and Gaël de Guichen, Honorary President, set up the ICCM Foundation based in the Convent of San Nicola in Belmonte in Sabina, Rieti in the presence of the Notary Fernando Gianpietro

In the Italian legal system, a foundation acquires legal personality at the moment of recognition by the prefecture, or territorial office of the national government. The recognition verifies that the legal and regulatory conditions have been met, that the purpose is correctly stated, that the assets and structures are sufficient for implementation, and that it is committed to the required checks and controls.

The International Foundation for the Conservation of Mosaics is governed by a board consisting of 11 elected members, an honorary president, a president emeritus and two ex-officio members representing ICCROM and AIEMA. The current legal address is the Convent of San Nicola in Belmonte in Sabina, Rieti.

On 14 April 2015, the foundation was awarded a tax number, and on 21 December 2015 received official recognition from the Prefecture of Rieti, the office responsible for the territory of the Convent of San Nicola. The final act in the story of the foundation's birth took place on 26 September 2016, when the Statute, as revised by the ICCM board meeting of 22 January, was registered with the notary public, Fernando Rosario Gianpietro of Rome (Fig. 1).

30 September 2015. Distribution of the Palermo International Conference Proceedings (2008)

In September of 2015, we completed the mailing of the Proceedings of the 10th International Conference of the ICCM, Palermo, 2008. Among the 248 conference participants, 162 were entitled to the volume, and of these we were able to reach 155, or 96%.

17-21 January 2016. Regional Advisory Meeting of the general directors of the departments of antiquities of the Mediterranean countries, Venice

The ICCM began the year 2016 with the organisation of a meeting of the heads of mosaic services and general directors of the departments of antiquities of the Mediterranean countries. The countries represented were Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, Tunisia and Turkey. The aim was to share the results achieved in each country under the Mosaikon Programme, operating in this region since 2011, thanks to funding from the Getty Foundation and under the direction of ICCROM, GCI and ICCM. Working together over the course of three days, the group drew up an overview of the current state of management and conservation of the mosaic heritage in the Mediterranean region, and advanced the planning of programs for the next three years.

22 January 2016. II Board meeting, Rome

The ICCM board held its second meeting of the triennium on 22 January 2016, at ICCROM headquarters in Rome (Fig. 2). In attendance were Komait Abdallah, Aïcha Ben Abed, Evelyne Chantriaux, Stefania Chlouveraki, Alessandro Lugari, Roberto Nardi, Hicham Rguig, John Stewart, Jeanne Marie Teutonico, Stefano De Caro, Gaël de Guichen and Anne-Marie Guimier-Sorbets. The first item of business was the review of the 2015 financial statements and 2016 budget, both unanimously approved. The board then devoted careful attention to the revision and refinement of the Statute of the ICCM Foundation, in view of its great importance to the life

Fig. 2. The II meeting of the steering committee took place in Rome on 22 January 2016, at the ICCROM premises, at San Michele

of our organisation. The first draft of the statute was presented in standard notarial and legal language, not fully adapted to the unique nature of the ICCM. Led by Jeanne Marie Teutonico, the board worked at length to cut and sew the text, so that it now represents the true reality of our organisation while still conforming to the legal requirements. Having revised and approved the statute, it was then ready for legal registration. This final act was carried out by Roberto Nardi, President, and Gaël de Guichen, Honorary President, serving as the founding members, on 26 September 2016, in the presence of the notary Fernando Gianpietro of Rome.

The other great event of meeting II was the proposal to host the 13th International Conference in October 2017, presented by Montserrat Pugès Dorca on behalf of the Archaeological Service of the Municipality of Barcelona. The candidacy received a warm welcome and the unanimous acceptance of the board members. The local organisers proposed the hosting of the conference as an opportunity to discuss and promote mosaics not only as a product of the past, but also as a continuing tradition - not only of the Classical period, but extending, for example, to the exceptional Art Nouveau heritage of Barcelona, and to

Fig. 3. Montserrat Pugès i Dorca, Responsable d'intervencions en el patrimoni Servei d'Arqueologia, Institut de Cultura Ajuntament de Barcelona and member of ICCM board, opening the working sessions at the Barcellona Conference on October 15th, 2017.

mosaic works of all kinds, materials and shapes, distributed in neighbourhoods throughout the city. After long deliberation, the board agreed on the conference title: "What comes to mind when you hear mosaic? Conserving mosaics from ancient to modern". The excellent results achieved by the conference are known to all, one of them being this very volume you are reading (Fig. 3).

2016-2017. Organisation of the 13th International Conference in Barcelona,

The organisation of our triennial international conference involves long preparation, not only by the local committee, but also by the ICCM officers. This includes travel to meet with authorities and logistics services, preparation and signing of memoranda of understanding, participation in on-site assessments and planning for visits and social events, in news conferences, and much more. Over the course of 2016 and 2017 a number of visits to Barcelona were made, always relying on Montserrat Pugès as the reference figure for the highly efficient organising committee. ICCM vice-president Stefania Chlouveraki also provided great support during this phase. On 26 February 2017, the Scientific Committee met in Rome, to complete the selection of papers and posters and the planning of the scientific program. On 1 March 2017, I attended the press conference organised by the local conference coordinators at the El Born Cultural Centre, the future conference venue, where we announced the main event and related activities.

May-November 2016, A strategy for ICCM in social media

The ICCM Foundation is the only international professional organisation with a specific focus on the care, conservation, and presentation of mosaics. It brings together a highly diverse network of heritage professionals from various disciplines and different parts of the world. Since 1977, the ICCM has relied on its organisation of triennial international conferences as the main forum for knowledge dissemination and exchange, further supported by regional symposia and meetings, workshops, and still more activities. Yet to remain relevant and visible in the digital information age, these face-to-face events and the supporting publications are not enough. Indeed, the digital age opens up to means of communication, education and knowledge creation. In view of this, in early 2016 the ICCM began the development of a communication strategy that could also create digital information, sharing spaces and forums that would consolidate the existing networks and encourage new members to engage with the work of the foundation and feel part of this community. A first step was to transform the www.iccm-mosaics.org as a more user-friendly resource. We then moved on to the launch of the ICCM Facebook page (July 2016) and more recently the creation of a YouTube channel (November 2017). For all this, the ICCM is indebted to the great commitment of our working group and their coordinator, Stefania Chlouveraki.

Launch of "Friends of ICCM Foundation" Facebook page

https://www.facebook.com/friendsoficcm/

The Friends of ICCM Facebook page serves for direct communication and immediate sharing of ICCM re-

Fig. 4. The *Friends of ICCM* Facebook page aim is to serve as an immediate/direct communication tool for sharing

lated announcements, selected professional articles and resources on mosaics conservation and presentation, selected mainstream media articles on mosaic art and conservation, and event announcements by partner organisations and national agencies. ICCM friends use the page as a bulletin board: posting news and inspirations, sharing their work, requesting advice, raising concerns and questions on conservation issues.

As of May 2020, the ICCM page numbers over 1000 friends from all over the world. The page is currently managed by ICCM board members, however we are looking into sharing responsibilities with younger ICCM members (Fig. 4).

27-28 February 2017, III Board meeting, Plovdiv, Bulgaria

The ICCM board held its third meeting of the triennium in Plovdiv, Bulgaria, European Capital of Culture for 2019, with the prospect of facilitating the city's candidature to host the 14th International Conference, scheduled for October 2020. In attendance were Aïcha Ben Abed, Evelyne Chantriaux, Stefania Chlouveraki, Roberto Nardi, John Stewart, Jeanne Marie Teutonico,

Gaël de Guichen and Montserrat Pugès. Apart from the conference, the main items of business were the 2016 financial statements and 2017 budget, the Getty Foundation grants and the fundraising campaign. Following the business meeting the board participated in a joint news conference with Dr Amelia Gesheva, Deputy Mayor for Cultural and Tourism of Plovdiv, to announce the city's candidature.
The ICCM board members ended their work in Bulgaria, for this occasion, by participating in the Balkans Regional Symposium on Mosaic Preservation, held at the 'Boris Christov' House of Culture, in Plovdiv.

1 March 2017, Balkans Region Symposium on Mosaic Preservation, Plovdiv, Bulgaria

On 1 March, 2017, the City of Plovdiv, European Capital of Culture for 2019, hosted a symposium on mosaic conservation, with organisational support and sponsorship from the Balkan Heritage Foundation (Bulgaria), the Bulgarian Heritage Trails Association, and participation by the ICCM board members (Fig. 5).
From the point of view of the ICCM, the main goal of the symposium was to present the Bulgarian public with

Fig. 5. On March 1, 2017, the City of Plovdiv, European Capital of Culture for 2019, hosted a symposium on mosaic conservation

successful examples of mosaic conservation and management from around the world, while also highlighting local mosaic projects. The presentations covered a wide range of topics, through case studies, discussion of preservation practices on mosaic sites, and illustration of training programs such as the Getty MOSAIKON initiative. Bulgarian conservator Elena Kantareva-Decheva and architect Milena Krachanova reported on the conservation and display project for the Episcopal or "Grand" Basilica of Philippopolis (modern-day Plovdiv). Stanislav Stanev, chairman of the Rest Art Association (Sofia) illustrated a rescue project for a Roman mosaic in the modern city of Stara Zagora. Dr Silvana Blazhevska, Director of the National Institution for the Management of the Stobi Archaeological Site (North Macedonia), reported on the conservation and presentation of buildings with mosaics at Stobi, capital of the Roman province of Macedonia Secunda (4^{th}-6^{th} century AD). Montserrat Pugès, of the Archaeological Service of Barcelona, reported on behalf of the conference host city concerning the preparations for the 13th triennial, to be held in October of 2017. The ICCM board members contributed as follows: Gaël de Guichen, speaking on the reasons for the creation of ICCM and its 40 years of history; Roberto Nardi, reflecting on significant current events and future perspectives for mosaics conservation; Jeanne Marie Teutonico, on the MOSAIKON educational initiative for the Mediterranean region, sponsored by the Getty Foundation; Stefania Chlouveraki, speaking on the in-situ conservation of mosaics; Aïcha Ben Abed, illustrating the range of mosaics in the MOSAIKON region; John Stewart, on the "realities" of implementing mosaic conservation projects, and finally Evelyne Chantriaux, who presented some recent mosaic conservation projects in France.
The symposium attracted a large number of Bulgarian specialists in conservation, archaeology and art history, as well as students from the National Academy of Arts (Sofia), the 'Paisii Hilendarski' University of Plovdiv, and the Plovdiv Academy of Music, Dance and Fine Arts. The Municipality of Plovdiv organised a panel-format news conference at the close of the symposium, featuring Amelia Gesheva, Deputy Mayor for Cultural and Tour-

ism, Roberto Nardi and Gaël de Guichen on behalf of the ICCM, and Jeanne Marie Teutonico representing the Getty Conservation Institute. The journalists attending were particularly interested in the impressions of the foreign guests on the cultural heritage of Plovdiv, especially the ancient mosaics.

The local and national media covered the event in depth: on Bulgarian national radio (four programs), Bulgarian national TV, Focus Radio (Sofia), on the City of Plovdiv home page, and on about 10 Bulgarian internet media outlets. In some cases, the coverage included interviews with Roberto Nardi.

At the close of the symposium, Dr Amelia Gesheva, Deputy Mayor of Plovdiv, extended an official invitation to hold the 2020 ICCM 14th triennial conference in Plovdiv.

The Municipality of Plovdiv invited the ICCM board members on a tour of the city, in particular the Roman and late Roman remains of what was then Philippopolis, including the newly discovered mosaics of the Episcopal Basilica (4^{th}-6^{th} centuries AD), considered to be one of the three greatest basilicas of the Balkan Peninsula for this period, and the 17^{th}-18^{th} buildings of the historic city centre. The ICCM board members and the local team for the Great Basilica welcomed this opportunity for in-depth and frank discussion on the conservation of the mosaics, and on the gap in training opportunities for the Balkan region.

The board welcomed the invitation from the Mayor of Plovdiv to an official dinner, along with the president of the America for Bulgaria Foundation and representatives of the Balkan Heritage Foundation, Bulgarian Heritage Trails Association and the Episcopal Basilica conservation team.

October 2017, Publication of the Proceedings of the international conferences in Meknes, Morocco (2011), and in Alghero, Sardinia (2014)

Thanks to the tireless work of our volunteer editors, in October 2017 we were able to publish the proceedings of both the 11^{th} and 12^{th} triennial conferences, held respectively in Meknes, Morocco and Alghero, Sardinia, in 2011 and 2014. The proceedings of the Meknes conference contain 41 contributions, in English and French, totalling 609 pages. The editors were Demetrios Michaelides and Anne-Marie Guimier-Sorbets, supported by Roberto Nardi, Chiara Zizola, Raffaele Manna and Francesca Guiducci. The Alghero proceedings, consisting of 67 contributions, were published by the Getty Conservation Institute, with Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi as editors.

12 October 2017. Consolidation of ICCM archives

The ICCM Archives consist of two main fonts. The first font, containing records from 1977 to 1996, was held at ICCROM, which during those years had served as the ICCM secretariat. The second font pertains in general to the period of presidency of Demetrios Michaelides, continuing from 1996 and essentially concluding with the events of the 11th International Conference, in the years 2011-2012. This font was held at the University of Cyprus. Thanks to an agreement signed by Stefano De Caro, Director General of ICCROM, and Roberto Nardi, ICCM President, ICCROM has now accepted the second font at its Rome headquarters, where it will be managed by the institutional archivist.

October 2017, Launch of the ICCM Foundation YouTube channel https://www.youtube.com/channel/UCTQHlUlC3fjx7djWYYpJMrg

The 13th International Conference, Barcelona, 2017, included a much-appreciated session on videos dealing with mosaics conservation, restoration, communication and training. Subsequently, the board decided to launch a YouTube channel were all 13 contributions to the session could be shown. This initiative contributes to the ICCM aims of effective communication on mosaic conservation projects and their outcomes among colleagues, to funding bodies, and most importantly, for sharing with the public. The board invites ICCM members and friends to add new posts, raising the visibility of their projects and current works. As of May 2020, the Barcelona conference videos had been viewed more than 2500 times (Fig. 6).

Fig. 6. YouTube page was created to make available all video contributions showed during the event. This initiative forms part of ICCM's efforts to communicate more effectively mosaic conservation projects and their outcomes with colleagues

15 October 2017, IV Board meeting, Barcelona

The last official act of the 2014-2017 board was "meeting IV", held before the Barcelona conference and election of the new board, at the Monastery of Pedralbes, Barcelona, on 15 October 2017. In attendance were Aïcha Ben Abed, Stefania Chlouveraki, Alessandro Lugari, Roberto Nardi, Jeanne Marie Teutonico and Gaël de Guichen. The board reviewed and approved the documents on the current ICCM activities, financial status and management, and prepared for the handing over to the new board members, elected five days later at the end of the conference.

This long list of the Foundation board activities over the 2014-2017 triennium is the best evidence of the good health of the organisation, encouraging us all to continue with the generosity and dedication that have always characterised the ICCM members. We look forward to seeing the results of the subsequent three years when these are presented at the 14th international conference, in Plovdiv, Bulgaria. The conference, originally planned for October 2020, was delayed due to the Covid-19 emergency, but we have now rescheduled it for 2021(Fig. 7).

Roberto Nardi

Fig. 7. The official announcement of Plovdiv 2020, now 2021. On stage, Elena Kantareva, Angela Pencheva of the organising committee and Ivan Valisev, the Balkan Foundation

SESSION I:
MANAGEMENT AND POLICIES

Montserrat Pugès Dorca
Kusi Colonna-Preti

Maria Mertzani, Maria Deliprimi
Elisavet Anamaterou
Fotini Getimoglou, Maria Krini,
Kassiani Pantazidou, Ioanna Vitsou

Marina Solomidou-Ieronymidou

My Neighbourhood's Mosaic: Citizen Participation for the Conservation of Barcelona's Mosaic Heritage

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Abstract

My neighbourhood's mosaic is a participatory project organised through a website, developed in 2017 to make Barcelona's citizens aware of the importance and necessity of conserving the city's mosaic heritage. Mosaics are part of the Barcelona urban landscape as well as the interior of many homes, meaning that there are shared responsibilities for their preservation, both for their heritage values and as a cultural identifier. The project was broadly communicated through an innovative strategy of modern media. Participants submitted images of "their mosaics", with brief identification, and in return received more in-depth knowledge of the works and the satisfaction of their on-line publication. The website includes tips for preventive conservation. The Barcelona City Council, the local authority organising the 13th ICCM Conference, used this project to bring joy and benefit from the event to the entire city. The organisers themselves gained new insights into the breadth and complexity of the city's mosaic heritage, public support for preservation, and new perceptions of the public-private balance in conservation.

Keywords: Preventive conservation, urban heritage, interior heritage, paving, website

Introduction

In January 2016, the board of the International Committee for the Conservation of Mosaics (ICCM) chose the city of Barcelona as the venue for the 13th International Conference for the Conservation of Mosaics. The bid to hold the conference was submitted on the sole initiative of the Barcelona City Council Archaeological Service. This would give rise to a series of circumstances, described in the sections that follow.

Why would an Archaeological Service develop this project?

The Barcelona City Council Archaeological Service is the municipal body responsible for managing archaeological activities conducted within the city. The accumulated experience of the service, dating back to 1920, has brought us to view the city as a single archaeological site, whose occupation evolves constantly in line with the needs of each historical period. At the same time, our background in archaeological methodology contributes to our understanding of the city's material heritage, as the tangible evidence of this continuous evolution, and in which no historical period takes precedence over any other. The whole of all the elements of material heritage helps us enormously in understanding the current city and the life that has developed here. Mosaics constitute one kind of these heritage elements.

Roman mosaics? Yes, those too!

Barcelona has a mosaic heritage of exceptional historic and artistic richness. The location has been occupied continuously since prehistoric times and this continuity is exemplified in the mosaics record, even though there are not mosaics from every period. Traditionally we would have associated "mosaics" with the productions of the classical period, but in Barcelona, how could we use this term without also including the World Heritage works of the modernist Hospital de la Santa Creu i Sant Pau, the Palau de la Música, Park Güell, and so many others examples of works of all kinds, materials and shapes? We find mosaics in the most unusual places in Barcelona, not only in antique pavements, but also in shop and house interiors, markets, the metro, in the historic centre and also in more modern neighbourhoods. Whether public or privately owned heritage, recognised as works of art or little appreciated, all of these works are the varying expressions of mosaic technique. They are the image and expression of particular historical periods, which help us understand the city and its development.

Contribution and benefit: Barcelona and the 2017 ICCM conference

Given the background we have outlined, it was clear that even in the early stages, our bid to hold the 2017 ICCM conference would be an opportunity to communicate this undeniable variety of mosaics and, still more importantly, the need to conserve them. So, as a logical consequence of the connection with Barcelona and its mosaics, we proposed that the conference theme should address the question of *What do we understand by mosaics?* In presenting the candidature of Barcelona, we thus proposed the opening of a discussion on the materials and techniques of an artistic and functional medium included in both architectural interiors and exteriors in the most varied forms, from pavements to walls, ceilings and roofs. Ultimately the ICCM board accepted our proposed candidature and theme. With this, we could realise the aim of bringing to light the techniques of the Catalan Art Nouveau within the global Modernist movement, including the *trencadís* (tile fragments technique) as Barcelona's own local form, but also other less known or still undiscovered techniques. We could aim for the inclusion of the 19th century materials produced in natural and Portland cements, the cement tiles or Nolla mosaics, or others that might come to light. All this with a view to promoting their value, conserving and popularising them, within the professional community.

But there was a further issue of the 13th Conference for the Conservation of Mosaics that was reserved for the consideration of Barcelona itself, and for the City Council. Given the aims and functions of a public body, in our case the local government, those of us in the Archaeological Service then posed the question of the viability, or opportunity, of considering *What impact might the conference have on the city?* In more concrete terms, what could be the effect of a conference of scholars on the city of Barcelona? Would we be capable of making sure our citizens benefited? How could we ensure a favourable impact from the conference on our heritage?

A municipal council is a public administrative body, whose responsibilities include the conservation and maintenance of assets in the local public domain. Aware of the city's vast public and private mosaic heritage, we have come to understand that citizen involvement and commitment is essential in ensuring its conservation. In this case, we also understood that as part of the public administration we had to achieve a positive balance of returns, given the willingness of the Barcelona City Council to organise and manage this international conference for the conservation of mosaics. The project we describe here arises from all of these realisations.

Project aims and requirements

Our aim was to develop urban participation in a preventive conservation project, focused on discovering, highlighting and conserving the mosaics in the city of Barcelona. The idea of the project, called *My Neighbourhood's Mosaic*, would be to show the city's mosaics in a place that would be visible and accessible to everyone. From this, the objective of creating a website dedicated to storing an inventory of mosaic images – contributed by the public – arose almost naturally, as a logical result of the requirements we had gradually defined. Having established "what", it was necessary to define other aspects, such as the sphere of action, participation, dissemination and web content. The sphere had to be the city as a whole. We could not restrict the search to the old quarter or the 19th-century expansion (Eixample quarter), given that we were convinced of the possibility of significant mosaics in each of the city's 10 districts and their 73 neighbourhoods. Modern Barcelona is the sum of towns and villages that were gradually absorbed by the larger city during 19th and 20th centuries. Each of these has conserved its historic quarters, and we would expect that these would at the least conserve examples of Modernists mosaics.

Closely linked to this broad sphere, we identified the necessity of involving as many participants as possible, without prior selection or distinction. The objective was to reach all kinds of people, throughout the city. Moreover, we perceived that a correctly designed project could serve as a link between generations and cultures, between those native to Barcelona and the city's newcomers. The mosaics could become a unifier, enabling us to enter schools and old people's homes, communities of neighbours and professional associations, universities and many other places. What we needed to develop first of all would be an interesting initial challenge: "discovering". Discovering has to do with playing and "finding hidden treasure", which could immediately lead to a subliminal kind of appreciation of the mosaics. The approach of a participatory game or discovery had been used previously in the cultural sector, such as in workshops in art, history and science museums, as well as in adult and children's books, even film plots, but we are unaware of a "discovery" for furthering the aims of conservation. The website would then reward the participants' initial expression of interest, with knowledge.

Although initially we had conceived of some kind of prize-based competition as a way of rewarding participation, we opted for the sharing of knowledge as the best way, imparting feelings of pride and personal satisfaction. Providing knowledge to the participants, often also the mosaic owners, would support them in arguments for taking care of and preserving the pavements. This project could then branch out in a cross-disciplinary manner, with further consequences on the participants own pavements and floors and on other individuals around them.

Organising and implementing the project
The cross-disciplinary and participatory philosophy of the *My neighbourhood's mosaic* website has been present from the outset, not only in the space where we ask someone to send a photograph of a mosaic, but also internally, in preparing the contents. Once the Archaeological Service had defined the general design and technical characteristics of the site, we invited various local government and teaching bodies, companies and professional experts to consider joining the working committee. The experts were assigned to different working groups according to their specialisations and the necessary tasks, leading to consensus and full definition of the project and the website contents.
The graph (Fig. 1) broadly shows the various contents originally planned as well as aspects linked to dissemination.

Fig. 1. Graph representing the content of the *My neighbourhood's mosaic* project

Disseminating the project

Disseminating the project was a key factor in ensuring the project's success. This meant publicising all the activities, but above all, encouraging public participation to build up the inventory of mosaic images. In designing this aspect we were greatly assisted by advice from the Department of Communication and Audiences at the Barcelona Institute of Culture. Drawing on a budget of €6,000, we were able to reach people through publicity in public spaces and the press, news and videos on Barcelona City Council channels, and social media. However, the resources were insufficient for development of in-person dissemination activities, such as small-scale exhibitions and talks.
Realising the need for a visual identity, we commissioned two images from the illustrator Marcel Pie Barba and the Estampa workshop for animation, graphics and multimedia. These communicate essential information on the concept of different mosaic techniques: one represents an interior mosaic (cement tiles in a living room); the other shows an outdoor mosaic (ceramic tiles on the Santa Caterina market roof) (Fig. 2). The two images were adapted to different formats: leaflets (Fig. 3), banners, standard posters and big street posters. The same author created a short video (1 minute 22 seconds) to explain the project and encourage people to take part.
A total of 42,000 posters were distributed. Among these, 1,500 were placed in building entrances in 28 neighbourhoods, in nine of Barcelona's districts. Fourteen

Fig. 2. Two versions of the poster for disseminating the project: one with interior mosaic, one with outdoor mosaic (design by the Estampa workshop for animation, graphics and multimedia)

thousand leaflets were handed out, focusing on areas of the city with a higher presence of mosaics. The video was screened in libraries, museums, civic centres, the metro and social media. Ninety large advertising posters (120 x 175 cm) were put up on streets in all 10 Barcelona districts from 2 to 15 May 2017. Both the printed and digital media publicised the launch and development of the campaign, including by means of videos showing the first results.

Contents of *My neighbourhood's mosaic* website

The website http://barcelona.cat/mosaics, *El mosaic del mio barru*, was designed with five areas, described in the following sections (Fig. 4):

1. The participatory inventory: approach and initial results

At the heart of the project is the participatory inventory, the driving force of the

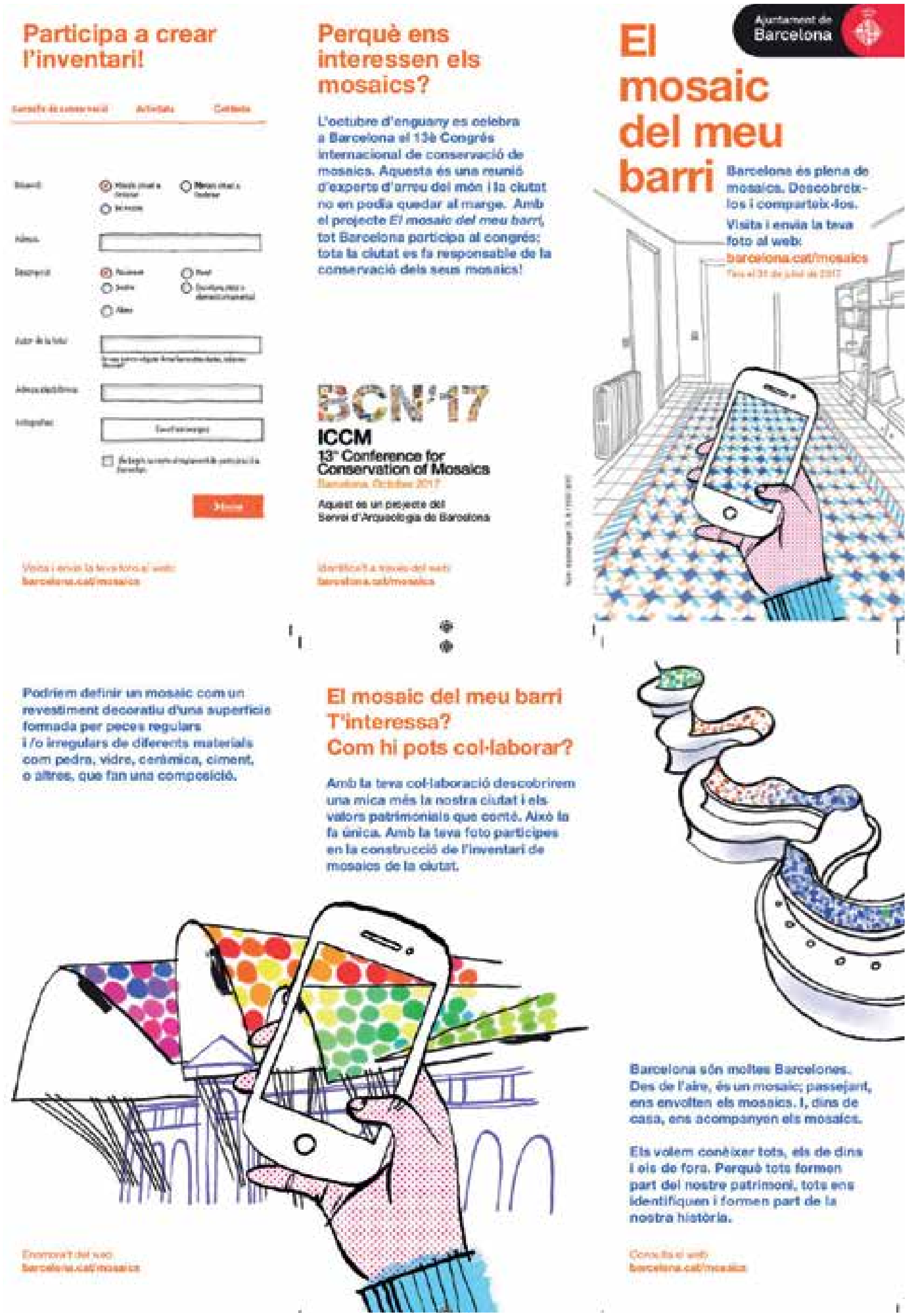

Fig. 3. Cover and interior of an explanatory leaflet on the project (design by Estampa workshop for animation, graphics and multimedia)

Fig. 4. *My neighbourhood's mosaic* homepage (web design Edittionarius SL)

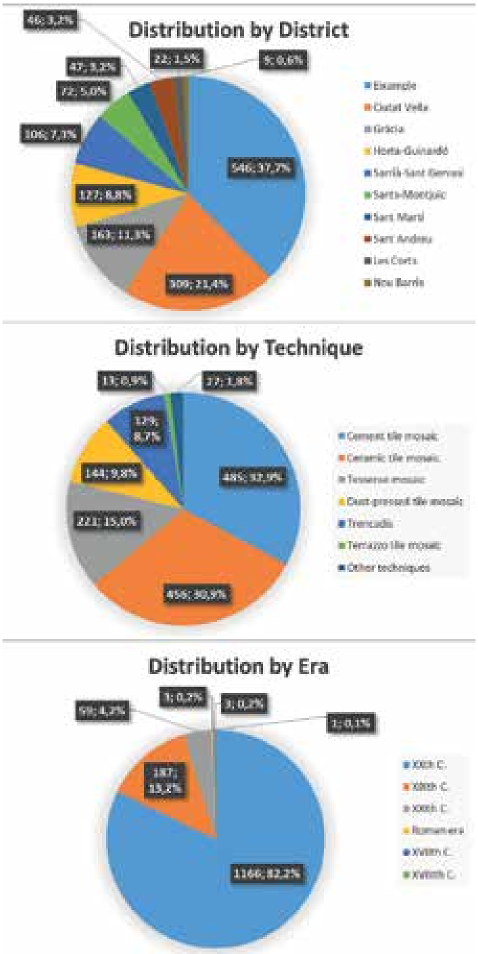

Fig. 5. Graphs of the spatial distribution of the mosaics reported, with photographs, by city district (Barcelona Archaeological Service; note that graphs by chronology and technique are also available)

website activity. Participants send a photo of a city mosaic to the site, contributing to the gradual development of an inventory. Along with the photo they report the address and location of the mosaic (e.g. building entrance, terrace, interior room). On receiving this, the editorial team draws up a fact sheet and publishes the image of the mosaic, notifying the participant that they can now see the image online. Each fact sheet can include photos of the same mosaic from different participants (up to three photos per participant). The fact sheet includes the location, as indicated by the participant, and adds further information on the mosaic technique, description, period and author, and where applicable, on the building (architect, period, style, original use). The entry can include further information, relevant illustrations, and references to sources.

The inventory can be consulted by paging through the successive entries, but also by selecting a district, mosaic technique or period. Images of mosaics then appear, captioned with the information of address, technique and period. The viewer can then proceed to more in-depth information by clicking on the image.

It was necessary to place a time limit on the initial phase of public participation, given the staff costs involved in preparing the fact sheets. Submissions were welcomed from 17 May to 31 July 2017; since then the inventory has remained open for consultation. During this period, 224 participants submitted a total of 2,480 images, and 1,450 mosaic fact sheets were prepared. The following graphs show the spatial distribution of the mosaics (Fig. 5). They can also be read by technique or chronology. The number of photographs received was roughly what we had expected, however these concerned a far higher number of mosaics than anticipated. There were only a very few occasions that participants sent images of the same mosaic, and the final result was an average of 1.7 photos per fact sheet.

As could be expected, most of the mosaics reported were situated in the old quarter (Ciutat Vella) and Eixample, a district developed at the height of Modernism, around the close of the 19th century. Nevertheless, submissions were received for all 10 districts of Barcelona, including even Nou Barris, which grew during the 1950s to 1970s. These observations might make us think that the geographical distribution was determined by the age of mosaic, which would in turn depend on the age of the quarter. However, the classification by period shows that most of the mosaics recorded are from the 20th century, with the 19th century second.

Curiously, the project participants sent only three photos of Roman mosaics! This observation leads us to consider the mosaic techniques in our overview. Approximately 33% are cement tile (Fig. 6), 31% are ceramic tile mosaics and 15% are tesserae mosaics. It is very interesting to see that the participants have assimilated the concept of the mosaic as much broader than the classical works in tesserae. This semantic broadening would have something to do with the Catalan term for cement tiles (*mosaic hydràulic*, versus *carreaux ciment* in French, for example). However a contribution could also be due to the design of *My neighbourhood's mosaic*, intended to describe and communicate the variants of modern mosaic technique within the broader concept.

Fig. 6. Cement tile mosaic by M. C. Butsems & Fradera, at Plaça Reial 10, currently the headquarters of Setba Foundation (photo by Barcelona Archaeological Service)

The inventory has enabled us to identify artistic trends and individual works of great value, particularly among the mosaics of the 1960s and 1970s (Fig. 7), and to discover the continuing evolution of Barcelona's mosaics through contemporary "street art" creations (Fig. 8).

Fig. 7. Mosaic of tesserae and ceramic tiles, by Armand Olivé Milián, at Carrer de Ballester 3-5 (photo by an anonymous participant)

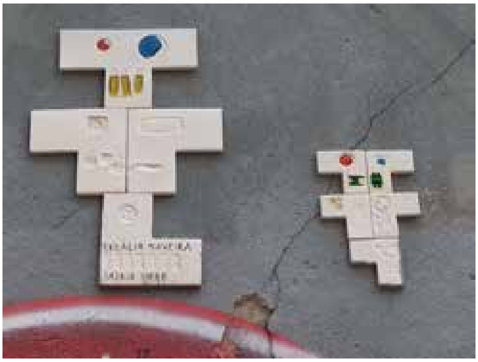

Fig. 8. *Zusammen Flies(s)*, contemporary street art mosaic by Eulàlia Naveira, Saskia Siebe and Peter Herr, at Carrer de Provençals 74 (photo by anonymous participant)

2. What is a mosaic?

The website included the tab "What is a mosaic?", which opened on the terms for eight mosaic techniques found in Barcelona: tesserae, ceramic tiles, *alicatado*, *trencadís*, dust-pressed tiles, cement tiles, papier-mâché and *terrazzo*. Each term was accompanied by a description of the technique, historical notes, a selected bibliography and illustrations (sometimes including videos), which would assist the site visitors in recognising the mosaic types.

Fig. 9. Screenshot of a web page explaining "What is a mosaic", in this case the *trencadís* technique (content by Teresa Navas and Barcelona Archaeological Service)

The development of this section presented challenges to us in defining the techniques and determining the appropriate terminology, including for the understanding overall term "mosaic". By consensus, we arrived at the definition of "*a decorative finish on a surface formed by regular and/or irregular pieces of different materials such as stone, glass, pottery, cement, or others, developing a composition of pictorial nature.*" With this conception we were led to discover unexpected types of mosaic, such as papier-mâché, which was used for a very short period of time. We could also confirm that *alicatado* tiling, inspired by the historic Islamic technique, appears only in Modernist contexts. *Trencadís*, on the other hand, is a very widespread technique in Barcelona, used for the first time by the architect Antoni Gaudí to produce decorations quickly, at little cost and with a great visual impact (Freixa, Saliné 2018) (Fig. 9).

3. Conservation tips

One of the great challenges for the Heritage Interventions Area of the Archaeological Service is to foster the conservation of the mosaics found throughout the urban context. Clearly, preventive conservation is the most effective tool for ensuring that our mosaic heritage survives in good condition. Apart from the positive effects of stimulating awareness, knowledge and appreciation, our project took up this challenge through the "Conservation tips" tab, where we informed the general public of simple interventions protocols. The main concept is that anyone keen to conserve their mosaic, but without professional experience, can carry out an initial diagnosis and occasional interventions for maintenance purposes. For more complex interventions, we recommend they contact a specialist through the Associated Conservator-Restorers of Catalonia (CRAC) or the Architects' Association for the Defence of Intervention in the Architectural Heritage (AADIPA).

Conservation measures must be carried out in relation to the technical characteristics of the mosaic, so we offer specific tips for dust-pressed tile, cement tile, ceramic tile and *trencadís* mosaics, further illustrated using photographs and videos. This part of the website was drawn up with the assistance of teams of conservation-restoration students and professionals, who also carried out applied research projects: the University of Barcelona Faculty of Fine Arts, the Escola Superior de Conservació i Restauració de Béns Culturals de Catalunya (ESCRBCC) and the Barcelona Provincial Council Office of Cultural Heritage Preventive Conservation and Restoration Laboratory (Fig. 10).

Fig. 10. Image of the "Conservation tips" page: examples for cleaning dust-pressed tile mosaics (content by Universitat de Barcelona and Barcelona Archaeological Service)

4. Itineraries

Based on the information gathered in the participatory inventory, we are currently developing 10 walking routes for discovery of the city's mosaics, to be mounted on the website. Individuals will be able to follow route maps, independently or in groups. The maps will indicate the mosaic positions, also illustrating historical and technical aspects for communication of knowledge and participant appreciation.

5. Activities

This section provides information on exhibitions, workshops and publications dealing with mosaics in Barcelona.

Project costs

It is difficult to make an economic assessment of a project like this, carried out over practically two years and involving a large number of people. Most of the work has been done with the resources of our own Archaeological Service or the departments of the Barcelona City Council. However, we can say that one person dedicated the equivalent of approximately 35 weeks to the project, of 35 hours per week, spread over two years. Other services were provided by specialist professionals such as IT experts with experience in creating cultural websites, graphic designers, art historians, architects, conservators and photographers. The project also benefited greatly from voluntary participation by many professionals and students from institutions involved in culture and heritage conservation. Bearing these considerations in mind, we have estimated the cost of the project as €43,466.93.

Conclusions

It might seem strange that a public interaction project such as this should originate in an Archaeological Service, however each day that passes confirms the logic of the initiative. One of our aims is to study and understand the city and its evolution. The paving, floors, and more specifically the mosaic finishes of Barcelona, provide tangible evidence in support of this task. We often perceive our most recent history as something that is known and managed in all its facets, because of the multitude of available studies and publications. However, given our research to provide the website information on the relatively small number of reported mosaics, we realised that there are still many gaps in our knowledge, and that often it is the most recent historical periods about which we know the least.

The research we conducted resulted in an internal process of discovery, with some genuine surprises concerning techniques about which we knew little or nothing, such as that of *papier mâché* (Quiney 2005). The process of discovering mosaics around the city revealed larger than expected numbers of historic survivals, but also projects that were abandoned in course, such as wooden paving for the Rambla (Esparza Lozano 2014) or the fleeting presence of Portuguese *azulejadores* on Passeig de l'Arc de Triomf, for the Universal Expo in 1888 (Esparza Lozano 2014). As a result, we have learned to look at our city in new ways, and realised the great wealth of what we are casually walking upon.

Mosaics have also opened the door to communication with many ordinary people: people who wanted to share the minor treasures within their homes. This has created new challenges for us in contributing to their conservation. We begin to address the confusions and contradictions of "public" and "private" heritage. We begin to realise that all of this belongs to the city and that all of us need to consider it in new ways. This leads us to the need to look for formulas for conserving the building interiors, inasmuch as these are part of entire three-dimensional structures that we have already accepted and understood as a responsibility. Conservation is taken out of the museum and into private homes, and turns the entire city into a sort of museum space that demands our respect and protection. The mosaics have spoken to us as items that identify a time, a culture and spaces, so that we no longer differentiate between them and the pieces in museum display cases. The project thus poses the great new challenge of conserving historic interiors. In this sense, the project and the experiences we have gained can become very useful in returning the lead to our citizens, promoting and supporting them in taking responsibility for conservation.

The joint work with our project collaborators, in particular the educational institutions, has served to open up unexplored fields of conservation-restoration research, particularly concerning 19th and 20th century materials such as Portland cement and dust-pressed tile, as well as *terrazzo*, which could open the doors to various specialisations. The association of conservation professionals (CRAC), encouraged by our initiative, now offers their members the possibility of identifying a specialisation in mosaics.

The *My neighbourhood* project is ongoing, and we hope it will continue to give us many surprises.

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This project would not have been possible without the contributions of many individuals, for which we are deeply grateful. Given the limits of space, we would like to note the following for special thanks: Teresa Navas, Marta Urbiola, Ángela López, Jordi Griset, Andri Tsiouti, Margarita Alcobé, Alicia Allué, Antonio Ambrona, Marta Artola, Arnau Aymí, Irina Ballestar, Andrea Barbarà, Eva Bas, Rosa Borrell, Andrea Campillo, Martí Carbonell, Joan Casares, Marina de Miguel, Maria Fiol, José A. Gutierrez, Noemí Huete, Gemma Ibars, Yolanda Leon, Miriam Lozano, Maria del Mar Lozano, Lucía Mairata, Mercedes Martin, Lucía Martínez, Irene Marés, Anna Miró, Maria Molina, Guillem Molons, Elena Morera, M. Teresa Pérez Puente, Sandra Orno, Mireia Remon, Marta Rodríguez, Matíes Sagrera, Èlia Solà, Paula Solé, Isabella Soligo, Mario Vazza, Nina Viladrich, David Zafra, Joan Escudé, Marta Badia Cortada, Aina Estevan Serrano, Eva Guiteras Casado, Sara Hernández Zárate, Joana Maria Mayol Adrover, Anna Ramón Moncasi, Blanca Rodríguez Granell, Carla Roig Ridao and Franc Seira Curto, Núria Avecilla, Marta Urbiola, Mònica Lòpez, Carme Comas and Jordi Ortells, Núria Flos Travieso, Sílvia Franch, Marta Antuñano Reñé.

References

Esparza Lozano D. 2014. *El diseño del suelo: el papel del pavimento en la creación de la imagen de la ciudad*. 89-110 / 125-130. (Unpublished master's thesis). Universitat de Barcelona, Barcelona.

Freixa M., Saliné M. 2018. *Gaudí i el trencadís modernista*. Sant Lluís: Triangle Postals SL: Triangle Postals.

Quiney A. 2005. *Hermenegildo Miralles, arts gràfiques i enquadernació*. Barcelona: Biblioteca de Catalunya.

For further references to the many works, catalogues, archives, libraries and websites used in developing *My neighbourhood's mosaic,* the reader is referred to the website http://barcelona.cat/mosaics.

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STRATEGIC PLANNING FOR PROTECTION OF MOSAICS IN GREECE

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Abstract

Strategic planning for the protection of mosaics in Greece has been conducted as part of an integrated approach to preservation of all cultural heritage. The Directorate of Conservation of Ancient and Modern Monuments has based the strategic plan for mosaics on monitoring and assessments by means of national surveys, consideration of the core mission and values, as well as the potential of the directorate's human resources. The planning priorities are: *in situ* preservation and conservation of mosaics; establishment of close collaboration and a common approach shared with other responsible institutions; implementation of large scale and complex conservation projects; design and promotion of solutions for treating and storing detached mosaics; and finally the communication of our work to colleagues and the public.

Keywords: strategic planning, long-term policy, *in situ* preservation, maintenance scheme, project implementation.

Protection of antiquities in Greece: legislation and organisation of services

The issues of cultural heritage have always been essential to Greek policy, as early as the foundation of the independent Hellenic State in 1830, whereas in 1833 a specific "Archaeological Service" was established. The current administrative framework regulating the protection of cultural property is provided by the Revised law of 2002 "On the Protection of Antiquities and Cultural Heritage in General", and a "Registry of Conservators of Antiquities and Works of Art" regulate the profession. In addition, a Presidential decree of 2014 establishes the current structure of the Ministry of Culture and Sports, describing the mission, its organisation, and areas of responsibility of each of its services.

The Ministry of Culture and Sports, led by the minister and general secretary, is organised in five general directorates. Of these, two are responsible for the protection of cultural heritage: the General Directorate of Antiquities and Cultural Heritage and the General Directorate for the Restoration of Monuments and for Museums and Technical Works. The general directorates are in turn structured in central and regional services. Under the General Directorate of Antiquities and Cultural Heritage there are seven central services, nine state museums and 52 regional services, also known as the "ephorates" (approximately translated as "superintendencies"), which have responsibility for the protection of prehistoric to Byzantine antiquities. The General Directorate for the Restoration of Monuments and for Museums and Technical Works is structured in five central services and eight regional

services, and is instead responsible for the protection of modern monuments.
The Directorate of Conservation of Ancient and Modern Monuments (DCAMM) is the sole central service responsible for the conservation of cultural properties, of all periods, including movable heritage and decorative architectural elements of immovable heritage such as mosaics. This directorate is placed under the General Directorate of Antiquities and Cultural Heritage and operates in close collaboration with the five central services specifically responsible for the protection and enhancement of monuments and sites (Ancient, Byzantine & Post Byzantine, Modern), the public museums, ephorates and other regional services.

The Directorate of Conservation: mission, structure and objectives

The mission of the DCAMM is to develop national strategies and policies; to issue regulations and promote best practices for the conservation and restoration of movable and immovable properties; to implement conservation technical studies and projects, and to conduct applied research for materials and techniques in conservation and restoration of cultural heritage.
The DCAMM is structured in four departments:

– *Department of Planning and Development of Conservation Projects* is responsible for the preparation, supervision and official approval (by the minister after the Central Council's opinion) of conservation studies. This department is also tasked with the management of the conservation library and DCAMM publishing activities, and the organisation of seminars and conferences.
– *Department of Implementation of Conservation Projects* is responsible for the implementation and supervision of conservation projects, the operation of the DCAMM conservation laboratories, and the management of EU co-funded projects.
– *Department of Applied Research in Conservation* is responsible for the official approval of sampling and analysis proposals for movable properties and immovable decorative architectural elements. This department is also responsible for applied research in conservation materials and techniques and for cooperation with other research institutions.
– *Department of Support* is responsible for administration and financial processes.

The DCAMM aims to coordinate, approve and supervise conservation work in archaeological sites, monuments and museums throughout the national territory. At the same time it provides a range of services and consultancies to the regional ephorates and museums on their own projects concerning the conservation, care, protection and exhibition of important monuments and cultural heritage. It also provides guidance and immediate assistance in cases of emergency or disaster. The DCAMM also works closely with the Greek Orthodox Church, the municipalities, and other public authorities that are involved in the preservation of cultural heritage.

The mosaics sector of the DCAMM

For the implementation of its mission the DCAMM relies on around 100 personnel, of which 43 are conservators and 33 are conservation technicians. These personnel are trained to deal with a wide range of materials and objects, from ancient to modern, often involving particularly complex and challenging cases.

The conservation of mosaics sector, although relatively small, is one of the most dynamic and productive of the directorate.

The art of mosaic work has been practiced in Greece since antiquity. Whether the mosaics are from the ancient Hellenic or Roman periods, Byzantine churches or monasteries, or contemporary art or building installations, these works can present challenging conservation projects.

In this regard, the DCAMM mosaics conservators have long inspected, provided consultancy services and supervised conservation projects. They have also prepared technical reports and undertaken conservation projects in different parts of Greece, depending on the staffing of the local services and the scale and the complexity of the project.

The extensive development of infrastructure in recent years has in particular given rise to a number complex cases. This has been a stimulating factor in our desire to develop a conservation strategy.

Analysis and assessment: towards a strategy

In 2010-2011 the DCAMM conducted a national survey on the particular issues of conservation of lifted mosaics, in collaboration with ICCM board member Dr Stefania Chlouveraki (Chlouveraki *et al.* 2017). The survey indicated the problem of a lack of control over this type of conservation execution and helped us develop our strategy. It provided vital information on the quantity of detached and untreated mosaics leading to proposals of schemes and solutions to the regional services for storing and managing these works.

However, given the core values of our sector, it emerged clearly that the strategic priority for managing preservation of mosaics in Greece should be to promote *in situ* preservation or backfilling wherever possible, rather than detachment as a means of treatment. For this reason the DCAMM also planned a further survey concerning the issues of *in situ* mosaics, from which we soon expect to receive the preliminary results (Anamaterou *et al.* 2015).

The process of both of these surveys has assisted us in developing a stronger informal network with colleagues in every part of Greece, which will be better able to confront the problems together and search for solutions that would take account of the different needs and priorities. We have also strengthened our promotion of training of professionals and initiated programs raising public awareness. Finally, the DCAMM should be responsible for implementing large scale conservation projects of particularly challenging monuments, for designing treatment and storage schemes for previously detached mosaics, encouraging the adoption of maintenance schemes, and guiding and assisting the ephorates where needed.

Towards *in situ* preservation and conservation of mosaics

As stated, the DCAMM is committed to promoting on *in situ* preservation, whenever feasible. In order to fulfil our values of minimum intervention and architectural integrity, we always examine this option first.

Fig. 1. Hellenistic baths in Messolonghi with pebble mosaic floor (photo Hellenic Ministry of Culture and Sports)

Fig. 2. Hellenistic baths in Messolonghi with pebble mosaic floor: conservation in situ (photo Hellenic Ministry of Culture and Sports)

Fig. 3. Hellenistic baths in Messolonghi with pebble mosaic floor: conservation in situ (photo Hellenic Ministry of Culture and Sports)

Fig. 4. Hellenistic baths in Messolonghi with pebble mosaic floor: long-term reburial (photo Hellenic Ministry of Culture and Sports)

Given the legislative framework, the ministerial structure and division of responsibilities, all conservation proposals must first be reviewed by the DCAMM, then passed to the Central Archaeological Council for formal opinion, which leads to a ministerial decision concerning approval. This is the critical stage where if necessary, through onsite inspections by specialised staff and in depth discussions with colleagues, we have the opportunity to engage our strategy and revise a proposal. Depending on the case, several other Ministry of Culture services may also play a role in the planning stage.

The success of this approach can be illustrated by several cases, such as that of a mosaic discovered in Messolonghi, western Greece during construction works for a new highway. As the assessments and monitoring for the construction works progressed a bath complex came to light, decorated with an exquisite pebble mosaic floor (Figs. 1-2). Our sector provided guidance and directions which convinced the regional ephorate to reconsider its initial intentions of detaching the mosaic, and practical assistance with the treatment design and selection of materials. The entire building complex including the mosaics was treated *in situ* (Fig. 3), followed by reburial (Fig. 4). The plan of the road was shifted slightly along a bypass, ensuring the protection of the site and providing an opportunity for public communication concerning the mosaics. The monument will remain reburied, for as long as a protective shelter will be designed, approved and constructed.

Another example is the case of the Roman Agora mosaics in the centre of the city of Thessaloniki. These had been treated repeatedly during the 1960s, 1980s and 1990s, when they were detached and relaid in hard cement mortars, with large areas of extensive losses filled with cement. These choices resulted in many problems, which recently led to a new proposal to repeat the detachments and once again re-lay the mosaics. We were able to discuss alternative possibilities and arrive at a shared decision for conservation treatment *in situ*, including removal of the cement fills and application of alternative methods and materials for gap filling.

In another case of a mosaic on private land, where expropriation would have been too costly for the state and damaging to the landowner, rather than *in situ* treatment and communication, the choice was made to simply carry out thorough documentation and then permanently rebury the site.

Detachment and re-laying or detachment for storage has now become much less frequent, but in some cases remains a suitable option. In ancient Corinth, for example, a sheltered mosaic was detached and then relaid in new mortars, as the original substrate had suffered severe damage from insects and rodents. In some cases, where modifying the plans for major public construction works is unfeasible, the solution of partial detachment and reburial can be chosen: architectural elements are thoroughly documented using laser scanning and the building materials are fully sampled, before detachment of a selection of high quality, well preserved mosaic floors for storage or display.

The DCAMM mosaics sector does not always achieve results that are completely in line with its aims. The case of the House of Dionysus mosaic from Dion in northern Greece is exemplary. Here a shelter had been constructed for protection of a part of the archaeological site, but the mosaics were subject to heavy flooding due to their proximity to a river crossing. The director of the excavations and local ephorate proposed that the mosaic be detached for conservation and exhibition in a specially constructed building. The DCAMM suggested to the Central Archaeological Council that a better choice would be *in situ* preservation, with some small fragment temporarily detached for treatment, and that instead the main focus should be on improving the drainage and frequent maintenance works on the site and the mosaic. However, the Central Council viewed lifting the mosaic as the more effective way of preservation, also allowing further excavations, which was the choice accepted by the Minister of Culture and Sports. The mosaic was thus detached and has since been on display, including parts that were sent to New York in a travelling exhibition.

Implementation of large-scale projects

During the current decade the DCAMM has executed several large-scale conservation projects, which have increased our experience in dealing with challenging monuments. Most of these were in cooperation with the Directorate for Restoration of Byzantine and Post Byzantine Monuments, the Directorate for the Protection and Restoration of Modern Monuments and the regional ephorates. These projects have required detailed planning of the collaborations involving different professional specialisations operating in parallel procedures, as well as patience and calm in coping with delays and difficulties.

The conservation of the wall mosaics of the Daphni Monastery, a World Heritage Monument, took place after a severe earthquake in Athens. In this case the conservation projects lasted almost 15 years and involved the thorough study of the building and its materials, the improvement of its stability and the conservation of mosaics (Anamaterou 2011; Anamaterou *et al.* 2017).

The conservation of the decorative architectural elements of the Ziller-Loverdos mansion represented one of the most complex tasks addressed by the DCAMM. Dating to the late 19th century, the mansion was one of the first concrete buildings erected in the city of Athens. Our division was responsible for the conservation of decorative elements, including the floor mosaics and tiles, however the most challenging intervention concerned the vault

Fig. 5. Ziller-Loverdos mansion, vault mosaic, severe damage of mosaic substrates (photo Hellenic Ministry of Culture and Sports)

Fig. 6. Ziller-Loverdos mansion, reconstruction of the substrates (photo Hellenic Ministry of Culture and Sports)

Fig. 7. Ziller-Loverdos mansion, conservation of mosaic surface (photo Hellenic Ministry of Culture and Sports)

mosaic of a small chapel. The program for structural reinforcement included opening a small section of the concrete vault to examine its condition. The metal reinforcement was discovered to be completely corroded, resulting in a gap between the tessellated layer and the concrete substrate (Fig. 5). A multi-component solution was devised in close collaboration with architects and civil engineers, for transfer structural consolidation and protection of the mosaic against earthquakes. The corroded enforcement was substituted using a combination of stainless steel dowels, fibreglass fabric and hydraulic grout, and the mosaic substrate mortars were consolidated. The new mosaic enforcement was supported by metallic structure that transfers the static load onto a concrete zoning system (Fig. 6). During the structural restoration, the tessellated vault was protected and supported and finally treated *in situ* (Fig. 7).

The DCAMM is now engaged in projects including the conservation of the 4th-century BC burial monument of the tomb of Amphipolis, decorated with a range of elements and a variety of pebble mosaic floors (Figs 8-9), and the con-

Fig. 8. Detail of the pebble mosaic floor in Amphipolis tomb (photo Hellenic Ministry of Culture and Sports)

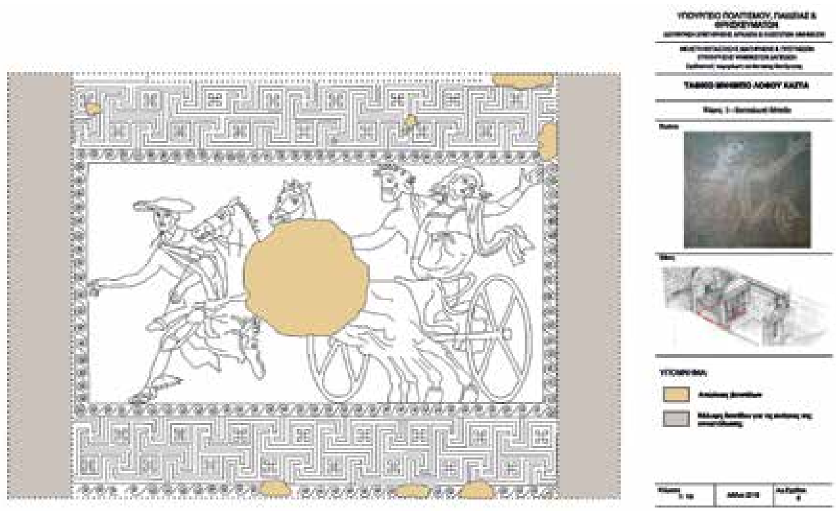

Fig. 9. Survey and documentation of the Amphipolis tomb pebble mosaic floor (photo Hellenic Ministry of Culture and Sports)

Fig. 10. Educational program for primary school children on conservation of mosaics at the National Garden in Athens (photo Hellenic Ministry of Culture and Sports)

servation and re-laying of six detached mosaic floors from Sami on the island of Cephalonia, for outdoor display in a new museum.

Dealing with the past: storage and maintenance of previously excavated mosaics

The history of decades of uncontrolled practices of mosaic detachment has resulted in a backlog of works requiring treatment and storage, sometimes resulting in inappropriate solutions. As mentioned, the DCAMM has identified the resolution of these problems as a strategic priority, to be addressed together with the ephorates and museums in the coming years.

Another priority concerns the adoption of maintenance schemes for treated mosaics that remain outdoors. The Directorate of Conservation has achieved good results in the case of the mosaics complex in the National Garden of Athens. Here, we have promoted the development of close collaboration between the municipal authorities and the Conservation Department of the Technological Educational Institute of Athens (TEI). The mosaics now receive regular maintenance, associated with the practical teaching program for students.

The Directorate is also evaluating the practicalities and results from seasonal reburial schemes, considering the effectiveness of materials and the times and costs of procedures (Krini *et al.* 2017).

Research, training and public communications

Another key area of research for the DCAMM concerns testing and assessment of treatment methods and materials, including supporting materials. Three-dimensional fibreglass, for example, has been identified as a light, strong material that can have uses in supporting vault mosaics, and we are currently examining its potential as a substrate for the exhibition of four detached mosaics from the Daphni Monastery.

Training and education is another key area of action. A particular concern is to ensure continuous professional updating, and for this purpose we participate with the TEI Conservation Department in the organisation of seminars on new materials and techniques, for those already active in the sector.

Our strategic plan also identifies raising public awareness of mosaics as an essential action for their preservation. In this area the DCAMM has designed educational programs for primary-school children (Fig. 10) and participated in a pilot project with the schools of Athens in May 2016, centred on the Roman mosaics complex of the National Garden. This project, also organised in cooperation with the municipal authorities, is now scheduled for continuation. The gardens receive high levels of public visitation, and we have therefore developed interpretive panels, designed by the Conservation Department of TEI, that illustrate the history of the mosaics and the nature of the conservation projects.

The future

The continuing goals for managing conservation of mosaics in Greece are to promote contemporary theories and principles, set national policies, expand national surveys, strengthen collaborations, develop and share knowledge, and communicate public understanding and support for mosaics conservation. To achieve this, we will continue to strengthen the network of conservation professionals in Greece and exchange knowledge and experience with our worldwide colleagues.

Acknowledgements

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References

Anamaterou E. 2011. "*Συντήρηση των εντοίχιων ψηφιδωτών της Μονής Δαφνίου* (Conservation of Daphni Monastery wall mosaics)". In *Έργα συντήρησης συγχρηματοδοτούμενα από το Γ' ΚΠΣ* (Conservation projects co-funded by Greece and European Union), edited by Maria Krini. Athens: Ministry of Culture and Tourism, Directorate of Conservation of Ancient and Modern Monuments.

Anamaterou E., Deliprimi M., Getimoglou F. and Krini M. 2017. "The Mosaics of the Daphni Monastery: A Discussion of the Dilemmas and the Decisions Made throughout the Ten-Year Conservation Program". In *Proceedings of the 12th Conference of the International Committee for the Conservation of Mosaics, Sardinia, October 27-31, 2014,* edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 123-130. Los Angeles: Getty Conservation Institute.

Anamaterou E., Deliprimi M., Krini M., Pantazidou K. and Chlouveraki S. 2015.

"*Η τεκμηρίωση ως μέσο για το σχεδιασμό και το συντονισμό δράσεων συντήρησης και διαχείρισης ψηφιδωτών δαπέδων στην Ελλάδα* (Surveying as a means for the strategic planning of floor mosaic conservation and site management in Greece)". In *Πρακτικά του συνεδρίου Η συντήρηση της πολιτιστική κληρονομιάς: προκλήσεις και επαναπροσδιορισμοί* (Conservation of cultural heritage: challenges and reviews. Proce*edings of the conference organised by the Hellenic Ministry of Culture and Sports-Directorate of Conservation of Ancient and Modern Monuments and Technological Educational Institute of Athens-Department of Conservation of Antiquities and Works of Art)*, (to be published).

Chlouveraki S., Krini M. and Anamaterou E. 2017. "Surveying as a means for the development of a national strategy for the conservation and management of the mosaics of Greece". In *Managing archaeological sites with mosaics: from real problems to practical solutions. The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24–27 2011,* edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 57-59. Firenze: Edifir Edizioni Firenze.

Krini M., Pantazidou K., Sotiropoulou G. Vitsou I. 2017. "Seasonal reburial of mosaics: at what cost?". In *Proceedings of the 12th Conference of the International Committee for the Conservation of Mosaics, Sardinia, October 27–31, 2014,* edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 369-371. Los Angeles: Getty Conservation Institute.

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CONSERVING AND MANAGING THE MOSAIC HERITAGE OF CYPRUS: OBJECTIVES AND ISSUES

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Abstract

The responsibility for the management, study, protection and promotion of the antiquities of Cyprus lies with the Department of Antiquities, which in 2003 adopted a strategic Conservation Programme with an important focus on the preservation of mosaics. The programme supports the broader aim of making cultural heritage accessible to the entire society and building awareness of its values, and includes specific measures in this regard. The programme initiated with operations on several internationally recognised sites, and is currently engaged in major new discoveries. It includes specific measures and projects for national survey, recording, knowledge-building, storage upgrading, graphic documentation and public access. The programme takes a multidisciplinary approach and draws on international cooperation, supporting the collection of data and enrichment of knowledge at the national and global level. Structural shelters and seasonal and long-term reburial are all used. Cyprus is among many countries facing economic restrictions. The strategic approach of the Conservation Programme has gained broader support for the preservation of archaeological heritage. Through collaborative efforts we are able to build a strong framework for management, conservation and promotion of the common values of heritage and benefits to future generations.

Keywords: Cypriot cultural heritage, Department of Antiquities, preservation, strategic plan, preventive conservation

The Department of Antiquities

The Department of Antiquities of the Ministry of Transport, Communications and Works is responsible for the management, protection and promotion of the antiquities of the Republic of Cyprus, including for educational purposes and cultural activities as part of everyday life (Fig. 1). The work of the department is therefore multifaceted, ranging from the legislative and administrative areas to excavation and research, to museological and educational functions. In 2017 the Department celebrated 82 years since establishment, since the mechanisms of its management operations are based on the Antiquities Law of 1935. This law, with subsequent amendments and regulations, provides the legal framework for the control of excavations and museums by the director of the Department of Antiquities and thus governs archaeological management in Cyprus. It also determines the listing of Ancient Monuments and defines the legal meaning of antiquities, for purposes of securing their protection.

The Department of Antiquities has in recent years focused particular attention on the issues of the protection and promotion of monuments, especially the ones containing mosaics, building on the knowledge of current issues acquired in international meetings and through cooperation agree-

Fig. 1. Aerial view of the Roman *agora*, Nea (Kato) Pafos Archaeological Park (Department of Antiquities of Cyprus)

ments with international institutions and renowned specialists. In this regard, the current economic crisis is not perceived as an excuse for the neglect of monuments. Instead, it is regarded as an additional motivation and challenge, as it increases our responsibility and duty towards protection and preservation (Fig. 2). The mission of the Department of Antiquities includes the enhancement and development of the value of Cypriot culture, considering its uniqueness and potential contributions to world culture. The departmental management has therefore determined to develop a Main Strategic Plan. The development of the strategic plan takes into account the decrease in financial allocations to the Department over recent years. Building upon the recognition that culture comprises the basis for social development and future advances, we have re-established our management strategies, with a special focus on preventive conservation, and the conduct of simple and inexpensive preservation works as opposed to large and impressive projects. In other words, we avoid the idea of implementing any *magnus opus*. Instead, we are committed to prioritising the problems and establishing concrete strategies in response, permitting rapid decision-making for the benefit of the monuments. This approach has resulted in important advancement and solutions for the preservation of monuments with mosaics.

The Department has responsibilities concerning a large number of listed Ancient Monuments, particularly considering the size of the national territory. It has primary responsibilities for over 3,000 sites declared as First Schedule Ancient Monuments, expropriated for archaeological purposes and situated on government-controlled land, as well as responsibilities for the supervision or conservation of more than 1,600 private or ecclesiastical monuments declared as Second Schedule Ancient Monuments

DESCRIPTION	2010	2011	2012	2013	2014	2015	2016
WAGES - PERMANENT STAFF	€53106,63	€55094,76	€51553,77	€52904,53	€52614,91	€50274,09	€54398,68
WAGES- STAFF UNDER CONTRACT	€26368,12	€33459,06	€37722,66	€22689,91	€21111,14	€28475,04	€39555,96
INVOICES/ SUPPLIES	€15138,68	€20837,93	€21343,91	€10989,02	€9395,68	€9697,56	€5685,95
FUEL	€2351,85	€4193,24	€5125,69	€4924,33	€ 5641,14	€4558,98	€4300,72
SHELTERS	------------	€78112,67	€119831,19	€34821,27	€ 37480,40	------------	------------
TOTAL	€96965,28	€191697,66	€235577,22	€126329,06	€126243,27	€93005,67	€103941,31

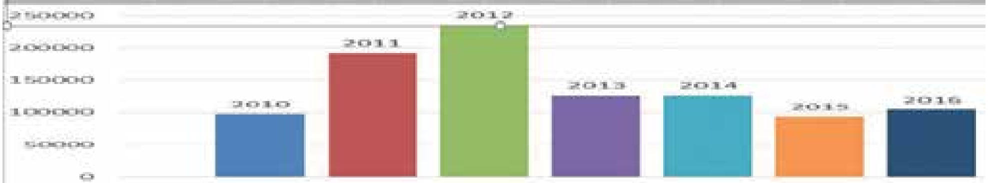

Fig. 2. Detailed table of mosaics conservation and related expenses (Department of Antiquities of Cyprus)

and situated on government-controlled land, and 2,750 Second Schedule monuments on properties that are completely privately controlled. Considering this, the Department lacks the relative specialised personnel that would be necessary, such as civil engineers, architects and monument conservators (Fig. 3).

Strategic Conservation Programme and the mosaics of Cyprus

To respond to the challenges and mitigate difficulties, the department has pursued managerial strategies that can achieve small but significant changes in its infrastructure and operations, in particular through the Conservation Pro-

Positions	Permanent Staff	Staff under Contract	Certified Positions	Vacant Positions
Archaeologists	19	5	20	1
Conservators	4	---	7	3
Technicians	22	2	43	21
Assistant Conservators	15	---	17	2
Stonemasons	34	---	36	2
Carpenters	8	---	9	1
Guards	95	---	99	4
Builders	18	62	18	---
Workers	22	141	23	1
Cleaners	28	---	29	1
TOTAL	265	210	301	36

Fig. 3. Summary of Department of Antiquities staff

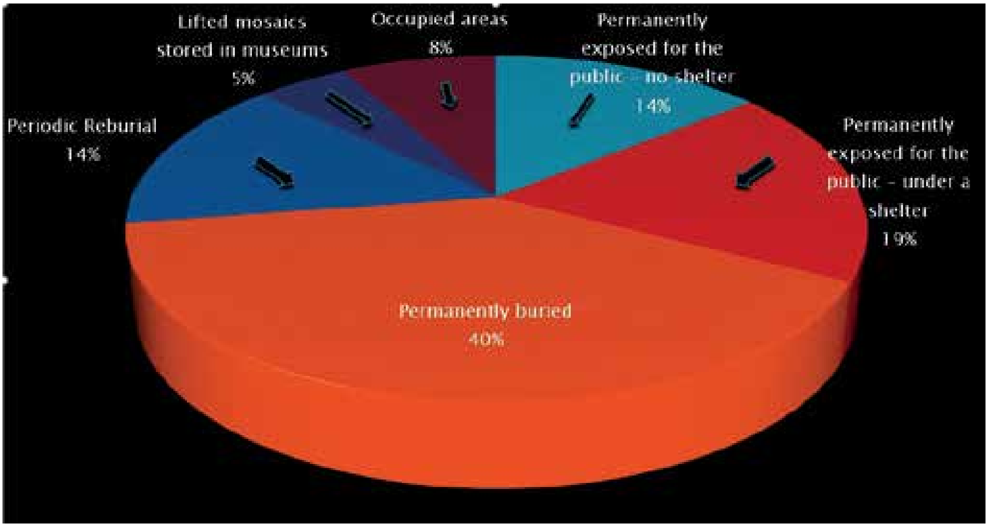

Fig. 4. Types of floor mosaic preservation (Department of Antiquities of Cyprus)

gramme, which spells out the approaches of management, documentation and digitisation, research, publication, and promotion, including the establishment of innovative projects aiming at social development.

The approaches of the Conservation Programme are applied continuously, however the first encompassing cases were for the major archaeological site of the city of Kourion, beginning in 2003, and then the Nea (Kato) Pafos Archaeological Park beginning in 2011. The aspects of mosaics conservation included in this programme are largely derived from our experience in the international MOSAIKON programme.

The archaeological excavations undertaken in Cyprus since the 19th century have resulted in the discovery of a large number of mosaics (Fig. 4), widely dispersed across the island. Mosaics are included in more than 16 major archaeological sites, 10 of which are accessible to visitors, while 4 are situated in the occupied territories of the island. In total, 248 mosaic floors are recorded in 52 monuments throughout Cyprus, covering 12 km^2, and the Department is also aware of further mosaic floors that have not been excavated or fully recorded. There are also more than 40 known *opus sectile* floors pertaining to Early Christian monuments, covering around 2.5 km^2. The total of around 15 km^2 of known excavated mosaics and *opus sectile* in Cyprus (Fig. 5) represents an enormous challenge of protection, conservation, and development, given the size and resources of our country. Particular issues of great concern to the Department have arisen since we were able to gain limited access to the occupied areas in 2004, enabling us to observe the grave problems of preservation for most of these monuments.

The first priority under the Conservation Programme has been to evaluate the preservation status of these many works, and

TABLE WITH MOSAICS LOCATED IN ARCHAEOLOGICAL SITES ACROSS CYPRUS

AREA	FLOOR MOSAICS	PEBBLE MOSAICS	*OPUS – SECTILE*
Areas under the effective control of the Republic of Cyprus	218	8	24
Occupied areas	24	----------	16
Total	242 12 Km²	8 0,5 Km²	40 2,5 Km²

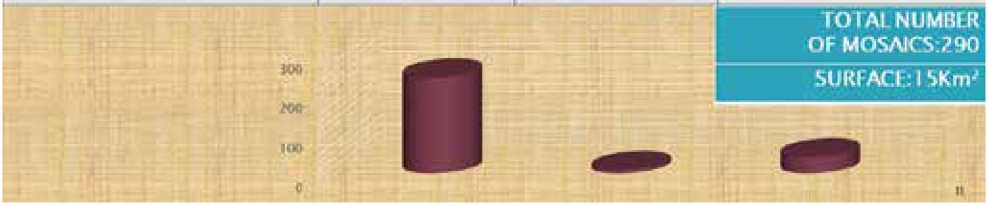

Fig. 5. Table of mosaics in Cypriot archaeological sites (Department of Antiquities of Cyprus)

on this basis to develop measures for addressing degradation, including collaborations with research institutions from other nations.

Initiation of the Conservation Programme at Pafos: houses of Dionysos and Aion, pebble mosaic of Fabrica Hill

The first major application of the Conservation Programme has been at the World Heritage designated site of the Kato Pafos Archaeological Park, in particular for the mosaics of the House of Dionysos, House of Aion and the pebble mosaic on the so-called Fabrica Hill. The Programme started in 2006 in collaboration with the CNR Padova Research Institute (ICIS, Institute of inorganic chemistry and surfaces), with the examination of the pathologies and characterisation of the original and restoration materials and their degradation. Samples were taken from the original tesserae, restorations, mortars, and salt efflorescences of two floors of the House of Dionysos subject to severe damage, and subject to systematic examination. The project for the conservation and maintenance of the mosaics from the three areas mentioned above was then designed based on these research results and on other data available to the Department, including the history of conservation-restoration and the local environmental parameters. The mosaic conservation process, conducted by a specialised departmental team, lasted for 15 months and included upgrading of the shelters built over the three monuments in a manner that would address all possible problems, from long-term conservation to safety and visitation issues.

The strategic principles applied in this early major project have been refined, elaborated and continued as the Conservation Programme continues.

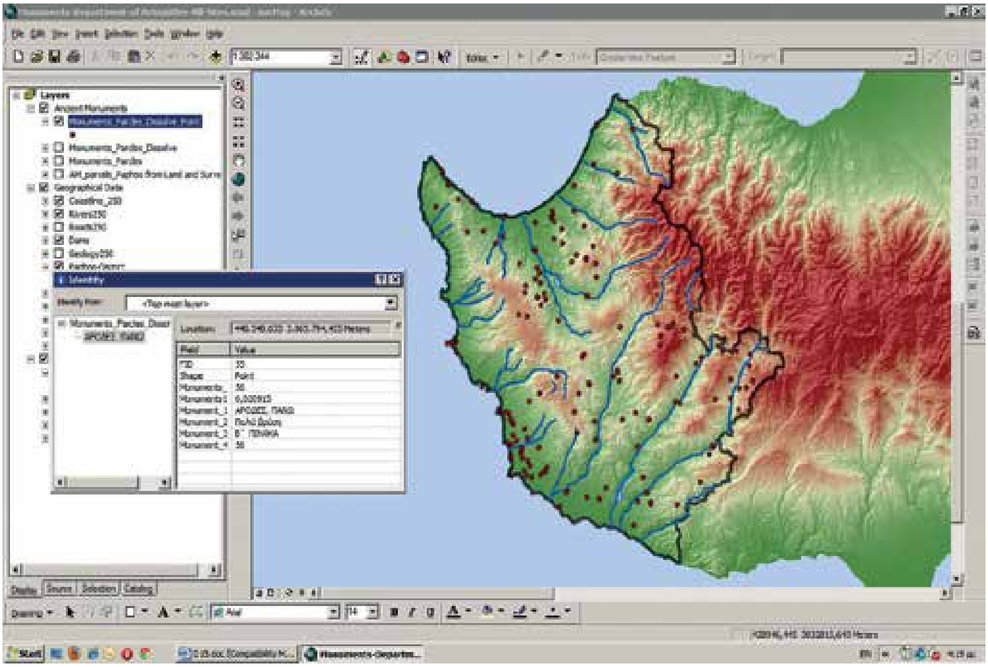

Fig. 6. Cyprus mosaics database (Department of Antiquities of Cyprus)

Recording conservation operations

More than 190 mosaics have been conserved since the start of the Conservation Programme. The operations on each mosaic are recorded in a specifically designed record file, with photographs and descriptions of the treatment and maintenance phases. The documentation includes computerised charts of the mosaic stratigraphy and decay factors. These records are inserted in a database, which will soon be available to researchers (Fig. 6). The database assists in the regular monitoring of the conservation state of the mosaics, and the evaluation of the measures previously applied.

Computerised recording and upgraded storage of detached mosaics and fragments

Another strategic aspect involves the documentation, graphic recording and improved storage of lifted mosaic fragments, such as those stored at Kato Pafos and Kourion.

From Kato Pafos, 246 trays of loose tesserae and lifted mosaic fragments have been recorded from excavations conducted over the past 50 years, as well as 103 from Kourion. Unfortunately, only general information is available on the material from Pafos; however it was possible to identify 143 fragments lifted from a total of 11 floors executed in tesserae and one in pebbles (Fig. 7).

As part of this strategic objective, the organisational and environmental conditions of the Pafos mosaic store-room were upgraded. New metal shelving was in-

Fig. 7. Mosaic store-rooms: digital data entry (Department of Antiquities of Cyprus)

stalled, and all the mosaics are now stored in keeping with basic principles of conservation storage. This improvement has been designed to contribute to a broader effort to upgrade the conservation workshops and store-rooms found in the different locations managed by the Department of Antiquities. Thus, all fragments from sites across Cyprus are now stored at the Pafos workshop, apart from a small number kept at the Cyprus Museum, and a small number of pieces displayed in fragmentary form in archaeological, district and local museums. The next stage of planned improvement is the installation of fire alarm and extinguishing systems for the Pafos storage and workshop facilities.

Fig. 8. Reburial methods and techniques (Department of Antiquities of Cyprus)

Preventive conservation: shelters, reburial, seasonal reburial

All mosaics in archaeological sites not open to visitors, are reburied. In some cases, temporary constructions to avoid winter flooding are installed.

Periodic reburial is an effective measure for protection of in-situ mosaics not under shelter, particularly against damage from freezing. Burial operations are conducted in early November and the mosaics are then uncovered beginning in early April, depending on weather conditions. Reburial slows the deterioration processes and gives us an opportunity for a more effective monitoring and planning of intervention measures on those mosaics that remain exposed (Fig. 8).

Pilot project for visually impaired access at two sites

The mission of the Department of Antiquities includes the communication of archaeological heritage and access by all citizens. For this reason, the pilot project "Guided tours for visually impaired persons" was begun in 2013 at the House of Dionysos in the Nea (Kato) Pafos Archaeological Park, and in 2014 extended to the House of Eustolios at the Kourion Archaeological Site (Fig. 9). Bilingual guides have been made available for visits, including direct contact by visually impaired persons for tangible perception of the mosaic character and understanding of the technology of execution. Informative panels in Braille have been installed at the House of Dionysos, including a floor plan in relief, illustrating the architectural organisation. A copy of a mosaic was created with the motifs evidenced in relief, so that visitors can sense their character. The Department now aims to extend these measures to other monuments and archaeological sites.

Fig. 9. Accessibility for visually impaired persons (Department of Antiquities of Cyprus)

Fig. 10. Mosaic of the Labours of Hercules, discovered in 2016 in the city of Larnaka (ancient Kition) (Department of Antiquities of Cyprus)

Major discoveries at Akaki and Larnaka

Archaeological investigations in 2013 at the *Pigadia* locality near the village of Akaki, 30 km west of Nicosia, brought to light the remains of a building with mosaic floors in a number of rooms. The most impressive of these shows the highly detailed scene of a *circus* race, including inscriptions with the names of the *quadriga* drivers and their horses. The floors were excavated and conserved under the direction of the Archaeological Officer of the Department of Antiquities, Dr. Fryni Hadjichristofi. These high quality mosaics are in general in excellent state of preservation, and add considerable knowledge of mosaic floors on the island during the 4th century AD.

In 2016 a mosaic floor depicting the twelve Labours of Hercules was discovered in the city of Larnaka during construction works on the urban sewage system. The work is of exceptional size (22 m x 6 m) and is situated within a bath complex (Fig. 10). The floor has suffered partial collapse owing to its positioning over a hypocaust system which is subject to static failure. Of the 12 panels, 7 are in good state of preservation. Research and planning are currently under way as we consider the difficult preservation measures for the 5 panels in poor condition. Expropriation of a house situated to the west of the mosaic is pending, at which point excavations will resume.

Conclusions

The policies of the Department of Antiquities respond with success to the difficult economic context, shared with many other countries. The strategic Conservation Programme places particular emphasis on the preservation of mosaics, which comprise a delicate and much appreciated part of our common archaeological heritage. The programme thus supports the broader departmental objectives for protection, promotion and communication of the entire cultural heritage, and supports the development and sustainability of present and future societies.

Author

Marina Solomidou-Ieronymidou graduated from Sorbonne University 'Paris IV' in 1980. She obtained her 2-year undergraduate degree (DEUG) in 1979 with additional diploma in 1980 and Masters in 1981, in Archaeology and Art History. In 1984 she received her post-graduate Diploma in Advanced Studies in Archaeology. In 2001 she received a PhD with honours from the Sorbonne University 'Paris I' in Medieval Archaeology. She has been a member of staff of the Department of Antiquities of Cyprus since 1986. In 2006 she was appointed Curator of Antiquities (Ancient Monuments Sector), with responsibility for coordination of the conservation, restoration, protection and promotion of all ancient monuments. In 2014 she was appointed Director of the Department of Antiquities.

SESSION II: METHODS OF SURVEY AND DOCUMENTATION

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Carla Puerto Giménez

Maria Paz Pérez Chivite

Anjo Weichbrodt
Matthias Kuhn

Stefania Chlouveraki

A CONSERVATION PROGRAM FOR MOSAICS OF UNDERGROUND ARCHAEOLOGICAL SITES OF BARCELONA

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Abstract

Since 1994, the Barcelona History Museum has developed a program aimed at conserving and managing the mosaics preserved in the difficult context of underground archaeological sites, situated under the streets and buildings of central Barcelona. Some of the sites concerned have been excavated and open to public visitation since the 1940s. The program takes a holistic approach to conservation. The starting point is the in-depth study and documentation of the original techniques and current condition of the mosaic, accompanied by studies and monitoring of the surrounding urban environment, the hydro-geological context, the structural envelope protecting the sites, and the internal environment. The resulting action plan includes remedial actions, monitoring, control, regular maintenance and prompt response to events. This approach is also strategic in dealing with the municipal and museum administrations and their personnel.

Keywords: Mosaic conservation, conservation program, urban site, underground, Barcelona

Introduction

The current article reports on the conservation program for mosaics preserved in musealised underground archaeological contexts, open to public visitation and under the responsibility of the conservation-restoration unit of the Barcelona History Museum. All these mosaics pertain to sites dating to the Roman era and Late Antiquity, and are situated at depths of two to three metres below modern street level, meaning at the level of the old city, with subsequent constructions above.

The remains with the greatest significance emerged in the early 1940s, at Plaça del Rei, in the course of works for the foundations of the museum itself. Over the years the excavations under the museum building were gradually enlarged, extending beneath the adjacent streets, squares and buildings, coming to occupy a total underground of approximately 4,000m². The floor mosaics discovered include: the *opus sectile* of a *fullonica* (laundry) of the 2nd century AD, the *opus tessellatum* of a *domus* on Plaça de Sant Iu, from the 3rd century, and an *opus sectile* from an early Christian baptistery, second half of the 6th century AD.

Other sites gradually added to the museum's responsibilities are of smaller extension, varying between 50 and 100m². Those included in the mosaics conservation program are a *domus* at Plaça d'Antoni Maura, excavated in 1954, with a re-laid *opus tessellatum* of the 3rd century AD, a *domus* on Carrer de la Fruita, excavated in 1999, and a site on Carrer Avinyó excavated in 2004. The latter two locations conserve 6th century *opus tessellatum*

Fig. 1. Construction of the roof in the excavations of Plaça del Rei, 1961. (photo Museu d'Història de Barcelona, MUHBA Archives)

and an *opus sectile* and an *opus tessellatum* of the 1st century AD.

Although some of these mosaics are preserved in the underground or the ground floors of modern buildings, a large share result from open air excavations, in which the sites were then surrounded by perimeter walls, with construction of overhead systems for the support the streets, squares or buildings situated above. In consequence, the remains have been exposed to profound changes, being conserved for centuries in a buried environment, then exposed to air and weather, and finally being shut away again in a closed space.

The Barcelona History Museum is also responsible for the unique case of the floors situated in the archaeological site of Turó de la Rovira, remaining from a shanty town built in the later decades of the 20th century, around an anti-aircraft battery abandoned after the Civil War. These precarious self-built homes were furnished with floors and mosaics created using hydraulic cement and glazed tiles, and are exposed to the elements as any other site preserved outdoors. (Fig. 1).

Since most of the floors in discussion are situated in underground or semi-underground spaces, they present the typical alterations deriving from presence of moisture, high humidity, salts, and proliferation of microorganisms. The extent and character of these problems in the different sites, including the specifics of microclimatic development, are related

Fig. 2. From left to right and from top to bottom, mosaics in sites below: Plaça del Rei, Plaça Antoni Maura, Carrer de la Fruita, Carrer Avinyó, 2018. (photo Oriol Clavera, MUHBA Archives)

to the specific geological, hydrological, and urban context. The characteristics of the wall and roofing systems, as well as the museographic development, are also significant. The musealisation of the sites may be more or less invasive, and in turn relates to factors of anthropic deterioration (Fig. 2).

For the past 20 years the Barcelona History Museum has included a specific mosaics conservation strategy (avoid, minimise, mitigate impacts) within its general program for the conservation of archaeological sites. The approach is in all cases to maintain the mosaics in situ, avoiding extraction or separation from the architectural context, considering that this only means of preserving their full value.

The mosaics conservation program

The mosaics conservation program takes a holistic, comprehensive approach, considering the entire medium, the individual mosaics, and their specific contexts (Font Pagès 1999; Font Pagès 2000).

From 2003 to 2005 the museum participated in the international APPEAR project ("Accessibility project: sustainable preservation and enhancement of urban subsoil archaeological remains"), in which the system of site and context was clearly conceptualised (Diaz Pedregal 2005: 31) (Fig 3). In practice, the museum applied this concept to the drawing up of systematic investigation procedures and data collection, facilitating identification of the factors and mechanisms of deterioration

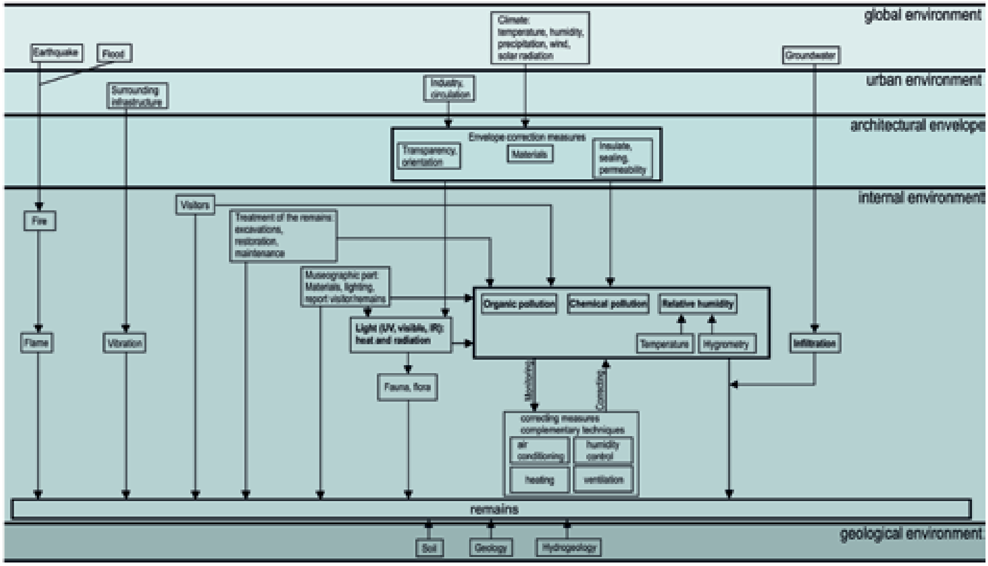


Fig. 3. Diagram by Pierre Diaz Pedregal

and the preparation of action plans dealing with the causes.
As a first step, a record sheet is prepared for each individual mosaic, dealing with different aspects:
- study of the mosaic materials and techniques;
- study of the current conservation status and the evolution since initial excavation;
- compilation of pre-existing photographic and documentary resources;
- mapping of conservation status, other graphic documentation.

In parallel, specific research is conducted and data are gathered on the characteristics and evolution of the site, dealing with:
- the urban environment;
- the geological/hydrological environment;
- the structural envelope protecting the site;
- the internal environment.

The program includes regular updating of the above records.

Record sheets on mosaic features and status of conservation

The museum provides regular monitoring for nine mosaics excavated in two distinct phases: a first phase from 1943 to 1950, a second phase beginning in the 1990s (Fig. 4).
Each record sheet includes a section of detailed description and graphic documentation of the techniques of execution and constituent materials of the mosaic.
The information collected facilitates comparative study. One of the significant aspects noted from this is the relation of the mosaic stratigraphy to the position of the work on the slope of the Mons Taber, a hill rising to 16 m above sea level, on which the Roman city developed. In analysing the stratigraphic structures we observe important variation in the execution of preparatory layers. In particular, the mosaics situated in the higher part of this hill take advantage of the so-

Fig. 4. From left to right and top to bottom, mosaics in sites below: Plaça de Sant Iu, Plaça d'Antoni Maura, Plaça del Rei, 2017 (ortophotographs by Pau Majó and 3 Peus, MUHBA Archives)

called petrocalcic layer (hard limestone stratum) as a solid base substituting the *statumen* (Julià Brugués and Riera Mora 2014: 76). The *rudus* laid over this layer, consisting of a mixture of clay, earth and limestone pieces (originating from the soil itself), serves in levelling the sloping terrain (Navarro Ezquerra 2017). Because of this the *rudus* can range between 50 to 400mm in thickness within a single room, and it is only the succeeding layers that are applied fully in line with the habitual pattern of Roman mosaic floors. In contrast, the mosaics situated on the lowest and gentlest sedimentary slopes required more regular preparation of the *statumen* and *rudus*.

The mosaic record includes measurements of the tesserae and their density/dm^2, as well as a breakdown of all the modular units and a summary table of all tesserae lithologies and colours (Table 2). From this, we observe that the lime mortars of the preparatory layers utilise aggregates of potassium feldspar, quartz and plagioclase (Iglesias Campos and Guasch Ferré 2015; Luxán 1996) (Table 1). The analysis of lithotypes reveals that in the case of *opus sectile*, the various stone materials have very often been salvaged from demolitions of earlier structures. The materials include limestones from Tarragona and Garraf, as well as local slates, and marbles from Tunisia, Greece, Turkey and Italy (Álvarez 1995; Royo Plumed and

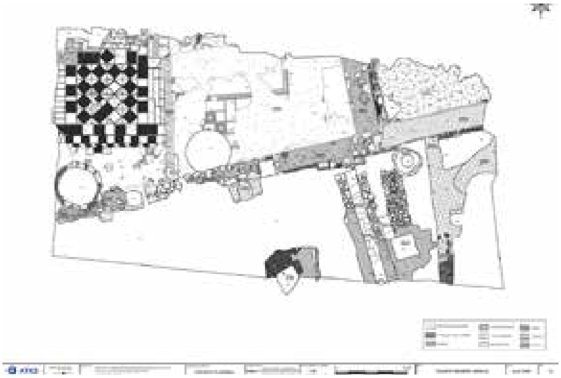
MUHBA MUSEU D'HISTÒRIA DE BARCELONA

DADES GENERALS — **Nº Catàleg:** 49

Tipus paviment i context arquitectònic: TESSELATUM – DOMUS AVINYÓ
Colors: Policrom
Cronologia: S.II
In situ / arrencat:

- [x] Conservat in situ
- [ ] Conservat "in situ"tot i quearrencat i traspassat sobre un nou suport
- [ ] Arrencat i traspassat a un nou suport (fragment MHCB3280)

Salvaguarda: Museu d'Història de Barcelona. Ajuntament de Barcelona



Imatge o plànol de l'entorn de l'estança

Esquema dimensions estança

Número/s inventari:
Accessibilitat: Obert al públic

TÈCNICA D'EXECUCIÓ (descripció d'estrats originals)
A) Anàlisi de l' estratigrafia

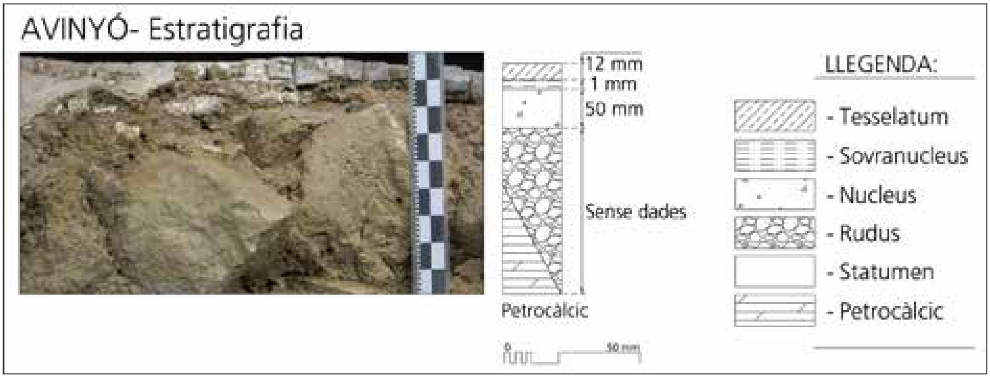


Table 1. Record sheet on mosaic characteristics: execution technique and constituent materials

MUHBA MUSEU D'HISTÒRIA DE BARCELONA

Densitat de les tessel·les:

Densitat mitjana: 113 tessel·les /dm2; amb un mínim de 102 t/dm^2 a l'àrea del tapis menor, concretament els quadrats negres de l'escaquer i un màxim de 126 t/dm^2 pertanyent al motiu decoratiu (desconegut) del tapis central. En general, hi ha diferència de densitat entre el color blanc i el color negre, essent a la banda blanca on la densitat és major.

1. Tapis central (panell): trena = 112 t/dm^2
2. Tapis central (panell): motiu decoratiu (?) = 126 t/dm^2
3. Tapis central: pelta –no és possible comptabilitzar la densitat-
4. Tapis perimetral (banda d'enllaç): Fulles d'heura = Part blanca 126 t/dm^2; parts negres 105/107 t/dm^2
5. Tapis perimetral (banda d'enllaç): Craters = 106 / 111 t/dm^2
6. Tapis menor (banda exterior?): escaquer = part negra 102 t/dm^2 i part blanca 121 t/dm^2

Dimensions de les tessel·les

Cúbiques d'1cm^3. de mitjana. Sent les blanques de 0'8cm. i les grogues del tapis central de 0'7cm.

Material del que estan fetes les tessel·les

Tapis central: Motiu decoratiu (?)

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Tapis principal: trena

Tapis perimetral: crater

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TESSEL·LA	
COLOR	**TIPUS**
Blanc	Calcària
	Marbre
Negre	Pissarra
	Calcària
Gris	Calcària
	Marbre
Ocre /groc	Giallo antico o Santa Tecla
Vermell	Rosa antico
	Brocatello
	Pasta vítria
	Ceràmica

Informació extreta de l'article de Beltran – Cortés citant les indicacions del tipus de material emprat fetes per Anna de Mesa i Hernando Royo.

Table 2. Record sheet on mosaic characteristics: dimensions, density and lithotypes of the tesserae

de Mesa Gárate 2019). In the case of the tessellated mosaics, the majority of the materials are local, in particular wackestone (a type of limestone), and a red fine-grained stone that may have been obtained from local riverbeds. There are also ceramic tesserae (Gimeno Torrente 2005).

The primary means of recording the conservation status is the map of alterations, which is periodically revised and updated. We observe that with greater time since excavation, the mosaics increasingly show the following deteriorations (Fig. 5):

- fissures and cracks in marble pieces, coinciding with the diaclasia;
- wear and/or darkening of the edges of the tesserae;
- losses in material due to pitting;
- fragmentation;
- delamination of slates, disaggregation of ceramic tesserae;
- generalised calcareous concretions;
- localised detachment of the foundation mortars;
- accumulations of soluble salts (more severe where acrylic emulsion "waterproofing" has been applied);
- previous consolidation interventions;
- accumulation of soil due to lack of maintenance;
- reintegration and reconstruction of pavements using cement or very hard resins;
- anthropic erosion.

In the sole case of the *opus tessellatum* at

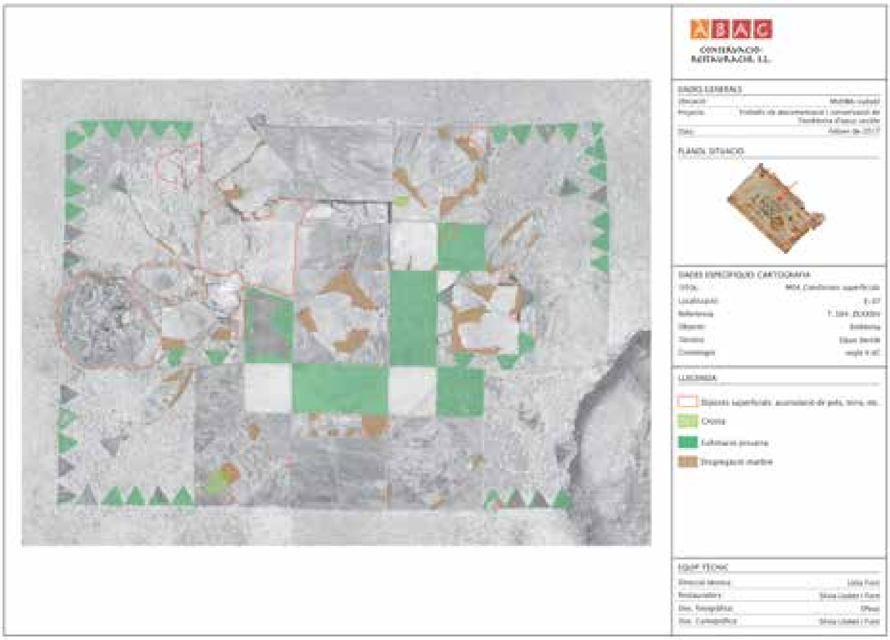

Fig. 5. Graphic of an *opus sectile* of fishes, showing alterations, 2017. (Sílvia Llobet. Abac Conservacio Restauracio SL, MUHBA Archives)

Plaça d'Antoni Maura, removed and then re-laid on a cement support in the same location, we observe that the cement rose to the surface and now masks the tesserae, and that there are problems of powdering of the ceramic tesserae.

The mosaics that have been brought under the museum's supervision since the year 2000 were generally excavated under urgent conditions, but received treatment by qualified professionals using compatible products. The circumstances required that the mosaics be reinforced to withstand the period until completion of the new sheltering constructions. This involved application of mortar along edges and in joints between tesserae, which in other circumstances might not have been necessary. Such treatments pose difficulties in our studies of the technique.

The floors of Turó de la Rovira shanty town represent a highly fragile material heritage. Despite carrying out regular maintenance, being inside the public park, total protection against uncontrolled anthropic actions results as impossible. However, an archaeological reserve has been established, for preservation of a part of the buried remains.

Environmental data

Over the years, the conservation team has conducted studies and sought specialised assistance aimed at precise understanding of the environment of mosaic conservation (Fig. 6).

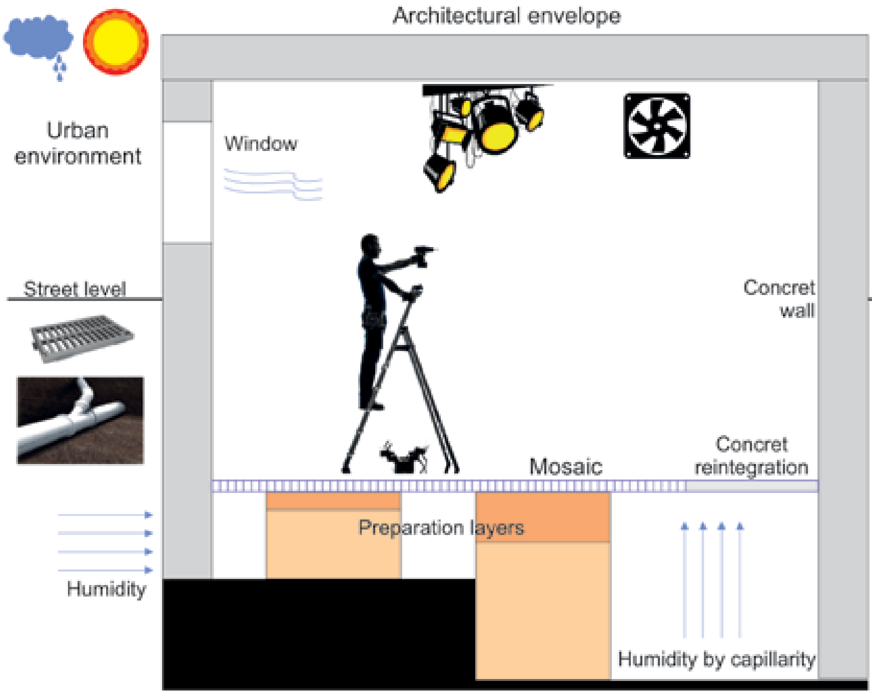

Fig. 6. Graphic of agents affecting the conservation of mosaics in underground contexts (Carla Puerto, MUHBA Archives)

The surface water from precipitation descends the Mons Taber slope and encounters the walls that close the drainage path at the foot of the hill. The resulting accumulations of water are aggravated by the soil structures, which include impermeable clays. The locations of the Roman buildings in relation to the slope meant that some pavements were immediately exposed to humidity, from the moment of construction. The result is that these mosaics are now among the most heavily damaged. One of the problems we are currently studying is the presence, in some areas, of pulverisation of the clays serving as joining material in the perimeter walls and as the substrate for the mosaics. One of the aims of the analysis is identify the relation of the deterioration phenomena to the varied presence of salt, water, microorganisms and their metabolic products, and the conditions of ventilation.

The soils contain microorganisms that draw nutrients from decomposing organic material, present in the soils. This effect has been augmented by cases of infiltration of sewage water. We have determined, among others, the presence of fungi and high levels of bacterial activity (Sanchez Ledesma 2006; Sánchez Ledesma 2007), in particular in areas near the walls where there is more humidity. These observations suggest risks to health and to the integrity of the materials, which must be controlled.

The architectural envelope plays a very important role in the conservation of the mosaics. Typically these are structures built mainly of concrete, in the form of retaining walls that can withstand the pressure of the surrounding earth and support the pavements or buildings constructed above, as well as blocking the flows of groundwater. The volumes of cement used give rise to large quantities of salts, which diffuse into the archaeological remains. Also, where moisture encounters the impermeable cement it tends to instead pass through the more porous materials of the archaeological remains.
The spaces enclosed by these concrete constructions typically feature no or very few windows, and very little natural ventilation.
The construction of the structures is itself aggressive and prone to risk. The construction process requires erection of heavy scaffolding, which can be placed directly over archaeological remains, while the surrounding ground is drilled for insertion of piles and micro-piles for the support of the new structures. The drilling process involves vibrations and additions of bentonite to the soil matrix.
We also observe that, with the passage of time, the enclosing structures lose their qualities of impermeability and insulating, and instead become vehicles for infiltrations of rainwater and leaks from pipes in poor conditions. In the case of the works from the 1940s and 1950s, the insulating and sealing materials have lost all their intended functional properties. Leaks also occur in the joints below street paving, where the structures meet the ground, and at windows with inadequate closures.
Unless subject to artificial condition, the relative humidity of the interior spaces is generally around 65%: a level that facilitates biological growth. However this level is punctuated by regular events of drought, when the wind is from the northwest. The cycle of alternating conditions favours crystallisation-dissolution cycles, resulting in detachment of mortar and the stone materials.
A last consideration in recording environmental data is that of anthropic activity. The musealisation of the sites involves the addition of potentially harmful materials, as well wear caused by visitors and from

Fig. 7. *Opus tessellatum* from the *domus* on Plaça de Sant Iu: reintegration of restorations previously conducted using cement, 1993 (photo MUHBA Archives)

Fig. 8. *Opus sectile* of the baptistery: the museography created circa 1960 seen in a photograph of 1993 the walkway is supported on the mosaic that is coated with dust (photo MUHBA Archives)

the actions of maintenance staff, for example when changing light bulbs. The lighting for musealised contexts is itself an environmental element requiring control (Figs. 7-8).

Action plan

Our first actions to resolve the conservation problems began in 1994, in the framework of the comprehensive remodelling of the Plaça del Rei underground spaces. At that time, the site had been open to the public for 50 years. One of the main objectives of the action plan was to eliminate the previously applied reintegration and consolidation measures, which had become the source of problems:

– removal of the acrylic emulsion consolidant applied in the 1970s;
– elimination of the mosaic reintegrations in cement.

In view of the problems caused by the previous interventions, one of the strategic criteria was to limit our new interventions to a minimum. Reintegrations, for example, were strictly limited to those necessary for the stability of the mosaic, and were conducted using materials similar to those of the original components.

The entire site was cleaned of dust and provision was made for continuation of full cleanings on a twice yearly basis (Fig. 9). The design of the new facilities incorporated elements designed to favour conservation. For example, the mechanical ventilation system is designed to limit the intake of external air when it is excessively humid as well as to prevent the stratification of the indoor microclimate and hinder the growth of microorganisms. In addition, the system is equipped with pollutant filtering systems. Microclimatic evolution is monitored and the data are extracted and processed statistically using a program designed in house. In this way we remain informed of the situation and can suggest improvements in the systems and their operation. Finally, the museographic design provided for installation of new walkways that respect the site integrity and facilitate ventilation.

Fig. 9. *Opus sectile* of fishes: cleaning process carried out by Abac Conservacio Restauracio SL, 2016. (photo MUHBA Archives)

Simultaneously with the reopening of the space to the public we established conservation management protocols, which we have continued to expand and update based on experience. These protocols govern all activity on the sites and regulate the actions of all personnel who could influence the archaeological remains, including maintenance and cleaning staff, surveillance, security and communications personnel. Among the rules are those restricting passage over the remains, and requiring coordination of any work on ceilings or facilities situated above mosaics and other delicate archaeological elements. One of the virtues of regular monitoring, inspection and cleaning is the advantage of rapid response to problems, for example, treating involuntary damage by visitors, stopping leaks, and collecting water in the interim.

As seen in the preceding sections of this paper, the challenges in the conservation of underground mosaics are closely related to the larger urban context. Solutions require the involvement of the authorities responsible for maintenance of public rights of way and nearby buildings, leading to agreement on coordinated actions in the immediate site environment. Through commitment to this task we have been able to obtain the renewal of the waterproofing system of some roads, the maintenance of joints between streets and facades, and the sealing of some sections of the sewage network. Unfortunately, the effectiveness of some of these interventions is limited in time and at best we are only able keep the situations contained.

Our objectives for the near future are to advance our studies of the soil and hydrogeological characteristics, and to explore systems for controlling their effects on the mosaics. We are also studying systems for effective, sustainable treatment of the remains of acrylic emulsion from previous interventions, which still impregnate some of the mosaics.

Conclusions

The conservation unit has now operated a program for mosaics conservation across the sites under its responsibility for a period of more than 20 years. This achievement required that we obtain the commitment of the competent bodies, for consolidation of an annual budget for protection of the sites and their most delicate elements, such as the mosaics. Our efforts in developing knowledge, strategy and ongoing actions have contributed to awareness among museum staff and in the external bodies responsible for design, maintenance and repair of public rights of way. Thanks to ongoing monitoring, the mosaics are offered in conditions suitable for public exhibition and the agents that cause deterioration are kept under control. Recent advances include updating of the planimetric mapping and photogrammetry of all the mosaics, thereby enabling improved monitoring. These latest records contribute to highly comprehensive dossiers of documentation, containing the entire history of each mosaic, which served as a fundamental tool in planning conservation actions.

At present, the main difficulties in the program of improved conservation derive from the underground structural containers, the soil and the urban environment: all areas where it is more difficult achieve results. With regard to the containers, we are witness to their continual ageing, in a context where remedial intervention would be exceptionally difficult. We can only recommend much greater care in the design stage for any such new structures, including the search for alternatives to the concrete walls that have in the past been used to surround the archaeological remains. The mosaics trapped under these walls and situated nearby present active deterioration processes that cannot be stabilised.

As regards climate, our observation is that the tendency is to install standardised control systems, when what is required is the design of systems dealing with the specific characteristics of the underground contexts, among which avoidance of excess drying and control over the intensity of air currents. The fact that subsoil remains typically appear in the course of new construction projects tends to precipitate rapid solutions, without accounting for a conservation perspective. In the future we will all must be identifying more sustainable control systems, better suited to the control of air quality, dissolved salts and microorganisms. We've tried.

In conclusion, the Barcelona History Museum faces a major challenge in the conservation of the diverse mosaics *in situ* under the modern city. This mission requires a holistic approach and, above all, the implementation of indirect actions on the environment. Our carefully developed conservation program is a fundamental tool for control and management of the necessary actions, and constant monitoring is the only instrument that will guarantee continuation.

References

Diaz Pedregal, P. 2005. "Sites archéologiques et Conservation". In *Urban pasts and urban futures: Bringing Urban Archaeology to life. Enhancing urban archaeological remains. International and Interdisciplinary Symposium, Brussels 4-5 October 2005, Annex to Conference Proceedings*, edited by APPEAR, 29-35. Brussels: European Union.

Font Pagès, L. 2000. "Musealizar y preservar: el programa de conservación preventiva del subsuelo arqueológico del Museo de Historia de la Ciudad". In *1er Congreso Internacional, Ciudad, Arqueología y Desarrollo. La musealización de los yacimientos arqueológicos. Alcalá de Henares, del 27 al 29 de septiembre de 2000*, edited by Antonio Méndez and Sebastián Rascón, 267-278. Alcalá de Henares: Gráficas Algorán.

Font Pagès, L. 1999. "Pla de conservació preventiva del Museu d'Història de la Ciutat de Barcelona: el subsòl arqueològic". In *VII Reunió Tècnica de conservació i restauració. Museu d'Història de Catalunya, 22 i 23 d'octubre de 1999*, edited by Conrad Galli, 24-33. Barcelona: Grup Tècnic. Associació professional dels conservadors-restauradors de Catalunya.

Gimeno Torrente, D. 2005. Informe corresponent a l'estudi petrogràfic de les tessel·les del mosaic de la vila romana trobada al carrer Sant Honorat de Barcelona. Servei d'Arqueologia de Barcelona. Ajuntament de Barcelona. Website date accessed May 22, 2019

http://cartaarqueologica.bcn.cat/Docs/3094/2012_05_07_12_14_44_Mem%C3%B2ria%20SANT%20HONORAT.pdf

Julià Brugués, R. and Riera Mora, S. 2014. "Evolució geomorfològica del Barri de la Ribera en èpoques històriques". In *Quaderns d'Arqueologia i Història de la Ciutat de Barcelona*, Època II, 10: 70-93.

Royo Plumed, H. and de Mesa Gárate, A. 2019. "Els paviments de la domus d'Avinyó. El luxe d'una casa de Bàrcino" *MUHBA Documents*, 13: 101-110.

Unpublished studies and reports commissioned by the MUHBA:

Álvarez, A. 1995. Identificació de marbres d'època romana procedents del Museu d'Història de la Ciutat. Departament de Geologia. UAB.

Iglesias Campos, M.A. and Guasch Ferré, N. 2015. Domus del carrer Avinyó,15 (Barcelona). Anàlisis de quatre mostres de morter, Grapac/Cetec-patrimoni (UAB-IQS).

Luxán, M.P. 1996.Técnicas constructivas y análisis de morteros y sedimentos del subsuelo arqueológico del Museo de Historia de la Ciudad de Barcelona. Convenio de Investigación AC 75/96.

Navarro Ezquerra, A. 2017. Estudi de mostres de terra de les ruïnes romanes del Museu d'Història de Barcelona. Ref 4987. Laboratori de materials de l'EPSEB.

Sánchez Ledesma, A. 2006. Análisis microbiológico de cinco muestras extraídas del subsuelo arqueológico de la plaza del Rey. Arte-lab.

Sánchez Ledesma, A. 2007. Estudio de identificación microbiológica en dos muestras procedentes de un yacimiento arqueológico. Arte-lab.

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A GIS/PHOTOGRAMMETRY METHODOLOGY FOR DOCUMENTATION OF MOSAICS *IN SITU*, APPLIED IN THE ROMAN SITES OF MÉRIDA, SPAIN

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Abstract

Within Mérida, Spain there are more than 1000 m^2 of mosaics conserved *in situ*, dating to the ancient Roman city of *Augusta Emerita*. The Consorcio Ciudad Monumental de Mérida [1] is the institution responsible for managing this heritage. For documentation we use the new technologies: a Geographic Information System (GIS) and 3D photogrammetry. These tools are essential for continuous control and maintenance. The result of this new methodology is practical, flexible, economical, and high-precision documentation. We developed a corpus of georeferenced orthophotos with scale 1:1 for each mosaic, and a set of conservation maps in the same database.

Keywords: Geographic Information System (GIS), 3D photogrammetry, orthophoto, *Emerita Augusta*, Roman mosaic

The challenge of graphic documentation for the mosaics of Mérida

The city of Mérida is known internationally for the importance of its monuments and archaeological sites. The organisation responsible for the management, research, conservation and communication of these heritage assets is the Consorcio Ciudad Monumental de Mérida (Consortium of the Monumental City of Mérida). The inventory of mosaic pavements from the ancient Roman city of *Augusta Emerita* currently totals more than 100, discovered through the decades since the 19th century. In general these works are widely known, thanks to the divulgation of iconographic studies in many congresses. One of the most important of these was the 6th International Colloquium of the Association Internationale pour l'Étude de la Mosaïque Antique, held in Palencia and Mérida in 1990.

Despite the importance of the works, very little documentation is available concerning the history of their conservation, restoration, and the current maintenance practices. In the conservation discipline, we know that it is essential to accurately document deterioration and treatment, in the form of maps, images and drawings, also containing references to additional data. However it can be difficult, if not impossible, to prepare a complete image of a mosaic pavement with sufficient quality for appreciation of the details. In fact the professionals engaged in mosaics conservation have always viewed the task of graphic documentation of the mosaics as one of the main challenges of their discipline. Until recently, in spite of important technological advances, the preparation of a high quality graphic registry of a *corpus* of mosaics such as Mérida's would have been a major project, requiring committed long-term application, resources of qualified personnel and time, as well as costly and complex equipment. In the absence of an adequate graphic register, the maintenance of conservation control and monitoring then remained difficult.

The main difficulties to graphic recording are inherent in the physical properties of the mosaic. These are complex works, occupying large surface areas. While traditional photography is an excellent tool, it still presents limitations: the photographer, typically on foot, has to distance themselves to take in an entire view in perspective, however these views do not offer full or undistorted vision. To see the tesserae and formal details in a planar view, the photographer must work from directly above, however in this case the focus is typically limited to a small area.

We can resort to partial views and then digital montages, but these are laborious and not necessarily fully accurate. In this regard, an essential source remains the guide published by Alberti *et al.*, in 2013 – *Supplemental Manual for Digital Photographic Documentation: Technician Training for the Maintenance of In Situ Mosaics* (Getty Conservation Institute and Institut National du Patrimoine de Tunisie). Newer technologies such as laser scanning and use of drones can be prohibitively expensive, and require highly qualified personnel, which can usually only be accessed for large projects. Once again, these are not practical tools for continuous, low-cost control over the conservation status of a substantial inventory of works.

New technologies for geographic documentation

The methodology we present is based on Geographic Information Technologies (GITs): consisting of a set instruments, techniques and methods for knowledge and representation of the territory. Great advances have been made in GITs since the early years of the 21st century, and their application is becoming common in the cultural heritage sector, both in Spain and elsewhere, particularly in architectural and archaeological contexts (Mayoral *et al.* 2017; Ortiz and Pino 2013). In general, GITs are used by multidisciplinary teams, including specialists in topography, a scientific area that also includes photogrammetry.

GITs can be used in the documentation and analysis of any works occupying a terrestrial space, meaning that that they are suitable for analysis *in situ* mosaic pavements. The application of GITs gains metric data which are particularly suitable in matters of documenting and conserving mosaics: they can establish the exact location and extension of the work as a whole, of the lacunae, of the deteriorations, and of any specific surface point, to a level of precision sufficient for recording the spatial coordinates (X,Y,Z) of individual tesserae. Indeed, all the exposed surfaces of every detail of the mosaic can georeferenced and measured. This means that we can use GITs to methodologies for the preparation of conservation inventories, and for individual studies, that are both highly accurate and practical in execution.

The two technologies serving for our new documentation and conservation methodology are:

– 3D photogrammetry, for obtaining a very accurate digital representation and performing mosaic orthophotography, creating the zenith image of the complete mosaic with the quality of the de-

tail that we define (Lerma *et al.* 2013);
- the Geographic Information System (GIS), for development of our database and damage maps, also linking the geographical data, images and text that we select.

A GIS/3D Photogrammetry methodology for documentation of mosaics

The methodology described here has been developed through a lengthy process of research and experience, including as part of the author's recent doctoral thesis, and with the Consortium interdisciplinary team, charged with the aim and responsibility for improving conservation of the mosaics of Mérida. The developments are made possible by the recent rapid development of GITs, with great potential for solutions in archaeological applications.

The methodology consists of two processes, each composed of two stages:

- Process 1, Elaboration of mosaic orthophoto
  - 1.1. Capture data *in situ*
  - 1.2. 3D modelling with photogrammetry software

- Process 2, Elaboration and use of GIS data
  - 2.1. Elaboration of database
  - 2.2. Studies with GIS

Process 1: Elaboration of mosaic orthophoto

In the first process we obtain a 3D model of the mosaic at 1:1 scale, with realistic photo colouring and exact spatial coordinates. From this 3D digital file we obtain the image that interests us, in this case with the view from directly above, called orthophotography, or orthophoto.

The two stages of this process consist of the capture the mosaic data *in situ* with a camera and GPS (phase 1.1.), followed by the transfer of the data and their processing in a 3D modelling program (phase 1.2.), conducted in the laboratory. The stage of 3D modelling requires a specific photogrammetry software, which until several years ago would have been very complex. The newer versions have been automated and are simpler for the user to operate. In our experience, PhotoScan Professional software has given the best results, however there are also free programs with good features.

The photo capture is done at short range, meaning on foot, from the ground. The care exercised when executing this *in situ* photography will have decisive influence on the results. The operator should first plan a route, considering the sequence of images necessary for the program, and the captures necessary to cover the entire area of the mosaic. A monopod is used for stability and ease of operation with the camera. The height of the camera should be between about 1.5 to 1.7 metres above the mosaic surface, with some variation permissible depending on the photogrammetric program and the precision needed in the final results.

The geographic coordinates can be taken with the help of a professional surveyor, using a total station or GPS. A minimum of three reference points should be recorded, for example by using temporary paper markers placed within the mosaic area. In the laboratory, the X, Y, Z coordinates obtained for these reference points will be entered in the software.

We consider the orthophotography of a mosaic to be sufficient when the average

of metric distortion is less than 5 mm over a surface of approximately 50 m^2.
The following lists the steps in the two stages of the orthophotography process:
Stage 1.1. Capture data *in situ*
– Reconnoitre the site, for understanding of access to the mosaic;
– Plan the capture date and time, considering weather and availability of shadow-free natural light (flash should not be used);
– Set up the camera with correct adjustment of parameters (Fig. 1);
– Take the pictures in an orderly sequence, from above, covering the entire mosaic (about 80% overlap between photos) (Fig. 2);
– Record geographic coordinates of at least three points, using GPS or total station.

Stage 1.2. 3D modelling with photogrammetry software
– Download the photograph files and coordinates into the computer;
– Conduct image processing using the photogrammetry software: orientation, generation of point cloud, triangulation mesh, and texture (Fig. 3);
– Introduce the topographic coordinates for the control points;
– Check the model generated in 3D for average of metric distortion;
– Automatic generation of technical report with the parameters used;
– Choice of overhead view on screen and generation of output orthophotography.

Process 2: Elaboration of GIS data: conservation maps and database

The use of the Geographical Information System allows the development of a single database containing information referenced to the global Geographical Coordinates System, in our case for management of information on the entire inventory of mosaic sites, which can then be used in subsequent studies. In Spain, the European Terrestrial Reference System 1989 (ETRS 89) is used. Given the use of GIS, the operator can obtain metric information and perform many calculations for purposes of quantitative studies. The design of the database, called a geodatabse, must define a series of parameters and contents for inputting the data, in orderly and consistent manner, allowing for practical operation and simple searches.
The work with a GIS consists of two stages: 2.1., development of the database, used for entry of all the information; 2.2. using the database for study purposes, through the plans and records produced.
We have found ArcGIS software to be satisfactory, although freeware is also available. Such software typically permits entry of a multitude of data and files, performance of calculations, and drawing of tables. It offers versatile tools with many

Fig. 1. *In situ* photography using a single camera and monopod, House of the Basilica (photo M.P. Pérez)

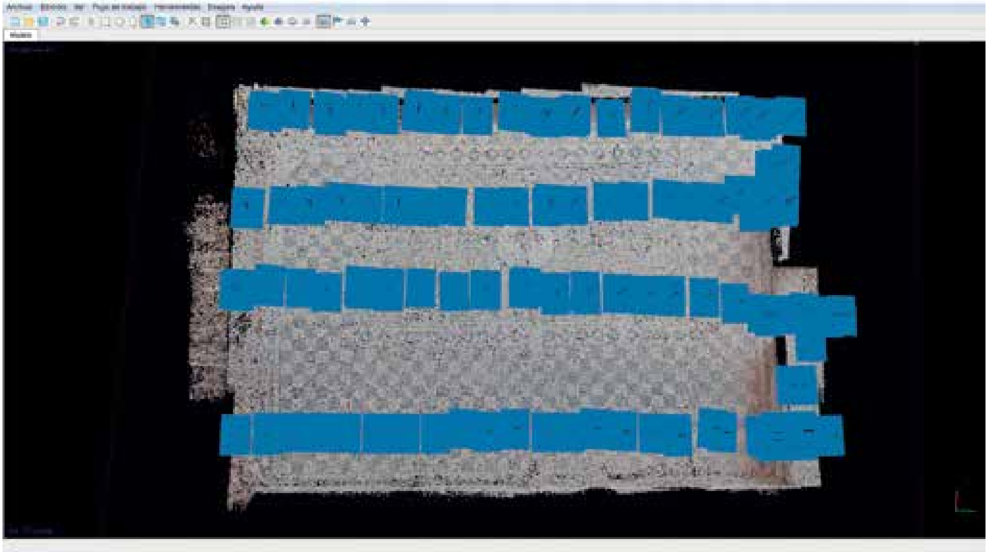

Fig. 2. A sequence of photos documenting an entire mosaic, viewed on the computer (image M.P. Pérez)

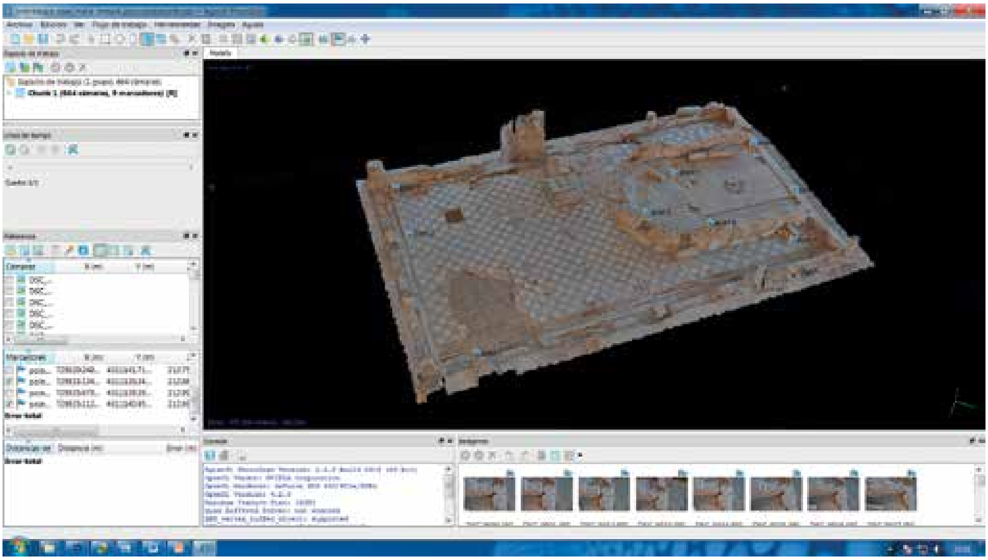

Fig. 3. The 3D modelling process; example of the House of the Marbles, viewed on the computer (image M.P. Pérez)

options for creation of vector drawings and maps. It allows connection to the internet for networking, and export of the contents in different digital formats.
The general data of the archaeological site, such as maps, plan drawings and aerial orthophotos, can be obtained through official permits, from local administrations and research centres. In Spain, we recommend the Municipal Cadastre [2] and the National Geographical Information Centre (CNIG), with the National Aerial Orthophotography Plan (PNOA) [3]. The process of inputting this material is done from the geodatabase that we have created in our computer. Once the orthophotography of the mosaic is projected in the corresponding system of geographical coordinates, the data is digitalised. This is done by layers of polygonal vector drawings to calculate the surfaces.
The subsequent drawings of the mosaics are prepared by "manual" operations of the software. As our orthophotography has a scale of 1: 1, we can perfectly draw each mosaic tile if desired, and know its exact location using the geographical coordinates. The surfaces can be measured (m^2) and placed in orthophotography (X, Y, and Z), as totally objective data. Once the orthophotography is produced the operators can make multiple kinds of studies and comparisons over time, for purposes of scientific control and monitoring.
The data is stored linked in the geodatabase and can be displayed in the plane with the graphs and in the form of text ta-

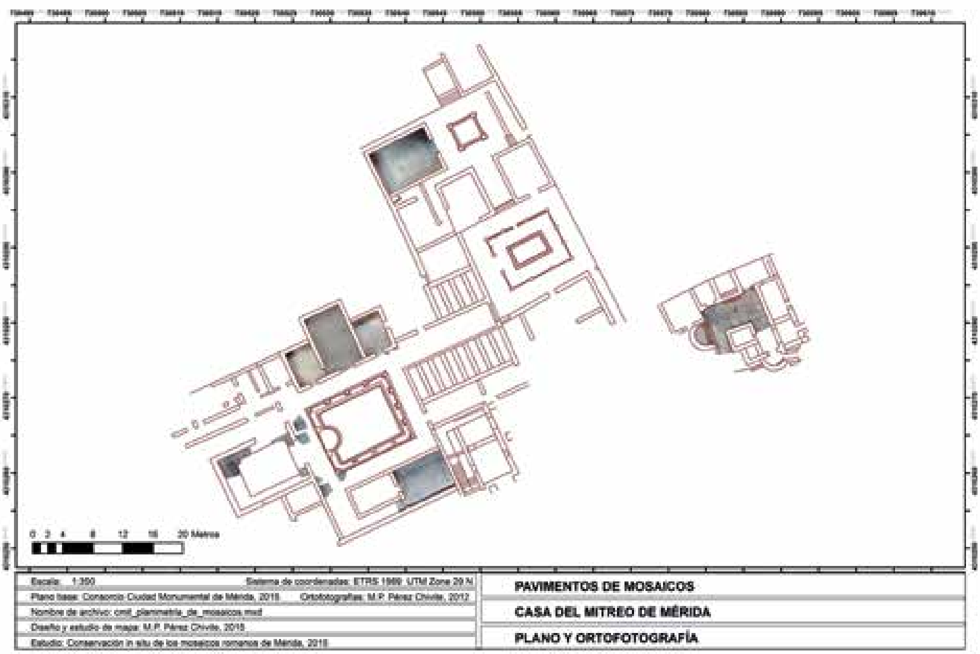

Fig. 4. Inclusion of the orthophotos of the mosaics in the planimetry of the archaeological site; example of the House of the Mithraeum (image M. P. Pérez)

bles. The data can be exported in different types of files.

The steps in the two stages of elaborating the GIS data are as follows:

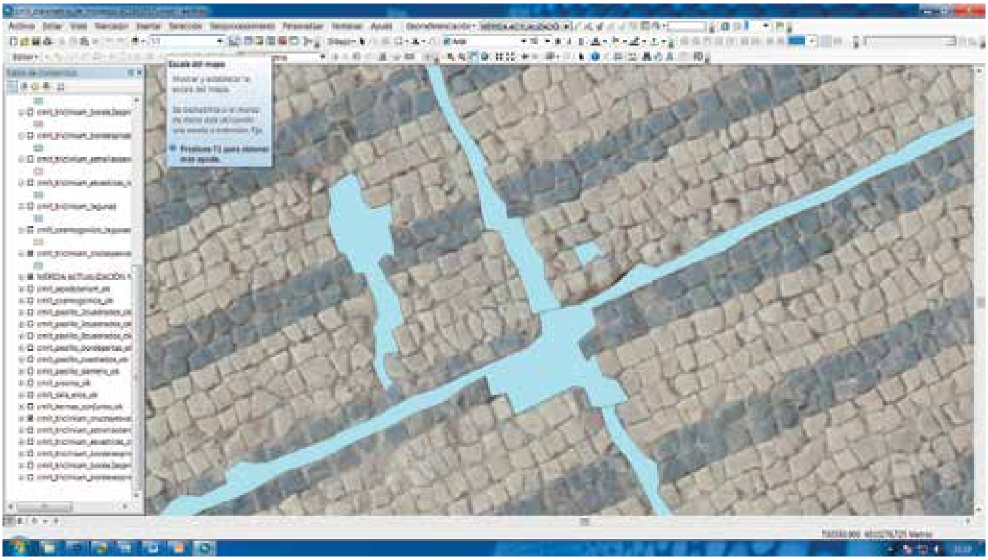

Fig. 5. Drawing lacunae on the orthophoto in 1:1 scale, example of the geometric mosaic of the House of the Mithraeum (image M.P. Pérez)

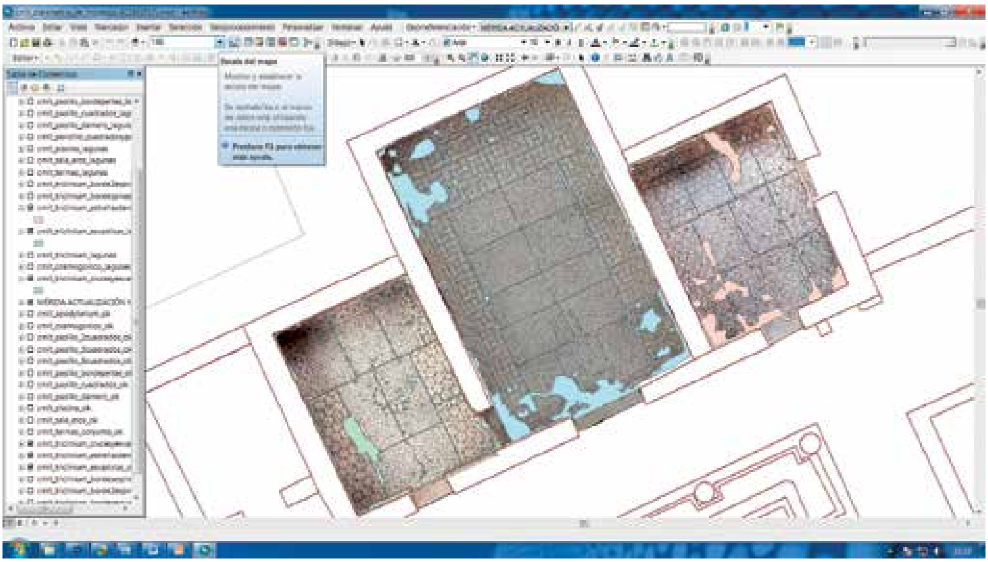

Fig. 6. Orthophotos with final drawing of the lacunae; example of the three pavements of the House of the Mithraeum (image M.P. Pérez)

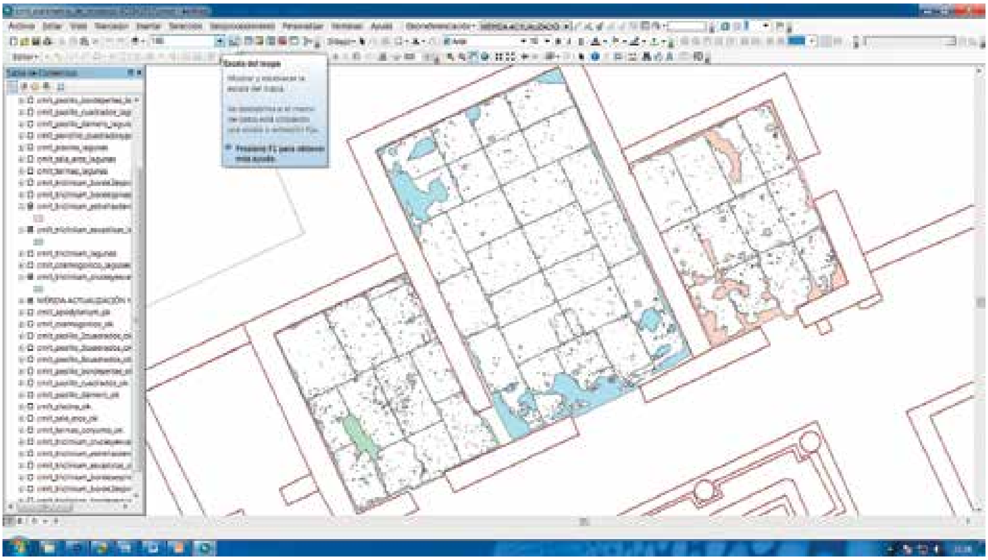

Fig. 7. View of the drawings of the lacunae of the three pavements, clearly revealing the cutting lines of past system for extraction of the three mosaics of the House of the Mithraeum (image M.P. Pérez)

Stage 2.1. Development of database

– Creation of a geodatabase and definition of parameters, using the geographic coordinate system for the country;
– Obtain official maps, plan drawings and orthophotography for the area of the archaeological site (optional);
– Introduction of mosaic orthophotography and location in general plan (Fig. 4);
– Creation of data table and data entry;
– Vector drawing of lacunae on mosaic orthophotography (Figs. 5-7).

Stage 2.2. Studies with GIS

– Table and map of location of mosaics *in situ* (Fig. 8);
– Production of data sheets with basic identification map of the mosaic (Fig. 9);
– Production of data sheets with conservation map and mosaic lacunae (Fig. 10).

Tools:

– Computer [4];
– Photogrammetry software (PhotoScan Professional or other);
– GIS software (ArcGIS [5] or other);
– Photo camera;
– Monopod (optional remote control);
– GPS or total system.

Team:

– 1 or 2 people, with sufficient knowledge of GIS and 3D photogrammetry software, topography, photography, conservation and mosaics.

Schedule for documentation of a mosaic:

– Day 1 - capture mosaic data *in situ* (photographs and coordinates);
– Day 2 - data processing using software, for development of the 3D model and introduction of the orthophoto in GIS;
– Day 3 - analysis in GIS and mapping.

Fig. 8. Map of all the mosaics documented in Mérida since the 19th century, on orthophoto of the city, prepared in GIS database (map by M.P. Pérez)

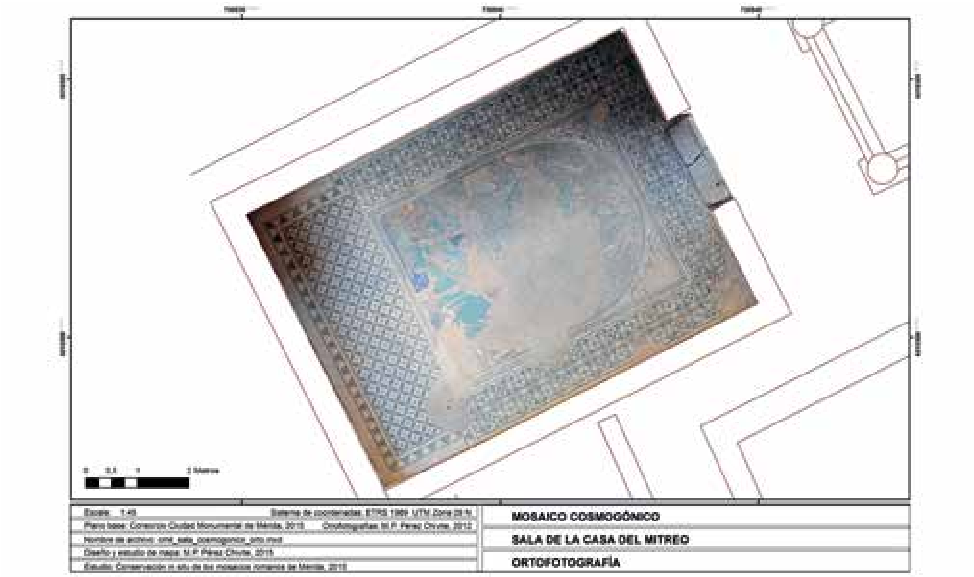

Fig. 9. Data sheet with mosaic orthophoto; example of the Cosmogonic mosaic of the House of the Mithraeum (map by M.P. Pérez)

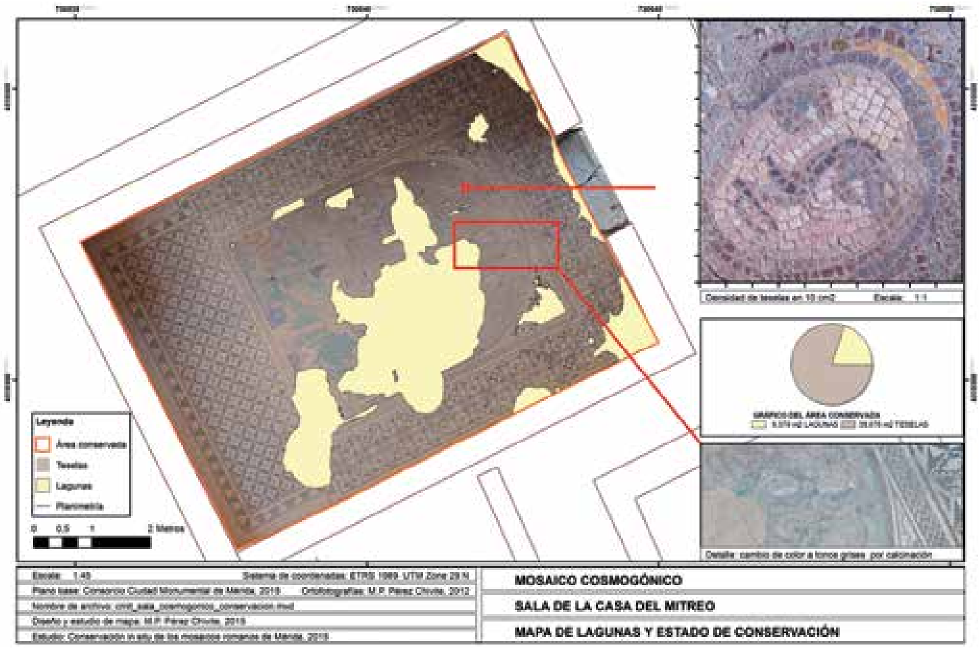

Fig. 10. Data sheet with conservation map and study of mosaic lacunae; example of the Cosmogonic mosaic of the House of the Mithraeum (map by M.P. Pérez)

Application: *in situ* mosaics of Mérida

The aim of the current application was to use the GIS/photogrammetry methodology to document and analyse the *in situ* mosaics of Mérida, conserved at five monumental locations accessible to visitation. The five sets of pavements represent a total area of more than 1000 m^2. Each of the sites contains the remains of a Roman *domus*: the House of the Mithraeum (214.2 m^2), the House of the Marbles (93.9 m^2), the House of the Tower of the Water (5.5 m^2), the House of the Basilica (57.6 m^2), and the House of the Amphitheatre (762.7 m^2, in course).

The application involved three types of study:

– *data table and map* for basic recording of mosaics throughout the site, considering nine essential items: year, street address, typology, coordinates, name, name of discoverer, first publication, author and date, any potential notes;
– *basic identification sheet* of the mosaic, for the elaboration of a corpus and as a basis for multiple studies, including orthophotography, map of current context, and basic information on the pavement: name, typology, materials, description, chronology and bibliography;
– *mosaic conservation sheet*, including the orthophotography with map of lacunae, calculation of surfaces of tesserae and lacunae in m^2, identification of the current deterioration zones, detailed density of tesserae at a scale of 1:1, and the basic conservation data (restoration interventions, current status, maintenance).

These data forms and maps are filed by date, permitting comparative studies and evaluation of the conservation status over time.

The GIS and the orthophotos we have created have allowed us to:

– analyse the spatial location and exact dimensions of the surfaces of mosaics conserved *in situ*;
– develop calculations and investigations involving historical data within the same database.

The design of the data forms and maps allows us to systematise the control work and evaluate conservation status through time. The level and consistency of detail and the overall vision are now homogeneous, removing obstacles to the study of these large-format works.

These Roman *domus* and their works are important not only at the historic and scientific level, but also as tourist attraction. They include, for example, the famous "Cosmogonic mosaic" of the House of the Mithraeum. This means that the role of the Consorcio of the Ciudad Monumental de Mérida in their conservation is essential. For the first time, we have demonstrated the state of conservation of these mosaics using scientific, testable data, through orthophotos. Any subjective value judgments on such matters, such as are common for archaeological heritage, are now banished.

Conclusion and general results

The application of the GITs for documentation of *in situ* mosaics provide a series of advantages, summarised as follows.

3D orthophotography enables:

– recording of the large, complex surfaces of mosaics;
– metric and colour accuracy, at precision sufficient to perceive the details of each tessera;
– a single digital image, easy to use and adapt to multiple applications;
– rapid, simple, low-cost implementation.

GIS database enables:

– storage and inter-linkage of spatial-textual data within a single database;
– objective, quantifiable and reviewable studies;
– adaptability of the same system anywhere in the world;
– versatile and modifiable design, adaptable to the needs and specificities of the case.

The aim of the GITs methodology has been to produce an image of the complete mosaic, of quality sufficient to perform different conservation analyses. Linking the data to the geographical coordinates is a great step forward for the in-depth knowledge of the mosaics.

The conditions we imposed were: ease of production; simplicity and economy of tools; operability with limited personnel and time; digital files in commonly used forms.

3D photogrammetry and GIS software are increasingly simple, with automated processes, and are increasingly suited to non-specialised users. This type of documentation is now affordable even in the case of projects with lower budgets. With the development of this methodology, the science and technology of short-range digital orthophotography has now become fundamental in the matter of any conservation studies on mosaic pavements.

Orthophotography and GIS become indispensable tools, elaborated to obtain the complete image of the mosaic and the database with the exact geographic information. With this we can carry out precise conservation studies and conduct preventive monitoring over time, which is the main aim for preservation of the mosaics and the larger archaeological heritage.

Acknowledgements

Consorcio Ciudad Monumental of Mérida, Spain
Instituto de Arqueología, Consejo Superior Investigaciones Científicas (IAM-CSIC) [6]

Notes

1. Consorcio of the Ciudad Monumental of Mérida, Spain, www.consorciomerida.org, accessed 10/02/ 2018
2. Sede Electrónica Catastro. Gobierno of Spain, www.sedescatastro.gob.es, accessed 10/02/2018
3. Centro Nacional Información Geográfica. Gobierno of Spain, www.cnig.es, accessed February 10, 2018
4. Software PhotoScan, downloads and tutorials, www.agisoft.com, accessed 10/02/2018
5. Software ArcGIS, downloads and tutorials, www.esri.com, accessed 10/02/2018
6. Instituto Arqueología of Mérida - Consejo Superior Investigaciones Científicas, Spain, www.iam.csic.es, accessed 10/02/2018

References

Alberti L., Bourguignon E., Carbonara E. and Chebbi A. 2013. *Supplemental Manuals for Digital Photographic Documentation: Technician Training for the Maintenance of In Situ Mosaics.* Los Angeles-Tunis: Getty Conservation Institute and Institut National du Patrimoine de Tunisie. Accessed February 10, 2018.

http://hdl.handle.net/10020/gci_pubs/manuels_engish.

Batalla C. M. (ed.) 1994. *Actas del VI Coloquio Internacional del Mosaico Antiguo: Palencia-Mérida, Octubre 1990*. Guadalajara, Spain, Junta Castilla y León. Consejería de Cultura y Turismo

Lerma J.L., Cabrelles M., Navarro S. and Fabado S. 2013. "Dalla fotografia digitale alla fotogrammetria per i Beni Culturali Documentazione e Divulgazione." *Disegnarecon* Vol. 6, no. 12: 1-8.

Mayoral V., Parcero C. and Fábregas P., eds. 2017. *Archaeology and Geomatics. Harvesting the benefits of 10 years of training in the Iberian Peninsula (2006-2015).* Leiden: Sidestone Press.

Ortiz P., Pino B. 2013. "Digitalización 3D automática con láser escáner, fotogrametría y videogrametría. El caso práctico del Templo de Diana (Mérida)." *Virtual Archeology Review*, Vol. 4. No 8: 90-94.

Author

Maria Paz Pérez Chivite holds undergraduate degrees and a PhD in conservation-restoration from País Vasco University, Spain. Her doctoral thesis concerned documentation of Roman mosaics in situ, and she received a scholarship for the study of mosaics in Ravenna, Italy. Since 2005, she has been the principal archaeological restorer of the Consorcio of the Ciudad Monumental of Mérida. She coordinates various projects and is a professor of International Heritage Courses for young restoration students.

MADE TO MEASURE: DEVELOPING AND USING A DATABASE-DRIVEN DOCUMENTATION SYSTEM

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Abstract

As the result of a cooperation between a geodatabase expert and a conservator, this paper illustrates the example of the Roman site of Orbe-Boscéaz and the development of a customised documentation system: a simple spatial database based on *PostgreSQL/PostGIS* operated through an adaptation of the open-source GIS application *QGIS*. The purpose of the documentation system is to gather – in a geographical context – photographs, survey mapping information, measurement, and analysis data; and to output selected information in thematic and archive-ready maps.
Keywords: Orbe-Boscéaz, Roman site, documentation system, database, open-source.

Introduction

In a 2014 ICCM article, Myriam Krieg, Noé Terrapon, and Anjo Weichbrodt presented the history of the documentation of the Roman mosaics of Orbe-Boscéaz. They gave examples of the diversity of the information and outlined the challenges of adapting verbose documentation language into language which can be transferred into a database. Furthermore, the group illustrated the benefit of analysing and representing gathered information in Geographic Information Systems (GIS).

We continued developing a customised documentation system and finalised the concepts of a hierarchical glossary into a spatial database in a cooperation between a geodatabase expert and a conservator. Our paper will illustrate the results of this work: a simple spatial database based on *PostgreSQL/PostGIS* which is operated through an adaptation of the open-source GIS application *QGIS*. The purpose of the documentation system is to gather – in a geographical context – photographs, survey mapping information, measurement and analysis data and to output selected information in thematic and archive-ready maps.

In the following, we will illustrate the challenges, steps, and the reasoning leading to the current documentation system. In this way, we will demonstrate the modelling of historic and contemporary data in a structured relational database with spatial integration using free and open-source tools from the database back-end with *PostgreSQL/PostGIS* to a user-friendly front-end based on *QGIS*.

Naturally, there are several projects already out there providing similar solutions for similar problems. To our knowledge, however, those systems are generally not discussed in detail in a publication. Thus, this paper does not have the ambition to be scientific, but rather to share an experience of creating a purpose-built documentation system.

Goal Definition – It is all about Input and Output

During the beginnings of our project, the question "What do we need?" surely came up. It became quickly clear that what we needed was "simply" to create useful output and facilitate and structure information input.

The most useful output for us, as of 2017, are thematic and archive-ready maps (Fig. 1). Printed maps and reports are still the major requirement from the archives as well. What needed to be on those maps was quite straight forward: We agreed that there would be two map sections: one for the mosaic and one for the larger context, both containing the North indicator and a scale. The mosaic map section would contain the observations made in form of coloured polygons which would be explained by a legend. In the context map, we wanted the area of the mosaic to be represented. Finally, we required an auto-filling cartouche providing information about the mosaic in question, such as which who had made what kind of observations, and when, as well as the filename of the exported PDF.

One of the main uses of the documentation system would be to gather survey mapping information, measurement and analysis data. To realise this with the help of a structured database seemed to be the best solution. It is clear that it is not very straightforward to fill in a complex database. Therefore, a made-to-measure

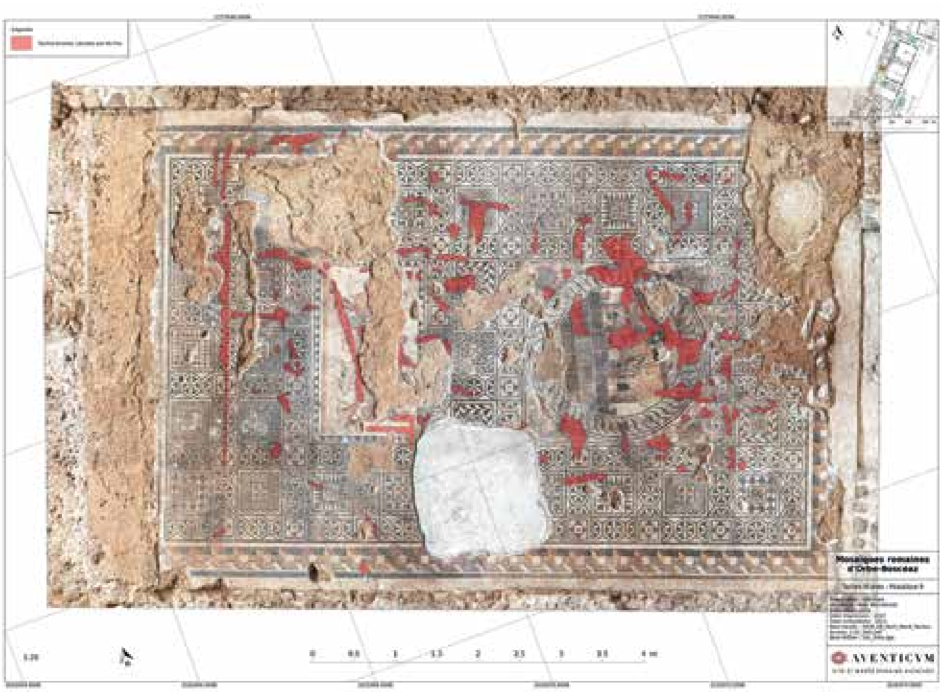

Fig. 1. One of the goals of the use of the documentation system: Archive-ready maps (image by Noé Terrapon & Anjo Weichbrodt, 2017)

front-end would be of great help. One final consideration regarded the terms in use: if terms in these tables were not predefined, inserted information would become disparate quickly and could not be easily queried and represented. Consider, for example, the of the terms crack and fissure, which basically represent the same thing but in a database those terms are substantially different. We tackled this issue by implementing a hierarchical glossary in development since 2013.

The development process

Launching

Beginning in 2013, we started with vectorised plans from our archaeology colleagues and some orthorectified images in a commercial GIS. We were using so-called shapefiles to store observations from different documentation campaigns. Shapefiles are basically tables containing geospatial vector data and are easily generated and modified. In the GIS one could simply draw a polygon and insert observations in the corresponding columns in the table. At that time, we did not have our hierarchical glossary ready and we experimented liberally with descriptions and registrations eventually destined for the maps. The shapefiles filled quickly and problems with redundancy, inconsistent labelling, and the limits of the initially defined structure of the tables arose. At this point we began creating a hierarchical glossary to refine our terms and which was also compatible with the structure of a database as described by Krieg, Terrapon, and Weichbrodt (2017). Since 2014 we consistently used our hierarchical glossary to digitise observations in the shapefiles, bringing us to the actual construction of the database.

Modelling

Bundling the expertise of a geodatabase expert and a conservator, we started the process of modelling the site's data. Modelling is the process of shaping the database structure and consisted of frequent discussions and pencilling down schemata, a very crucial and social activity. At the outset we surveyed the site to inventory the objects one could see and touch – such as the pavilions and the mosaics – and then considered the kinds of observations made *in-situ*. It was thus obvious to divide our database into "real-world objects" and "observations".
Our initial hierarchical glossary in continuous use for three years immediately yielded a huge advantage, as the modelling stage revealed what had worked well and what had not. We were able to understand the degree of complexity necessary to create the most simple database to make consistent and holistic observations of the mosaics. Thus, modelling the site's data helped us simultaneously improve our hierarchical glossary.

Database structure

In the following, we will look step-by-step at the different sections of the database. The descriptions will be related to the database schema represented in Figure 2. In the schema, each box with a blue heading stripe contains the information needed to define a table. At the top in the blue heading is the name of the table. The different rows actually represent the different columns in the real table: the left label of each row names

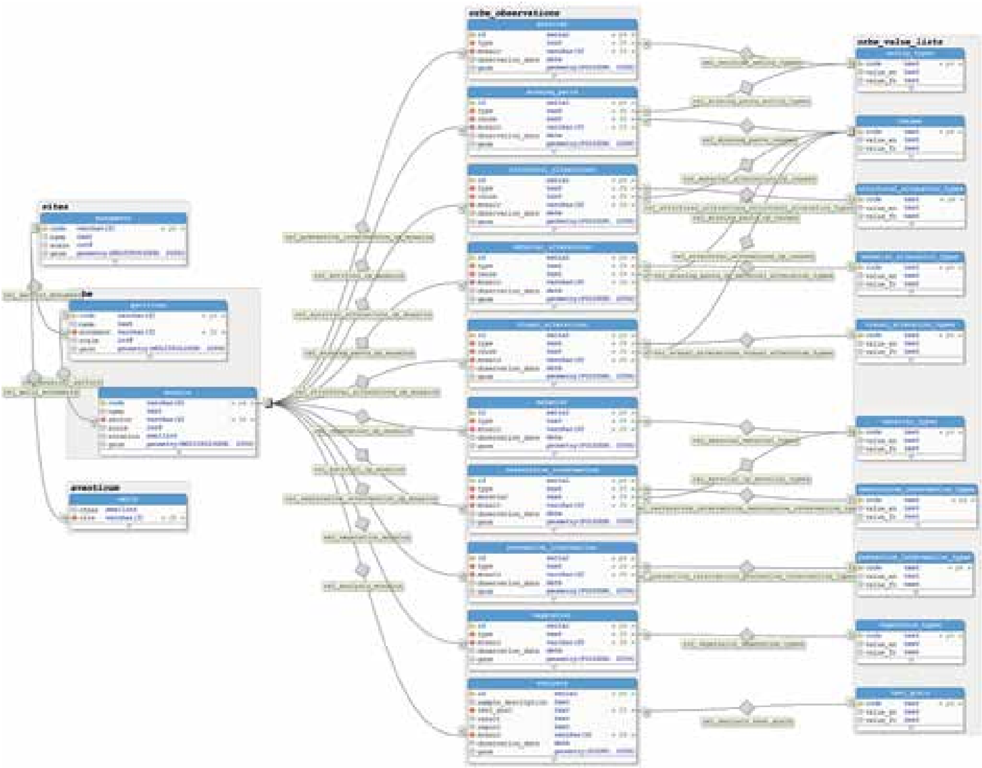

Fig. 2. The complete schema of the database with the "real-world objects" in the first column, the "observations" in the middle and the value lists containing the applicable terms on the right (image by Matthias Kuhn & Anjo Weichbrodt, 2017)

the columns, while the right label defines the data type. The tables relate to each other by using so-called primary and foreign keys, and these connections are represented in the schema by lines.

Real-world objects

On the left in Figure 2 are the table definitions of the "real-world objects".

The "monuments" table host the different monuments. In our case some monuments of Aventicum and Orbe-Boscéaz are represented in Table 1. This table has the columns: *code*, *name*, *scale* and *geometry*. In the case for the highlighted row, this is filled with this information: "OB", "Mosaïques romaines de la villa Orbe-Boscéaz" and "5000". The geometry information is represented by the blue polygon in Figure 3.

The "pavilions" table has the columns: *code*, *name*, *monument*, *scale*, and *geometry*. This table is connected to the monuments table through the monument column, because a pavilion is part of the monument. The example for *Pavillon 4* (Table 2), results in: "Pav4", "Pavillon 4", "OB" and "100". The geometry is represented as yellow in Figure 4. The other pavilions are described by the light green shapes.

code	name	scale
TRA	Théatre	1000
TP	Thermes de Perruet	1000
OB	Mosaïques romaines d'Orbe-Boscéaz	5000

Table 1. Monuments table, containing monuments of Aventicum and Orbe-Boscéaz

Fig. 3. The blue area represents the selected geometry of the Orbe-Boscéaz site (image by Anjo Weichbrodt, 2017)

CODE	NAME	MONUMENT	SCALE
Pav1	Pavillon 1	OB	100
Pav2	Pavillon 2	OB	100
Pav3	Pavillon 3	OB	100
Pav4	Pavillon 4	OB	100
Pav5	Pavillon 5	OB	100

Table 2. Pavilions table, containing pavilions at the site Orbe-Boscéaz

Fig. 4. The yellow area represents the selected geometry of Pavillion 4 (image by Anjo Weichbrodt, 2017)

CODE	NAME	SECTOR	SCALE	ROTATION
Mos1	Mosaïque 1	Pav1	20	66
Mos2	Mosaïque 2	Pav1	15	66
Mos3	Mosaïque 3	Pav1	20	66
Mos5	Mosaïque 5	Pav2	10	-110
Mos6	Mosaïque 6	Pav3	15	67
Mos7	Mosaïque 7	Pav3	15	66
Mos8	Mosaïque 8	Pav4	15	68
Mos9	Mosaïque 9	Pav5	20	-20

Table 3. Mosaics table, containing mosaics at the site Orbe-Boscéaz

Fig. 5. The yellow area represents the selected geometry of Mosaïque 8 (image by Anjo Weichbrodt, 2017)

The "mosaics" table looks similar to the previous one. It has the columns: *code*, *name*, *monument*, *scale,* and *geometry* with the additional column of *rotation*. The mosaics table is connected to the pavilions table through the sector column, because a mosaic is part of a pavilion. The information contained in the rotation column helps to orient the mosaic to fit it best to the shape of the print support. The example of *Mosaïque 8*, contained in *Pavillon 4* looks like this: "Mos8", "Mosaïque 8", "Pav4", "15" and "68" (Table 3). The geometry is represented in Figure 5.

Observations

The "observations" define observations made *in-situ*, which can be anything one might want to map on a plan. For this particular database structure, all the observation tables are connected to the mosaics table because the observations are made on the mosaics. Each observation table also has an attributed date field attributed describing when a particular observation occurred. Lastly, there is of course a geometry column containing the information of the place and the extension of the observation. At the moment we have defined ten observation tables in the database structure, which are represented by the middle column in Figure 2. Furthermore, each observation table is linked to a value list from which to choose the type and sub-type of observation as shown in the third column of Figure 2. The value lists can be easily extended without modifying the structure of the database. Terms in the value list can be registered in different languages as well. For our documentation system, we use terms in French and English hosted by the columns *value_en* and *value_fr*. This means we can export our archive-ready maps in two languages by just selecting the language of our choice.

Below we will describe the function of the observation tables:

The "entities" table represents components of the mosaic like the *tessellatum*, *preparatory layer,* or *masonry*. Followed by the "missing parts" table, which share the "entity type" list and contain an additional column for "causes", meaning that we can accommodate observations of a missing part in the *tessellatum* caused by *vandalism*. Similarly causes can be attributed to deterioration phenomena like in the observation categories of: "structural alterations", "material alterations" and "visual alterations".

In the same hierarchical level as previous observation tables we find the "material" table. This table makes it possible to register observed materials. Then there are two tables for interventions: "restorative interventions", where in addition to the intervention type, the materials used can also be specified; and "preventive interventions", where there is only a type from which to select. Through the vegetation table, we can attribute different flora to a specific area of the mosaic. And last, but not least, is the analysis table, which enables the conservator to register a specimen taken, describe it, and enter the results of an analysis.

Choosing the tools to implement the concepts of the documentation system

Front-end

The decisions regarding the basis of the front-end system were made early: geospatial data of an archaeological site, such as georeferenced plans and orthoimages are

probably most efficiently used and managed in a GIS. A main requirement was using open-source software to avoid high license costs but also to take advantage of the adaptability of the products and the thriving community. We started to use the front-end tool *QGIS* [1] in 2014 at the *Site et Musée romain d'Avenches*, so we knew that it was relatively easy to learn and that we could create archive-ready maps with its map composer. Another selling point was that one of the authors of this paper (Matthias) is also one of *QGIS*' major developers. *QGIS* is generally described as cross-platform free and open-source desktop geographic information system GIS application that supports visualisation, editing, and analysis of geospatial data, and this, along with the other two factors made it clear that *QGIS* would be the front-end for our documentation system.
Even though *QGIS* is intuitive, it remains a complex piece of software. As of 2018, it is not common that conservation professionals are proficient with using GIS applications, and it thus crucial to simplify the use of the documentation system. Creating an interface that would lower the barrier of entry was a priority so that any new team member could start inserting observations into the database. Matthias thus developed the plug-in called *Quick attribution* [2] for our project, which allows the user to simply select mosaics and observations and to draw corresponding polygons without being confronted with the complexity of *QGIS* or the underlying database. We think that this example underlines the incredible power of open-source software, where financial resources can be devoted to efficiently adapting a product to one's needs and to training instead of spending it on licenses. Additionally, the *Quick attribution* plug-in has become popular and is used by a myriad of *QGIS* community members.

Back-end

Behind the curtain, however, the "real work" is done by the object-relational database management system *PostgreSQL* [3]. The main task of a database management system in general is storing data and returning it when requested by the user or from other software applications. A great benefit of *PostgreSQL* is that its main goal is to be standards-compliant and extensible. This makes us more confident about long-term compatibility and the advantage of not being trapped with a specific product. In its standard configuration, *PostgreSQL* cannot deal with geographic objects, but the database extender *PostGIS* [4] adds this functionality.
The previously presented database structure is defined through structured query language (SQL) by the database expert. Though pure SQL is usually far out of the knowledge-sphere of conservators, data modelling tools like *pgModeler* [5] allow the easy visualisation and database structures we have seen in Figure 2. With the help of this tool, the conservator can develop a better understanding of the database and can contribute (for example) by adding the previously discussed standard value lists to the project.

How it works

We mentioned above that the front-end is *QGIS* and that we are using the *Quick attribution* plug-in to interact with the database. To digitise observations in the documentation system, the team member

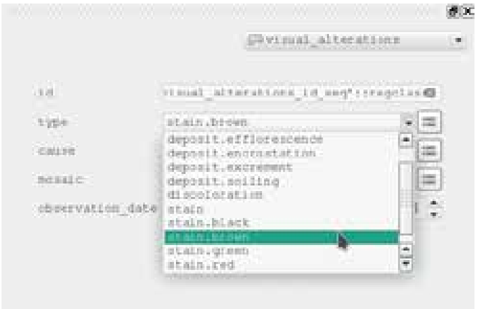

Fig. 6. Quick attribution plug-in: the team member is guided through the annotation process by developing menus (image by Anjo Weichbrodt, 2017)

Fig. 7. Observations are annotated by "drawing" polygons or points on the base of orthographic photographs (image by Anjo Weichbrodt, 2017)

would begin by opening the *QGIS'* project file. Project-related files are loaded and the connection to the database is established. In the next step, the *Quick attribution* plug-in is activated, and the team member is guided through the annotation process by developing menus representing choices from the *PostgreSQL / PostGIS* database. First an observation is selected, then an observation type or sub-type, followed by choosing the mosaic, and lastly a date is defined (Fig. 6). Additionally, if deterioration phenomena are digitised, corresponding causes can be registered. Following, observations are annotated by "drawing" polygons or points on the base of orthographic photographs (Fig. 7).

Exporting the archive-ready maps is normally carried out by the more experienced user. This is especially true for the creation of templates in the print composer, where the general appearance for the thematic maps are defined. The final representation on the map is ideally managed through visual placeholders and variables in the template, so that the information to fill these blanks in can be directly supplied from the database. When a template is well-defined, a mosaic can be selected and the map simply exported. This can be realised in a batch process as well all mosaics at once. Those procedures are very well documented by the *QGIS* community.

Conclusions and outlook

Creating a purpose-built documentation system has been beneficial from many perspectives. First, it gave us the chance to get in close contact with the documentation which has been produced by our predecessors. Secondly, it forced us to refine our terms in relation to the observations we make at the site and to define a hierarchical glossary. And thirdly, our comfort zones were challenged to embrace technologies such as GIS and databases in general.

This process started in 2013 and has been a slowly simmering project with few resources trickling in. We, the conservators, first had to figure out our goals and then increase our familiarity with GIS and databases. Then using the momentum of two conservation projects in AVENTICUM and at the site of Orbe-Boscéaz, we were able to invest in a cooperation with a geodatabase expert (Matthias). During this two-year cooperation we developed the made-to-measure documentation system. Our total investment in time comes down to eighty-four hours for the geodatabase expert and about double that time has been invested from the conservators site. With this purpose-built documentation system, we are able to consistently and holistically describe numerous observations made *in-situ* and create useful output in the form of archive-ready maps. Additionally our colleagues with no previous experience in *QGIS* are empowered to help digitise observations thanks to the user-friendly front-end.

It is important to mention that we have not aspired, nor have we succeeded to create a documentation system which fits everybody. We rather used established tools and shaped them to our needs and wanted to share are some crucial aspects we felt were important to us.

In the near future we will have to think about how to store the important amount of raster images which we are using in the GIS but which are for now not integrated in the database. We will also look around to discuss these issues with colleagues having analogue challenges. In this context it would of great interest to gather and share database schemata as developed by different groups.

Acknowledgements

This project could only have been realised with the participation and guidance of Noé Terrapon and Myriam Krieg, as well the director at the Site et Musée romain d'Avenches, Marie France Meylan-Krause. We thank them for their continuing support.

Technical Notes

1. *QGIS website* - https://www.qgis.org/en/site/
2. *Quick Attribution* plug-in repository - https://plugins.QGIS.org/plugins/quick_attribution/
3. *PostgreSQL* website - https://www.postgresql.org/
4. *PostGIS* website - http://postgis.net/
5. *pgModeler* website - https://pgmodeler.io/

References

Krieg M., Terrapon N., Weichbrodt A. 2017. "Des aquarelles du 19ème siècle au système d'information géographique (SIG): la documentation des mosaïques à Orbe-Boscéaz/VD (Suisse)." In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et préservation des mosaïques: A quel cout? Actes de la 12e Conférence de l'ICCM, Sardinie, 27-31 octobre 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aicha Ben Abed and Roberto Nardi, 96-105. Los Angeles, CA: Getty Conservation Institute.

Authors

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Matthias Kuhn is senior developer and managing director of OPENGIS.ch. He has got 15 years of professional experience in application development and a master degree in Geography with specialisation in GIS. This position and background allow him to fully dedicate his energy into spreading and improving open tools in GIS.

THE MOSAIC ICON OF 'PAMMAKARISTOS MOTHER OF GOD': DOCUMENTATION AND CONDITION ASSESSMENT

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Abstract

The mosaic icon of 'Pammakaristos' is one of the most important ecclesiastical artworks of the Ecumenical Patriarchate of Constantinople, renowned for its outstanding artistic and religious values. It is a masterpiece, made of minute glass, gold and stone tesserae set on wooden panel with wax-mastic paste, that demonstrates the meticulousness and brilliance of Byzantine art. The icon was conserved in 1933, yet its condition today is critical, owing to the severe damages that have occurred in the past. Macroscopic observation, Reflectance Transformation Imaging, radiography and computed tomography were employed in the examination, documentation and assessment of its condition.

Keywords: Mosaic icon, documentation, Byzantine, radiography, RTI

Introduction

The mosaic icon of '*Pammakaristos Mother of God*', ('the all-blessed Mother of God'), is emblematic of the Ecumenical Patriarchate of Constantinople and a ceremonial item of the Patriarchal Church of Saint George (Fig. 1). The Mother of God is portrayed in the iconographic type of the *Hodegetria,* holding the infant Christ in her left arm, and presenting him to the viewer with her right arm, a gesture that indicates the 'Savior of the World'. Christ, dressed in a brown-red tunic highlighted with gold streaks, with his face turned towards the Mother of God, makes the sign of blessing with his right hand, while in the left he holds a rolled-up scroll. Archangel Gabriel is skillfully portrayed, with minute tesserae, in a medallion in the upper right hand corner (Fig. 2).

Except for a major spiritual and ceremonial item, the icon is one of the finest examples of the Byzantine art. Some scholars date the icon to the 13th century (Gioles 1994) while others have proposed dates ranging from the 11th to the 14th century (Sotiriou 1933, Belting *et al.* 1978:10). It measures 92x62 cm and is made of minute glass, gold and stone tesserae, set on a wooden panel with a wax-mastic paste, a rather rare technique that is met in Byzantine art of the Middle and Late eras. The icon has suffered severe deterioration caused by biological agents and mechanical stresses related to the continuing worship practices. Extensive interventions were undertaken in 1933, which provided sufficient support at the time and allowed the safe litany and worship of the icon; yet, the interventions compromised its aesthetic value and authenticity.

Reflectance Transformation Imaging (RTI) and non-invasive diagnostic techniques such as radiography (X-Ray) and computerised tomography (CT-Scan) were employed in the study and docu-

Fig. 1. The mosaic icon of Pammakaristos, Ecumenical Patriarchate of Constantinople (photo by S. Chlouveraki, March 2015)

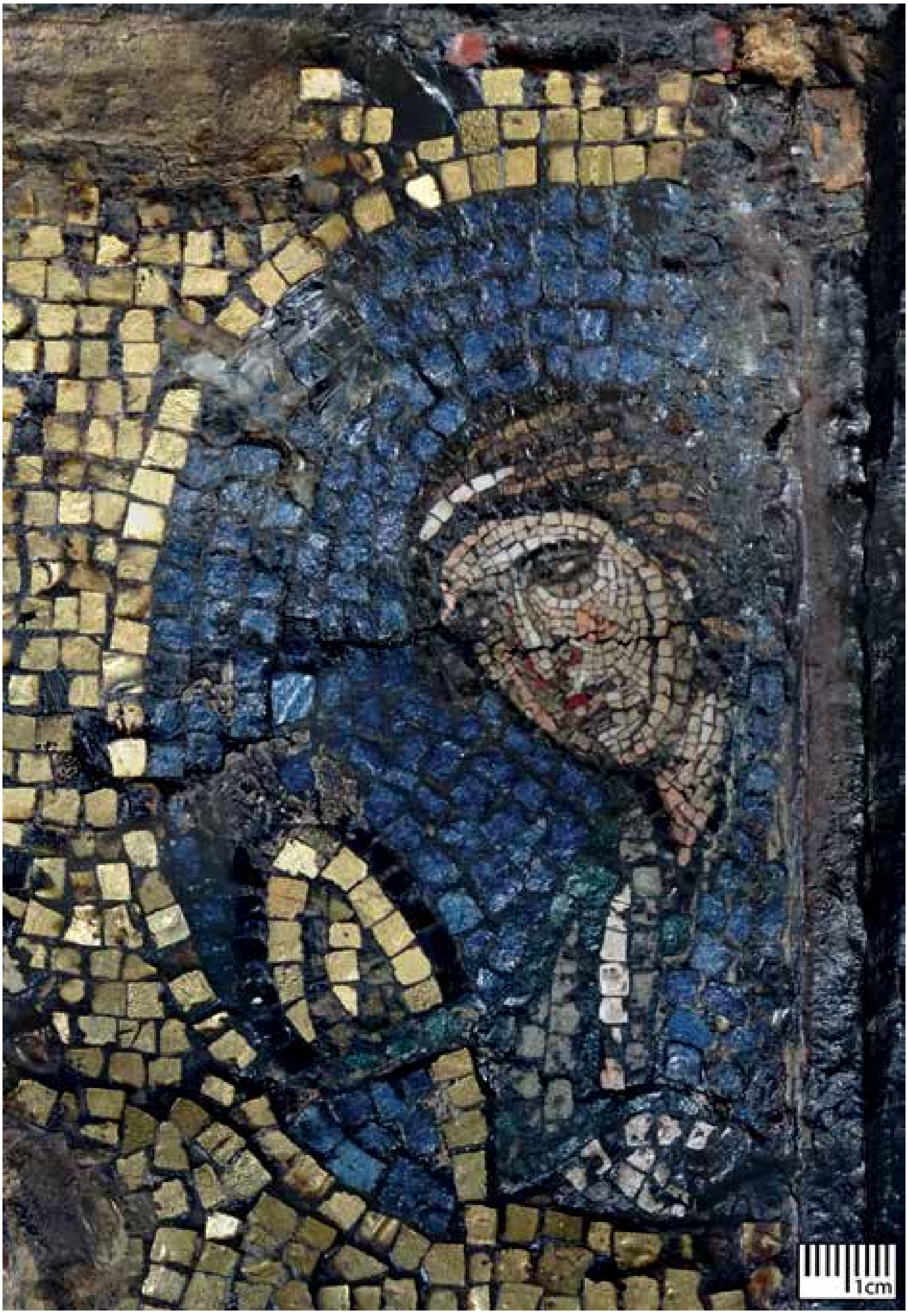

Fig. 2. Detail of Archangel Garbiel, made with minute tesserae (photo by S. Chlouveraki, March 2015)

mentation of the icon. Macroscopic observation combined with imaging techniques enabled a better understanding of the icon's condition and elucidated the conservation interventions and integrations that were undertaken in the past.

The mosaic icon of Pammakaristos in context

Mosaic icons became popular in the Middle and Late Byzantine Periods, however, only a few examples (around 50 of them) are preserved today, which date from the end of the 11th to the 14th century AD, and are commonly classified amongst the most magnificent examples of Byzantium's luxury arts. The Byzantine mosaic icons are divided in two groups: a) the portable 'kneeling icons' and b) the mosaic miniatures (Chatzidakis 1974, Demus 1991, cited in Evans and Wixom: 130, Efeenberger 2004: 209).

The first group consists of large to medium size icons ranging from 30 to 120 cm in height, which were intended as movable "kneeling icons", placed in stands (*proskynetaria*) or at the iconostases in churches and monasteries and were often used in litanies. Only eleven icons of this type are known today. The technique was similar to that employed in the wall mosaics, except that the tesserae were set on a wooden panel with a paste of wax and mixed with natural resins (usually mastic) and in a denser placement, as they were meant to be seen been from a close distance. The tesserae, ranging from 1 to 4 mm, were made of stone, glass and gold tesserae, and occasionally of semi-precious stones.

The second and largest group is the mosaic miniatures. This group consists of small icons, which rarely exceed 20 cm in height and were probably intended for private worship and only for the most intimate devotion. They were made of minute tesserae ranging from 0.5 to 1mm, and were set on wooden panel with a paste made of wax -resin, as the larger icons of the first group. Glass, gold, silver, gilded copper, glass and semi-precious stones were the most common materials used in the *tessellatum* (Efeenberger 2004: 209).

The great majority of the mosaic miniatures are dated to the Late Byzantine period, the so-called 'Paleologean Renaissance Art' (1204-1453) (Weyl-Carr 1997). There is no reference in the written sources about the origin of these icons, however, it is assumed that they were made in the court ateliers of Constantinople, which were responsible for the production of luxury items and that they would have been commissioned by members of the imperial family and the upper class. It is believed that some of these icons may were made in Thessaloniki, the Balkan Peninsula or Mount Athos. Mosaic icons were also in use in the Slavic countries and especially in Russia, before the fall of Byzantium, however their origin is not verified. The iconography includes Christ, the Virgin, saints, and, more rarely, scenes depicting the Twelve Feasts. Some of the most magnificent examples of the miniature mosaics are the diptych of the Opera Di Santa Maria Del Fiore, depicting the Twelve Feasts and the icon of the V&A in London, which depicts 'The Annunciation' (Efeenberger 2004: 209).

Two of the largest icons of the first group, are found at the Ecumenical Patriarchate of Constantinople; the icon of 'John the Baptist' (Sotiriou 1936) and the icon of 'Mother of God Pammakaristos' or 'All-blessed Mother of God' (hereafter referred to as Pammakaristos). It is believed that these icons were originally placed in the iconostasis of the Church of *Theotokos Pammakaristos*, present day Fethiye Mosque (Fethiye Camii), where the Orthodox Patriarchate was housed soon after the fall of the Byzantium, from 1455 until 1585, and that the Pammakaristos was the patron icon of the Church. The icon is a living monument that is considered miraculous (or miracle-working), it is worshiped, and takes part in specific ceremonies of the ecclesiastical year, hence, its conservation presents a real challenge.

Documentation and Condition Assessment

Examination, documentation and research are parallel processes aiming at a better understanding of the object and its condition before making a decision or taking action for its conservation. In addition to photography and mapping, documentation includes all the research that is deemed necessary in order to understand the properties of the constituent materials, the deterioration processes and the pathology of the object under treatment (i.e. bibliographic/archival research, examination with non-invasive diagnostic techniques, instrumental analysis, laboratory tests). Moreover, the historical context and the values associated with the object have to be identified and taken into consideration in the decision making process.

The examination of the icon was necessitated when a rainwater leakage was observed, in March 2015, at the window above the *proskynetarion,* (the stand), where the icon was kept. Although the front of the icon was protected with a glass frame, the *proskynetarion* was open to the wall, thus it could be affected by the increased level of humidity. The icon was removed from its stand and was transferred to a safe room within the Ecumenical Patriarchate, in order to examine and assess its condition.

Macroscopic examination revealed the severe problems of the *tessellatum* and raised several questions regarding the previous interventions, the condition of the wooden panel and the cohesion of the icon in its entirety. The icon's condition urged the application of more sophisticated methods of examination. Reflectance Transformation Imaging (RTI) was applied for the investigation and documentation of the surface relief, while Radiography (X-Ray) and Computerised Tomography (CT-Scan) were employed in the study of its inner structure.

The documentation of the icon comprised of four key axes: macroscopic examination, photographic documentation, bibliographic/archival research, and investigation with radiographic imaging techniques.

A. Macroscopic Examination

Macroscopic examination involved direct and magnified observation under natural and artificial light. The initial examination of the icon pointed out major structural problems such as bulges, depressions, cracks and the severe bio-deterioration of the panel. A surprisingly large number of nails were observed on the mosaic surface mainly around the hands. Thick layers of lacquer cover the entire surface resulting in the alteration of the chromatic quality of the mosaic.

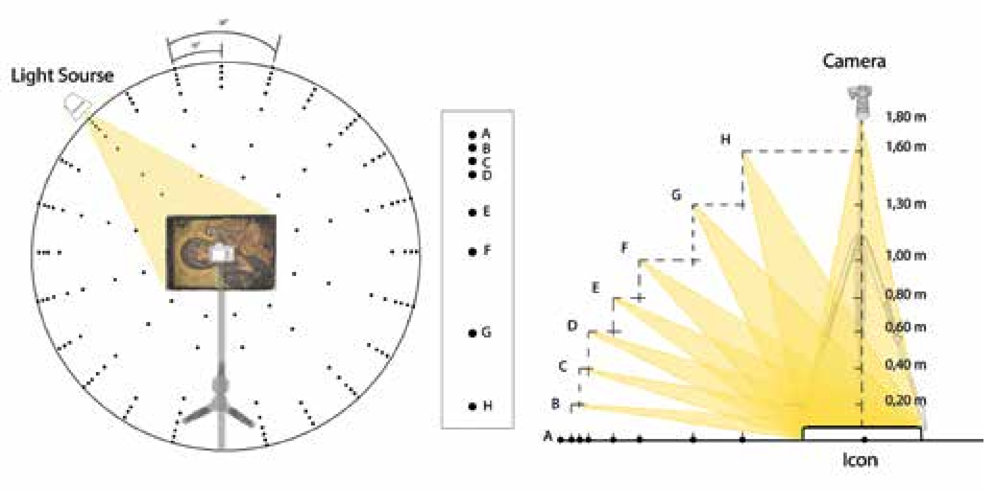

Fig. 3. RTI image capture and lighting positions (drawn by L. Vlachopoulou, 2016)

In addition, mechanical micro-tools, and mild solvents (ethanol and acetone 1:1 in deionised water) were used in order to investigate obscure areas of past interventions, especially the painted integrations, which seemed to cover original parts of the *tessellatum*. Gold tesserae were identified under the red painted outline, on the left side of the halo of the Mother of God, while on the right side original lines of red and gold tesserae were revealed under the inpainting. After closer examination, it was identified that painted integrations were overlaying the *tessellatum* around all the fills of the lacunae, the boundaries of which could not be distinguished visually.

B. Photographic Documentation - Reflectance Transformation Imaging (RTI)

Digital photography was applied for the documentation of the icon, (Nikon D5100, Nikkor 18-55 mm lens, f/3,5-5,6G-VR) under natural light. General views and details of the surface were captured in raw format. Additionally, raking light was used to detect and record the topography of the surface. In order to detect and capture all the details of the surface under various lighting angles, Reflectance Transformation Imaging (RTI) was tested. RTI is a photography-based imaging technique (Computational Photographic method), which captures the shape and colour of a surface under different lighting angles. It provides selective information extracted from sequences of standard digital photographs by computer algorithms. RTI images are captured from a stationary position, while light is projected from different directions, at a constant distance from the object. This process produces a sequence of images of the same frame with varying highlights and shadows. Lighting information is mathematically synthesised to generate a mathematical model of the surface, enabling the user to re-light the RTI image interactively and examine its surface on a computer screen. The images are processed and viewed in open-source software, constructed by a team of interna-

Fig. 4. RTI images of the icon, format: RGB PTM, Rendering Mode: Default (left) and Diffuse Grain (middle and right) (by S. Chlouveraki, L. Vlachopoulou, A. Tsoupra)

Fig. 5. Upper part of the icon, standard digital photo (left), and RTI images, RGB PTM, Rendering mode: Diffuse Grain (middle) and RTI PTM, Rendering mode: Specular Enhancement (by S. Chlouveraki, L. Vlachopoulou)

tional developers and is available through the website of Cultural Heritage Imaging (http://culturalheritageimaging.org/). The software permits the mathematical enhancement of the subject's surface shape and colour attributes and provides tools and functions, which improve the visual inspection and perception of the detail of the surface under examination (Mudge *et al.* 2008). The value of RTI in the documentation and investigation of cultural heritage has been demonstrated in recent projects amongst which is the study of the effect of light in the perception of the wall mosaics of the Church of Angeloktisti in Cyprus, a remarkable case study that motivated the author to test the technique (Zányi *et al.* 2007).

The RTI image of Pammakaristos was created from 207 photographs, captured with a Nikon D5100, Nikkor 18-55 mm lens, f/3,5-5, 6G-VR, from a height of

1,80 metres, with varying angles of the lighting source. The positions of the lighting source equal the number of the photographs and are indicated in (Fig. 3).
RTI was proved a powerful tool for investigating and recording the icon's surface in all its details and revealed information that could not be detected by standard visual examination (Fig. 4). Polynomial Texture Mapping (PTM), shading enhancement functions and the zoom factor were used in order to improve the perception of surface topography and to capture details, which best demonstrate the pathology of the icon. Surface deformations, structural damages, and the shape and texture of previous interventions were disclosed and systematically documented (Fig. 5).

C. Radiography: X-ray Imaging and Computed Tomography

Radiographic techniques were deemed necessary in order to investigate the inner structure of the icon, to assess the condition of the panel and to distinguish and document the interventions. X-Ray imaging is rarely applied in the examination of mosaics, however the example of the British Museum collection of the turquoise mosaics from Mexico has demonstrated the range of information that can be acquired and the potential of the employment of radiography in the study of Pammakaristos (Lang *et al.* 2005: 41, McEwan *et al.* 2006).
The radiographic examination required the removal of a copper sheet, that was added at the back of the icon as reinforcement, and the transfer of the icon out of the premises of the Ecumenical Patriarchate, for the first time after the establishment of its current headquarters in 1586. The decision involved an extensive discussion with the stakeholders, where adequate justification of the potential of the radiographic techniques was presented. Standard and enhanced RTI images were particularly useful in communicating the problems and demonstrating the necessity of further investigation. Following the approval of the proposed procedure, the copper sheet was removed, thus enabling the observation of all the sides of the icon. A curved socket exists at the lower-middle part of the icon, which indicates that the icon was indented for processions (litanies), and explains the loss of the *tessellatum* in this area, which was subjected to increased mechanical stresses. It was also identified that a second panel, consisting of two vertical boards, had been added to the back of the icon, presumably as reinforcement. Finally, a crack was observed at the top of the icon, which seemed to penetrate its entire thickness.

Digital Radiography

In April 2015, the icon was transferred to the Balikli Greek Hospital to be examined with radiographic techniques. The resulting X-ray image of the icon comprises of fifteen digital radiographs, which were provided in DICOM format, 17.5 MB each, and viewed in Canon CXDI Light Viewer Version 1.0.0.06. A low tube voltage setting of 60 kV and 3 mA tube current was recommended to the operator, based on the published examples of the British Museum Mexican masks, which consist of similar materials (Lang *et al.* 2005: 41). After a series of tests the operation conditions were adjusted: the energy ranged from 55 to 60 kV, the X-ray tube current from 0,2 to 0,63 mA, and the exposure time from 20 secs to 3 mins. Exposure time was significantly lower at

Fig. 6. X-Ray image of the icon, 15 sections merged and enhanced in Photoshop, Energy 55-60kV, Tube Current 0,2-0,63mA, Exposure Time: 20sec-3mins

Fig. 7. Upper part of the icon: Digital photograph (left) and R-Ray image (right). Original setting of tesserae in the background (red arrows), remains of the tessellated halo (green arrows), relaid tesserae at the neck of Christ (blue arrow)

Fig. 8. Lower right part of the icon: Detail of the hand of Mother of God. Digital photo (left) and X-Ray image (right). Distribution of lacunae, fills and nails around the hand. Misaligned fragments indicated by red arrow, integration at the feet of Christ indicated by green arrow

the original parts of the icon, while longer exposure and higher energy was required for the interventions. The distance between the X-ray source and the icon was kept constant at 1,077 m. The digital radiographs were enhanced using the Gamma Correction option in the CXDI Light Viewer and were exported in Portable Document Format (PDF). They were merged and further processed in Photoshop to improve the visibility of various details of interest. Adjustment of levels, brightness, contrast and enhancement of edges were applied (Fig. 6).

X-ray imaging provided a fascinating insight into the inner structure of the icon and clarified the losses and past interventions. The radiographs demonstrate that the background has been re-laid in a random tesserae setting, except for a small part at the upper right-hand corner, which preserves the original setting of the gold tesserae in horizontal lines (Fig. 7). Original parts of the *tessellatum* were detected under the plaster fills and the painted integrations in the halo of the Mother of God (Fig. 7). Misaligned fragments were observed on her left hand (Fig. 8), while the tesserae at the neck of Christ have been randomly re-laid (Fig. 7).

The number of nails that were detected in the radiographs was extraordinary. The great majority of them are concentrated at the halos, the perimeter of the hands and the background. Lacunae and integrations are also distributed around the hands, the halos and at the lower-middle part of the icon. Vertical lines, which run the entire length of the icon, indicated the join of the second panel, which was observed macroscopically, and indicated that the main panel may also consist of two boards. Additional lines, almost parallel to these joints were observed in the radiographs, suggest cracks, which propagate parallel to the wood grain.

Computed Tomography (CT)

Standard Radiographic images provided information from the entire structure of the objects, projected in a 2-D image. In order to obtain spatial information with respect to the third dimension (depth) Computed Tomography was employed (Lang *et al.* 2005: 37, Re *et al.* 2015).

The tomographic system that was used for the examination of the icon presented some limitations. Due to the size of the instrument's chamber, the icon was marginally fitted in the cabinet, however the scan did not cover it in its entirety. Another issue was the number and thickness of the axial slices that could be provided. Sixty axial slices were acquired which were projected as transversal sections. The tomography provided information on the spatial distribution of the metallic elements with respect to depth. Yet, due to the limited coverage, it did not verify all the elements that were detected in the radiographs. The scans confirmed that both panels (the original and the second support) consist of two boards, which are still held together, while the vertical crack that was observed on the surface penetrates the entire thickness of the left board of the original panel, at a distance less than 2 cm from the join line (Fig. 9). Hence, this first attempt did not provide all the information that is required in order to understand and document the exact location and function of all the metallic elements, but has revealed the major and most threatening conditions. The potentiality of the technique has been proven, yet, further research and interdisciplinary collaboration is required in order to determine (a) the required specifications of the tomographic system (b) the conditions of image acquisition for achieving optimal results and c) the work-flow for generating a 3-D model of the inner structure of the icon.

D. Bibliographic Research

Research in the literature provided some insights in scholars' the perception and interpretation of the icon from the beginning of the 20th century. Sotiriou (1933) reported the condition of the icon and the conservation interventions that were un-

Fig. 9. Computed Tomography: Joins of the panels (left section, green arrows), crack line (right section, red arrow) and nails (right section, blue arrow)

dertaken by the artist K. Vasmatzidis in 1933. Images of the icon were published in 1915 and 1933 (Kondakov 1915: 200, Sotiriou 1933: 359), which provide clues about the condition of the icon at the time (Fig. 10). Silver-plated revetments were already in place, in 1915, covering the halos, the hands of both figures and the body of the Christ. This explains the concentration of nails and lacunae around the hands and the severe damages in the halos. The dark appearance of the faces suggests oxidation of varnishes that made the icon practically illegible.

According to Sotiriou (1933), its artistic value was not appreciated until major conservation interventions were undertaken in 1933. Vasmatzidis removed the revetment, stabilised the icon, re-laid loose tesserae, filled the lacunae with cement and/or plaster of Paris and integrated the losses with inpainting. Sotiriou, further reports that the halos were severely damaged and that the existing remains indicated that were probably made in the stucco technique. Details on the techniques and materials used for stabilisation are not mentioned in the text.

In 1994 the Byzantinologist N. Gioles considered the random placement of the tesserae at the background as an important characteristic that differentiates the technique and the style of Pammakaristos from the icon of the Baptist. Furthermore, he suggested that the stucco halos provide strong evidence for dating the icon to the 13th century, as opposed to the 11th that is suggested by other scholars (Gioles 1994). The results of the current investigation provide new data, which may contribute to the interpretation and dating of the icon. It has been shown that the original halos were tessellated and that the gold tesserae of the background were set in parallel lines, however these characteristics do not necessarily obliterate the aforementioned arguments, which are based on multiple criteria. Radiocarbon dating

Fig. 10. Images of the icon of Pammakaristos as illustrated in the publications of Kondakov, 1915, pp. 220 (left) and Sotiriou 1933, pp. 359 (middle, before conservation and on the right, after Vasmatzidis' interventions)

of the wooden panel and the wax-mastic medium may clarify the date, yet the icon needs to be revisited by scholars, taking into account the new data.

Conclusions

Macroscopic examination, combined with non-invasive diagnostic techniques has revealed striking information on the current condition of the mosaic icon, the past interventions, the style and the execution techniques and has allowed for a better understanding of the deterioration processes. The results pointed out the severity of the mechanical damages and raised awareness on the vulnerability of the icon and the risks involved in its handling. Besides, radiography demonstrated the misconceptions on the techniques and the style, which have dramatically changed our view and understanding of the icon, and has provided new evidence on the debate of dating. Computed Tomography has proved a valuable tool for investigating and capturing the inner structure, however it requires exploiting the expertise of other disciplines in order to obtain optimal results. RTI does not require high expertise or specialised equipment and is particularly efficient in documenting and communicating information. Bibliographic research provided limited, yet helpful information, about the handling and treatment of the icon in the past and the factors, which have affected its current condition.

The methodology and the outcome of this study cannot be discussed exhaustively in the present publication. Nevertheless, the critical role of documentation and the contribution of non-invasive diagnostic techniques in conservation have been demonstrated. Documentation lays the groundwork for a successful conservation program, regardless the nature of the object under treatment, hence conservators owe to seek cross-disciplinary collaboration in order to take advantage of edge-cutting technology and to exploit all the expertise that are available in other disciplines.

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References

Belting H., Mango C. A., and Mouriki D. 1978. *The mosaics and frescoes of St. Mary Pammakaristos (Fethiye Camii) at Istanbul.* Washington: Dumbarton Oaks Center for Byzantine Studies.

Chatzidakis M. 1974. The Mosaic Icon of Christ in Lavra, (in Greek) Χατζηδάκης Μ. 1974. Ψηφιδωτή εικόνα του Χριστού στη Λαύρα, Δελτίον ΧΑΕ 7 (1973-1974), Περίοδος Δ›, σελ. 149-157.

Demus O. 1991. *Die Byzantinischen Mosaikikonen: I. Die Grossforgatigen Ikonen.* Wien: Verlag der Österreichischen Akademie der Wissenschaften.

Effenberger A. 2004. "Images of Personal Devotion: Miniature Mosaics and Steatite Icons". In *Byzantium, Faith and Power (1261-1557),* edited by Helen C. Evans, 209-214. New York: The Metropolitan Museum of Art.

Gkioles N. 1994. The mosaic icons of the Ecumenical Patriarchate and their Donors (in Greek). Γκιολές Ν. 1994. Οι ψηφιδωτές εικόνες του Οικουμενικού Πατριαρχείου και οι αναθέτες τους, Δελτίον της Χριστιανικής Αρχαιολογικής Εταιρίας ΧΑΕ 17 (1993-1994), Περίοδος Δ', σελ. 249-258.

Kondakov N. P. 1915. Iconography of the Mother of God (Volume 2). St. Petersburg (in Russian). Н. П. Кондаков. 1915. Иконография Богоматери (Том 2). Санкт-Петербурге.

Lang J., Middleton A., Ambers J., and Higgins T. 2005. "Radiographic Images". In *Radiography of Cultural Material*, (2nd edition), edited by Janet Lang and Andrew Middleton, A., 20-48. Oxford: Elsevier Butterworth-Heinemann.

Mudge M., Malzbender T., Chalmers A., Scopigno R., Davis J., Wang O., Gunawardane P., Ashley M., Doerr M., Proenca A., Barbosa J. 2008. "Image-Based Empirical Information Acquisition, Scientific Reliability, and Long-Term Digital Preservation for the Natural Sciences and Cultural Heritage". *EUROGRAPHICS 2008 –Tutorials*, edited by in Maria Roussou and Jason Leigh. The Eurographics Association. DOI: 10.2312/egt.20081050.

McEwan C., Middleton A., Cartwright C., Stacey R. 2006. *Turquoise Mosaics from Mexico*. London: British Museum Press.

Re A., Corsi J., Demmelbauer M., Martini M., Mila G., and Ricci C. 2015. "X-ray tomography of a soil block: a useful tool for the restoration of archaeological finds". *Heritage Science*, *3*:4. https://doi.org/10.1186/s40494-015-0033-6

Sotiriou Y. 1933. The Icon of Pammakaristos (in Greek). Σωτηρίου Γ. 1933. "Ἡ εἰκών τῆς Παμμακαρίστου". Πρακτικά της Ακαδημίας Αθηνών, (ΠΑΑ) 8, Αθήνα, Ακαδημία Αθηνών. 359-368.

Sotiriou Y. 1936. The mosaic icons of Constantinople (in Greek), Σωτηρίου Γ. 1936. "Ψηφιδωταί εικόνες της Κωνσταντινουπόλεως". Πρακτικά της Ακαδημίας Αθηνών, (ΠΑΑ) 11, Αθήνα, Ακαδημία Αθηνών. 70-81.

Vlachopoulou L. 2017. "The mosaic icon of Pammakaristos: a proposal for the documentation, conservation and restoration". BSc *Dissertation*, Department of Conservation of Antiquities and Works of Art, Athens University of Applied Sciences (TEI of Athens).

Weyl-Carr, A., 1997. "Popular Imagery". In *The Glory of Byzantium; Art and Culture in the Middle Byzantine Era, A.D. 843-1261*, edited by Helen C. Evans and William D. Wixom, 113-117. New York: The Metropolitan Museum of Art.

Zányi E., Schroer C., Mudge M., Chalmers A. 2007. "Lighting and byzantine glass tesserae". In *EVA London Conference*, 11–13 July 2007. 22.1-22.8, Accessed on 20 September 2017.

http://culturalheritageimaging.org/What_We_Do/Publications/eva2007/EVA_2007.pdf

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SPECIAL SESSION: THE SANTA CREU I SANT PAU HOSPITAL'S MOSAICS

Kusi Colonna-Preti
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THE FIGURATIVE MOSAIC FRIEZE OF THE ADMINISTRATION BUILDING OF THE HOSPITAL DE LA SANTA CREU I SANT PAU, BARCELONA: INSIGHTS INTO THE ORIGINAL TECHNIQUE FOR NEW APPROACHES TO CONSERVATION-RESTORATION

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Abstract

The team responsible for conservation-restoration of the modernist mosaic frieze of the Administration Building of the Hospital de la Santa Creu i Sant Pau conducted in-depth research into the artists responsible for the work and the original mosaic production techniques and materials, drawing on historical and photographic archives, on-site observation and scientific analyses. The insights gained from this process contributed substantially to the conservation-restoration approaches and methods. The experience demonstrates the necessity of in-depth study in planning the intervention.
Keywords: Mosaics, manufacturing technique, Modernism, Maragliano, Barcelona

The early-20th century construction of the Hospital de la Santa Creu i Sant Pau

The Hospital de la Santa Creu i Sant Pau, built in the early years of the 20th century, represented a merger of the older Hospital de la Santa Creu, founded in 1401, and the new Hospital de Sant Pau. The Catalan banker, Pau Gil i Serra (1816-1896) (Fig.1), having observed the flaws in hospitals and healthcare in the late 19th century, left a legacy for the purposes of building the new Sant Pau facilities. These were to incorporate most recent scientific advances in terms of hygiene and sanitary conditions (Figueras 2001: 126). The architect Lluís Domènech i Montaner (1850–1923) was commissioned for the creation of the new facilities, also intended to improve the well-being of the patients by the creation of an ornamentally and architecturally innovative system of isolated pavilions, surrounded by gardens. The first 12 of the eventual 48 pavilions were built between 1902 and 1911, at which point Pau Gil's legacy was exhausted. The remainder of the pavilions were built by Lluís' son, Pere Domènech i Roure, but did not follow the design of the original project and were assigned to the Hospital de la Santa Creu, due to the financial difficulties of the new hospital (Bohigas 2000: 89).

The narrative frieze of the Administration Pavilion

The Administration Pavilion is composed of three volumes, each of three stories, on which the ornamentation play a very important role. Over the brick canvas, Domènech worked in the elements of colour, texture and light, using stone, ceramic, mosaics and stained glass. The Pavilion provides a display welcoming the visitor to the complex, and it is on the exterior and interior of this structure that the mosaics are present, more than all the others of the precinct (Bancells 1988: 43). The

Fig. 1. The Administration pavilion under construction, 1902-1912. The first mosaic panel can be seen already installed (photo Arxiu Fotogràfic Centre Excursionista de Catalunya)

mosaic frieze of the comprises a group of 16 large panels (each 2.6 m high by 3 to 5 m wide), on the first floor of the pavilion façades. The frieze is organised in two bands (Fig. 2): an upper zone depicting the history of the institution in chronological order, and a much narrower lower band with inscriptions referring to the events depicted, in blue letters on a light green background.

The creators of the frieze

Based on research into the construction contracts maintained in the Historical Archive of Sant Pau, we are able to provide significant detail on the figures most important in the creation of the frieze.

Lluís Domènech i Montaner, commissioned for the construction of the hospital under the terms of Paul Gil's legacy, espoused a global vision of architecture, interweaving structure with ornamentation. In his conception, construction should be a matter of collective workmanship, in which collaboration between architects, artists and craftsmen would result in the exchange of skills and enrichment of knowledge (Sala 1990: 259). The architect assembled a group of craftsmen who would spend the large part of their days on the site, in a manner intended to facilitate the work. The intention was that these would engage as a community, and the results of this approach are clearly evident in harmonic results of the architecture and ornamentation (Bohigas 2000: 89).

Fig. 2. Two of the panels of the Administration Pavilion frieze (photo Àbac Conservació i Restauració SL)

The first artist to appear in the contractual documents, on 23 March 1906, is Mario Maragliano (1864–1944), a member of a Genoese family of mosaicists who had been established in Barcelona since 1884. The contract is for execution of the frieze mosaics, to be compensated by payment of 13,802 pesetas (García-Martín 1990: 120). The last contract naming this individual is dated 16 June 1911, and by this time his total of payments had reached 30,582.20 pesetas. This means that during the works in progress the amount of commissions had likely increased. In fact Maragliano would go on to lead the execution of all of the mosaics of the frieze, and from the records on the numbers and dimension of the panels we can deduce that the first of these was executed in June 1908 and the last on May 1911.

The second artist to appear in the contracts, on 28 December 1907, is the draftsman and painter Francesc Labarta i Planas (1883-1963), author of the designs for the figurative scenes of the frieze. He also prepared the drawings for the mosaic panels of Sant Jordi and Sant Martí of the Administration Pavilion, those of the Santa Apol·lònia and Sant Jordi pavilions, and those for the Surgery Pavilion (Sant Pau Historic Archive, Hospital de Sant Pau Obres, certifications 308, 327, 533, 545). Labarta received his first payment in April of 1908, and the last one in February of 1910. For each of the 16 drawings he received 250 pesetas (Historical Archive of Sant Pau, Hospital de Sant Pau Obres, certifications 227, 443).

According to Serraclara and Martí (2009: 56), the scenes depicted by Labarta were in a 1:5 scale. The same authors report that they were transferred to the walls in full scale with the help of a grid, and coloured so that Mario Maragliano could develop them as mosaics. To facilitate the work, Labarta also promised to paint the faces and other body parts in full scale.
The draftsman and heraldry artist Alfonso Vicente (1886-unknown) was commissioned to design the lower part of the frieze with the legends narrating the historical events, seen in the figurative scenes (Serraclara and Martí 2009: 56). He worked from July to December 1908, charging a total of 706.25 pesetas based on the actual hours worked (Historical Archive of Sant Pau, Hospital de Sant Pau Obres, certifications 260, 270, 279, 288, 299).
From the entirety of the documentation we can understand that the figurative and text bands of the frieze would have been executed between April 1908, when Labarta received payment for his first drawings, and May 1911 when Maragliano received the last payment for his work. The three artists would not always have been present on the worksite together, however the project is the result of one unified creative period.

Technical aspects

Materials used

The publicity issued by the mosaicists of the period describes the work of Mario Maragliano as combining both "ceramic mosaic" and "Venetian mosaic" techniques (Fig. 3). The former technique involved the use of ceramic tesserae in regular shapes, manufactured for the purpose or cut from glazed ceramic tiles. Such "enamelled" ceramic products were not new, however it was during the Modernist era that they were first used in the production of mosaics (Saliné 2007: 227-228). Given the porosity of the ceramic material and its relative softness compared to stone, it was considered to be suitable primarily for wall mosaics (Subias 2003: 274).
The technique of "Venetian mosaic" refers to the use of opaque glass tesserae. In the Administration Building frieze there are primarily square, with 1cm sides, although some of 2.5 cm dimension have been found, as well as some rectangular ones of 1 cm by 1.5 to 1.7 cm. In the early 20th century, such glass tesserae were imported from Italy (Saliné 2005: 72), where they were cut from glass roundels (*piastre*) or prepared from glass sheets to the desired measures (Bertelli 2011: 111-115). During the works some rounded-edged pink tesserae were found, of about 0.5 cm thickness. The curvature of the edge of the tesserae showed that it was cut from a roundel of diameter between 15 to 20 cm.
Our estimations are that 95% of the frieze tesserae are ceramic and the remaining 5% are glass. This combination of materials provided bright colours in a very rich chromatic range, achieving dazzling effects at reduced expenses compared to what would have been possible using glass alone. The more costly glass tesserae were used exclusively for skin tones, some garments, and a few landscape elements; the highest frequency of use was on the panels of the front facades, developing striking effects in the most visible areas.
The conservation team also examined samples of the different preparatory layers of mortar in detailed photography and

Fig. 3. Panel composed of glass and enamelled ceramic tesserae (photo Àbac Conservació i Restauració SL)

Fig. 4. Photograph of F. Labarta's preparatory drawings for the narrative frieze of the Administration Pavilion. Two different drawing formats can be identified. (images from Fons Labart, Biblioteca Nacional de Catalunya)

by visual examination under stereomicroscope, for purposes of further defining the materials and methods used by Maragliano. A representative fragment of each sample was also chosen for observation and analysis by scanning electron microscopy with energy dispersive spectroscopy (Merino *et al*. 2010; Vendrell *et al*. 2010). Three types of mortar were discerned. The first of these is a lime-based foundation mortar applied to the brick wall, in which the relatively few aggregates are mainly siliceous, with some traces of clay.

The second layer is that for insertion of the tesserae. The composition is similar to that of the first layer, but using aggregates of smaller particle size, and with the addition of vegetal fibres. In particular, these were found to include the previously unidentified element of esparto grass, used to improve the mortar's structure and hardness and to reduce the risks of shrinkage and cracking during the drying process.

The last mortar was that used to fill the tesserae interstices and other joints. This was again a lime-based mortar, with siliceous aggregates of a white colour, although there was also an uneven distribution of traces of reddish "patina". From analysis it was determined that, depending on the effect desired for specific areas of the mosaic, the colour had been achieved by mixing the lime-based plaster with clays rich in iron oxides, and by addition of organic components, and then applying this over the mortar surface of the tesserae interstices and joints. This last mortar can also be found in the joints and interstices of the sculptural elements of the facades. The purpose appears to have been to even the surface at the joints between the different mosaic panels, and to attain a more harmonic appearance across the many decorative elements of the facades. This last surface mortar is applied between all the ceramic tesserae, however with the exception of a few panels, it was not found between the glass tesserae.

Mosaic techniques used on the frieze

The National Library of Catalonia holds black and white photographs of Labarta's preparatory drawings, exceptionally useful in understanding the techniques of the mosaic frieze. The photographs illustrate two types of drawings: the easel preparatory drawing in smaller format and the full-scale drawings applied over a wall (Fig. 4). The grid used with the two different drawings allowed an accurate transfer to the larger scale. The lack of colour prevents definitive conclusions, however the full-scale drawings appear to be executed in charcoal and then have colour applied, since in one photograph we can make out what appears to be an artist's assistant wielding brushes and a palette.

In spite of some small changes between the smaller drawings and the mosaics, the mosaicist obtained an impressive degree of precision in transferring the original drawing to the final composition of tesserae (Fig. 5). From observations made during our own conservation-restoration work we can confirm that Maragliano mainly used the indirect mosaic method for execution of the frieze panels, likely because of its advantages in terms of ease of composition and speed of application. The method consists in preparing the layout of the tessera in the studio, working from the reverse, meaning laying them upside down over the design (generally on paper), and then applying a layer of setting mortar. These assemblies would later to be transported to the construction site for final placement on the facades. Here, the panels would be applied to the fresh foundation mortar and the paper removed from the surfaces.

Some elements supporting these assertions are the observations of differences in level along straight lines, seen over the mosaic surface under conditions of raking light. The junction of the many smaller panels is also revealed by the occasion of wider joints between the tesserae where these were mounted on the façade. The panels take a variety of forms and dimensions, tending to trace the lines of the drawings. In one example we observed an area on the rear facade measuring 5.43 m wide by 2.74 m high, in which the frieze had been formed from about 100 individual panels. Another important technical observation is that the ceramic tesserae are enamelled on both the front and back sides (Fig. 6). The SEM-EDS analyses conducted by Vendrell *et al.* (2011) indicate that the white fabric of these tesserae is rich in calcium (CaO) and was prepared using clay with no iron content. The enamel glaze consists of silica with lead (PbO) flux, tin oxide (SnO2) as the opaquing agent, and other elements as colorants. There are no significant difference in glazes between front and back sides of the tesserae.

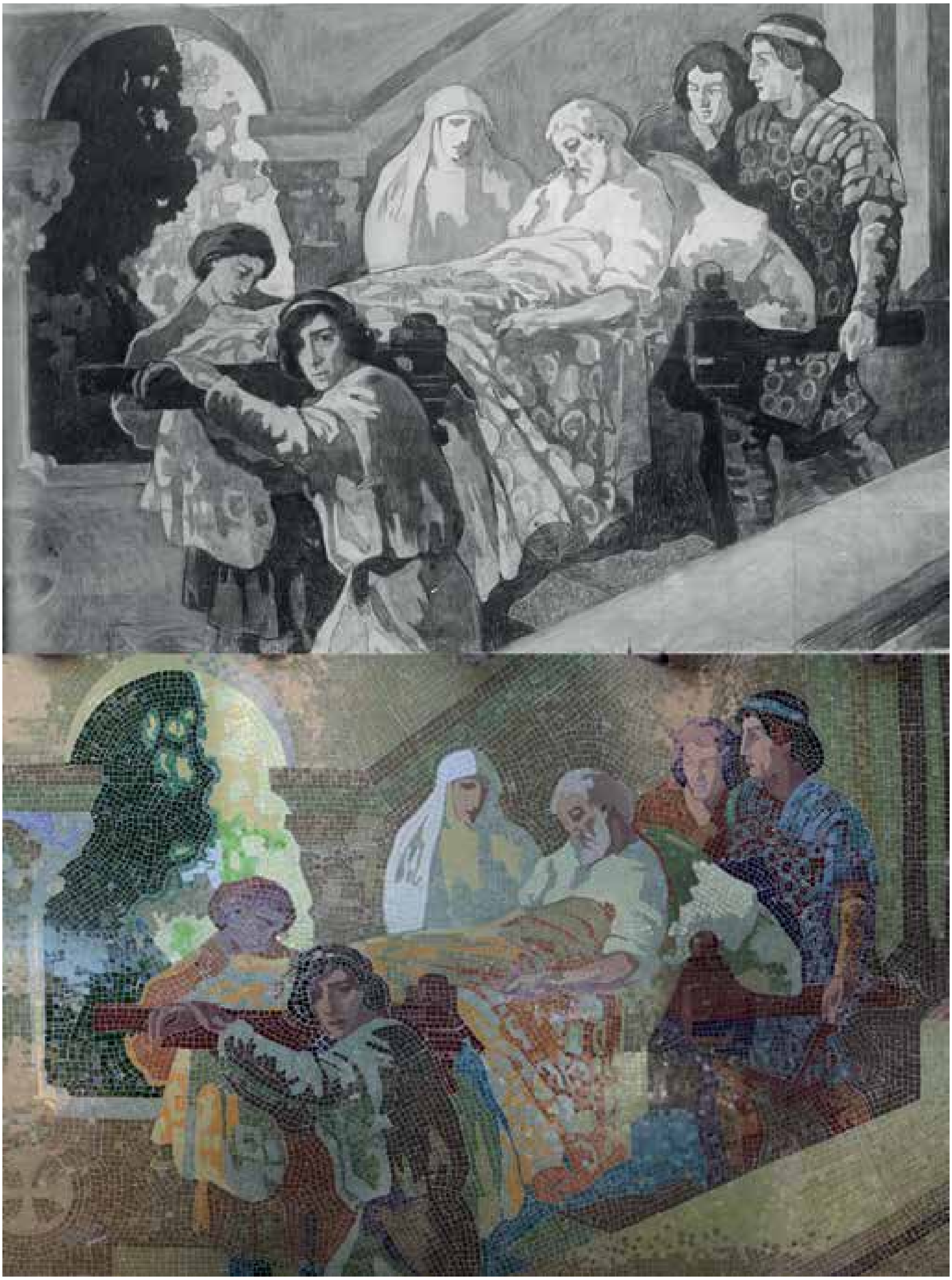

Fig. 5. Comparison between F. Labarta's preparatory drawing and the mosaic, as executed by M. Maragliano (image from Fons Labarta, Biblioteca Nacional de Catalunya; photo Àbac Conservació i Restauració SL)

Fig. 6. Mosaic fragment seen from the rear showing enamel glaze on the reverse of the tesserae (photo Àbac Conservació i Restauració SL)

This particularity would have allowed the mosaicist to see the colour of the tesserae from their back sides, as these were applied over the paper drawings in the studio. This does not happen in the case of glass and stone tesserae, as the colour can can be seen from all sides.

However there appear to have been some exceptions where the direct mosaic technique was used, revealed by the irregularity of the surfaces. These occur in particular near the stone rosettes and some other places presenting more difficult access, where it would have been easier to leave space next to the panels and insert the last tesserae into fresh mortar.

Conservation-restoration

Condition and previous interventions

The conservation status of the mosaic was highly variable. The surface alterations were entirely due to environmental exposure. These effects including covering of all the panels with soil, and the presence of black aureoles deriving from particulate atmospheric pollution. The presence of biodeterioration was limited to scattered insect nests and algae in some humid locations.

Structural deterioration had been mainly caused by movements of the building, related to subsoil events and interior renovations. The severe deterioration observed on a few panels had derived from damage to a water-piping system. The penetration of the water had caused detachment between the different mortar layers, resulting in bulging deformations as well as some accumulations of salt efflorescence.

Two significant areas of loss concerned the faces of some of the personages. In one of these areas, on the façade facing Sant Antoni Maria Claret street, the losses outline the shape of the face. Although there is no record of a previous intervention in that area, there is no doubt that this particular loss is due to human causes.

In 1990 the hospital developed a collaborative project with a workshop school of the Labyrinth Park of Horta for conservation treatment on the mosaics. A large fill was identified on the façade on Cartagena Street made with reused original tesserae and others newly cut over a cement layer and an applied cement-based fluid layer over the surface between the tesserae interstices.

Some of the ultramarine glass tesserae were suffering from surface flaking. These, analysed in SEM-EDS, showed a glass composition of silica, lead and copper (the colorant element), as well as other compounds as aluminium, calcium, and potassium. The detached glass flakes no longer contained lead, since this is the component most prone to leaching in the case of contact with water circulating over the surface (Vendrell *et al.* 2010).

Intervention

The interventions on the mosaic panels began with mechanical removal (Fig. 7) of the accumulated surface dirt deposits, followed by steam cleaning. The mechanical cleaning of the adhered surface dirt and black aureoles required application of localised pressure using brushes of various hardness, as well as steel wool. This method was first tested under stereomicroscope examination, verifying that the surfaces of the tesserae would not be scratched or in other way damaged (Giráldez *et al.* 2009).

The disaggregated joint mortars were mechanically removed using scalpels, and the cement mortars applied in previous restorations were also removed from the interstices. The large fill intervention carried out by the Horta Labyrinth Workshop School was left intact, with only the mortar of the interstices being removed.

Fig. 7. Mechanical cleaning (photo Àbac Conservació i Restauració SL)

A test was conducted using lasers [1] on the Sant Antoni Maria Claret Street façade, for removal of the black aureoles and surface deposits. The results were mixed. The cleaning of the green ceramic tesserae and joint mortars achieved rapid and uniform results. On the other hand the tests on the pink ceramic tesserae resulted in alteration of the colour to a yellowish tone. Given this and other considerations, laser cleaning was not adopted as a general technique, however it certainly represents an interesting approach deserving further experimentation in other contexts.

A lime based mortar [2] was used for consolidation of detached preparatory layers and resetting of loose and detached tesserae. Where the enamel glazes required consolidation this was accomplished using a fluoroelastomer and acrylic polymer based adhesive (®Fluoline A), applied by brush. Where the loss of enamel glaze had already exceeded 50 percent of the tesserae surface, it was agreed with the Hospital's Project Management that the treatment would be to remove the tesserae, turn them upside down and relocate them in their original positions using the consolidation mortar (Fig. 8), thereby avoiding the need for

Fig. 8. Left: tesserae with enamel loss. Right: the same tesserae turned upside down (photo Àbac Conservació i Restauració SL)

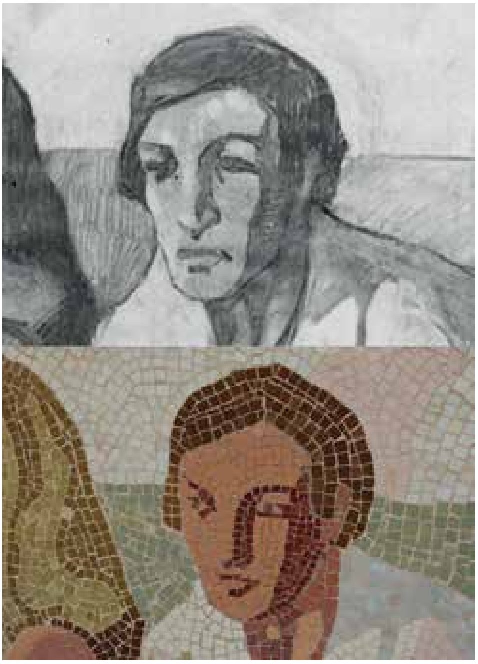

Fig. 9. Comparison between the preparatory drawing by F. Labarta and the reintegration of the current project (image from Fons Labarta, Biblioteca Nacional de Catalunya; photo Àbac Conservació i Restauració SL)

Fig. 10. Detachment of the bulged area (photo Àbac Conservació i Restauració SL)

chromatic reintegration (Fig. 6). Where there was loss lower than fifty percent the tesserae were chromatically integrated using acrylic paint, protected with a glossy UV-resistant varnish (®Golden Acrylic and ® Golden Hard ®MSA Gloss Varnish, with

ultra-violet light stabilisers). Small losses were integrated using new ceramic and glass tesserae, with the date of the intervention indicated in pencil on the of the reverse of the ceramic tesserae and etched by micro-tool on the reverse of the glass ones.
For the two large areas of loss in the areas of the personage faces, the main project managers instructed that new glass tesserae be used for reintegration, providing uniform overall legibility of the work. The "indirect method" was used for this restoration: the area of loss was copied by tracing, and the new tesserae were applied to the paper bearing the traced design. The new were engraved on the reverse side indicating the date of intervention. Next, two layers of mortar [3] were applied and further reinforced with fibreglass. This assembled panel was set in the location of the loss. The reintegration of the loss to the face of the personage Sant Antoni Maria Claret façade was carried out under a tight schedule; unfortunately it was only after this work was completed that we were able to retrace the archival photograph of Labarta's preparatory drawings, showing the missing face (Fig. 9).
Treatment of a large bulge in the mosaics of rear façade required detachment of the area in question. The outline of the area to be removed was traced, recording the positions of all the tesserae involved, so as to facilitate the reattachment. The area was detached in two sections. The bordering tesserae were removed and holes were created through the mortars. The process was carried out by inserting chisels into the already created holes to remove the bulged area divided in two fragments (Fig.10). The degraded preparatory layers were cleaned out and the reverse of the removed sections was also cleaned, prior to application of new support mortar, reinforced with fibreglass mesh. The same mortar was then used to reattach the fragments to the wall. Localised pressure was applied, using bracing, until the mortar set. The surrounding tesserae were then relocated in their original places.
Finally, most of the mosaic surfaces were treated with new joint mortar, for purposes of consolidation, sealing of cracks, and to restore the original continuity and legibility. Different compositions of this final mortar were used depending on whether the tesserae were ceramic or glass, and no mortars were used where the glass tesserae had originally been installed without such material [4].

Conclusions

The conservation-restoration works for this very extensive group of mosaics required a total of four years (Llobet *et al.* 2015: 5-26). The works were preceded by in-depth study and complete, accurate documentation, and the interventions were specifically designed in consideration of the original techniques of execution and specificities of the mosaics. The research into written and photographic archival sources, scientific analyses and rigorous on site observations permitted full understanding of the basic aspects of the techniques used by Mario Maragliano. This knowledge had immense impact on our approach to the conservation process. This work again illustrates the essential importance of thorough preparatory research using historical documentation and scientific analysis, for achievement of more respectful and accurate conservation-restoration of original works.

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Notes

1. A Q-switched Nd-YAG laser with 1064 nm wavelength and a pulse duration of 10 ns, used at 60 cm from the surface, with irradiation diameter of 5mm and pulse energy of 300 mJ, pulse repetition rate of 30Hz.
2. NHL 3.5 (2.5), pumice powder (1.5), pozzolana (0.5), ceramic powder (0.5), Acril AC33® 5% in water.
3. NHL 3.5 (1) and sand 0'2Ø (3).
4. Joint mortar for ceramic tesserae: NHL 3.5 (1), rosa corallo MK000 (0,5), giallo oro MK000 (0,5), sand 0'2Ø (2). Joint mortar for glass tesserae: NHL 3.5 (1), nero ebano MK000 (0.5), sand 0'1 Ø (1.5), rosa corallo MK000 (1).

References

Bancells C. 1988. *Sant Pau, hospital Modernista*. Barcelona: Edicions de Nou Art Thor.

Bertelli C. 2011. "Angelo Orsoni: la storia, la fornace, il prodotto". In *Tamo. Tutta l'avventura del mosaico*, 111-115. Milano: Skira.

Bohigas O. 2000. *Domènech i Montaner. Any 2000.* Barcelona: Col·legi d'Arquitectes de Catalunya.

Figueras L. 2001. "L'Hospital de la Santa Creu i Sant Pau, entre la funció i símbol modernistes". In *L'Hospital de la Santa Creu i Sant Pau 1401-2001*,123-147. Barcelona: Lunwerg Editores.

García-Martín M. 1990. *L'Hospital de Sant Pau*. Barcelona: Catalana de Gas.

Giráldez P, Birosta J, Vendrell M. 2009. *Hospital de la Santa Creu i Sant Pau. Pavelló d'Administració. Seguiment i avaluació de les intervencions de neteja en el mosaic* (unpublished).

Llobet S., Andino L., Colonna-Preti K. 2015. "La conservació-restauració dels elements de mosaic del pavelló de l'Administració de l'Hospital de la Santa Creu i Sant Pau (Barcelona). *Unicum,* Number 14: 5-26.

Merino L., Birosta J., Vendrell M., Giráldez P. 2010. *Hospital de la Santa Creu i Sant Pau. Pavelló d'Administració. Caracterització de morters dels mosaics* (unpublished).

Sala M.T. 1990. "Tallers i artífexs en el Modernisme". In *El Modernisme, Museu d'Art Modern*, 259-268. Barcelona: Lunwerg Editores.

Saliné M. 2005. *Lluís Brú, dibuixant i pintor per a les arts ornamentals. Disseny i procés de creació. Fragments d'un creador, els mosaics modernistes*. Esplugues de Llobregat: Ajuntament d'Esplugues de Llobregat.

Saliné M. 2007. "Els mosaics a l'arquitectura interior. Catifes de pedres i pintures de ceràmica". In *Espais interiors. Casa i art (S.XVIII-XXI),* edited by Rosa M. Creixell, Teresa-M Sala, Esteve Castañer, 223-232. Barcelona: Edicions Universitat de Barcelona

Serraclara M.T. and Martí M. 2009. *Hospital de la Sta. Creu i St. Pau. Història, arquitectura, art*. Barcelona: Fundació Privada de la Santa Creu i Sant Pau.

Subias P. 2003. "Paviments, mosaics i rajoles". In *El Modernisme, a l'entorn de l'arquitectura Vol. 2*, edited by Francesc Fontbona, 272-277. Barcelona: Edicions l'Isard.

Vendrell M., Boularand S., Birosta J., Giráldez P. 2010. *Hospital de la Santa Creu i Sant Pau. Caracterització de morters dels mosaics de l'edifici d'Administració, façana sud-est* (unpublished).

Vendrell M., Merino L., Boularand S., Ventolà L., Giráldez P., Vadillo A., Senouci S. 2011. *Hospital de la Santa Creu i Sant Pau. Caracterització de tessel·les de l'escut del cos central del pavelló d'Administració.* (unpublished).

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SESSION III:
CONSERVATION OF MOSAICS FROM ANCIENT TO MODERN

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THE SUNS OF THE HYPOSTYLE HALL, PARC GÜELL, BARCELONA: THE COMPLEX CONSERVATION OF THE GLASS *TRENCADIS*

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Abstract

The four *trencadis* mosaic "suns" were created by J.M. Jujol for installation in the Hypostyle Hall of Parc Güell, during the early years of the 20th century. These products of creative genius suffered from technical problems from the beginning. The conservation-restoration of the four decorative works, included within a broader program of structural consolidation for the Hall carried out in 2016, represented an opportunity to document the complex selection of materials (size, texture, colours, positioning) and the techniques of execution of the underlying medallion structures, as well as the history of subsequent repair works. The problems presented by the project led to calculated choices in the use of thermo-mouldable materials, and the selection of the polyester and adhesive backing for the glass fragments composing the *trencadis.* Other challenges included the development of systems for removal and reinstallation of the mosaics in their precise original locations, and the weighing of decisions concerning the retention or elimination of previous restoration materials.

Keywords: Antoni Gaudí, Josep Maria Jujol, Parc Güell, *trencadís,* glass mosaic

Introduction

Parc Güell is a work developed by Antoni Gaudí for Count Eusebio Güell, between 1900 and 1914, originally intended as the setting for residential housing in a hilly area of Barcelona. By 1926 the decision had been made to transform it as a municipal park.

The Hypostyle Hall serves as the substructure of a great terrace on the hillside and at the same time as a collector for rainwater, channelled from the square above through the columns to a subterranean tank, and then used for the irrigation of the park (Martinez Lapeña and Torres 2002).

The structure of the Hypostyle Hall consists of 80 shallow vaults supported by columns. The four ornamental suns are situated precisely in the locations where the viewer would normally expect a column: a feat of architectural daring made possible by using beams hidden above the ceiling surface, in support of the weight above. The suns, representing the four seasons of the year, are executed in glass *trencadis* (literally "fragments") mosaic, and are the work of J.M. Jujol, a modernist architect who in his early career worked closely with Gaudí on such works as Casa Milá, Casa Batlló, and Parc Güell itself. The work of removal, conservation-restoration, and reinstallation of the four suns carried out as part of a structural consolidation project for the Hypostyle Hall.

Workflow

As a first measure, to halt the detachment of glass pieces, the medallions were covered with gauze adhered with Paraloid®

B-72 acrylic resin (Fig. 1), reversible using acetone. By means of visual analysis and percussion we could detect that within each medallion, 70% to 80% of the glass pieces were substantially detached from the structure to above. This preliminary analysis was confirmed as we began mapping the individual mosaics, prior to detachment. The task of mapping (Fig. 2) proved highly useful tool in revealing the problems and permitting discussion during the periodic visits made by the project's architectural management team. The initial maps were further elaborated as we progressed through different stages of the work, and served as essential tools in developing an understanding of how the medallions had been constructed, and for documenting the reverse side of the glass mosaics and all previous repair interventions. Some of these repair events could be dated, for example one using glass from a bottle of a local brewery, Estrella Damm, bearing a label first produced in 1940.

Prior to detachment we mapped each of the four medallions in 20 sections and identified their planned division into four radial sections. The division aimed to follow the straightest possible lines between the fragments composing the design, obtaining sections of manageable size for handling and transportation (Fig. 3). The axes of the medallions were also marked in relation to the ceiling, so that the medallions could be correctly positioned at the moment of reinstallation. Prior to detachment, a light

Fig. 1. Initial condition of suns 2 and 1, *Winter* and *Summer* (photo Gamarra & Garcia)

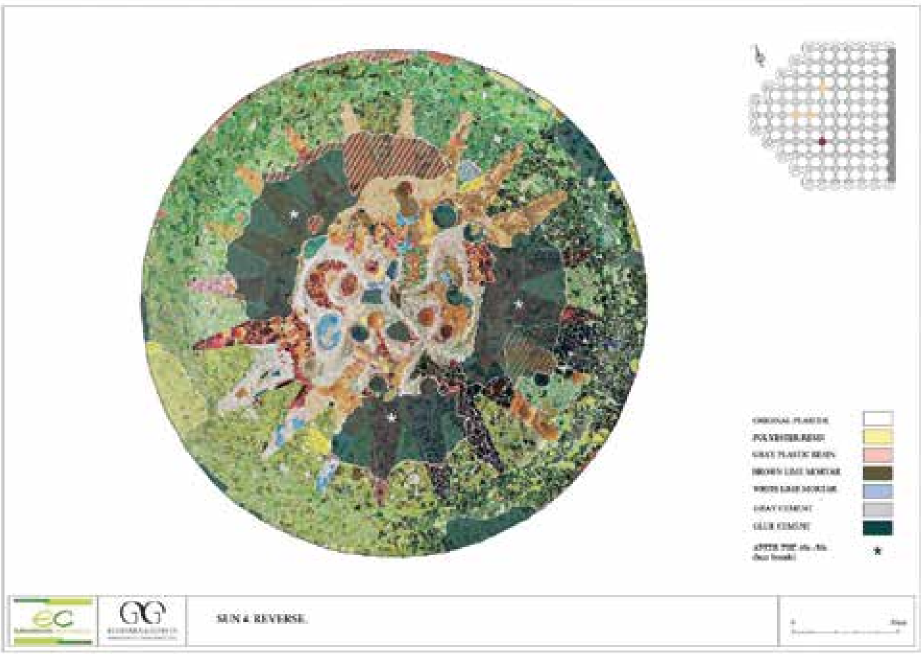

Fig. 2. Mapping the back of sun 4, *Autumn* (graphics by I. Millet)

Fig. 3. Application of facing and marking of cut lines between sections (photo Gamarra & Garcia)

Fig. 4. Making a mould using thermoform sheeting and polystyrene (photo Gamarra & Garcia)

extruded polystyrene form was applied to each mosaic using a thermo-mouldable Worbla® sheet. The polystyrene followed exactly the curved three-dimensional surfaces of the medallion "skin" (Fig. 4), enabling us to maintain the exact position of the glass fragments throughout the restoration process up until reinstallation.

Fig. 5. Cutting using micro-tool with diamond blade (photo M. Fábregas, La Fotografica)

Fig. 6. Detachment of a mosaic section (photo Gamarra & Garcia)

Next the cut lines were made for purposes of dividing the medallions into the planned sections, using a micro-tool with 1mm diamond blade, enabling precise

Fig. 7. Cleaning and processing in the laboratory (photo M. Fábregas, La Fotografica)

cuts along the extremely irregular contact lines between the glass fragments. The sections could then be manually removed (Figs. 5-6). The detached fragments were individually packed and transported to the security of the Gamarra & Garcia Restoration Laboratory on a daily basis.

At this stage, and then as the cleaning of the backing mortar progressed, we were able to observe that the four medallions were identical in size and form, and had in fact been made in a workshop using a single mould. For this reason the visitor observes the mosaics without any visible joins between sections, and as conservators we observe no irregularities in thickness, normally caused by the pressure of applying the tesserae to a mortar base. The cleaning stage involved removal of all the original cement mortar and plaster as well as the various materials that had been used in different repair events, such as latex modified mortar, PVA adhesive and polyester resin (Fig. 7).

Just as the structural consolidation project in these areas of the Hypostyle Hall provided for analysis of materials suitability, we were also obliged to carry out adhesion and stability tests concerning

Fig. 8. Preparation of sections for reinstallation in the mould (photo Gamarra & Garcia)

the materials proposed for readhesion of the mosaic components. Exact simulations of the materials requiring adhesion were prepared, and then fixed to the original support, as would be the case once the structural consolidations were completed. Once the test samples had been prepared and the materials had hardened they were submitted for adherence testing, carried out by the Technical Architectural Materials Laboratory of the Polytechnic University of Barcelona.

The best properties, comparable to standard values in current construction works, were achieved by adhering a synthetic polyester gauze to the back of glass fragments using vinyl glue; to this pre-measured Keracoll Ecoflex H- 40 adhesive mortar could then be applied for attaching the mosaic medallions in their original structural locations, previously consolidated by installation of stainless steel structures and application of Sika Monotop mortar, as specified for the project.

Once this selection of materials had been identified, and the gauze-glue backing was then applied to the sections, we could proceed with the removal of the extraction facings from the mosaic surfaces and the processes of their in-depth cleaning of the mosaic faces, prior to reinstallation.

During the reinstallation phase, the polystyrene moulds made of each medallion section proved indispensible in guiding the pieces together as we reattached them to the curves of the consolidated architectural support, maintaining the exact position of the tesserae and the absence of any visible joints (Fig. 8). We first aligned the positions of each section relative to

Fig. 9. Reinstalling sections in situ (photo M. Fábregas, La Fotografica)

Fig. 10. Final touches for suns 1 and 2 (photo Gamarra & Garcia)

the marks established during the detachment process, then applied the adhesive mortar to the back of the sections and the structural support. Using a form specially made in the shape of the curves, each section was moved into position on the ceiling, and initial pressure was applied to attach the fragment (Fig. 9). Subsequently we were able to move the sections on the fresh mortar for correct adjustment of their position in relation to the adjacent ones (Fig. 10).

Conclusions

The most important aspect of the work of detaching and reinstalling the 3-dimensional "skin" of glass fragments was the unique opportunity provided for documentation and understanding of the construction system for these very special decorative works. The project revealed the enormous quantity of objects, smooth and textured fragments of glass, very different in form and composition, used by the artist Jujol in making of the medallions, as well as the specific technique of production within a mould, shared by all four medallions.

The project also led us to elaborate and improve on the range of available techniques for detachment and reinstallation of ceiling mosaics. Among the innovations were the selection of thermo-mouldable sheeting (Worbla®) for three-dimensional support of the mosaic surface, and the selection of a resistant polyester mesh and adhesive combination for backing of the cleaned *tessellatum*. Also useful was the selection of the diamond blade with micro-tool for separation of the mosaic sections.

It is the colours, materials and forms of these decorative surfaces, in combination with the reflections of natural light entering the Hypostyle Hall as the day progresses, that bring the space of the Hypostyle Hall to life. Throughout the restoration work we were aware of the importance of all the subtleties embodied in the ornamental medallions, and so during the restoration process we made every possible effort to maintain the exceptional features of these artworks, so characteristic of Parc Güell and of Gaudí.

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References

Martínez Lapeña J.A. and Torres E. 2002. *Park Güell.* Barcelona: Gustavo Gili.

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APPRECIATION FOR THE ART NOUVEAU MOSAICS OF BRUSSELS: CHALLENGES IN CONSERVING MOSAIC FLOORS IN ACTIVE USE

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Abstract

Parts of the late 19th century floor mosaics heritage in Belgium are currently being lost due to functional changes of the mosaic floors and lack of appreciation of their cultural significance. The safeguarding of this legacy is complicated by difficulties in compatibility between aspects of the mosaics and their intended restorations. This paper examines compatibility in terms of three aspects: technological approaches, the current and future function and use of the mosaics, and the expectations and aesthetic views of owners, architects and authorities. The aim is to promote technical expertise and the survey of mosaics in Belgium, for promotion of maximum preservation.

Keywords: floor mosaics, Art Nouveau, compatibility, heritage, Belgium

Introduction

This contribution reviews the current state of research into the origin of mosaics as an aspect of architecture in Brussels at the turn of the 20th century, and the factors that currently hinder the preservation and correct restoration of this heritage. We touch on the issues of the terminology used in referring to these mosaics. We review some common problems in the conservation of mosaic floors that are still in use, based on personal experience, observation and evaluation.

Our general aim is to stimulate greater awareness of the importance of these artworks and a broader, well-reasoned, compatible approach to their management and restoration.

The 19th century revival of mosaic arts

The use of floor mosaics made a gradual reappearance in architecture during the 19th century. The reasons for this return appear various. The indications in Belgium are that the revival began in the 1860s, possibly with the works of the Pellarin family in Molenbeek, Brussels (Fig. 1), and the technique certainly gained in use from the 1870s onwards (Bernardon 2004). In Brussels, Bernardin was active by at least 1874. In 1880, Mion began operations in Antwerp and Bernardin in Liège. Godchoul, also in Brussels, began in 1885 and soon became one of the largest companies (Baeck 2015).

As in the neighbouring nations, the first factor in the revival were *the craftsmen*, of whom most, if not all, arrived from the area of Friuli region to the northeast of Venice. The craft knowledge of working with *i sassi*, the name for the river pebbles found in the Friulian area, was passed from father to son, and initially grew with

Fig. 1. Advertisement for the P. & A. Pellarin Frères company, Coll. MoMuse, Fonds Pellarin, B3, IIIA3.02

involvement in restoration works in the buildings of the Venetian lagoon.

The brotherhood of *terrazzieri* was established in Venice in 1582. The workers had mainly Friulian surnames, including Avon, Cristofoli, Crovato, Del Turco, Fabris, Facchina, Foscato, Mander, Mora, Pasquali, Pellarin, and Odorico. In the 19th century, for economic reasons, many of these Fri-

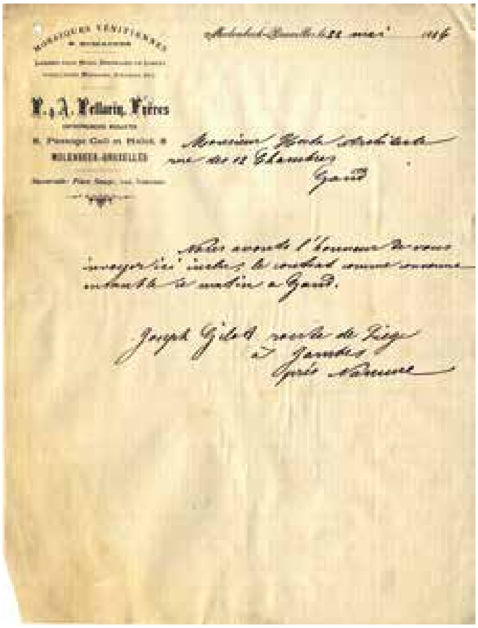
P. & A. Pellarin Frères
MOLENBEEK-BRUXELLES
Gand

Fig. 2. Correspondence between P. & A. Pellarin Frères and Victor Horta, Coll. MoMuse, Fonds Pellarin, B1, IA1.03

ulian craftsmen departed from the Venetian area for other centres of Europe, in cyclical waves (Colledani and Perfetti 1994).

A few of these families came to Belgium. In 2011, M. Kindt discovered a previously unknown archive of the Pellarin family – in particular P. & A. Pellarin Frères (*mosaïques vénitiennes et romaines*) – in the Sint-Jans-Molenbeek district of Brussels. This interesting documentation includes correspondence from the year 1886 between P. & A. Pellarin Frères and Victor Horta (Fig. 2), about mosaics to be executed in some of Horta's very first works, in particular two middle class houses at Twaalfkamerenstraat 51-53, in Ghent (Agentschap Onroerend Erfgoed 2016).

A second factor was the mid-19th century *discovery of Roman floor mosaics in ar-*

chaeological sites, particularly in the south of France, such as at sites in the areas of Provence, Montpellier, Nimes, Tarascon and Béziers (Lemaître 2008). A large part of these floor mosaics were recovered by museums, and many were restored with the help of Friulian craftsmen. These events in turn stimulated the development of the indirect method for the creation of new work.

In fact the development of *rovescio su carta*, or the "indirect method", constituted a third factor in the regeneration of the mosaics industry, amounting to *a technical revolution.* It was Gian Domenico Facchina, born in Sequals, Friuli, who understood that without such innovation, there could be no progress in the art craft of mosaics. Indeed the renaissance of monumental wall and floor mosaic in Europe and the USA in the 1900s was permitted by the savings in time and money gained through this method. The growth of the practice is mainly due to Facchina and his first great patron, Charles Garnier, with whom he worked in the realisation of the Paris Opera.

The fourth factor was precisely Garnier's development of the Paris Opera, with its masterful mosaic decorations by Facchina, executed using his newly invented artistic technique. Inaugurated in 1875, these remarkable mosaics exerted a powerful influence on the architects of the time. The new technique spread across Europe, leading to increasing demand for skilled workers.

Since the 16th century, only the Studio del Mosaico Vaticano had operated both a factory of enamels and a workshop where the art of mosaics could be taught, in that case mainly wall mosaics. However, in 1859, the important restoration works for Saint Mark's Basilica in Venice stimulated a revolution, in particular with the establishment of an atelier in Muranol, founded by Antonio Salviati. This studio would go on to become one of the most active in Europe, including through the execution of several works in Belgium.

A fifth and final stimulating factor, from what can be established by the current research, was the *rediscovery of the original polychromy* of classical buildings, which strongly encouraged the use of colour in contemporary architecture. Beginning in the mid-19th century, polychrome architectural ceramics, monumental works in stained glass, and marble and ceramic mosaics, were all reborn in Europe, although the mosaic technique had never quite disappeared in neoclassical architecture. In creating polychrome wall and floor coverings, clients and architects needed to make choices about the shape, colour settings and motifs of decoration, as well as concerning the most suitable material in terms of maintenance and economy. Richness of colour, aesthetic qualities, durability and weather resistance were all understood as important characteristics.

The growing appreciation of mosaics was paralleled by that of polychrome ceramics and cement tiles, but appears to have developed somewhat earlier. The contact with many brilliantly coloured works in Rome, Venice, Ravenna, Orvieto and Palermo, as well as the growing knowledge of the Byzantine architecture of Constantinople and other sites, appear to have stimulated interest in polychrome mosaics from 1830 onwards. The development of mosaic workshops and the industrialisation of enamels and tesserae in *grès cérame* in the second part of the 19th century facilitated the dissemination of the art. From the address directories of the time we can clearly observe the spread of mosaic workshops through all the major Belgian cities. A number of these workshops were still led by Italians or employed Italian specialists well into the 20th century, and in some cases the fourth generations of these families are still active today.

However, with the development of weather-proof polychrome ceramics in the 1880s, the mosaic technique lost some of its appeal. A first real dip in popularity occurrred around 1914, due to war. A decisive reason was the higher cost of mosaic work compared to architectural ceramics and tiles (Baeck 2015).

Emblematic architects of Brussels

In the current state of research, it appears that the first modern execution of mosaics in Belgium took place in prestigious religious and public buildings, after which came the applications in civil architecture (Baeck 2015). The urban explosion of the late 19th century resulted in a wave of construction, beginning in 1896. Victor Horta, a student of Alphonse Balat (Aubry 2015), played a key role in the development of a new school, diverging from the traditional architecture of homes. Horta used metal and glass to create subtle new forms of design, not just for the elite. Many other architects contributed to the development of design for all social levels, making Brussels a great centre for Art Nouveau.

The floor mosaics designed by Horta were developed mainly in two colours (Fig. 3): in most buildings in white and red (Autrique, Tassel, Winssinger), less often in green and red (Van Eetvelde). In later works, the use of a slightly darker line in

Fig. 3. Bi-chromatic floor mosaic with sinuous lines (photo M. Kindt)

Fig. 4. Emblem with dragon (photo M. Kindt)

the contours often provides an extra accent (Waucquez, Hallet).
Similar realisations can be found in the oeuvres of, among others, Octave Van Rysselberghe and Henry van de Velde (Hotel Otlet), Paul Saintenoy (Old England), Léon Govaerts (Le Gresham) and Jules Brunfaut (Hotel Hannon). In contrast, Paul Hankar usually worked in more geometric designs for his floor mosaics (Hotel Ciamberlani), as did a group of younger architects including Paul Hamesse (Cohn-Donnay House).

Uses, designs, characteristics

Our *in situ* research evidences that floor mosaics, in all possible neo-styles, were widely used as an alternative to ceramic tiles and natural stone, along with softer materials such as parquet. The floor mosaics are generally designed in "carpet" form, with ornate borders, often on a background of *opus circumatum*. The harmonious chromatic combinations of ornate borders and corners contribute to the beauty of the floor. The motifs have a variety of compositions, sometimes observed repeatedly. Quite remarkable is that the motifs of Art Nouveau mosaics could go in any direction, often independent of the corners and geometry of the room. The centres of the floors are often marked by rosettes, seen in many different shapes and largely executed by indirect method. The rosettes can be classical types, recognisable as copies from Venetian floor mosaics. The floral motifs are stylised, achieving harmonious effects in the leaves and blossoms. Animals are more rarely depicted, often rather schematically (Fig. 4),

Fig. 5. Detail of mosaic complementing steel structure (photo M. Kindt)

Fig. 6. Detail of floor carpet contributing to architectural lines (photo F. Lombaers)

but can be appreciated for their honesty and immediacy of inspiration. Curved, organic lines adorn many realisations.

The peak of success for floor mosaics was clearly during the Art Nouveau period, or more correctly in conjunction with Art Nouveau style, because such designs were used until well after World War I, as late as 1929 and exceptionally into the 1930s (Baeck 2015). In this style, the wall and floor mosaics were integral to conception of the building exterior and interior.

The designs of floor and ceiling mosaics can echo each other, as in the Hotel Solvay, while in the Magasins Waucquez, the mosaic lines reflect those of the ironwork (Fig. 5). In some examples the lines of the floor seem to derive directly from the structure (Rue de la Vallée 40, Ernest Blérot), playing an important part in developing the overall architecture (Fig. 6). The architectural components within the room could in turn play an important role in development of the floor design (Hotel Hannon).

In these paragraphs we have sketched some broad characteristics of floor mosaics in Belgian architecture, however we stress the need for further research in these matters. Many questions arise. How did the design of the pavements enter into the creative process of designing the building? What and who determined where the mosaic pavements would be placed in the building? What was the contribution of the craftsman in the realisation of the mosaics? Did they have any artistic freedom in interpreting the designs? On a sadder note, what would have been the reasons for the disappearance of so many mosaics from the Art Nouveau buildings that still survive?

Important steps in understanding the characteristics of the Art Nouveau mosaic pavements would be developing a thorough inventory and continuing the archival research.

Matching mosaic terminology with conceptions

As well as the in-depth research of characteristics, we stress the need for further consideration of terminology, both in Belgium and internationally. The language of mosaics in antiquity applied a terminology of specific "opus", but we lack a consensus of terms for modern mosaics. In some cases we see the identical term in different countries and languages, but with different meanings. The word *terrazzo*, for example, can have completely different meanings in Barcelona and in Greece.

At first glance, the Belgian definition of "mosaic" coincides with that established by the Archeological Service of the Institute of Culture, City of Barcelona: "*A mosaic is a decorative covering of a surface formed by regular and/or irregular pieces of different materials, such as stone, glass, ceramics, cement, or other, forming a composition of decorative character*" (Ajuntament de Barcelona 2017). However the interpretation of this definition differs substantially, since none of "*mosaic de rajola ceràmica*", "*mosaic hidraulic*" or "*cartó pedra*" would be considered as mosaic works in Belgium.

For the time being, we can categorise Belgian art nouveau mosaics into maximum three groups:

1. Roman mosaic/*tesserae*: a composition of *tesserae*, cut manually and applied one by one (Fig. 7);
2. Venetian mosaic/*seminato*: tesserae coming from waste in various colours with irregular shapes, are applied one by one, or sown on a layer of mortar (Fig. 8);
3. *Granito* (also known as *terrazzo*): crushed stone or marble granulate is mixed with mortar and applied as a screed (Fig. 9).

Nevertheless, the third group is not considered as mosaic in the full meaning of the term, although it usually includes a frame of mosaic tesserae as an expansion joint, and is sometimes embellished with decorative mosaic motifs.

The architectural choice between aforementionedtypes was generally guided by the importance or prominence of the room. Sometimes all three types were used in the same building, in rooms of differing prominence.

Challenges in the conservation of actively used mosaics

In Belgium there is no source of official training for mosaic restorers or craft workers. Some of today's craft workers are the fourth-generation descendants of the Friulian mosaicists who constructed the pavements we now restore. Others have only received basic training as a screed worker or tiler, then gained experience on work sites. While any of these can master the mosaic technique, their approach is generally different from that of a restorer.

There are many challenges to achieving "ethical restoration", and as we will see, the situation of mosaic floors that are still in use imposes criteria that indeed seem unethical.

Fig. 7. Detail of a Roman mosaic (photo M. Kindt)

Fig. 8. Detail of a Venetian mosaic (photo M. Kindt)

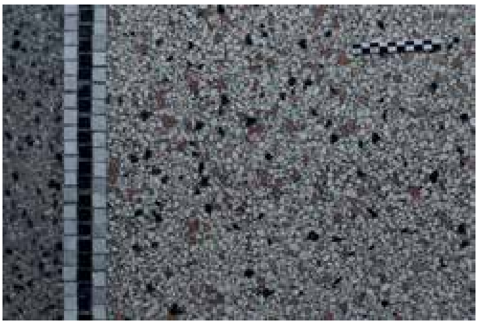

Fig. 9. Detail of *granito* (photo M. Kindt)

A first problem is the very common situation that mosaic restoration is conducted *without preliminary testing*, and without the consultation of an expert in architectural heritage or conservation. Not only the clients, but even many architects may not have knowledge or experience in mosaics restoration, meaning that they lack information on the range of possibilities for maintenance, repair, detachment and replacement, and – in the case that no other treatment is possible – reconstruction. They may fail to engage in preliminary examination, or draw on those with prior experience. This could demonstrate that, what is seemingly unrecoverable, is indeed restorable. The most important role in these cases then becomes that of the contractor, who may be able to guide both client and architect through the necessary processes.

The specifications for building renovations often *prescribe polishing,* without consideration that a part of the original material is lost at each polishing, eventually leading to total loss of the *tessellatum* and exposure of the bedding layer. Polishing also eliminates the textural and tactile qualities of the materials, resulting in substantial loss of values.

Another important aspect is the *consequence of budgetary and operational choices* with respect to the object. The owners, project managers, craftsmen and restorers will have different opinions on ethics and suitable approaches. This could then influence the cost of operations, and so, the resulting restoration decisions. In the event of opting for restoration, the project cost can still be significantly affected by further choices: choices between traditional and/or new materials and techniques, choices from the range of options between minimal intervention and complete reconstruction. Vague or incomplete specifications can play out in widely differing restoration costs as the project proceeds. In fact the specifications for maximum preservation may not be the most expensive solution. A project planner searching for quotations will probably find that the craftsmen or restorers with foresight are not the lowest bidders. And so, when preparing plans, the quotations will often be based on unclear job descriptions, instead of specific and defined assignments. This frequently causes unnecessary fees and unwanted price increases as the project proceeds.

As restorers we are often called in after significant *consequences from interventions* have become visible, when it is too late to propose more appropriate methods. Such interventions can cause unnecessary damage, making it difficult or impossible to provide good restoration. Removing original material can only happen once!

When repurposing, or otherwise, renovating a space, the impact of the *new functions and use* on the mosaic floors should be taken into account. The impact of installing new partitions, electrical and water systems can be particularly harmful, since the loss or abrasion due to such linear forms tends to be more disturbing than those of irregular form and uneven edges. The interventions can make it difficult to recover or integrate with the original material, thus causing irreversible damage.

The *short time for execution can force unwanted treatments*. The realities of planning and managing construction sites insufficiency of time for the slow drying of lime mortar. Since everything needs to be done quickly, fast-cure synthetic materials and cements are often used to speed up the work. However, treatments should be based on established conservation principles and there should not be an automatic resort to the fastest solution. The intervention should instead be planned on the basis of dialogue between traditional methods, time-tested practices, and the specificities of the physical and management aspects.

Among non-specialists, *aesthetics are often seen as more important* than conservation, and will often prevail over the preservation of the original material. Previous interventions were often poorly planned. In spite of intentions, the positioning, colour, size and shape of inserted materials can have negative impacts. The aim of the intervention can be to re-establish a replica of the original work a perfectly camouflaged reintegration, achieving all the characteristics and qualities of the surrounding original surfaces (texture, composition, finishing, etc.) is almost impossible to achieve. Instead, the aim should be to re-establish the image, without falsifying, in a manner that is distinguished from the artist's own hand (Chiantore 2012). A crack in a mosaic, for example, is part of the history of the floor and should not been seen as a degradation, but as something that requires regular maintenance.

The current trend is to expect high gloss or mirroring effects from mosaic floors. Clients also want easy maintenance and request smooth surfaces for this purpose, thereby pushing conservators to replace damaged tesserae, instead of preserving the original unevenness. Both of these trends result in a complete change from the historic aspect, and complicate the restoration choices for the future of such smooth pavements.

Finally, the protection of floor mosaics during restoration work can itself bring about irreversible damage. Moisture – sensitive stones are covered with impermeable materials, sometimes for months, with loss of materials as a result.

Conclusions

Although the state of research on mosaics in Belgium is still far from complete, it is abundantly clear from observations of different sites that there should be an awareness campaign, aimed at public and private owners, on the values of mosaics and *terrazzo*, stressing their importance and ensuring maximum preservation.

Some of the areas requiring planning are:

- *Survey and mapping* of *the mosaics of Belgium*, for enhanced knowledge of this heritage. The example of the "*El mosaic del meu barri*" project guided by the Barcelona Archaeological Service provides an excellent model, of which we hope that Brussels and other Belgian cities will follow. We are currently working towards this goal.
- *Launching an awareness campaign* to raise the interest and appreciation of public and private owners concerning mosaics and *terrazzo*, and to communicate the availability of professional artisans and restorers.
- *Collaboration with architects, heritage experts and administrations* to develop clear specifications for restoration of mosaics and *terrazzo*.
- *Promotion and improvement of technical expertise* through training of craftsmen.
- Development of cooperation between craftsmen and restorers.
- *Provision of subvention funds* for maintenance or necessary restorations of floor mosaics.
- *Promotion of preventive conservation,* as the best means of preserving mosaic artworks through time. When difficult problems require treatments, these must be based on thoroughly tested procedures, aligned with the essential principle of minimising the intervention.

At the time of preparing this paper we are hopeful that progress can be made in many of these areas, thanks to the Centre des métiers du patrimoine Wallon "La Paix-Dieu" of the Agence Wallonne du Patrimoine. The center is planning a study day and round-table, bringing together craftsmen, restorers, architects, engineers, art historians, trainers and representatives of the heritage administration, to be held in June 2018.

References

Agentschap Onroerend Erfgoed, 2016. *Twee burgerhuizen ontworpen door Victor Horta*, https://inventaris.onroerenderfgoed.be/erfgoedobjecten/21281.

Ajuntament de Barcelona, 2017. *El mosaic del meu barri: Projecte, participatiu per descobrir, valorar I conserver els mosaics de Barcelona: Què és un mosaic*, October 18th. http://ajuntament.barcelona.cat/arqueologiabarcelona/mosaics/que-es-un-mosaic/.

Aubry F., ed. 2015. *Het Brussel van Horta*. Brussels: Ludion.

Baeck M. 2015. *De schoonheid van het materiaal, Ontwikkeling van de Belgische industriële tegel (1840-1980) in een Europese context*. Gent: Universiteit Gent, Faculteit Letteren & Wijsbegeerte.

Bernardon M. 2004. *Terrazzieri Friulani in Nord America*. Maniago: Grafiche Mazzoli.

Chiantore O. 2012, *Conserving Contemporary Art: Issues, Methods, Materials, and Research*. Los Angeles: Getty Conservation Institute.

Colledani G. and Perfetti T. 1994. *Dal sasso al mosaico: storia dei terrazzieri e mosaicisti di Sequals*. Sequals: Comune di Sequals.

Lemaître C. 2008. *La conservation des mosaïques: Découverte et sauvegarde d'un patrimoine (France 1800-1914)*. Rennes: Art & Société.

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KEY ASPECTS AND CRITERIA FOR THE RESTORATION OF NOLLA MOSAICS

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Abstract

Nolla mosaics are composed of small geometric, ceramic tiles, composed in patterns without intervening grout lines. The manufacture of such tiles originated in England, and was brought to the Valencia area of Spain by Miguel Nolla in the 1860s. The product gained wide application throughout Spain and had great impacts from the practical, art historic and industrial points of view. The use of these tiles also extended to other countries of Europe and the Americas. The rigidly geometric sequences of shapes and the lustrous, non-polished character of the tiles are two aspects that influenced their installation, and so also create specific conditions for restoration processes. As always, adequate restoration can only be achieved through a basis of thorough knowledge of the mosaic characteristics and pathologies. A recent revival of interest in the material has encouraged the development of protocols and procedures for the preservation and restoration of these floors, which are summarised in the current article. Consideration must now be given to the revival of the trade of *mosaiqueros,* skilled in the art and techniques of this particular material.

Keywords: Nolla mosaic, historic stoneware tile, industrial tile, *mosaiquero*, Meliana

Introduction

As for other interventions on historical, artistic and architectural heritage, the restoration of mosaics must follow guidelines concerning the respect of original material. The conditions of the intervention must respect the criteria and qualities characterising the object. Knowledge of the object and its state of conservation are needed before acting. In the case of a mosaic, we must study not only the original materials, the support, the pathologies and their extensions, but also consider the cultural value of the object, which can depend on its composition, location, rarity, extension, and other factors (Laumain and López Sabater, 2016a). We will see that all of these conditions have particular relevance in the restoration of Nolla mosaics, and in the implementation of the intervention.

Origin of Nolla mosaics

Miguel Nolla chose to establish his mosaic factory in the town of Meliana, near Valencia, within a region having a centuries long tradition of ceramics. We might imagine that the choice of this location, rather than for example Seville, would have been influenced by this legacy, however this was not the case. In fact the technique of production and the aesthetics of the material were more strongly linked to English industry than to local tile work (Fig. 1), and the choice of the location was due more to technical reasons, such as proximity transport routes, supplies of raw material and availability of labour availability.

Fig. 1. Nolla mosaic factory in Meliana (Source: Centro de Investigación y Difusión de la Cerámica Nolla (CIDCeN))

Nolla established his factory in 1860. This was an entrepreneurial decision for the introduction in Spain of a product until then produced by the English ceramic industry. His aim was to provide a product of quality equal to the most noble materials used at the time, in particular marble. Given these standards, as well as his skill in marketing, Nolla achieved rapid success, and his products soon achieved a global reputation, with associations of good taste, culture and social achievement. The emergence of this industry in the region of Valencian orchardry revolutionised the local productive economy and social context. From the kilns of Meliana (Laumain and López Sabater 2012) there emerged mosaic tiles that went to cover the floors of buildings in Cartagena, Gijon, Seville, Valencia, Barcelona and Madrid with colourful compositions, but also those of Paris, Moscow, Buenos Aires, Havana and many other cities. Architects such as Antonio Gaudí chose these pavements for the floors of emblematic buildings, such as the Casa Batlló, in Barcelona.

As we proceed, we must understand that the individual pieces of the Nolla floors have no decorative value. It is their composition as a whole that achieves formal and aesthetic relevance, meaning that the object must be considered as an integral composition, and in fact as a mosaic (Fig. 2).

Manufacture of the product: conservation considerations

The gradual deterioration of the original buildings, combined with lack of knowl-

Fig. 2. Page of a catalogue from the Hijos de Miguel Nolla company (CIDCeN)

edge and appreciation of these mosaics, has led to the disappearance of many. However, the appreciation of this heritage is experiencing a gradual revival, and the problems of their conservation and restoration are receiving attention. In order to choose appropriate solutions, we must understand the characteristics and specificities of these works, as established by the process of manufacture (Fig. 3).
The appearance of Nolla tile represented a revolution in the ceramic production of the 19th century. This was the first high-performance ceramic produced in Spain, a precursor to the stoneware still produced a century and a half later, for which the Valencian producers remain leaders of national production. The qualities of this new material stimulated a remarkable change in the perception of users towards ceramic flooring, as evidenced by the numerous contemporary testimonies and sales arguments presented by Nolla in his advertising. These historical documents testify to the durability of the material, its resemblance to stone, the resistance to attack by acids, as well as its beauty, luminosity, warm colours, and adaptability to any design. To some extent the publicity exaggerated the true qualities of the material (whether consciously or unconsciously we cannot know, given the limited testing technologies of the time), however it is certainly true that Nolla tile represented a qualitative leap in production.
To understand the physical and chemical characteristics of Nolla ceramics we must first understand it as an industrial material, resulting from a specific process of production. In this way we can gain fundamental understanding useful for understanding the conservation status of the surviving floors, the development of

Fig. 3. Examples of mosaics in Villena (photo X. Laumain)

potential pathologies, and the materials and techniques suitable for preservation, maintenance and restoration.

The Nolla ceramics manufacturing process was derived from that of the Minton & Hollins company of England, which at the time of the Valencian undertaking, in 1860, had already offered a similar product for more than a decade. The achievement of this new, highly performing material required two conditions. First was the preparation of the base material of powdered clay, mixed to achieve uniform colour and pressed to a very high density, completely free of air bubbles. The second was a high firing temperature, so that the tile would vitrify, achieving the revolutionary characteristics of resistance. The experimental trials conducted by J.J. Sánchez-Aznar and E. Sánchez *et al.* (2017), and reported at most recent National Congress on Nolla ceramics, have revealed that the essential composition was a clay mixture of kaolin, quartz and feldspar, with the addition of oxides for achievement of the desired colours.

The raw materials were ground until total pulverisation of the mixture. The tiles were then formed using moulds of the desired shape and size, within hand-operated presses. The dimensions and forms of the moulds continued to evolve over time, resulting in considerable differences in the tesserae found in the floors from different years of execution. Due to the strong English influence in the initial production, the tiles were originally conceived in measures of inches, and it was not until the early 1900s that the transition was made to the metric system. These aspects of evolving form are of essential importance in the restoration of the mosaics, making it essential to find spare pieces from the same period of production, to avoid inconsistencies and imbalances.

Also important in restoration were the facts that the tiles obtained composed strictly geometric forms, of high density and smooth surface, coloured in mass and usually monochrome, and that the mosaic pieces would then be placed without gaps. Although the dimensions evolved through time, Nolla produced very complete geometric series of tiles from the outset. Each series consisted of a main form, that when cut in half or "unfolded", generated new dimensions and vertices, which could in turn serve as the basis for another series. The strict mathematical character of the system allowed great flexibility in the creation of motifs, once the tiles were used in installation (Fig. 4).

In addition to the monochrome pieces there could be a second type of tile, less frequent and generally used to enhance compositions, given the greater complexity and cost of production. These pieces, also known as "encaustic tile", typically show a design consisting of a simple bicolour cross or flower. These tiles were achieved by double pressing of the clays, maintaining all the features specific to the material. The inlaid design had a maximum depth of 2 mm, which would be sufficient resist normal surface abrasion. However, as in the case of the so-called "hydraulic tiles", these cannot be polished by grinding, which would lower the surface of the tile and risk losing the design. Such operations must be prohibited for these floors (Coll Conesa and Porcar Ramos 2016).

As previously reported by Laumain and López Sabater (2013), Miguel Nolla originally produced a chromatic range limited to nine colours, with the potential of one further colour at request. In the early

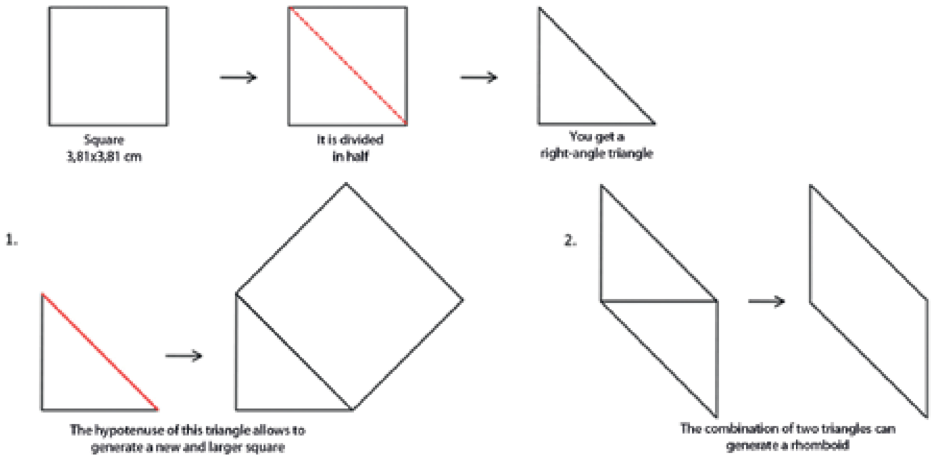

Fig. 4. Geometric series of tesserae (CIDCeN)

1900s Miguel's sons expanded the range to include variants of the ten initial colours. In the mid-20th century, Mosaico Nolla SA would considerably expand the chromatic range, as well as the availability of surface finishes.

The rear surface of the Nolla tiles are finished with a grid in relief, facilitating grip on the mortar. Within the grid there is generally an inscription of a code referring to the piece shape and size, as well as the factory of production. The most common pieces, 1.5 inches square, were assigned number 9, a number which also indicates the place of the tile within the geometric chain mentioned above (Laumain and López Sabater 2017) (Fig. 5).

After the tesserae were formed in the presses they were fired at temperatures were between 1200°C and 1300°C. This intense heat resulted in the vitrification of the material, achieving mechanical strength and excellent resistance to chemical agents. Pieces installed more than a century ago will still maintain their colour and be almost free of marks from wear or impact, and the tiles were known to support the application of products such as hydrochloric acid (Fig. 6). However the firing process could also result in the development of pathologies in the tiles, such as bubbles, cracks or powdering, in the case of even minimal presence of moisture in the prepared material.

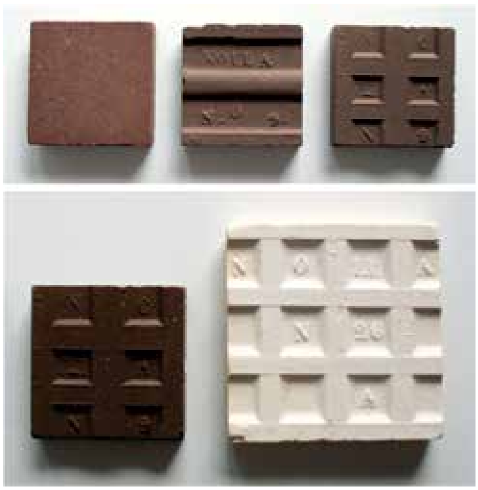

Fig. 5. Front and back of Nolla tesserae (photo X. Laumain)

MOSAICO NOLLA, S. A.

Datos Técnicos

El MOSAICO NOLLA es un pavimento de grés fino cerámico, y su composición corresponde al de una porcelana dura. - Está cocido a la temperatura de 1350º.

Resistencia a la compresión.- 625 Kgs. por cm.²

Resistencia al desgaste.- Coeficiente medio de desgaste con relación al mármol de Carrara 0'189. Es decir, unas 6 veces más duro.

Prueba a la percusión.- Con una bola de 250 gramos de peso, rompe el mosaico dejándola caer desde una altura de 85 cm.

Acción a los ácidos.- Completamente inatacable a los ácidos clorhídrico, nítrico y sulfúrico a cualquier concentración y duración de la acción.

Porosidad.- Impermeable.

Colorido.- Inalterable a toda acción química ó atmosférica.

Estos datos corresponde a las pruebas efectuadas en el Laboratorio Central para ensayos de Materiales de Construcción de la Escuela de Ingenieros de Caminos, Canales y Puertos. según. exp. 5032 y 5038.

Datos comparativos con otros pavimentos

	MOSAICO NOLLA	HIDRAULICO	MARMOL
Peso por m.²	15 Kgs.	40 Kgs.	51 Kgs.
Cantidad de argamasa que entra por m.²	13000 cm.³	20000 cm.³	20000 cm.³
Peso por de m.² pavimento	43 Kgs.	83 Kgs.	94 Kgs.

Fig. 6. Physical characteristics of Nolla tile, described in a factory catalogue (CIDCeN)

Another result was variation of the final colour, due to varying temperature and duration of the firing. For this reason, different batches could present slight variations in tone within the same colours. The skilled *mosaiquero* would deal with these variations during execution, by strategically placing the pieces within the overall design, however this is another important factor to consider in the restoration of Nolla mosaics.

In conclusion, the Nolla tile can be considered as a proto-porcelain stoneware. The study of Sánchez-Aznar *et al.* (2017) showed that in regards to porosity, Nolla ceramics achieved a degree of water absorption ranging between about 3% and 8%, depending on the colour of the tile. These are excellent results, indicating a material of very low porosity, however this is again a factor that requires consideration when planning a restoration.

Design and layout of installations

The installation of Nolla mosaic was and still remains a crucial and delicate work, requiring specially trained operators. In his catalogues, Miguel Nolla stressed the complexity and importance of the tasks. The company offered guidelines for design and installation, as well as the possibility of calling on specialised personnel, trained in the factory (Laumain and López Sabater 2016b). Nolla was aware that installation had to be executed with absolute perfection, in order to achieve a quality consonant with that of the physical product. As with other mosaics, the tiles are placed piece by piece on a mortar base, however there are three main aspects that make the installation and the overall mosaic unique: the absolute geometric regularity of the pieces and design, the completely planar surface, and the total absence of joint spaces.

The original conception of Nolla tiles was that they would be laid in the design of a "carpet", composed and patterned of the individual colours (Laumain *et al*. 2012). Another option was the repetition of a geometric module over the entire surface of the space. In the case of the composition inspired by carpets, the installation generally consists of three parts: the central field, a border, and finally a neutral or patterned perimeter area.

Although the sequence of available tiles corresponded to a strict sequence, the range of achievable effects was highly variable. Given the rigid geometry and dimensions of the tiles, the space between tesserae could not exceed 0.5mm. Any mismatch would disrupt the required graphic regularity, quickly bringing about the displacement of pieces relative to those of the neighbouring rows, and therefore the inability to place the ones creating the crossing patterns. The sharply angular corners of the tesserae also imply that any variation in orientation of the surface plane is immediately evident, among other things generating shadows with effects on the viewing. To avoid these consequence, it is essential that the installer fit all the pieces perfectly. These features

Fig. 7. Examples of carpet patterns in the cities of Carcaixent and Cartagena (photos X. Laumain)

meant that the *mosaiquero* had to learn specific techniques of placement, and for us as restorers, that we require systems of removing and reinstalling the floors that are often different from the ones usually employed in mosaics conservation, where the joints, even when minimal, still allow some flexibility (Fig. 7).

Traditional installation materials and systems

The *mosaiquero* proceeded with the installation according to a series of rigidly established steps. First came the design and preliminary layout, always beginning from the middle of the composition. In this way, the accumulation of any errors in placement would not be so severe as in the case of starting from one side and working across the entire width. In the same way, the outermost lines of the design could be prepared in a manner that would find solution to the forms of the room and the irregularities in the walls.

The second step is the application of the base, in lime mortar of proportion 1:3, over an area corresponding to what the *mosaiquero* could install before excessive drying. A qualified operator could achieve between 6 and 9 m² of mosaic per day. Some installers would sprinkle the wet mortar with lime, for better grip of the pieces. Towards the end of the 1800s the technical instructions provided by the Nolla company recommended that the lime mortar be sprinkled with a thin layer of Portland cement.

Once the lime mortar was applied and checked for level, the *mosaiquero* began to draw on small piles of identical tiles, placing them swiftly according to the planned design, while taking great care not to leave any gaps. joint. Once an area of sufficient size was laid the tiles were levelled to perfect plane within the mortar, using a wood panel struck with a weight. This operation was particularly delicate and required particular know-how to avoid displacement of the perimeter pieces.

As restorers we can observe the way the mosaics were installed and understand the details of the *mosaiquero* skills, such as in the resolution of problems. In spite of careful planning and installation there could be small discrepancies, including from differences in size between batches, and the installer would almost always need to solve minor deviations by installing trimmed tesserae in inconspicuous places. The placement of these pieces helps us understand the order of installation, and provides information that will be essential in the case of an intervention.

Intervention: techniques and recommendations

Main criteria

Restoration techniques must respect the specificities of Nolla mosaic, thereby ensuring the quality of the intervention. As for any mosaic, the principle of *in situ* conservation avoids decontextualising the work, and in this case ensures preservation of the original craft of the *mosaiquero*. Complete disassembly of a mosaic should be limited to contexts where *in situ* preservation would be impossible, such as in the case of excessive movement of the floor substructure (Fig. 8).

The restoration of a Nolla mosaic must also adhere to three fundamental criteria:

Fig. 8. Example of mosaic with mythological pattern (photo X. Laumain)

i) the gaps between pieces can never exceed 0.5 mm; ii) the installation mortar must be lime based; iii) the surface must not be ground or polished. In applying these three conditions, the restorer is attempting to maintain the same techniques as the original.

The first condition considers that this is mosaic composed of pieces that are industrially produced to rigid geometric criteria. They were designed to be laid without gaps or lines that could disturb the design, and the restoration must follow the same criterion.

The second condition adheres to the general principle that restoration materials should be consistent with the original ones. As well as deriving from all the same reasons as for other cultural properties, these floors have the special consideration that the ductility of the lime mortar perfectly absorbs movements that could affect the tiles themselves, which are too rigid to support any deformation.

Finally, as we can understand from the description of their manufacture, Nolla tiles have a unique surface, lustrous but not reflective. Grinding can remove the designs in the case of bicoloured tiles, and like polishing, creates a finish that irreversibly eliminates this peculiarity.

Removal and reinstallation procedures

The removal of any part or whole Nolla mosaic should only be conducted following complete, clear planning of the processes of documentation, removal, cleaning and replacement.

The removal can be done in two ways. The first is to use the archaeological method of lifting, with paper or gauze facing, for which the reader should refer to the existing extensive literature. The other procedure is piece by piece removal, which requires great care to avoid breakage, given the difficulty of finding replacement material. The restorer should also avoid cutting pieces with circular saws or other tools, resulting in damage to the original material.

Once the tiles are removed, the restorer must eliminate the mortar. In the section on installation we have seen that the most traditional method was to begin with a 3.5 cm layer of exclusively lime-based mortar. If the mortar was properly prepared, and especially if the tiles were set at the correct moment, the resistance of this system is very good and the tesserae will not detach in conditions of normal use. Still, once the tiles are lifted, the final adhering mortar can be quite readily cleaned using acids. On the contrary, the use of cement in the application procedure resulted in the formation of a thin, rigid layer that connects the pieces, to the extent of generating breakage of the tiles during removal. In addition to spreading over the underside, the cement would also penetrate the narrow gaps between the tiles, further strengthening the bonds. Finally, once the pieces are extracted, the cleaning process for the rear and edges becomes more laborious. In the case of using

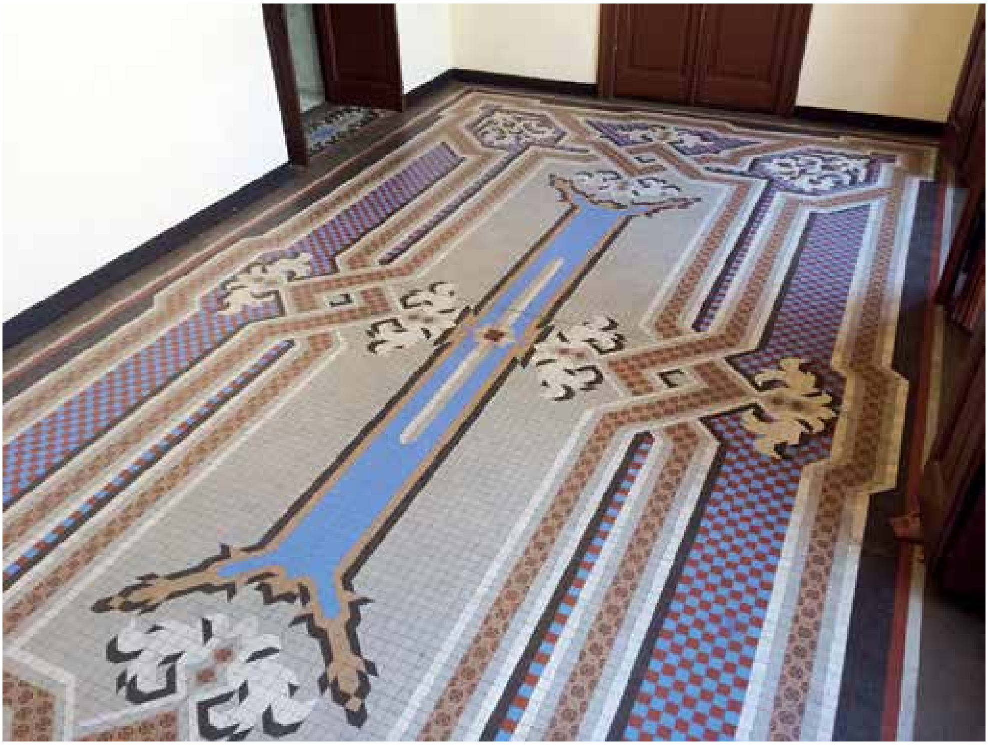

Fig. 9. Mosaic with interlaced pattern, in Villena (photo X. Laumain)

acids, the restorer must test to ensure that all of the product has been rinsed, before reinstallation.
The reinstallation should use the traditional materials and system as described above: initial layout, installation beginning from the centre over a base of lime mortar, with utmost care to avoid gaps (Fig. 9).

Conclusions

Nolla pavements present all the characteristics qualifying them as mosaics. However, the specificities of this product, first developed in the mid-19th century, require certain peculiarities in the techniques and procedures of installation, and so in intervention, that are very different from those of other mosaics. It would seem obvious that restorers must respect the fundamental characteristics of the rigid geometry, absence of gaps, and lustrous, non-polished finish of these mosaics, however such respect is often forgotten. Those who encounter the material will soon gain great respect for the expertise of the ancient *mosaiqueros*, and perceive the evident the loss of this craft and its skill in the modern era. We are able to define a series of conditions, criteria, and key aspects to consider in the restoration of these mosaics. The communication of these considerations is necessary, but still insufficient. We must begin to deal with the issue that, despite all the good will and guidelines, the provision of correct materials and tools, the restoration procedure still lacks something essential. In order to revive Nolla mosaics, with all their art, we need those who first made them possible, the artists. What we need is to recover the skilled trade of the *mosaiqueros.*

References

Coll Conesa J., Porcar Ramos J. L. 2016. “El mosaico Nolla: tecnología, producto y utilización”. In *El Mosaico Nolla y la renovación de la cerámica industrial arquitectónica en Valencia. Actas del I Congreso Nacional sobre la Cerámica Nolla, 9 y 10 Abril de 2015, Meliana,* 13-64. Valencia: CIDCeN.

Laumain X., López Sabater A. 2017. “Evolución de los productos de la empresa Nolla. Elementos para la datación”. In *La difusión del mosaico Nolla y su dimensión internacional*. Valencia: CIDCeN.

Laumain X., López Sabater A. 2016a. “La fábrica de cerámica y el Palauet Nolla. Un conjunto que revolucionó el sector industrial valenciano del siglo XIX”. In *El Mosaico Nolla y la renovación de la cerámica industrial arquitectónica en Valencia. Actas del I Congreso Nacional sobre la Cerámica Nolla, 9 y 10 Abril de 2015, Meliana,* 65-88. Valencia: CIDCeN.

Laumain X., López Sabater A. 2016b. “Nolla y el modernismo: un mosaico entre industria y artesanía”. In *Congreso Internacional El modernismo en el Arco Mediterráneo. CIMAM2016*, 643-650. Cartagena: Universidad Politécnica de Cartagena.

Laumain X., López Sabater A. 2013. “El Palauet y la cerámica Nolla: el color del modernismo”. In *Actas del X Congreso Nacional del Color*, *Valencia 26,27,28 Junio 2013*, edited by Ángela García Codoñer, 463-471. Valencia: Universitat Politècnica de València.

Laumain X., López Sabater A. 2012. “Restoring the social and historic Heritage of Meliana”. In *Heritage 2012. Proceedings of the 3rd International Conference on Heritage and Sustainable Development* edited by R. Amoêda, S. Lira & C. Pinheiro, vol. 2, 1285-1293. Porto: Green Lines Institute for Sustainable Development

Laumain X., López Sabater A., Rios Alos J., Gadea Diez M.F. 2012. "Los oficios perdidos del mosaico Nolla: un patrimonio inmaterial en peligro". In *Patrimonio inmaterial e intangible de la industria. Artefactos, objetos, saberes y memoria de la industria,* edited by Miguel Ángel Álvarez Areces, 647-654. Gijón: CICEES.

Sánchez-Aznar J.J., Sánchez E., García Ten F.J., Bordes M.C. 2017. "Caracterización microestructural del mosaico Nolla de una obra de Bochons y Lorente de 1880". In *La difusión del mosaico Nolla y su dimensión internacional.* Valencia: CIDCeN.

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CONTEMPORARY MOSAICS: THE CASE OF THE HYDRAULIC MOSAIC

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Abstract

The 'hydraulic mosaic' was designed and first used beginning in the late 19th and early 20th centuries. The focus of the current paper is on Catalan production, particularly by the most prominent and long-lived of the commercial actors, the Escofet tile manufacturing company. It draws attention to the recognition of the hydraulic tile as flooring that embodies a high degree of artistic creativity, yet has always excelled in adapting to the defining characteristics of industrial design, namely: business strategy, production that remains autonomous with respect to individual architecture projects, satisfaction of market niche and evolving consumer tastes, plus links with contemporary cultural and social factors.

Keywords: Flooring, industrial design, Escofet, Barcelona, Modernist movement

Introduction

Of the entire set of architectural finishes, the tiles used for flooring are perhaps least able to escape their functional conditions, i.e. the needs for a smooth and resistant surface, suitable for foot traffic, providing a proper insulating finish over the entire subfloor, whether laid on natural ground or on the structures creating the different levels of a building (Paricio 1981). These same technical requirements had existed ever since the first flooring solutions, devised through the history of building. However, at the same time, given its skin-like character, and because of its service as the final, visible layer of any constructed floor, a tiled floor clearly offers the opportunity of decorative qualities that combine with its architectural capacity, to finish off and cover spaces.

In the territory of the modern Barcelona, decorative floorings are first known from Roman *domus* houses and baths, and share techniques of execution and decorative motifs with the mosaics known throughout the Romanised world. With the introduction of ceramics in the mediaeval era, the cultures of the area experimented with highly ingenious arrangements, based on the alternation of single pieces in specific shapes and sizes. The mainly geometric motifs originated from the classical period, but the combination with their botanical stylisations and variations on mediaeval arrangements established a series of formal repertoires, developed in the exposed face of the materials, which would become a constant feature and enjoy long-lasting currency. This tradition can be observed to continue in the floors of Barcelona, remaining consolidated today, although it must be recognised that not many floorings from prior to the contemporary era can still be found day.

Two main factors contribute to this failure to survive. Firstly, the pre-eminently functional nature of the city's floor coverings, consisting mostly of undecorated ceramic or of slabs of stone from the mountain of Montjuïc, which rises next to the old city, contrasting with the ornamental floor coverings present elsewhere, in embellishment of Renaissance and Baroque churches and palaces. Second, during the great stage of transformation of construction materials as a result of industrialisation, preferences led to the substitution of a large part of the interior floorings of Barcelona's buildings, eliminating all traces of the previous ones. This phenomenon became apparent in the mid-19th century, thanks to the wealth of technical and formal possibilities made available by industrial production. The range of options became so broad that eventually the element of choosing the floor covering became a standard moment in developing the design of any interior space.

Not only that, the materials were also easily integrated into the culture of modern industrial design, as products capable of continuous improvements in technical features as well as in response to consumer tastes and market preferences, without forgetting their link with the dimension of social representation, always inherent in the architectural phenomenon. It is no exaggeration to affirm that floor coverings were the architectural finishes most quickly and decisively incorporated into the new forms of industrial production, inserting in the processes of innovation and mechanisation of procedures for the mass production of construction materials. Firstly, traditional processes were updated and techniques were diversified, responding to growing demand from the building sector, in turn descending from processes of economic growth and urbanisation. Secondly, remarkable efforts were made to combine the functional features of strength and durability with formal and aesthetic qualities, for the development of true decorative arts.

As well as responding to more insistent demands for economy, technical perfection, and hygiene in flooring, manufacturers and designers had also to address the quest for beauty. Thanks to the solutions offered, it became apparent that floorings could play their part in the decorative programmes for the interiors of the habitations being constructed in the second half of the 19th century. The offer was so diversified, attractive and affordable that, by the end of that century, industrial mosaics had invaded the floors of Barcelona and of larger Catalonia, in both newly constructed buildings and those from previous centuries, now being renovated. As we will see, 'hydraulic mosaics' were to be the great protagonists of this diffusion.

Industrial floorings

The first materials contributing to the new outlook for floors in Barcelona were those produced in ceramics, and the qualitative and technical leap was achieved by 'Nolla mosaics'. These were produced from 1860 onwards by the industrialist Miguel Nolla, in his new factory in Meliana (Valencia), granted the exclusive national rights for application of an English procedure of stoneware manufacture, achieving remarkable characteristics of hardness, compactness and impermeability. Nolla manufactured monochrome pieces coloured through their entire mass, in series of elementary geometrical forms. The main references for these geometries were the compositions descending from the era of Roma *opus sectile*, now achieved in standardised ceramic, either monochrome or at most in a simple bicoloured design. Their indisputable success in terms of a broad range of evaluative criteria made them one of the most often used covering materials during the era of Catalan Modernism, as demonstrated by the housing of Barcelona's main areas of expansion of the late 19th century, such as that of the well-known project of the Eixample, laid out by engineer Ildefons Cerdà.

The floorings contributed actively to the taste for spaces full of colour and rich in sensorial stimuli, but still comfortable (Rosselló 2005). The different living spaces inside houses could be distinguished thanks to the intensity of finishes, further graduated in accordance with the housing category. This enabled spaces assigned to social representation, in any home, to be distinguished from the more private rooms and service functions. The hierarchy obtained expressed new concepts of privacy, of balance between public and intimate spaces.

This new culture of inhabiting (Sala 2001), and the associated importance afforded to decorative finishing elements, permeated all residential architecture of the era. In this context, it was the 'hydraulic mosaic' that was best able to interpret the distribution of interiors through the diversification of floor coverings, changing from room to room. The most important spaces would be those distinguished by mosaic floorings whose arrangement imitated a coloured rug – with a three-part division into field, border and surrounding side band. In contrast, in the simplest of service areas, a single type of tile with a monochrome design would be laid continuously across the entire area (Fig. 1).

Fig. 1. Mosaic in the first commercial catalogue published by the Escofet company, 1891 (Teresa Navas Collection)

The hydraulic mosaic

After an initial period of gradual penetration, it was in the 1890s that the hydraulic mosaic arrived at predominance as the flooring 'par excellence' of Catalan construction, ultimately relegating the previous ceramic production to the level of a niche market. The first factory established in Barcelona was that of Francisco Garreta, in 1864, as a subsidiary of the Garreta-Gojon company, in turn based in the Marseille area (Fig. 2). Even though the company did not remain in business for long, it must be recognised that it transferred an innovative technique drawing on the advantages of cement, one of the greatest of the materials of industrialisation, at that time the subject of much research regarding its potentials for intensive application in the building sphere. Other companies then took over the manufacturing of hydraulic mosa-

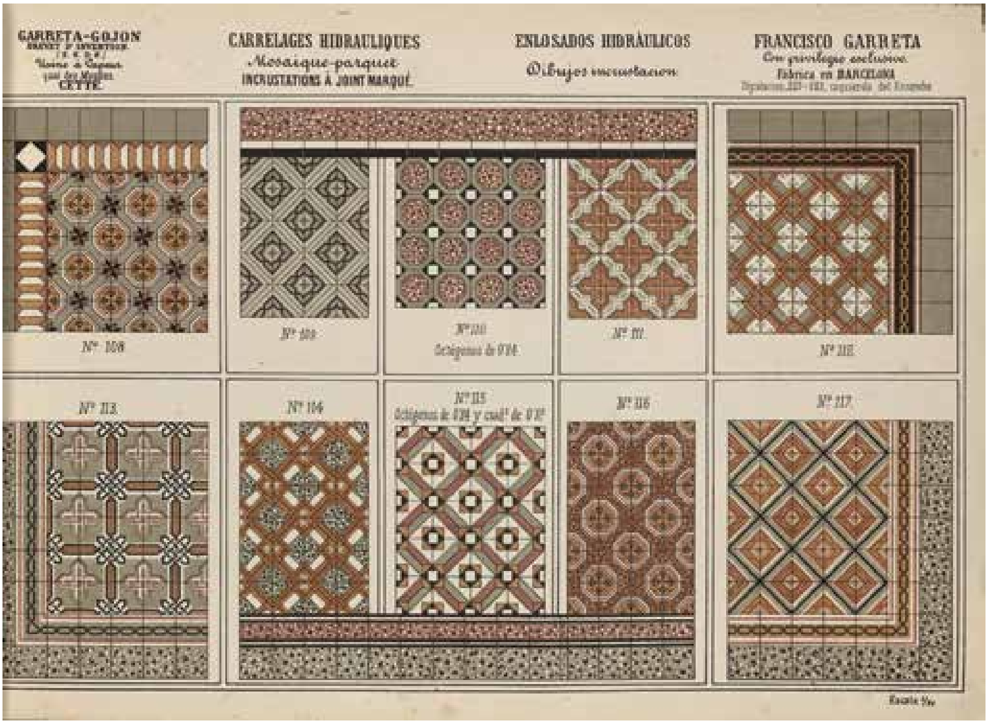

Fig. 2. Commercial catalogue of the Francisco Garreta hydraulic mosaic factory in Barcelona, no date (Arxiu Històric de la Ciutat de Barcelona)

ics in Barcelona, including Orsola, Solà i Cia, operating from 1876, and Butsems i Fradera, who since 1854 had already been producing artificial stone, granite and marble. Over time, major industrial establishments, but above all a proliferation of small workshops, were united in a form of production that required a certain level of industrial infrastructure, but still maintained elements of craft as parts of the procedure (Navas 2015).

The dual industry-craft aspect of the production of hydraulic tiles is witnessed in the manufacturing process. Each piece is obtained through the operation of an iron mould, compressing different layers of cement composed of dry materials of diverse qualities and dosages. A grey cement mortar makes up the first layer, or main part of the tile. Accompanying this is a second layer of cement powder with a certain level of silica sand, added largely with the aim of absorbing the excess water from the first layer. The last and most important layer, resulting as the face of the tile, is formed as a fluid mixture of cement, dry products and pigments. Control of its consistency is important, for purposes of ensuring even distribution in the mould, with uniform thickness. The design of this last layer is obtained by interposing a thin metal stencil, known as the *laiton,* responsible for the correct separation of the colours of the composition, and so the definition of the desired drawing within the surface of the tile. Once the iron mould has been filled

Fig. 3. Iron mold and metal alloy stencil for the manufacture of a hydraulic tile (Escofet 1886 S.A)

with the described layers it is subjected to heavy compression in a press – originally of a hydraulic type, hence the name of the product – obtaining a piece that is sufficiently solid for removal from the mould. Once 24 hours had passed the product could be stocked in piles (Fig. 3).

Among the available new materials, the hydraulic "mosaic" was the one that featured all the aspects most appreciated for the construction of the modern city: standardisation of 20 x 20 cm pieces, facilitating their installation and long-term maintenance, with reasonable cost and artistic qualities. This duality of strength and beauty was communicated through commercial catalogues made available to both market operators and individual consumers -meaning construction technicians, architects and end users – in a very broad range of design options.

It is necessary to recognise that the hydraulic mosaic, unlike any other flooring type, was capable of bringing together the entire repertoire of geometric motifs and stylised vegetal decoration that had been produced over the course of the centuries, and therefore had become classical resources of the overall decoration and ornamentation sector. The catalogues were very often true 'grammars of ornament', with a selection of patterns supplied under the style concept developed in the 19th century, with formal and material solutions and techniques extracted from the different phases of the history of art. However, even more importantly, in parallel, the hydraulic mosaic showed its great capacity for creation of new motifs in line with the aesthetic renewal of the *fin-de-siècle* in Europe by introducing the industrial design factor as a top-ranking business strategy (Fig. 4).

The Escofet hydraulic mosaic company

The pioneering and indisputably most interesting firm in terms of incorporating the design factor was the Escofet compa-

Fig. 4. Work on laying a hydraulic floor covering, image ca. 1900-1910 (Teresa Navas Collection)

ny, founded in 1886 under the name of Escofet i Fortuny. The founder was Jaume Escofet i Milà, who had learned the hydraulic technique with Orsola, Solà i Cia, and then committed to founding an enterprise with a capitalist partner capable of financing development of a factory with the industrial infrastructure for large-scale production, responding to the boom in housing construction. The factory was built in the most industrialised part of the city of Barcelona, the Poble Nou sector, alongside the railway line parallel to Spain's eastern coast (Fig. 5). With the Olympic Games of 1992, this entire urban area gave way to today's Vila Olímpica district.

At the same time, Escofet was personally concerned with inserting the company's capacities in the debate on renewal of the arts, taking place at the end of the 19th century. This led him to seek close collaboration with the most recognised artists and creators, for the design of exclusive mosaics to be inserted in the company's catalogues. Having decided on this proactive approach, Escofet achieved 'signature production', still measurable in the record left by the catalogues and their explicit communication of the authorships of the individual designs. Although the production of creator-signed mosaics was not exclusive to Escofet, the company was the first of the sector to adopt the approach, and its evolution of the option over time only served to consolidate its continuing status.

This aspect can be seen in the stable relationship established by the company from its early years, with the artist and decora-

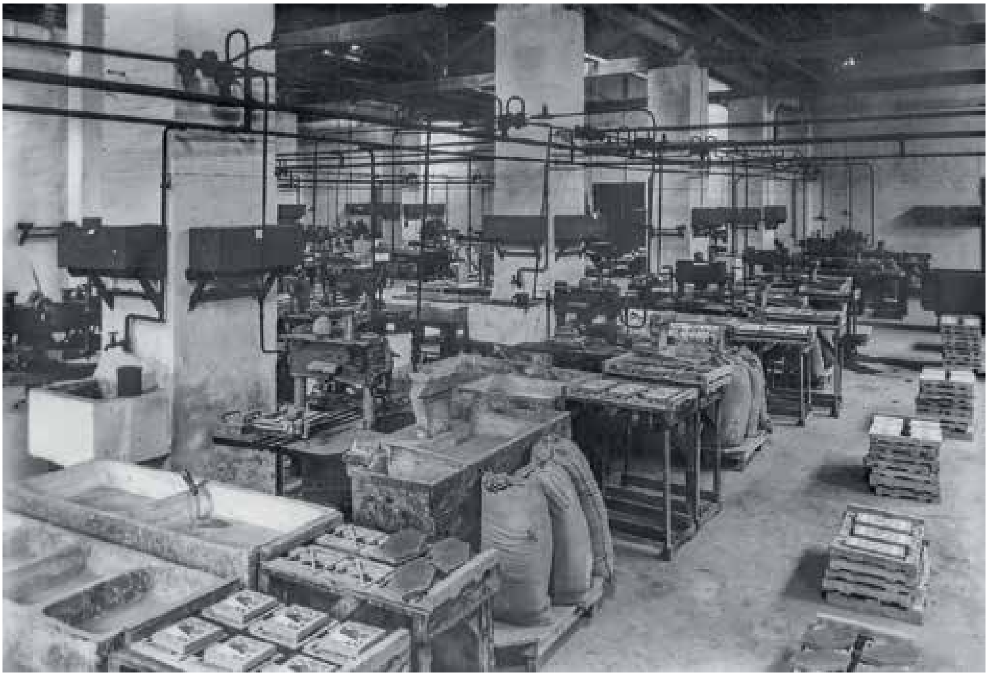

Fig. 5. Presses room at the old Escofet factory in the Poblenou district of Barcelona, image ca. 1930-1940 (Teresa Navas Collection)

tor Josep Pascó (1855-1910). There is no documentary evidence that Pascó held any official role as artistic director for Escofet, but in 1890 he assumed responsibility for the design of the façade of the shop, situated in the heart of middle-class Eixample of Barcelona. Moreover, in the company's first catalogue, published in 1891, he signed twenty-three models, a figure never equalled by any other collaborator (Fig. 6). During the early years of the 20th century he developed the company's commercial image, based on iconographic motifs originating from his mosaics for Escofet, in motifs fully framed within the new Modernist sensitivity.

It is significant that a recognised artist such as Josep Pascó should be chosen by the company, as the ideal creator for development of a specific, recognisable image, leading the company's participation in the stylistic tendencies that best identified the tastes of an upwardly mobile middle-class. In fact both Pascó and the multi-faceted artist Alexandre de Riquer (1856-1920), also a collaborator of Escofet, were important figures in the emergence of Catalan Modernism: the former influenced by English aestheticism; the latter a key figure in the introduction of the Arts & Crafts movement to Catalonia. These two were responsible for the creation of an iconographic repertoire aimed at renewal of domestic architecture and the attainment of refined, attractive and modern interiors. Later, Escofet would gradually expanded collaboration with the great creators of Catalan Modernist architecture.

Fig. 6. Interior of Casa Thomas with workshop (1898), designed by Lluís Domènech i Montaner, with the Josep Pascó mosaic from the Escofet catalogue of 1891 (photo Consol Bancells)

The fruitful relationship between industry and the main figures of Modernism resulted in creations in the applied arts that contributed to identity and qualitative substance for the Catalan Modernist movement (Navas 2017).

The maximum materialisation of this relationship between industry and art takes form in the publication of the Escofet Album-Catalogue of 1900. As a commercial catalogue it is certainly exceptional, large and luxuriously bound, at 55 x 44 cm; featuring 32 mosaics, all signed but one. Escofet issued this communication simultaneously with its appearance at the Universal Exposition of Paris in 1900, with the aim of introducing itself on an international market platform. Research is still under way as to what extent Escofet's production came to be exported on a European scale, however from the data currently available it would appear that the company's influence was confined to the Spanish mainland and colonial markets. However, what remains truly distinguishing is the desire to show itself with a production that was highly competitive and designed for an international market – a quite unusual practice in Catalan Modernism.

In any case, the so-called Album-Catalogue of 1900 represents a turning point in the history of Escofet. The catalogue featured the most charismatic architects and artists of turn-of-the-century Barcelona. It takes a step ahead in the professionalisation of design, with the role of the architect appearing forcefully above that of the artists, who had led the early years of the decor sector in Barcelona. This is undoubtedly a sign of modernity, in terms of the demand for designs to be used by the Escofet company, materialising in a product that adopted a rug-type composition, made with pieces measuring 15 x 15 cm, i.e. of a size smaller than the habitual cement tile of 20 x 20 cm. With the 1900 catalogue the company arrived decidedly closer to the provision of material suited to the highest level of commissions, with its carefully designed flooring, close to the qualities offered by compositions of what was then called 'Roman mosaic', formed of small pieces of stone. Once again, the catalogue illustrates the company's proactive and leading role in achieving a status of competence at the top market range.

A seemingly unanimous current of opinion is that one of the best mosaics in the

Fig. 7. 'Lizard' mosaic by Lluís Domènech i Montaner, designed for the Escofet Album-Catalogue of 1900 (Teresa Navas Collection)

1900 catalogue is the one signed by Lluís Domènech i Montaner (1850-1923), architect of great works of Catalan Modernism such as the Palau de la Música Catalana (1908). Characterised by floral and animal motifs, it is popularly called *de la sargantana* (the lizard), thanks to the reptile featured in the borders of the model. Twenty pieces are needed to form the composition, when the usual number in hydraulic mosaics was four. Its cost per square metre, 2.5 times more expensive than other mosaics in the catalogue, is the result of this formal complexity. 'The lizard' is rightfully valued as one of the most successful creations of Catalan Modernism (Fig. 7).

However, despite its undeniable originality, Domènech i Montaner did not design this mosaic with the thought of any specific location, which means its importance lies precisely in the fact that such a delicate creation was based on the demand from a company catalogue.

The other great mosaic of the 1900 catalogue is one designed by Alexandre de Riquer, known as 'the swan' due to the presence of the bird in this border, in fact representing the main protagonist of the composition. Neither did Riquer create his piece for any determined location; rather he used it profusely in design projects for high-level interiors, such as the renovation of the Cercle del Liceu within the Barcelona Opera House, between 1900 and 1903. However, its condition as a commercial catalogue piece became evident, as also occurred with the mosaic by Domènech i Montaner, when other architects used these models in very diverse spaces, ranging from rental apartments to summer houses and hotels (Fig. 8). In

Fig. 8. Casa Sans Moré in Tossa de Mar, Costa Brava, designed by Antoni de Falguera, (1906). Main courtyard with 'swan' mosaic by Alexandre de Riquer for the Escofet Album-Catalogue of 1900 (photo Teresa Navas)

short, these were independent productions, which despite their high level of singularity, had nothing to do with the conception of a design intended as a unique and therefore unrepeatable work of art.

Attention is also due to the hexagonal tile with marine motifs designed by Antoni Gaudí and ultimately used in the secondary rooms of his work known as *la Pedrera*, in 1906: the architect executed a masterly reinterpretation of continuous flooring, achieved by breaking with the typical coloured-rug convention of the hydraulic mosaic and substituting it with monochrome single-form tile, in subtle relief (Fig. 9). A masterpiece dating to the origins of Catalan design, its versatility has led it to become a paving stone for public spaces, and its current identification as an icon of the city of Barcelona (Navas 2014).

In the 1920s, the hydraulic mosaic became indisputably dominant as the hegemonic flooring material of the city, until practically the 1950s. Hydraulic mosaics from the most important sectoral companies, such as Escofet, Butsems y Fradera and Orsolá Solà, were capable of evolving with the changing tastes of the early to mid century. The entry of the new cultural and artistic guidelines of *Noucentisme* also affected the designs of the floors of buildings, which would increasingly tend towards the value

Fig. 9. Hexagonal mosaic tile by Antoni Gaudí, used in his design for the La Pedrera bulding, Barcelona (1906) (Escofet 1886, S.A)

Fig. 10. Mosaic designed by architect Rafael Masó for the Escofet catalogue of 1916 (Teresa Navas Collection)

of extreme simplicity. Against the outburst of colours and formal resources of the Modernist phase, what was now witnessed was a reduction in the palette, a preference for greys, two-tone black and white and, above all, the combination of pieces with diverse geometries. The new generations of architects opted increasingly for more contained forms, for pieces with variable dimensions that offered fairly versatile possibilities for design (Fig. 10). By the late 1920s, monochrome tiles, or alternatively those in a light motif, were laid as unitary flooring throughout an entire house without distinguishing the different rooms. These substituted the previous rug-type compositions, generalising the single-colour tile with the aim of attributing the flooring with sufficient decorative discretion to be considered as the best "receptacle" for the furniture to be placed above it.

Conclusions

Beginning in the mid-19th century, industrially produced mosaics "invaded" the floors of Barcelona, and by extension Catalonia. Among them, the hydraulic mosaics were the great protagonists of the expansion.

The new material of cement, together with the perfection of the necessary machinery and technical processes, permitted the fabrication of floorings that could demonstrably offer the combined capacities of visual richness and formal diversity, seen in the repertoires produced through the entire history of art. Meanwhile, the so-called 'hydraulic mosaic' was the one product in this new material which best interpreted the need for singularised treatment of domestic interiors, from the most representative of spaces to more functional rooms and simple services.

The richness of the material was demonstrated in the commercial catalogues. And excelling among those companies working in hydraulic tile production was Escofet. The fact that this firm opted for a high-intensity industrial infrastructure is quite remarkable – particularly in a context where small workshops would continue to proliferate – however, even more remarkable is the company's insistence on design, in this phase of *fin-de-siècle* artistic renewal. This aspect of the company's internal demand has remained invariable in Escofet, which still survives to the present day in the prefabricated cement products sector.

Escofet, therefore, had a constructive influence in shaping the Barcelona design market (Calvera 2013). Since its foundation, its approach has embodied the distinctive characteristics that enable evolution from the binomial of art and industry towards industrial design, in the modern sense: integration of design in the business strategy; production that is autonomous of individual architectural projects; dissemination through commercial catalogues and media; establishing links with contemporary cultural and social factors. Last, but not least, accepting the influence of market preferences on the characterisation of its designs, in other words the interventions of the chain of agents from those that design the piece through the enabling technicians, to end users and consumers. Because in industrial design, as recalled by professor Isabel Campi, it is essential to account for both the issuer and receiver, as part of an *"...ideological phenomenon, which implies ideas, creativity, tastes, styles and sentiments"* (Campi 2011).

Notes

1. The author received the verbal description of the manufacturing process for hydraulic mosaic in May 1986, from Josep Maria Farré-Escofet, who had entered the family company in 1929 and served as managing director from 1939 to 1973.

References

Calvera A. 2013. "La formació del mercat del disseny a Barcelona: significació del Modernisme català en la història local de disseny". In *I Congrés internacional Coup de foue. Barcelona*, 26-29 June 2013 http://www.artnouveau.eu/ca/congress_mainstrands.php?strand=5

Campi Valls I. 2011. *Reflexions sobre la història i les teories historiogràfiques del disseny: Discurs d'ingrés de l'acadèmica Isabel Campi i Valls*. Barcelona: Reial Acadèmia Catalana de Belles Arts de Sant Jordi.

Navas T. 2014. "The Gaudí floor tile: memory, trajectory and identity in Catalan industrial design". In *Tradition, Transition, Trajectories: major or minor influences? ICDHS 2014 - 9th Conference of the International Committee for Design History and Design Studies*. 341-346. Aveiro: Blucher Publishers.

Navas T. 2015. "Les arts decoratives més industrials". In *Modernisme. Arts, tallers, indústries.* Exhibition catalogue, 116-129. Barcelona: Fundació Catalunya La Pedrera and Viena Edicions.

Navas T. 2017. "Trajectòria Escofet dins el disseny català. El mosaic hidràulic. 1886-1939". In *Escofet, símbol industrial de Barcelona*: *Arts, disseny i arquitectura en la creació de valor*, edited by E. Farré Escofet, 333-358. Barcelona: Angle editorial.

Paricio Ansuátegui I. 1981. "La construcción en ruina: El forjado y la cubierta plana como muestras del progresivo deterioro de la técnica constructiva". *CAU*, 73: 49-64.

Rosselló M. I. 2005. "*L'interior a Barcelona en el segle XIX*." PhD diss., Universitat Politècnica de Catalunya.

Sala T. M. 2001. "Historiar la casa. Aproximaciones a la historia del mobiliario y del diseño de interiores de Cataluña (1860-1914)". In *Historiar desde la periferia: historias e historias del diseño*. *Actas de la 1a Reunión Científica Internacional de Historiadores y Estudiosos del Diseño, Barcelona, 1999*, edited by Calvera A. and Mallol M., 157-165. Barcelona: Publicacions Universitat de Barcelona.

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CONCRETE AND THE REVIVAL OF MOSAIC AND *TERRAZZO* FLOORS IN ATHENIAN ARCHITECTURE

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Abstract

For the city of Athens, the most creative architectural phase of the past century was the Interwar period, beginning around 1922 in the Greek case, and ending with World War II. The present paper explores the use of mosaic and *terrazzo* floors in the buildings of the new architectural languages of those times: Neo-Academic, Popular, the Modernist movement and Modernism. All of these currents were characterised by the use of concrete, the most important of the modern materials, including in the fabrication of floor finishes. The investigation reported responds to a knowledge gap, since there have been no publications on the matter. Based on field research into a sample of buildings, representing each of the four identified currents, it finds that the ancient flooring techniques were adapted to the modern architectural context, modified only by the use of concrete. The different kinds of floors were chosen in relation to the socio-economic class of the building users, and the function and representational significance of their spaces. In the case of Modernism, the use of *terrazzo* floors is found to be an inseparable part of the language. The ultimate aim of this research is to create awareness of the material, historic and financial values of these floors, promote their safeguard as inseparable elements of Greek architectural history, and ultimately, to show respect for the people and events of those times.

Keywords: *Terrazzo*, concrete, Modern architecture, Athens, Interwar

Introduction

The present paper aims at analysing and understanding the use of *terrazzo* and mosaic floors in Interwar buildings of the Greek capital, Athens, and the issues in their conservation.

Mosaics and *terrazzo* are ancient arts used in different architectural contexts, since they offer both excellent mechanical characteristics and possibilities for artistic creativity. Floors are one of the major witnesses in the culture of habitation through the centuries but have often been undervalued or even destroyed (Bucci *et al.* 2006). The main objective of this study is therefore to stress the significance of these ancient artistic forms in a modern context, and therefore the importance of their preservation.

Since there has been little previous attention to the subject, the aim of the current study is to provide as much relevant data as possible, organised in a series of main themes. First, the historical and social context of Athens during the Interwar, then an overview of the main concrete-based flooring techniques and, finally, an analysis of architectural styles and the relative choices for their floor finishes.

Geographical, historical and social context

In most contexts the "Interwar period" refers to the years from 1918 to 1939, between the signing of armistices at the conclusion of the Great War and the onset of World War II. However the interwar in Greece starts later, at the final conclusion of the Second Balkan War and the subsequent Asia Minor Campaign, which closed disastrously in 1922. These were turbulent and tragic times, still with effects in contemporary Greece.

Athens, the capital, situated in the south-eastern part of mainland Greece, maintains a deep relationship with its monumental and historic context: a natural consequence for a city that has been continuously inhabited for some 6500 years. What tends to be lost in this continuous view of history is that there was a starting point for the form of the contemporary capital. The new free state of Greece was founded in 1830, and the city of Athens was legislated as its capital in 1833. The flow of slow constant development that begun in 1833 was interrupted by the Great War, a hiatus that continued through the Balkan and Greco-Turkish wars. The events exhausted the country morally and financially. Unlike the other European states, Greece was still at war in 1919, having been entangled in the Asia Minor Campaign. The disastrous ending in 1922, in which tens of thousands of people were killed and survivors became refugees on Greek territory, contributed strongly to the first population explosion of Athens (Clogg 2002), indeed Kaplan (2002) estimates that the war refugees tripled the population of Athens virtually overnight.

Therefore, for Athens, one of the great problems requiring resolution during the interwar years was the housing of these people, within the broader context of their social and economic integration, at the same time within an unstable political context. However the Interwar also represented a period of hope and vigorous redevelopment for the city, visibly manifested through architectural creations. With the disastrous conclusion of 1922, there came the realisation that the politics of war had failed (Ladogianni 1989) and that a new era of national reconstruction and modernisation was necessary. The starting point would be Athens, transformed from historic capital to international Metropolis.

Amidst continuous friction between conservative "old" and new "modern" currents, innovative and interesting experimentations would develop in all of the arts, but especially in architecture. Cholevas (1994) defines this period of continuous development as one embodying an *architecture of transition*. The grounds for development of new architectural languages were the appearance of the industrial revolution, delayed with respect to other countries, and the new social and economic context.

The two main characteristics of experimental development were the elimination of academism and the use of new materials as an expression of the new style of urban life (Cholevas 1998). In terms of the new materials, it was only during this period that concrete entered extensive use, even though the first concrete building of the city had been constructed in 1907 (Vatopoulos 2000). Reinforced concrete became widely produced in Greek factories, and though it did not yet possess all the qualities seen in other European countries, from this point onwards characterises then national building technology, up to the present day (Fessa-Emmanouil and Marmaras 2005).

Generally speaking, the interwar development of the Athenian built environment took place in a highly wavering architectural context. Distinguished architects continued in their personal evolution, executing works in completely different styles and even mixing them in a single building. Still, the following main styles can be identified, for analysis in relation to the choices of floor finishes: Neo-Academism, Popular, Modernist, and Modern Movement.

Terrazzo, mosaic, cement

Mosaic and *terrazzo* have obvious similarities in terms of materials and techniques of execution, just as there are obvious differences. In both cases the constituent materials include stone or other hard materials and a bedding mortar. As Tosi (2004b) reports, when analysis fabrication, the *battuto* mortar of *terrazzo* can be incorporated into the preparatory laying layers of contemporary mosaic. Bosia (2002) reflects that even the most modern culture of construction has never entirely repudiated traditional flooring techniques.

Nevertheless, the term “mosaic” is often used indiscriminately or ambiguously in naming floors made by different techniques (Guarino 2004). The confusion is deeper in Greece than in some other contexts because, in common parlance, the term *μωσαϊκό* (mosaic) refers to floors made by *terrazzo* technique, while what are ‘mosaics’, for rest of the world, are instead ‘ψηφιδωτό’ (‘tessellated’). To clarify the matter, the following provides a brief review the passage from *battuto* to *terrazzo* floors, as well as at some basics in the evolution of the mosaic production.

From battuto to terrazzo

The *battuto* floor – a Latin or Italian term, but commonly seen in international scientific studies – has been translated into English, according to Farneti’s glossary (1993) as ‘cement pavement’, ‘lime-mortar’, and ‘beaten’ floor. In depicting this flooring technique, Fiorentini (2001) describes how Friulan artisans developed a treatment of the *battuto* floor surface to obtain a more compact and brilliant finish, by smoothing and polishing after the mortar was set. From then on, these kinds of floor finishes would be called ‘terrazzo’. The significant change in the fabrication technique came about with the substitution of lime mortar by Portland cement, in the mid to late 19th century, which also achieved quicker installation and harder finished material.

From battuto to mosaics

During antiquity, the insertion of patterns of pebbles, stone chips or tesserae characterised a development in the floor finish techniques and a transition from the *battuto* floors to mosaics. However, as Dunabin (1999) argues, this is not a matter of a full transition from one to the other, since the use of both mosaic and *battuto* floors would continue through time, in the same houses and even on a single floor level, in relation to the function and significance of the rooms (Orsini 2004).

Two key evolutions occurred in mosaic production during the modern era. The first, originating again Italy and in Friuli, was the invention of the indirect method, around 1869-1874 by the artisan Facchina (Tosi 2004a). The second, at the turn of the 19th to 20th century, was the development of industrially produced porcelain tile suitable for flooring and external spac-

Fig. 1. Detail of precast ceramic tesserae thickness, Loverdou -Ziller mansion (photo by L. Tapini)

es, which could then be used for production of pre-formed tesserae. This opened up new prospects in mosaic production: the colour range became unlimited, and by combining precast tesserae with the indirect method, it moved the production of mosaics from the arena of solely artisanal and artistic production into the industrial area (Lavagne 1988).

A final event involved the substitution of lime with Portland cement, where, thanks to the strong adhesive power, it was no longer necessary to plant the tesserae deeply into the mortar. This allowed for thinner tesserae (Fig. 1), and also meant that the preformed tesserae, now thinner than those cut by hand, reduced the total weight of an equal area of mosaic. Among other considerations for construction, this facilitated the transportation of works created in a workshop using the indirect technique.

Floorings and reinforced concrete

The mosaic and *battuto* techniques remained essentially unaltered over time, although there were certainly stylistic variations across space and time. The most significant alteration was the eventual substitution of lime mortar for a cement based mix, which provided more durable, water-resistant floors and enabled much more rapid execution. It was this relatively minor modernisation in techniques of fabrication that was most important in permitting the incorporation of *terrazzo* and mosaics in the buildings of interwar Greece. As already mentioned, since that time, buildings in Greece are mainly developed in reinforced concrete, so there a "concordance" of materials between the core construction and the *terrazzo* or mosaic floors.

Athenian interwar architectural styles

Neo-Academism

Greek Neo-Academism mixed different stylistic currents, including those of German Classicism, Eclecticism and the Beaux Art tradition (Giacumacatos 1999). The architects involved, mainly in public buildings commissioned for the city centre, aimed at creating a coherent context of urban architecture within the Greek capital, worthy of European identification, even if only in ornamentation. Neo-Academism utilised modern materials but drew on older motifs, for development of structures with a nostalgic aspect. Socially, the current of Neo-Academism in interwar architecture has been related to conservative thinking and resistance to innovation or change.

Popular Architecture

In 1911, Aristotelis Zachos published "Popular Architecture", a short manifesto emphasising the need for a new, genuine national identity in architecture (Cholevas 1994). The socio-political aspect of Popular Architecture was very significant, as it countered the longstanding vision of a glorious antiquity carried forward. For the architects of this current, the Byzantine years had a more direct influence on the material culture of the population, but this had been repressed in the views of contemporary Greece within the European context. After the humiliation of the Asia Minor disaster, strongly blamed on the European Powers, this movement expressed its resistance by returning to the natural roots of popular tradition (Fessa-Emmanouil and Marmaras 2005).

Modernist Architecture

In Greek constructions of the Interwar, Modernist architecture represented a trend opposing that of Neo-Academism. Biris (2003) describes how this movement, present mainly in the 1920s, opposed conservatism by proposing models that incorporated elements of Art Nouveau and Art Deco. Art Nouveau is closely integrated with the Industrial Revolution, which developed quite late in Greece, beginning only at the close of the Second Balkan War (Vatopoulos 2002). Another social factor that supported the diffusion of Modernist architecture was the arrival of refugees from Asia Minor, including both architects and general populace, who were already familiar with and greatly enjoyed the forms of this movement.

Modern Movement

Following all the architectural experimentation prior to the 1930s, Athens was then ready to embrace Modern Movement. Just as in the rest of Europe, this movement developed in natural relation with diffusion of modern materials, especially the use of reinforced concrete. These new materials promoted the vertical development of buildings, as well as offering other new solutions for structures and architectural finishes.

For the Greek state, the acceptance of Modern Movement was a necessity, considering the housing crisis stimulated by refugee arrivals, and the obligations of presenting a new face towards a regenerating society. Modern architecture represented a realistic and communicative solution for the three main state construction programmes: those for school buildings, hospitals and social housing (Tournikiotis 1999). For the private sector and the newly formed urban middle class, Modern Movement was equally welcome. Private investors identified with the modernisation of society in general, hence their appreciation of the Movement for its systematic approaches and potentials in generating social equilibrium (Fessa-Emanouil and Marmara 2005). The middle class adoption of Modern Movement meshed well with the new institution of sub-division of real property, made possible by multi-storey buildings, which immediately became the most common type of dwelling construction in Athens and continues in this role today. The new multi-storey building enabled the ideal housing solution: a Mediterranean version of Bauhaus, ornamented with Art Deco elements, meaning yet another situation of the integrative use of multiple architectural styles.

Concrete-based floor finishes

Portland cement or "concrete mortar-based" floors can be seen in different areas of the buildings of all the above architectural types, indoors and outdoors (Fig. 2). Unfortunately, in the flourishing bibliography on interwar architecture, floor finishes are not usually considered important, and there is just one mention

Fig. 2. *Terrazzo* with original logo of the Café Brazilian, ex- Army Share Fund Building constructed between 1928-1940 (photo by L. Tapini)

of *terrazzo*, concerning a use in urban apartment dwellings (in Papadam-Riza 2002). For this reason, our research on the relations between architectural types and the choice of floor finishes, as well as the preservation status of the floors, was conducted through onsite visits and data collection. The research identified examples of flooring in each architectural style, which were examined *in situ*, documented and catalogued, thus allowing a comparison on the choice of floor finishes, their position in the building and their status of preservation.

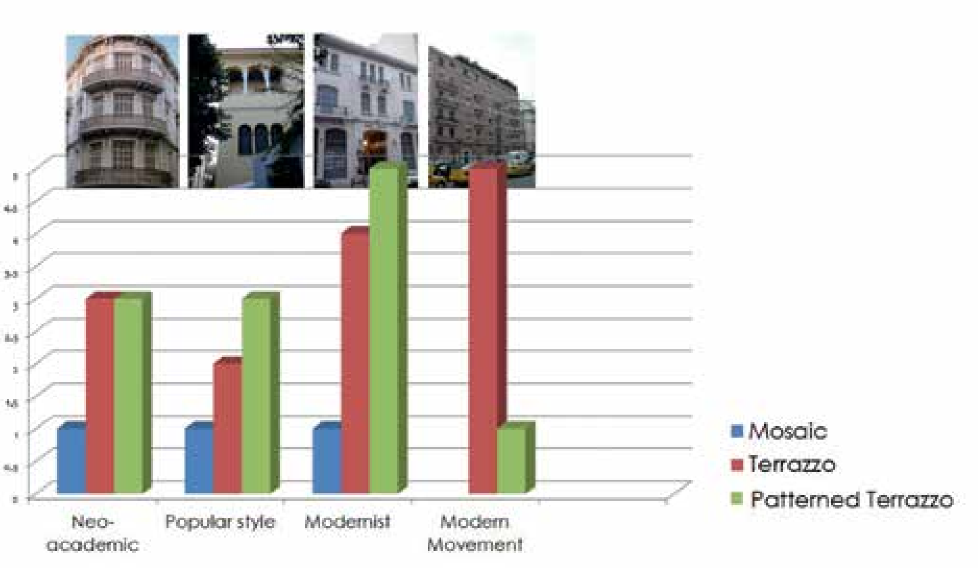
The analysis of the case studies typo very soon revealed that the use of mosaic floor

Fig. 3. Details of *terrazzo*, patterned *terrazzo* and mosaic of the Athenian Interwar (photo by L. Tapini)

finishes in the interwar buildings of Athens was very limited, in contrast to the widespread use of *terrazzo* flooring. For more constructive continuation of the research, we then identified of three flooring types: *terrazzo*, patterned *terrazzo*, and mosaic (Fig. 3).
Some first indications from the research is that among the Interwar architectural styles: mosaic was completely ignored within the Modern Movement; *terrazzo* was used within all currents, yet with a distinctive predominance of patterned *terrazzo* in the buildings of the Popular style and Modernist movement (see Table 1). What follows provides more detailed observations on the relations between choice of floor finishes and architectural style, location within the building, and symbolic significance.

Terrazzo

Simple or monochrome *terrazzo* was found in all the case studies, revealing the use of this technique in all four architectural styles, extensively through time, with execution in widely varied mortar and aggregates, colours and grain sizes. However the choice of location for these floors was directly affected by the social status of the building itself, in particular whether the construction was intended as prestigious or simply functional.
In the case of "poor" construction, mainly for housing of refugees, *terrazzo* floors offered a hygienic environment at very modest prices, with the possibility of simple decoration. *Terrazzo* thus came to be used in all areas of the apartment and the courtyard, varying in colours and aggre-



gates so as to define the different rooms (Fig. 4).

On the other hand, in urban constructions of the city centre and in some public buildings we find *terrazzo* mostly in the secondary and/or service areas: bathrooms, corridors, balconies, auxiliary entrances and servant rooms (Fig. 5). The rest of the house would be finished with more prestigious and expensive wooden floors. These cases, particularly as concerns housing, demonstrate very clear social discrimination. The emerging urban class wished to differ from the houses of the poor, and since *terrazzo* did not provide such distinction, and was appreciated only for its high resistance and hygienic qualities, it was only used in the necessary applications of secondary and service areas.

Patterned Terrazzo

Patterned *terrazzo* can be classified as an intermediate solution between mosaics and simple *terrazzo*, in that these types proposed decorative motives of ancient mosaics but by creating zones of differing colours, or by the geometric insertion of marble slabs. Patterned *terrazzo* floors are found in important parts of the buildings, such as entrances, main halls and main corridors, demonstrating that they were made to attract attention and respect. Indeed the architects of the time found a strong ally in concrete *terrazzo*: they could create durable floors, compatible with the concrete structure of the building, at the same time with ornamentation, thus adding decorative value to their building.

Patterned *terrazzo* can be found in all the interwar architectural types, however these decorative works are found only in buildings initially designed as housing for the emerging urban class, or for significant public buildings. Exceptional examples can be found in some Modernist constructions (Fig. 6). So once more we have a symbolic distinction: the application of

Fig. 4. Two-storey residence in Modern style, constructed 1936, with alternating colours of mortar used for the floors of each room (photo by L. Tapini)

Fig. 5. Two-storey residence in Popular style (now Aggeliki Hatzimihali Folk Art museum), constructed 1924-1930 (photo by L. Tapini)

Fig. 6. Modernist, four-storey apartment building by V. Kouremenos, constructed 1930, with extensive use of patterned *terrazzo* (photo by L. Tapini)

Fig. 7. Byzantine Museum**,** constructed 1840, with renovation by A. Zachos, 1926-1930, showing integration of lacunae in a Byzantine *opus sectile* (photo by L. Tapini)

a technique serving the lower classes, but developed in a more prestigious manner.

Three notes on the use of terrazzo

Before moving on to mosaics, the case of the Byzantine Museum, originally built as a residence in 1840, deserves particular note. Beginning in the late 1920s, the main building was renovated as the first national Byzantine and Christian Museum, by Aristoteles Zachos. All the floors were finished in *terrazzo*, and on the ground floor, in two rooms replicating the interior of a Byzantine church, the lacunae of a re-laid Byzantine *opus sectile* were integrated, completing the original patterns, using marble slabs and fine *terrazzo* (Fig. 7).

We should also note the extended use of both simple and patterned *terrazzo* in public buildings, such as hospitals, schools, and universities. We can clearly understand from these notes that the architects of the time had realised the value of this material as a very economical and resistant solution for large areas, also one that could harmoniously integrate with whatever architectural language was of interest.

Finally, we can note the diffused use of patterned *terrazzo* in the entrance halls of Modern Movement's multi-dwelling buildings, which are important representational areas of such constructions (Moiras 2001). This and other aspects of the widespread use in Modern architecture indicates that *terrazzo* was particularly appreciated by the designers of this movement, and should therefore be considered an inseparable element of Modern architectural language.

Mosaics

Only three of the buildings examined contained mosaics floors. The author has also received personal communication from the architect E. Kalliga (2009) of the presence of a courtyard of mosaics in the Kanellopoulos mansion (now demolished). Apart from their rarity, what is also significant in all four cases is the prestigious character of the buildings: the Bank of Greece, where vitreous glass tesserae were used; the Loverdou-Ziller mansion, now a private museum, where ceramic tiles were used (Fig. 8); the Pallas Theatre, the greatest of all the Balkans when built, again with ceramic tiles (Fig. 9). These were all exclusive constructions, whose public or

Fig. 8. Detail of signature on precast ceramic tesserae, Loverdou - Ziller mansion (photo by L. Tapini)

Fig. 9. Detail of precast ceramic tesserae mosaic in the lobby of Pallas theatre, ex- Army Share Fund Building, constructed 1928-1940 (photo by L. Tapini)

private owners were among the few who could afford such luxury during an economically difficult period. The choice of mosaic flooring again has strong symbolic value, providing significant distinction from the wider public, for those who could afford such decorative elements.

Final notes

In closing this report based on field research, it is worth noting that not only was *terrazzo* found in all the interwar architectural styles, but it is also the most frequent of the three choices.

A direct relation between the architectural current and the choice for or against a specific flooring could be observed only in the Modern Movement. Mosaic was not used in any building of the Modern Movement observed, given that the aesthetic and complexity of the technique were both antithetical to movement's principles of simplicity and functionality. Apart from that there is no unique connection between the architectural style and the choices of floor finishes. In all other architectural currents there are buildings with each of these floor finishes, or even two of the finishes, and with variations in technique, colour and location.

Within all the architectural currents there is however a relation between the floor types and their selection for location within the building, and so also for the social values and significances attributed to the types. Such symbolic communication is best summed up in the example

Fig. 10. Bank of Greece, in Neo-Academic style, constructed 1933-1938: the contrast of simple *terrazzo* in the back working corridors versus glass mosaic in the representational atrium (photo by L. Tapini)

of the Bank of Greece, where the mosaics made from imported Italian material are located in the most important central hall, while the third floor, intended only for the traffic of employees, has simple *terrazzo* floors (Fig. 10).

CONCLUSIONS

The history of our cities and their inhabitants is incorporated in and expressed by their architecture (Zivas 1991). The preservation and safeguard of the architectural past is therefore an act of respect towards history. Safeguarding the architecture of the difficult times that marked the creation of the modern urban society of Athens is of crucial importance, of respect towards the events of those times. However, in Greece, beginning with the foundation of the modern state, architectural continuity has repeatedly been disrupted, sacrificing recent testimonies for the sake of the ancient, glorious past (Lavvas 1983).
In the case of the four main architectural styles of the Athenian Interwar, the main ones easily salvaged are the Neo-Academic constructions, obviously perceived as monumental. In the cases of the preservation of *terrazzo* and mosaic floors, there are significant differences. In this research, in the case studies where floor mosaics were found, the buildings were intended to be monumental. They are usually listed or widely recognised as significant, so public awareness of the value of their architectural finishes and consequently of the necessity for their conservation comes as a natural reaction.
Terrazzo, on the other hand, is widely undervalued, and due to the large quantity of Interwar buildings in Athens, the key for its preservation is public recognition. People and public awareness are the key for safeguarding the undervalued *terrazzo* floors of the Athenian Interwar. Once the citizen realises the historic and financial value of these constructions and their constituent elements, they can actively participate in their conservation through the inexpensive solution of ordinary maintenance. In order to save *terrazzo*, an everlasting flooring technique and inseparable element of Greek architectural history, it is vitally important to divulge its historical, symbolic and aesthetic values.

REFERENCES

Biris M. 2003. Αθηναϊκή Αρχιτεκτονική 1875-1925 (Athenian Architecture 1875-1925). Athens: Melissa

Bosia D. 2002. "La tecnica 'moderna' del Mosaico", in *I Mosaici Cultura, Tecnologia, Conservazione*, edited by Biscontin G. and Driussi G., 380-388. Venezia: Arcadia Ricerche.

Bucci G., Farioli R., Guarieri C. 2006. "Mosaici di Ravenna e del Mediterraneo." In

Santi Bancheri Re. Ravenna e Classe nel VI secolo, edited by Andrea Augenti and Carlo Bertelli, 84-96. Milano: Skira.

Cholevas N. 1994. Αρχιτεκτονική του μεσοπολέμου στα Βαλκάνια (Architecture of the interwar in the Balkans). Athens: Filippoti.

Cholevas N. 1998. Η Αρχιτεκτονική της μετάβασης στην Αθήνα του μεσοπολέμου *(Architecture of transition in Athens of the interwar).* Athens: Libro.

Clogg R. 2002. Συνοπτική ιστορία της Ελλάδας 1770-2000 (A concise History of Greece). Athens: Katoptro.

Dunabin K. 1999. *Mosaics of the Greek and Roman World*. Cambridge: Cambridge University Press

Farneti M. 1993. *Glossario tecnico-storico del mosaico: con una breve storia del mosaico= Technical-historical glossary of mosaic art: with an historical survey of mosaic art.* Ravenna: Longo Editore

Fessa-Emmanouil E. and Marmaras B. 2005. *12* Έλληνες Αρχιτέκτονες του μεσοπολέμου *(12 Greek Interwar Architects).* Heraklion: Crete University Press.

Fiorentini-Roncuzzi I., Fiorentini E. 2001 *Mosaico. Materiali, tecniche e storia.* Ravenna: MWeV.

Giacumacatos A. 1999. "From Conservatism to populism, pausing at Modernism." In *Greece 20th century - Greece,* edited by Kontaratos S. and Wang W., 26-39, Munich: Prestel.

Guarino M. 2004. "La lunga stagione di un'arte minore." In *L'immagine e il frammento - Il mosaico in Emilia-Romagna*, edited by Micaela Guarino, 13-25. Bologna: Editrice Compositori.

http://online.ibc.regione.emilia-romagna.it/I/libri/pdf/immagine_frammento.pdf

Kaplan R. 2002. Φαντάσματα των Βαλκανίων *(Balkan Ghosts),* Athens: Roes.

Lavvas G. 1983. 'Θεσμική προστασία της Ελληνικής Παραδοσιακής Αρχιτεκτονικής: Φάσεις- Αντιφάσεις – Κίνδυνοι' στο Συντήρηση και Αναβίωση Παραδοσιακών Κτιρίων και Συνόλων (Constitutional protection of the Greek traditional architecture: Diction – Contradiction – Dangers in *Conservations and revitalisation of Traditional Buildings and Urban complexes*), 126-140. Thessaloniki: University Studio Press.

Ladogianni G. 1989. "Το περιοδικό "Ιδέα» 1933-1934. Παρέμβαση στην κοινωνική κρίση και την αισθητική αναζήτηση." (Magazine Idea 1933-34, Interference with the social crisis and the aesthetical research). PhD diss., Ioannina University.

Lavagne H. 1988. *Il mosaico attraverso i secoli*. Ravenna: Longo.

Moiras N. 2001. "The entrance to Apartment Buildings of the Interwar period." In *Urban House of the 30s,* edited by Fillipides D., 43-50. Athens: Nireas.

Orsini B. 2004. "Archeologia musiva in Emilia- Romagna." In *L'immagine e il frammento - Il mosaico in Emilia-Romagna*, edited by Micaela Guarino, 35-43. Bologna: Editrice Compositori.

http://online.ibc.regione.emilia-romagna.it/I/libri/pdf/immagine_frammento.pdf

Papadam-Riza, E. 2002. "Η συμβολή της πολυκατοικίας στη γέννηση της ελληνικής οικοδομικής" (Contribution of urban multi-dwelling in the birth of contemporary Greek construction). PhD diss., Athens E.M.P. Polytechnic University.

Tosi M. 2004a. "Dal mosaico paleocristiano al mosaico moderno" In *L'immagine e il frammento - Il mosaico in Emilia-Romagna*, edited by Micaela Guarino, 85-93. Bologna: Editrice Compositori.

http://online.ibc.regione.emilia-romagna.it/I/libri/pdf/immagine_frammento.pdf

Tosi M. 2004b. *Il Mosaico Contemporaneo. Tradizione, evoluzione, tecnica e conservazione*. Milano: Mondadori.

Tournikiotis P. 1989. "Social Aspiration and Modern Architecture in Greece during the Twenties and the Thirties." In *DOCOMOMO Vth International Conference Proceedings: Vision and Reality, social aspects of architecture and urban planning in the modern movement, Stockholm September 16–18, 1998,* 241-245. Stockholm: Docomomo Sweden

Vatopoulos N. 2000. "Η Αθήνα σήμερα." στο Αθήναι από την κλασσική εποχή ως σήμερα ("Athens today." in *Athens form the Classic ages till today*), 370-397, Athens: Kotinos.

Vatopoulos N. 2002. Το πρόσωπο της Αθήνας (The face of Athens). Athens: Potamos.

Zivas V. 1991. Τα μνημεία και η πόλη *(Monuments and the city).* Athens: Libro.

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MOSAIC CONSERVATION METHODS IN RESTORATION OF VENETIAN TERRAZZO FLOORING

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Abstract

The techniques of *pavimenti alla Veneziana,* or Venetian flooring, were developed beginning in the Medieval and since the 15th century have been recognised as a form of high craftsmanship, with their use extending throughout much of Italy. As well as offering great beauty, these floors have highly useful technical qualities, including great flexibility and resistance to stresses. This aspect allowed the floors of a 19th century building in the city of L'Aquila to withstand the devastating earthquake of 2009, without major damage. The aesthetic and technical qualities of these floors, with ornamental patterns, compare to the finest mosaics. The qualities of the floors of Palazzo Visconti justified the decision of full restoration, to be conducted using techniques identical to those for conservation of mosaics. The thin surface layer containing the marble granules was detached, followed by *restauro al dritto,* or "front side restoration", and then re-laying of the floors in their original locations.

Keywords: Venetian floor, restoration, L'Aquila, Palazzo Visconti, *terrazzo*

Preface

The floors known by the Italian term *terrazzo* are now popularised throughout the world with both that name and as "Venetian floors". Such floors are in fact very common in the older buildings of Venice, both in rooms used for daily activities and in the elegant spaces intended for relaxation and public presentation. The beauty of these floors lies in the wide range of colours and decorative effects achievable within a single layer of mortar, as well as the possibility of inserting designs and patterns, without any cuts or joints. This led to great popularity for the technique, spreading through all Italy, beginning in the Medieval and lasting to the early 20th century (Piana 2008: 82).

The oldest *terrazzo* are the so called *pastellone*, which have a surface of a single colour, generally brick red. These first became common in Venice in the 11th century, at a time when the original lagoon village, with its simple wood and brick houses, was becoming an important international centre of commerce. As the first prestigious palaces were built, they could also be equipped with this type of flooring (Cacciatori 2008. 23-24). Beginning in the 15th century we also see the first appearances of *terrazzo a semina,* literally "seeded" *terrazzo*, or "strewn stone" flooring. This technique was similar to the original, but with the enriched by the addition of small pieces of differently coloured marble scattered in the top layer.

The *palazzi* built on the muddy soil of the Venetian lagoon are supported by substructure of densely spaced wooden piles, inserted deep into the underwater silt. The

Fig. 1. Systems of beating the mortar layer and final smoothing (illustration S. Virdia)

swaying movement inherent to the structural system is managed by effectively "disconnecting" the walls from the floors (Piana 2008: 75-76). However another important aspect of the structural system is that the floors are built in such a manner that in the normal event of soil movements, they can withstand deformation without fractures or disconnections. And in fact it is the long, complex procedure of laying the bottom layers of *terrazzo* floors that makes them flexible, but also resistant and stable (Piana 2008: 79).

In the original procedure, the first layer consisted of a mixture of aggregate and hydrated lime laid directly over the boards of the subfloor. The mix, once prepared, was stirred regularly over a period of 15 days, so as to obtain very uniform setting of the binder once it was applied (Piana 2008: 77). This first layer of mortar was then applied to a depth of 20 centimetres, spread and smoothed using rakes. It was then beaten continuously with long heavy blades called *ferri da battere*, or "beating irons", so that the mortar would eventually adhere to and conform completely with the subfloor, assuming a highly compact, uniform structure (Fig. 1).

The second layer was composed of smaller-grained aggregate bound by a larger share of hydrated lime, applied in a similar manner to the first layer but to a lesser thickness. The final layer was prepared according to effect desired, meaning either in *pastellone* or *seminato*. In the first case the finishing layer is a thin layer of brick-red mixture, applied using special trowels with convex blades, achieving a smooth, shiny, and damage resistant surface. The preparation of the *seminato floors* instead required the application of a further layer of mortar, called the *stabilitura.* While this layer was still fresh, it was coated with the small fragments of coloured marble, either strewn in a uniform overall array or applied in ornamental patterns. The final phase for the *seminato* floor was then to roll and level the surface, impressing the crushed marble into the mortar. Finally, both the *pastellone* and *seminato* floors would be treated with linseed oil and polished. As well as creating a lustrous finish, this procedure filled the micro fractures produced during the beating of the mixes. To maintain the resistance of the floors it was also necessary to regularly reapply linseed oil (Piana 2008: 80-81).

A good example of the astounding resistance and adaptability of *terrazzo* to shape and stresses is the floor of the *Sala del Maggior Consiglio*, in the Palazzo Ducale of Venice, last decorated in the late 16th century following a disastrous fire. Although this vast hall measures over 1,300 square metres, and is set on what would appear to be a rather haphazard subfloor, it does not in any part suffer from cracks, discontinuities or other forms of damage. Nowadays it would be extremely difficult, if not impossible, to achieve such an expanse of continuous flooring without also resorting to network of expansion joints (Piana *et al.* 2008: 77).

Terrazzo floors also provide sound-proofing, thermal mass and insulating action against the effects of extreme temperatures, due to the thickness of the *battuto* layer, and last but not least, the ability to stop fires from expanding downwards (Piana 2008: 81).

The floors of Palazzo Visconti in L'Aquila

Terrazzo floors were popular in L'Aquila, a provincial capital city in the region of Abruzzo, south-central Italy, during the 19th century. The installations on the first floor of Palazzo Visconti adhered to the traditional techniques, and although the building has now been subdivided as separate homes, the floors still possess their typical qualities of beauty, shape, and uniqueness (Fig. 2).

The devastating earthquake that took place at 3:32 a.m. on 6 April 2009 caused various damages to the entire building, except the Venetian floors. These were able to withstand the seismic oscillations without cracking in the central parts, and therefore became detached from the vertical structures as individual horizontal blocks. The repair, restructuring and strengthening of the building required emptying the it of all its detached parts, which at that point included three of the *terrazzo* floors (Fig. 3). After dismantling the floors of lesser value, the three Venetian floors were carefully dismantled in a manner that would enable their correct repositioning once the restorations were complete.

The restoration project

Detachment and transport

Our planning of the detachment, restoration, and re-laying procedures for the

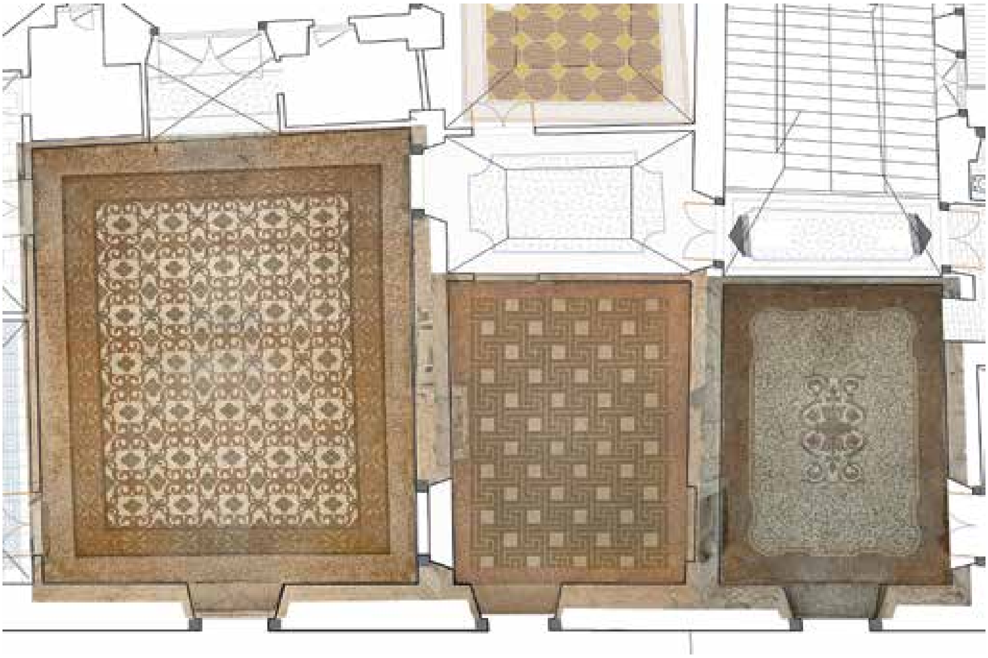

Fig. 2. Plan of the three Venetian floors (illustration R. Cassio)

Fig. 3. Dismantling and removing the floors (photo R. Cassio)

Fig. 4. Documentation of detachment (photo R. Cassio)

floors was based on previous experience. The similarities between a Venetian floor and an ancient mosaic (Cacciatori 2008: 17, 21-25), are such that the same conservation-restoration methods can be used for both. However the *terrazzo* floors have the further characteristic advantage of their flexibility, making it possible to detach and handle them with relative ease.

We treated the floors as we would mosaics: cleaning the surface by removing the wax, laying a large cotton facing cloth using a flour glue, and accurately marking and measuring the floor and its position,

Fig. 5. Using chisels to detach the uppermost layer of mortar (photo R. Cassio)

Fig. 6. Rear of detached mosaic section (photo R. Cassio)

Fig. 7. Small detached sections on supports (photo R. Cassio)

using reference lines that will later serve in precise relocation (Fig. 4). The floor was then divided into manageable sections, similar to the pieces of a puzzle, which could be lifted from the underlying layers using chisels inserted beneath the mortar (Fig. 5). During this operation the underlying mortars were removed, without causing damage to the top layer containing the crushed marble (Fig. 6). Once the sections were freed of all underlying mortar, they were wrapped for transport to the conservation laboratory in Rome (Fig. 7).

Restoration

In certain areas of the floor the marble chips had been severely worn to thicknesses of as little as a millimetre and less, risking instability and loss, particularly in consideration of the relaying of the flooring on new mortar. In these areas the most worn marble chips were removed and replaced with new pieces. This work was carried out using two techniques: working from the back side of the flooring in case of monochrome marble chips and/or geometric decoration, and from the top in the case of more sophisticated decoration, typically of floral designs. In this second method, we recreated small sections of the floor on a temporary clay base, which could then be reinserted among the other "unaltered" sections. This obviously entailed longer, more painstaking craft work, but with the reward of maintaining the floor in its exact original splendour (Fig. 8).

After completing the restoration phase, with the square sections organised in their original positions, a large cotton facing cloth was again applied, and both the "jigsaw" and straight reference lines were reapplied. With the facing cloth applied, the floor was then once again broken into its sections, and the

Fig. 8. Restoration of surface granules on a temporary clay base (photo R. Cassio)

clay backings could be removed where these had been used. The sections were once again wrapped for shipping to L'Aquila where in the meantime Palazzo Visconti had received major restructuring and repair works, including redesigned foundations and restoration of *intarsio* wood floors and vaulted ceiling decorations.

Reinstallation

The first floor to be reinstalled was that of the grand *salone*, having the most elaborate decoration of the three removed floors. This stage relied on the reference lines re-set on facing at the close of the restoration stage, along with lines tracing the outlines of the central area of floral design. The relaying began with the central part (Fig. 9), placed on mortar about two centimetres thick, composed of hydraulic lime with limestone sand, crushed marble of mixed small grain size, and a small quantity of lime putty. To improve the fixing of the small marble fragments on the bedding mortar, we applied a more fluid mixture of mortar on the back of these parts, using smaller grained aggregate with the addition of a small share of powdered resin (2:1000).

Being aware that a light grinding of the finished floor would be required, we took great care to ensure precise levelling during the relaying of the detached sections. In this manner the grinding was kept to a bare minimum, so as not to cause undue not wear to the elaborate decoration, composed of small granules.

The same procedures were for re-laying and finishing of the other two floors, smaller than that of the *salone*.

Elements in the mortar	mm thick	Kg/m2 x 2 cm h
limestone sand (sabbia calcarea)	0.2-3	17.6 kg
cocciopesto	1-3	8 Kg
grain of yellow marble (granello giallo mori)	1-3	1.6 Kg
Verona red marble powder (polvere rosso Verona)	0.2-3	4.8 Kg
hydraulic lime NHL 3,5 (calce idraulica)	binder	13 Kg
Lime putty (grassello)	binder	3 Kg

Fig. 9. Re-laying the *terrazzo* on site (photo R. Cassio)

CONCLUSION

This restoration job has brought great sat-isfaction all those who participated, not only because of the marvellous final result (Fig. 10), but also for the deep importance of this reconstruction to all the citizens af-fected by the earthquake.

It is our hope that such precious floors, created using the traditional Venetian techniques throughout the cities of Italy, will receive greater appreciation for their intrinsic worth and beauty, being less subject to "misuse and abuse", including through the unfortunate application of inappropriate conservation-restoration methods. Even though some of these floors are now protected as components of nationally or locally designated mon-uments, it happens very often that their custodians lack understanding of their artistic, historic and technical value, and

Fig. 10. *Terrazzo* floor of the grand *salone*, fol-lowing re-laying (photo R. Cassio)

that they fail to provide for their conservation using the correct techniques, as is instead done for mosaic masterpieces.

References

Cacciatori V. 2008. "Storia ed evoluzione artistica" In *I pavimenti alla veneziana*, edited by Lorenzo Lazzarini, 13-49. Venezia: Cierre Edizioni.

Piana M. 2008. "I terrazzi e l'edilizia veneziana". In *I pavimenti alla veneziana*, edited by Lorenzo Lazzarini, 73-90. Venezia: Cierre Edizioni.

Author

Roberto Cassio, born in Rome, Roberto learned mosaic arts and restoration under his father, Antonio Cassio. Since 1983 he has collaborated in mosaics restoration with the Rome Superintendency of the Ministry of Culture and Heritage, and with institutions in Italy and abroad. Since 1993 he has been head of the mosaics restoration laboratory of the Vatican Museums, while continuing his activity as mosaic artist. Since 2011 he has taught mosaics conservation courses with the Centro di Conservazione Archeologica, Rome, Italy.

THE REMOVAL AND TRANSPORTATION OF WALL MOSAICS BY BEDRI RAHMI EYÜPOĞLU AND EREN EYÜPOĞLU (1956, ANKARA)

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Abstract

The article provides a useful example of the transportation and conservation of mosaic works by contemporary artists, complementing the ample publications and knowledge concerning mosaic restorations in archaeological sites. The works in question are mosaics in Venetian glass, executed in 1956 by prominent artists, for the headquarters of a national mining company, which were recently scheduled for demolition. The removal and transportation works began with the study and recording of the figuration and materials and techniques of execution. This was followed by application of protective facing, then gradual removal of the rear masonry walls and dismantling of the mosaics in conformity with their original construction in sections. The rear mortar of the removed sections was then thinned, the sections were levelled using synthetic mortar and adhered to new carriers in glass fibre/aluminium panel. The sections were packed and labelled for temporary storage in the mining company archives, preparatory for remounting in original form in the new headquarters.

Keywords: Restoration, conservation, removal works, transportation, wall mosaics

Introduction

In 2012, a decision was made to vacate the general directorate building of the Eti Mine Works (*Eti Maden İşletmeleri*) on the Sıhhiye campus: one of the important institutions developed in the Republican period within Ankara, capital of Turkey. The dismissal of use of the building would also involve the detachment and removal of two wall mosaics to storage (Figs. 1-2). The mosaics were made in 1956 by the husband and wife, poet and painter Bedri Rahmi Eyüpoğlu (Fig. 2) and artist Eren Eyüpoğlu (Fig. 1), both of whom have an important place in the history of Turkish art. The mosaic by Eren Eyüpoğlu was situated in the building entrance hall, that by her husband in the doorway to the secretariat of the general directorate, on an upper floor. Both were made of Murano glass imported from Venice and represented themed figurations on the theme of Anatolia, inspired by the Hittite (Eti) civilisation that is the namesake of the company and its building.

Removal and transportation works of the mosaics began with identification and recording of the figuration and the materials and techniques of execution. Following this came the application of facing, in which the surface was coated with a temporary protective cloth layer, division of the mosaics into sections, and removing the sections from the wall. Next came the stage of the restoration intervention, including thinning the back mortars of the removed sections, levelling them with synthetic mortar, and transferring them to the new support-

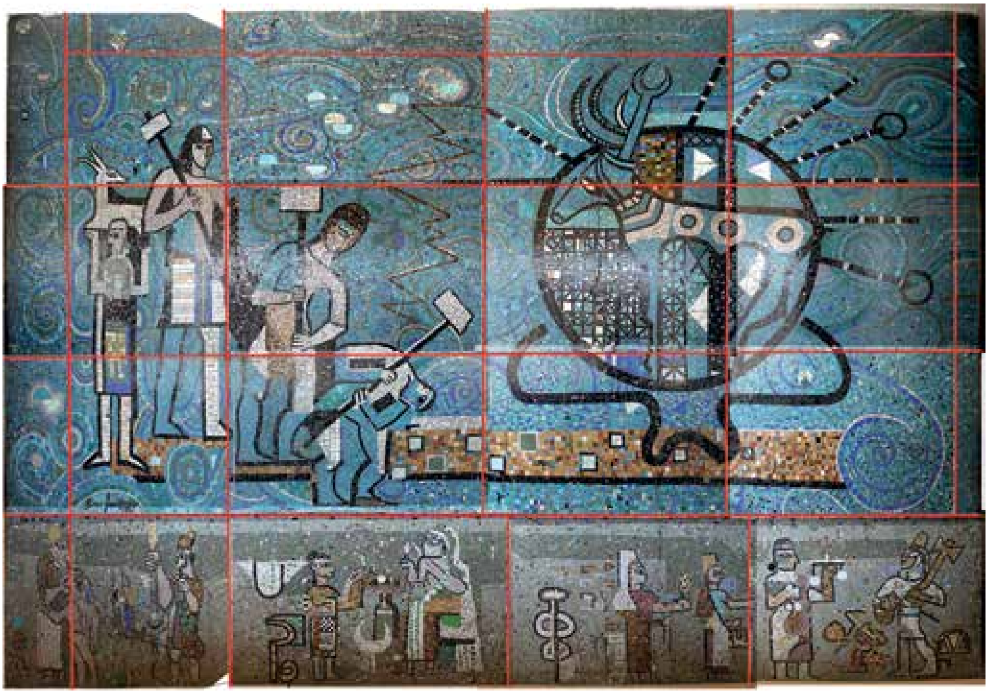

Fig. 1. Preparations for removing the Bedri Rahmi Eyüboğlu Mosaic (photo S. Şener)

Fig. 2. Preparations for removing the Eren Eyüboğlu Mosaics (photo S. Şener)

ing carrier. These stages of the works were begun on 2 April 2012 and completed by 31 May of the same year. The final stage was to move the two detached mosaics to the Archive Building of the Directorate General in Ankara, on 7 June 2012. Eti Mine Works is currently planning to exhibit the mosaics in their original form in the new General Directorate building.

All works were carried out by a group composed of eight people under professors Dr Bekir Eskici and Dr Y. Selçuk Şener, with conservation technicians Kurtuluş Türk, Ömer Çokdoğan, Levent Bakır, and conservation students Hakan Uçar, Esma İvrendi and Deniz Saykı.

The work described constitute a useful example of transporting and conserving mosaic art works by contemporary artists, complementary to what is known and published about mosaic restorations in archaeological sites.

Overall operation: removal, restoration, transportation and storage

The works on the Eren Eyüboğlu mosaic in the building entrance hall and the Bedri Rahmi Eyüboğlu mosaic on the private secretarial office wall involved the stages of: breaking the carrier brick wall to access the mosaic mortar; removing the mosaics in sections by cutting them on their building lines; making the sections transportable by fixing them on carrier panels; transporting them safely to the prepared storage space.

Preparations for removal: identification and documentation of the works

The first task concerning the mosaics was their documentation. In the case of the Eren Eyüboğlu mosaic the production lines could be traced, and from these it was discerned that the composition had originally been produced in a workshop in the form of 27 panels. These had then been fixed on the carrier wall with a cementitious mortar, and the assembly lines were then integrated by filling with mortar (Fig. 1).

The decision was made to cut the mosaic along the building lines to facilitate removal. Prior to cutting, the condition of each panel was documented in detail by photography, including the detection of any deteriorations.

In the case of the Bedri Rahmi Eyüboğlu mosaic, the tracing of the production lines revealed that the work had been composed of 12 panels, fixed to the wall using mortar (Fig. 2). The inspection and photographic documentation of condition was conducted similarly to the other mosaic. The inspection revealed that the continuity of the mosaic had been interrupted at some previous time, perhaps by moving on a previous occasion. This interruption had caused some losses, recognisable by gaps in the pattern lines, and had been resolved by preparing a frame at the sides of the work, in a mortar containing plaster. The decision was therefore made to cut the mosaic on the building lines of the 10 main sections, in order to avoid damage, and to remove these pieces, leaving two narrow areas of mortar at the sides.

Identification of the original support structures

Along with the identification and documentation of the works, another early stage was to identify the existing support structures: the mortar used for the mosaic itself, its thickness, and the structure and bricklaying forms of the carrier wall. From these examinations, it was identified that

the Eren Eyüboğlu mosaic was supported on a structure of cement briquette and clay-brick masonry, followed by mortar of the mosaic itself, of 1.5-3 cm thickness. In the case of the Bedri Rahmi Eyüboğlu mosaic the support structure consisted of a wall in hollow firebrick masonry, followed by a thick (5-6 cm) layer of mortar.
Preliminary preparation for removal
As noted above, and considering the dimensions of the mosaics, it was decided that the Eren Eyüboğlu and Rahmi Eyüboğlu mosaics would be respectively removed by cutting into 27 and 10 sections. Before applying the facing to the surface, the lines of these sections were made apparent as grooves, cut to 1 mm thickness and 1 cm depth using a diamond disc attached to a micro motor.

Application of facing

Facing was applied to both mosaic surfaces for purposes of preventing the loss of tesserae and against potential risks during removal. The application was carried out by covering the surface with a layer composed of a recycled resin (within a 25% ratio of Paraloid B72, acetone) applied to

Fig. 3. Application of temporary facing (photo S. Şener)

the surface with brush and gauze cloths of 15x15 cm size (Fig. 3).

Removal

After the fixing of the *tessellatum* by means of the facing, the works of thinning the backing wall and removal of the sections were initiated, starting with the Bedri Rahmi Eyüboğlu mosaic. The thinning process was completed by breaking off pieces from the wall structure with the help of a percussion power drill, approaching the mosaic gradually from the rear. When the thickness to the rear of a mosaic section had been reduced to 5 cm of mortar, the cut lines marked on the front surface were deepened. Once the cutting of each section was completed it was removed from its original position and placed on a temporary carrying panel in MDF (Medium-density fibreboard), cut to a slightly larger size. Indications of the section number, top and bottom, and orientation were written on the MDF panels. Once entirely dismantled, the panels with the attached mosaic sections were transported to the workshop (Fig. 4).
The Eren Eyüboğlu mosaic was more problematic, since the back of the mosaic panel was blocked by the presence of water pipes to one side, an elevator shaft in the middle, and chimney of the central heating on the other side. The supporting masonry was therefore reached by cleaving from the edges, at which point we could begin the task of thinning the wall section, using a procedure very similar to that for the first mosaic, until arrival at the 5 cm thickness of mortar, followed by the same procedures of cutting, removal, temporary support on MDF panels, annotation, and transport to the workshop.
Thinning the back mortars, crack filling

Fig. 4. Removal works for the mosaics (photo S. Şener)

Fig. 5. Levelling of the mosaic panel thicknesses (photo S. Şener)

On arrival at the entrance of the workshop building, the weight created by the thickness of the mortars, made it necessary to thin this material, for correct management of the section in the workshop environment. For this purpose, linear cuts were made to a predetermined depth using diamond blades attached to a drive motor. The sectors thus created were cleared by breaking them off with further cuts using thinner blades. Using this procedure, the 5-6 cm mosaic thicknesses were reduced to 1.8-2 cm. The mosaic parts that came off and cracks that emerged during this application were filled by means of mortar application (Fig. 5).

Levelling the mosaic panel thicknesses

The mosaic panels had been thinned by a careful procedure, however the remaining defects on the rear surfaces were levelled by applying synthetic mortar:

1. The dust on the surfaces was cleared using a vacuum cleaner.
2. A glass-fibre cloth was adhered to the surface using PVA resin (Mowilith D 50), for development of a stronger support.
3. Levelling was completed by spreading the synthetic mortar (fine sifted sand and Mowilith D 50), smoothed by floats moved along 2.5 cm supports placed at the sides. This method achieved a standard 2.5 cm total thickness for each mosaic section, comprising the mosaic, original mortar and synthetic levelling mortar.
4. To enhance the integrity of the revised support system, the dried levelling mortar was inserted with a pattern of cuts to the level of the original mortar, prepared using the circular blade, and a sort of inner-mortar support was created by filling these cuts with an epoxy mortar (Fig. 5).

Mounting on new backing

1. The levelled mosaic sections were turned upside down.

Fig. 6. Adhering the mosaics panels on the Aerolam (photo S. Şener)

2. Aluminium honeycomb panels (Aerolam), used as new carriers, were cut to the sizes of each section.
3. Epoxy resin was spread on the Aerolam surface and the sections were placed in contact; the level in relation to the Aerolam was stabilised and maintained through the 1 hour period of hardening, then subsequently through the 24 hour curing period (Fig. 6).

Removing the facing and filling the rear contours

The temporary protective gauze and acrylic resin facing was removed from the surface by softening the with acetone spread with a brush, then removing the last of the resin using cotton soaked with acetone (Fig. 7).

Fig. 7. Removing the facing and filling the contours in the mosaics (photo S. Şener)

The gaps between the rear of the mosaic sections and the Aerolam were filled using the same synthetic mortar as previously.

Restoration of the tessellatum

The tesserae that had been removed during the processes of thinning and sectioning the mosaic, and then transferring to the new Aerolam carrier, as well as those from the sides and from cracked areas of swelling/expanding, were re-lain in their places. Some lacunae that had already been present prior to removal from the original location were filled and completed using mosaic tesserae in similar colours.

Border refinement and re-assembling (bringing the panels together)

The original plaster edging around the contours of the Bedri Rahmi Eyüboğlu mosaic was removed and renewed. The width of the renewed edging was narrowed with respect to the original, and made to follow the mosaic border as closely as possible.
The assembly of all the sections of the two mosaics was trialled. For this purpose,

Fig. 8. Application of joint filler to the *tessellatum* (photo S. Şener)

the ridges and splits along the surfaces of the synthetic mortar were thinned using the motorised disc blade, for purposes of grouting the gaps between the carrier and the mosaic.

Application of grout to the *tessellatum*

Grouting was carried out for the gaps between the re-laid tesserae, the cracks originating prior to and during removal, and for the mosaic sections that had been rejoined during the stage of preparation and transfer to the new Aerolam carrier (for example, before panels 1+2+6 end after +1). The grouting was conducted using Kalekim (cement mortar) and acrylic emulsion (Primal AC 33), as had also been used in the original production. The mortar was liquidised and applied with a sponge; the excess mortar was cleaned from the surface by wiping with a damp sponge (Fig. 8).

Fig. 9. Surface protection of the mosaics (photo S. Şener)

Surface protection

The mosaic sections were protected by brush application of acrylic resin (8% Paraloid B72 in acetone) to the surface and side mortar contours (Fig. 9). Detailed surface cleaning was conducted prior to application of the resin, removing all residues and remnants.

Packaging

The mosaic sections, on their new carriers, were packaged by placing against styrofoam panels and wrapping in stretch film and/or nylon. Each package was annotated with the name of the mosaic, the place of the section in the overall work, its location, and numerical data, along with a schematic photograph/drawing.

Transportation and storage

The packaged mosaic sections were transported to the archives building of the Eti Mining General Directorate in Ankara. The packages were placed on steel shelves, prepared in advance, in the presence of company officials. The storage space now contains 20 packages of single and united sections of the Eren Eyüboğlu mosaic, and 10 packaged sections of the Bedri Rahmi Eyüboğlu mosaic (Fig. 10).

Fig. 10. Packaging and storage of the mosaic panels (photo S. Şener).

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THE *TAROT GARDEN* BY NIKI DE SAINT PHALLE: PROTECTIVE COATINGS FOR GLASSY AND CERAMIC MATERIALS

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Abstract

The *Tarot garden,* realised between 1979 and 1998 by the French-American artist Niki de Saint Phalle, in Garavicchio, Italy, is a well known work of art and important destination. The main sculptures are constructed in concrete around steel frameworks, and decorated with tens of thousands of multi-coloured tiles of broken mirror, glass and hand-crafted ceramic. The deterioration of these materials is aggravated by the context of the sculpture park: the wooded hills of southern Tuscany, near the Tyrrhenian seacoast. In keeping with the artist's testament, the deteriorated tiles are typically replaced with copies. For authenticity of certain tiles painted by de Saint Phalle, and as an alternative to constant replacement of vast numbers, we propose to prolong their lifespan, protecting them through the application of products chosen by experimental study. Nine kinds of original material are sampled; five protectants are selected; the original materials are characterised by different measurements before and after exposition to artificial ageing, with application of the protectants. Finally, *in situ* application will provide information of the products' performance under real conditions. The project consists of seven phases, currently under way.

Keywords: Coating, tile, mirror, protection, preservation

Introduction

The *Tarot garden* is a well-known sculpture park realised between 1979 and 1998 by the French-American artist Niki de Saint Phalle, in the locality of Garavicchio, region of Tuscany (Fig. 1). The research reported in the current study arose from an initial study of all the materials and techniques employed in the construction (Vella *et al.* 2018). With time, we have been able to open up the research, to develop understanding of the overall conditions of the sculptures, and to begin dealing with concerns regarding the preservation of the decorative tiles covering the sculptures.

Art historical background

Catherine Marie-Agnès Fal de Saint Phalle (Neuilly-sur-Seine, France 1930-La Jolla, USA 2002), known as Niki de Saint Phalle, was an internationally acclaimed artist, active through the second half of the 20th century, most notably in the United States, France, Switzerland, German, Japan, Israel, and Italy. Her greatest life work was the *Tarot garden*, a sculpture park developed in Italy near the town of Capalbio, Tuscany. The great journey of developing the park, undertaken with her husband, the Swiss sculptor Jean Tinguely (1925-1991), would cost some billion Italian lire (approximately 10 million euros, unadjusted to inflation). The *Garden* was begun in 1979, on the basis of the donation of a small piece of land by the Caracciolo family. Here, for some 20 years, the couple intermittently guided the work of a team as they created sculptural machines and built the skeletons of the great forms (Vella *et al.* 2018: 84-85), coating virtually all the surfaces in fragments of mirrors, glass and coloured ceramic. The park was still incomplete at the time of the artists' death.

Inspired by the first twenty-two tarot cards, the roots of the *Garden* can also be traced to two main art-historical sources. The earlier of these, from the second half of the 16th century, is the *Sacro Bosco* (Sacred Wood), also known as the *Parco dei Mostri* (Park of the Monsters), developed by the architect Pirro Ligorio on behalf of Prince Vicino Orsini, near Bomarzo – some 80 kilometres from Capalbio. The second one is Parc Güell, the famous project by the architect Antoni Gaudí, backed by Count Eusebi Güell and developed between 1900 and 1914. Other sources related to the *Tarot garden* are the *Watts towers*, built by the mason and self-taught artist Simon Rodia, between 1921 and 1954 in Los Angeles, and the *Palais idèal*, a massive structure built by the postman Joseph Ferdinand Cheval, between 1879 and 1912, in Hauterives (department of Drôme) (Vella *et al.* 2018: 85).

A stroll through the *Tarot garden*

The *Garden* occupies a two-hectare plot within the *pòggi di Garavicchio*, an estate of wooded knolls just a few kilometres from sea, in the open countryside of the *bassa Maremma* of Tuscany. The park welcomes the public over the six months between April and October, and can receive thousands of visitors in a day. Since the installation of the works, the daily average temperature has ranged between 10.5°C and 16°C in winter and 20°C in summer, with these averages encompassing extremes well over 30°C and below 0°C. Relative humidity is quite high, typically ranging between 65% and 80%.

We enter through the central hole in a monumental tuff-stone wall, designed by Swiss architect Mario Botta, which separates the world of the *Garden* from its surrounding reality. Within a few minutes, following an uphill path, we arrive at the first group of sculptures situated on the outcroppings of an old stone quarry: the *High Priestess*, a clear reference to the *Orcus* of Bomarzo, the *Magician*, the *Sun*, the *Empress-Sphinx* and the *Strength*. Proceeding onwards from these figures, we will find a second group: the *Pope,* the *Justice,* with the *Injustice*, the *Tree of life* with the *Hanged man*, the *Emperor*, the *Falling tower*, the *Temperance* with the *Judgment*, the *Choice* or *Lovers*, the *Hermit*, the *Oracle* and the *Star*. The original project also foresaw a horticultural labyrinth, but this remained incomplete at the death of Niki de Saint Phalle.

The sculpture are immersed in nature. The highest reach to more than 10 metres, and within, two of them, the *Sphinx* and the *Tower*, we find habitations, no longer in use. The underlying structures are built using the industrial materials of steel and concrete, then decorated with tens of thousands of multi-coloured shards, a large share of these in turn prepared from handcrafted products: Murano glass and *murrine*, mirrors from France and Bohemia, and glazed tiles produced by the ceramist Venera Finocchiaro and by de Saint Phalle herself, on the premises of the Garavicchio property (Fig. 2).

Fig. 1. The *Tarot garden* by Niki de Saint Phalle (photo S. Vella)

Fig. 2. The *Empress-Sphinx* under construction. Once the skeleton was built, it was covered by a layer of concrete using spritz beton technique, and by an additional layer of lighter concrete. The form was then decorated with ceramic, glass and mirror tiles (photo S. Vella)

Covering materials: mirror, glass and ceramic tiles

The first material used to cover the sculptures was colourless mirror, salvaged from local glass factories. Later, the artist introduced the use of coloured and decorated mirrors produced by Verrerie de Saint-Just, a French company specialising in the production of precious glassy materials. De Saint Phalle exploited the optical effect of the mirror for the reflection of the environment, developing intimate exchanges between the sculptures and their surrounding nature. A comparison conducted through chemical analysis on two pieces of mirror – one original and one which had been substituted at a later date – demonstrated that the silver metal layer of the original also contained lead, which improves the durability of the amalgam, while the metal layer of the replacement piece contained no lead. The absence of lead in such replacement pieces results in a material that is much more susceptible to degradation (Vella *et al.* 2018: 89) (Fig. 3).

The artist also used other covering materials imported from France, Poland and Bohemia. The glass tiles of the *Garden* were mostly crafted by Mosaici Donà Murano, a well-known Venetian artisanal glass company founded in 1926, today owned by Stefano Donà (Vella *et al.* 2018: 89).

The tile pieces are made by different kinds of pastes, such as hard and soft earthenware, many kinds of porcelain stoneware, and semi-refractory clays. The individual pieces can be pre-shaped using moulds, or

Fig. 3. The *Falling Tower* - The mirrors covering the form reflect the surrounding environment, developing exchanges between the sculptures and their surrounding nature (photo S. Vella)

broken from fired slabs and plates. These were all designed by Niki de Saint Phalle and the ceramist Venera Finocchiaro, who arrived at the *Garden* in 1983, and crafted on the premises of the Garavicchio property (Vella *et al.* 2018: 90).

Condition of the sculptures and their decorative tiles

The sculptures are maintained by a team including many of the individuals that originally participated with the artist in the construction of the *Garden*. However, the presence of such material complexity in the immersive *plein air* park environment, close to the sea, under the prevailing conditions of thermal excursion, precipitation, humidity and aerosol water, wind, sunlight, and atmospheric pollutant, brings about significant phenomena of physical, chemical and biological degradation.

More specifically, the conservation status of each work is influenced by:

- microbiological pollution, contributing to the dispersal of fungal spores, algal cells, and propagation of lichens;
- atmospheric aerosols, in particular marine aerosols of sodium, chlorine, magnesium, and sulphur, responsible for the formation of salt efflorescences and subflorescences, in the forms of sodium and potassium chlorides and calcium sulphate;
- mechanical stresses generated by tree roots;
- differing behaviours of the structural, superficial and covering materials in relation to the environment, depend-

ing on their chemical and mechanical and resistance, their elasticity, porosity, their thermal conductivity and coefficients of expansion, and their resistance to thermal variation;

- interaction between different materials comprising the sculptures;
- penetration of meteoric water, condensation of moisture and marine aerosols within the structures, causing dissolution of the decorative tiles and concrete, promoting iron core corrosion and consequent increase in volume, with lifting and subsequent detachment of the tiles from the structure;
- anthropogenic factors arising from the constant flow of visitors during opening season and from specific events of vandalism.

The combination of these factors results in:

- cracking of the superficial materials and breaking of the mortars between the tiles;
- biological attack, with development of fungi, mosses and algae;
- cracking and loss of the ceramic glazes;
- cross linking of ceramic glaze;
- abrasion of the gold glaze;
- leaching of the glass and the glaze ceramic surface;
- oxidation of the silver mirror coating;
- dissolution of the tiles, fillers and adhesives, with consequent washout on the surfaces;
- fractures and detachment of the tiles from the structures (Fig. 4).

CONSERVATION PROJECT DESIGN

SITE-SPECIFIC GOALS

In keeping with the directions of Niki de Saint Phalle's will, the damaged tiles are usually replaced. Glass, mirror, and ceramic shard tiles are substituted with new materials. Copies of the pre-formed ceramic pieces are produced using the original moulds prepared by de Saint Phalle and Venera Finocchiaro.

Fig. 4. Left to right: cracking of the surface materials; cracking and loss of the ceramic glaze; cross linking of the ceramic glaze; abrasion of the gold glaze, biological attack (photo S. Vella)

Fig. 5. The tiles covering of the *Tree of Life*, painted by Niki de Saint Phalle (photo S. Vella)

As an alternative to a constant replacement of the original tiles, and for authenticity of those created and painted by the artist herself (e.g. *The Tree of life*) (Fig. 5), we propose to prolong their life by applying protective materials chosen through experimental comparison. Where the replacement of the tiles must in any case continue (i.e. mirrors), the protective materials will be chosen to obtain longer duration of the new production.

The broader context of architectural tile

Many works of art and architecture include surfaces of ceramic tile, making their preservation a constant concern. Some of the most famous European examples are the monument of Portugal, containing *azulejos*, the *vietresi* and Caltagirone ceramics of Italy, and the works of Parc Güell by Antony Gaudí in Spain, which also include surfaces tiled in glass. The conservation of the tiles is often associated with other kinds of preservation works: for the architectural structures, in affiliation with stone conservation or the restoration of non-architectural ceramics, in conservation-restoration of ancient mosaics or medieval windows (Mendes *et al.*, 2015). The information concerning the procedures and the materials employed in the conservation of the architectural tiles thus tends to be unfocused and scattered, without definitive identification of specific products for the protection of glazed and non-glazed materials, or their methodologies of use. The current project aims to respond to these shortcomings in the published information. The diversity of materials and techniques used in the sculptures of de Saint Phalle *Garden* makes this an excellent candidate for the research, and a *sui generis* example. The small park near Capalbio, Tuscany, could become a text and centre of reference text for all those works of art made using related materials and techniques.

Previous studies

A survey conducted by Marta T. Mendes and collaborators in 2015 found that the most commonly used products for the protection of architectural tiles were acrylic resins (more than 50% of reported cases). Microcrystalline waxes were used in 24% of cases, and finally polyurethane varnishes and epoxy resins in 17%. Earlier publications confirm that these same products have been used as surface coatings for ceramic and glassy materials since the 1970s (Pearson 1974: 11-12; Newton and Davison 1989: 272-274; Collarini and Bertuzzi 1994: 99-104; Jing *et al.* 2010). All of these have been variously advocated as "protective coatings", even though it is also known that, over time, they will develop evident signs of degradation.

In the past decade, other works have suggested new materials for protection of glass and ceramics: acrylic-silicone mixtures, nano-silica (Donà 2011; Donà *et al.* 2011), ethyl silicate (i.e. Tegovakon V) (Cultrone and Madkour 2013), siloxanes (i.e. Silo 111), and ethyl silicate and siloxanes mixtures (C.T.S. 2013). Based on the results from phases I and II of the current study, both nano-silica and siloxanes, in addition to other products selected, have been proposed for the tests with original materials (see Phase III). Ethyl silicate will not be considered, since, as demonstrated in the written report, it shows signs of degradation over time.

Schedule

Nine types of tile samples from the *Tarot garden* have been provided, representing the different materials to be treated, allowing application of the different protectant products and techniques. Five different products have been selected for testing.

The project will consist of seven phases.

Phase I: Definition of methods and parameters of application

This preliminary phase serves for identification of the methods and parameters of application, before treating the nine samples from the *Tarot garden*. During this phase the five protectants will be applied to samples that are technologically comparable to the *Garden* samples. The products will be applied by spray, brush and immersion, and where appropriate in different percentage concentratrions.

The samples collected will be the following:

- n. samples of glazed ceramic;
- n. samples of semi-refractory clay;
- n. samples of porcelain stoneware;
- n. samples of mirror;
- n. samples of glass;
- n. samples of industrial tiles.

At the end of this phase, the choice of the parameters and methods of application was made on the basis of:

- the adhesion of the product to the sample substrate;
- the aesthetical properties.

Phase II: Chemical, physical and morphological characterisation of the original samples

The technological features and degradation phenomena will be observed in the original samples, in their current status, and will be characterised by measurement and description in chemical, physical and morphological terms.

Moreover, this phase will be preceded by:

- high resolution photographs of the nine original samples;
- collection of a limited number of micro-samples directly from the sculptures, for submission to the analytical methods.

The samples of original material have been selected, as follows:

- six tiles of blue-glazed hard earthenware ceramic, from the decoration of the *Arch of the Sun*;
- six tiles of red-glazed hard earthenware ceramic, from the covering of a column in the colonnade of the *Emperor Castle* (Fig. 6);

Fig. 6. Top - detail of column, colonnade of the *Emperor's castle*; Bottom - sample of red-glazed hard earthenware (photo by S. Vella)

- six tiles of unglazed semi-refractory ceramic applied to the *Temperance Chapel* (Fig. 7);
- a tile of porcelain stoneware executed using *neriage* technique, from the covering of the base of the *Pope*;
- a tile of porcelain stoneware executed using *neriage* technique, applied to the terrace floor of the *Emperor Castle* (Fig. 8);
- six tiles of blue mirror used in the decoration of the *Sphinx's* hair and terrace (Fig. 9);
- six tiles of silver mirror, as found in the coverings of many parts of the sculptures (e.g. the *Tower*);

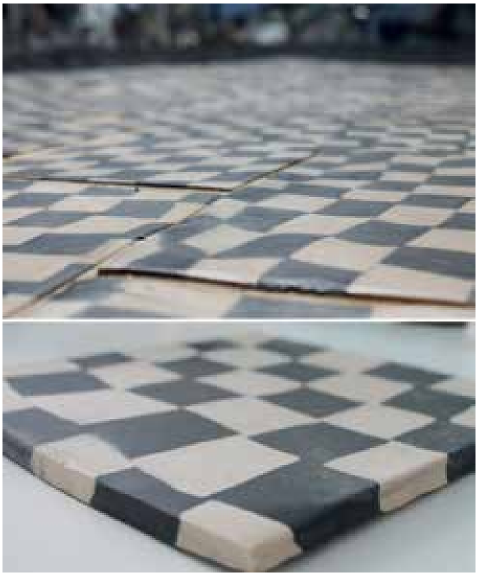

Fig. 7. Top - detail of the *Temperance chapel*; Bottom - sample of unglazed semi-refractory ceramic (photo S. Vella)

- a tile of blue Murano glass, also used to cover many portions of the sculptures (Fig. 10);
- a white industrial tile from the decoration of the *Tree of Life*.

The methods of examination are:
- colorimetric measurements;
- microscopy/cross-sectioning: a preliminary invasive technique obtaining highly magnified images of the samples permits their observation, manipulation and examination. With these analysis will obtain information:
  – to characterise the crystals and groundmass, technique and morphology;
  – concerning microbiological degradation and microstructural modification of the ceramic paste:
- Environmental Scanning Electron Microscopy with Energy Dispersive Spec-

Fig. 8. Top - detail of the floor of the *Emperor Castle's* terrace; Bottom - sample of porcelain stoneware executed using *neriage* technique (photo S. Vella)

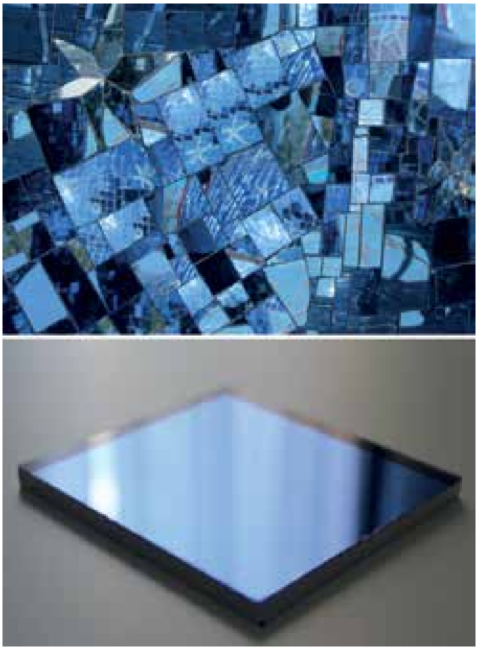

Fig. 9. Top - detail of the hair and terrace of the *Sphinx*; Bottom - sample of blue mirror (photo S. Vella)

troscopy (ESEM-EDS), an invasive technique obtaining highly magnified images, and providing information on:

a. morphology and chemical composition;
b. microbiological degradation, microstructural modification, chemical degradation of the glaze;

- Raman Micro-spectroscopy, a non-invasive method obtaining information on the firing temperatures of the original materials and the chemical composition of the glaze layer;
- X-Ray Fluorescence (XRF) Spectroscopy, an invasive or non-invasive method providing information about:
  – chemical composition of the ceramic paste and the ceramic glaze;

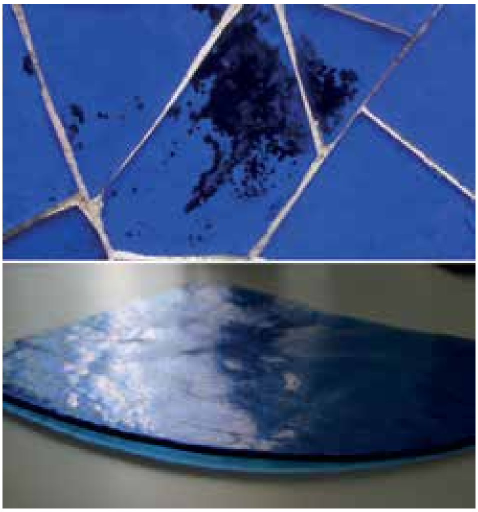

Fig. 10. Top - detail of the hair and terrace of the *Sphinx*; Bottom - sample of blue mirror (photo S. Vella)

– chemical degradation of the ceramic paste and the ceramic glaze.

Phase III: Application of the products to the samples collected from the Tarot garden

In Phase III the products will be applied to the samples collected from the *Tarot garden*, considering the methods and the parameters chosen in Phase I.

The products for the test have now been selected, as follows:

1. SiOX-5 [1], a nano-silica gel developed for the protection of glassy and ceramic materials (Bertoncello *et al.* 2006). The product has been used in the treatment of the *Chiesa di Santa Maria Annunciata* by Gio Ponti in Milan (constructed 1964-1966), where it was applied to the decorative glazed ceramic tiles of the church facade (Bortolussi *et al.*, 2012; Bertoncello *et al.*, 2014). Preliminary tests with SiOX-5 were also performed on a blue-glazed ceramic fragment from the *Tarot garden* [2]. The ESEM images show that SiOX-5 slows the development of microcracks in the blue glaze and tends to refresh the original brilliance of the surface without influencing its chromatic and aesthetic features. Reducing the roughness, the water repellence consequentially increases and the number of particulate deposits on the tiles surfaces reduces. The laboratory tests will further assess the capacities of this silica gel to form protective coatings;
2. Syton X30, a nano-silica acid dispersion used as a surface fill and modification medium;
3. Fluorinated titanium and zinc based polymers, such as PF4 [3], a photocatalytic protectant developed for applications on mineral building materials, based on aqueous dispersion alkyl alkoxy silane modified titanium dioxide nanoparticles. From a recent study (Helmi *et al.* 2016) aimed at identifying suitable products for the protection of granitic obelisks, we concluded that PF4 could be a good candidate for the test;
4. Protectosil WS 610 and VP 1805 [4], both siloxane water repellent emulsions with almost no volatile organic components, developed for waterproofing mineral building materials. These products have a good repellence, are resistant to UV light and they do not interfere with the original colour.

Phase IV: Chemical, physical and morphological characterisation of the treated samples

After treating the samples, they will be subjected to chemical, physical and morphological characterisation, to verify the products performance. The characterisation of the samples will be provided by means of different measurements:

- colorimetric measurements;
- contact angle and water absorption by capillarity, quantifying the wettability of a solid surface by a liquid;
- ESEM-EDS, providing information on the surface morphology;
- reflectance spectroscopy, used to determine the thickness, roughness and optical properties of the applied products.

Phase V: Chemical, physical and morphological characterisation of the samples after artificial ageing

After the characterisation of the treated samples, they will be subjected to artificial ageing and then characterised using the same chemical, physical and morphological measurements as in Phase IV, for assessment of the product performances.

Phase VI: Choice of the product or products

After the phase of artificial aging and reassessment by characterising measurement, we will choose a product or products, in relation to their achievement of the following properties:

- compatibility between the product and the sample surfaces;
- good adhesion to the sample surfaces ("Adhesion is a primary requirement of a repair material" (Viera 1996: 320);
- chemical inertness with respect to the materials being treated;
- absence of harmful products after ageing;
- chemical and physical resistance to severe environmental conditions (e.g. acid and alkali, thermal excursion, wind, rain, pollution, oxygen);
- stability under ultraviolet radiation;
- negligible or no chromatic variations;
- low permeability to liquid water (water repellence);
- good permeability to water vapour ("Permeability is the capacity of a material to transmit liquids or vapours. If coatings are too highly impermeable, water moving through the substrate will become entrapped at the interface, potentially causing failure" (Viera 1996: 320);
- modulus of elasticity and coefficient of thermal expansion comparable to the material of the sample surface;
- achievement of consolidation;
- real effectiveness in preservation of the original tiles;
- possibility of re-application;
- reversibility.

Phase VII: Product's performance under real conditions

Once the laboratory analysis will be completed and the results obtained, *in situ* application, planned on precise criteria, will be carried out on specific areas in order to provide information of the product's performance also under real conditions.

CONCLUSIONS

The material complexity of the *Tarot garden* sculptures and the environment in which they are immersed, *en plein air*, makes their conservation very complex. The sculptures are decorated using tens of thousands of multi-coloured tiles and fragments of ceramic, mirror and glass. In keeping with the directions of Niki de Saint Phalle, any pieces that are observed to be damaged are generally replaced. As an alternative to such constant replacement and in consideration of the authenticity of tiles painted by the artist herself, we propose to protect them, prolonging their lifespan, through the application of protective products chosen by experimental study. The management team of the *Tarot garden* permitted a selection of samples of nine surface materials. Five protectant products were selected, which are now being tested in application to the samples of original material. The final choice of the product or products will consider the specific features of the material to be treated and the performance of the products after exposure to artificial ageing and to real conditions.

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Notes

1. Supplied by Siltea Srl, Padua
2. Analysis performed by Siltea Srl, Padua
3. Supplied by Chem Spec Srl, Milan
4. Supplied by Chem Spec Srl, Milan

References

Bertoncello R., Bortolussi C., Cecchin. M., Lattanzi D. 2014. "Silica Thin Film Synthesized by Sol-gel Process for the Protection of Outdoor Artistic Ceramic in Architecture." In *Proceedings of the 6th International Congress on 'Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin'*, 340–346. Roma: Valmar.

Bertoncello R., Dal Bianco B., Voltolina S. 2006. Patent no. 0001370467: Synthesis of Silica Protective Films by the Tin-Catalized Sol-Gel Process, University of Padua.

Bortolussi C., Cecchin M., Lattanzi D., Mapelli M., Mischiatti F., Munerato E., Righetti M., Bertoncello R. 2012. "Film di Silice Sol-gel per la Protezione della Ceramica nell'Architettura di Gio Ponti a Milano." In *La conservazione del patrimonio architettonico all'aperto superfici, strutture, finiture e contesti, atti del 28° convegno internazionale di Scienza e Beni Culturali, Bressanone*, 405–415. Venezia: Edizioni Arcadia Ricerche.

Collarini A., Bertuzzi V. 1994. *Il Restauro delle Vetrate*. Fiesole: Nardini Editore.

C.T.S. 2013. "35.1 Ci Sono Anch'io – Un Protettivo Irreprensibile: Silo 111." April 6. http://www.ctseurope.com/dettaglio-news.php?id=174

Cultrone G., Madkour F. 2013. "Evaluation of the Effectiveness of Treatment Products in Improving the Quality of Ceramics used in New and Historical Buildings." *Journal of Cultural Heritage* 14, no. 4 (July–August): 304-310.

Donà V. 2011. "Diagnostica e Monitoraggio del Degrado di Manufatti Ceramici di Valore Storico-artistico: la Facciata dell'Hotel Hungaria a Venezia Lido." PhD diss., University of Padua.

Donà V., Cavallin T., Gambirasi A., Russo U., Nodari L., Bertoncello R., Favaro M. 2011. "A Survey of Polymeric Treatments applied on the Liberty Glazed Tiles of the Hungaria Façade." In *6th International Conference on Water Repellent Treatment of Building Materials*, edited by Borrelli Ernesto and Vasco Fassina, 47–58. Freiburg: Aedificatio Publishers.

Helmi, F. M., Hefni Y. K. 2016. "Nanocomposites for the Protection of Granitic Obelisks at Tanis, Egypt." *Mediterranean Archaeology and Archaeometry* 16, no 2: 87-96.
DOI:10.5281/zenodo.48820.

Jing Z., Weidong L., Hongjie L., Jianmin M. 2010. "Research on protection on protection of the architectural glazed ceramics in the Palace Museum, Beijing." *Journal of Cultural Heritage* 11, no. 3 (July–September): 279-287.

Mendes T. M., Pereira S., Ferreira T., Mirão J., Candeias A. 2015. "In Situ Preservation and Restoration of Architectural Tiles, Materials and Procedures: Results of an International Survey". *International Journal of Conservation Science* 6, no. 1 (January–March): 51–62.

Newton R., Davison S. 1989. *Conservation of Glass*. Oxford: Butterworth-Heinemann Ltd

Pearson C. 1974. "The Use of Surface Coatings in the Conservation of Cultural Heritage." *Australian OCCA proceedings and news* 11, no. 6 (June): 10–12.

Vella S., Bortolussi C., Zanardi B. 2018. "The Eternal Youth of Capalbio's "Monsters": A Planned and Preventive Conservation Project." In *Proceedings of the International Conference "Spark: Conservation of Sculpture Parks"*, edited by Sagita Sunara and Andrew Thorn, 84–97. London: Archetype publication.

Viera R. J. 1996. "Testing and Analysis of Terra Cotta Glaze Repairs." In *Standards for Preservation and Rehabilitation, ASTM Special Technical Publication 1258*, edited by Stephen J. Kelley, 319–336. West Conshohocken: ASTM.

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SESSION IV: CONSERVATION, PRESERVATION AND DISPLAY

Jessica Chloros

Carolyn Riccardelli
Beth Edelstein
Dorothy H. Abramitis

Roberto Nardi

Cristina Martí Robledo

Isabel Moreno Martínez

Stefano Borghini
Alessandro Lugari
Roberto Narducci

Mishko Tutkovski

Trinidad Pasíes Oviedo

Alessandro Lugari

Cécile Giroire
Michel Marque

56 YEARS LATER: *"A ROMAN MOSAIC PAVEMENT REBUILT"*

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Abstract

The 2nd century AD *Mosaic Floor: Medusa* serves as the focus of the breathtaking courtyard of the Isabella Stewart Gardner Museum in Boston. The museum structure was erected in 1901 on top of wooden piles in an area of reclaimed marshland. The mosaic was installed in the courtyard without such underlying support, and was soon observed to be sinking. By 1960 the subsidence was measured at almost 0.9 metres. In 1961, George L. Stout, the Museum director and chief conservator, undertook a major project to treat, re-support and return the mosaic to its original level. Fifty-six years later, the mosaic is re-evaluated to determine its condition.

Keywords: Mosaic, sinking, George L. Stout, epoxy, aluminium

Introduction

Isabella Stewart, was born in New York City in 1840 and received her education at schools in New York and Paris. In Paris she became friends with Julia Gardner, who introduced Isabella to her brother, John L. "Jack" Gardner Jr, heir to a wealthy family active in East Indies trading. In 1860, he and Isabella were married and they moved to Jack's hometown of Boston, Massachusetts. Their only child, a son, died from pneumonia before the age of two. Isabella struggled with depression and loss, and in remedy the Gardners travelled abroad. Amongst all their global destinations, Venice stole Isabella's heart. The couple returned to Venice many times, typically residing at Palazzo Barabaro on the Grand Canal. As they continued their travels the Gardners expanded their art collection. Their original home on Beacon Street soon became crowded with acquisitions, and so they decided to build a museum which would include a private residential apartment on the top floor.

As a location they identified an area of recently filled marshlands, known as Back Bay Fens. At the time it had no major buildings but would later also become the site of the Boston Museum of Fine Arts. Jack died from a stroke before they could purchase the land, however Isabella went through with the acquisition and hired Willard T. Sears for the architectural design and execution of the building. Isabella was an extremely hands-on client and visited the construction site regularly, even climbing ladders to instruct the workers on her specifications.

On completion of the building, she personally supervised the installation of galleries over the course of the following year (Fig. 1).

The museum opened on New Year's Day 1903, to great excitement. The exterior

Fig. 1. The Isabella Stewart Gardner Museum in the Back Bay Fens area of Boston, 1901 (Isabella Stewart Gardner Museum (ISGM), photo I. S. Gardner)

of the museum presents as a simple Venetian palace; however, inside visitors are awe-struck by the iconic four-story central courtyard, surrounded with galleries and capped by a glass ceiling, preserving a year-round blooming garden (Fig. 2).

The courtyard façades continue the theme of a 15th century Venetian *palazzo*. At the centre of this space is a 2nd century AD Roman mosaic floor showing the Medusa (Fig. 3).

The mosaic features the head of Medusa surrounded by four birds, representing the seasons. The birds are perched on vases, from which foliage develops in a delicate system of scrolls. This figurative panel is set within a wide guilloche border and a thinner outer border of scrollwork. The mosaic is executed in marble and glass tesserae in a broad spectrum of colours.

Fig. 2. Courtyard of the Isabella Stewart Gardner Museum, 2014 (ISGM, photo S. Dungan)

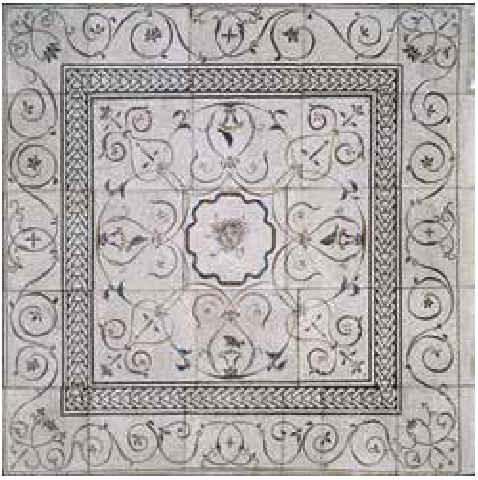

Fig. 3. *Mosaic Floor: Medusa*, 2015 (ISGM, photo D. Matthews)

PROBLEMS IN THE INSTALLATION OF *MOSAIC FLOOR: MEDUSA*

The *Mosaic Floor: Medusa* (4.8 m x 4.9 m) was executed for the villa of Empress Livia, last wife of Emperor Augustus. The villa is situated about 13 kilometres north of the historic centre of Rome. Based on excavations conducted in 1892, it was deduced that the structure included three apartments on an upper level, with a heating system, as well as apartments at the ground level (Marucchi 1892: 160-174). The ornamentation of these apartments included the *Mosaic Floor: Medusa*, as well as other mosaics and frescoes. The Gardners bought the Medusa mosaic from the dealer Pio Marinangeli in Rome on 2 November 1897, for 10,000 lire (Isabella Stewart Gardner Museum Collection Database). Museum records indicate that the mosaic was divided into 26 panels and backed with Portland cement, likely in preparation for shipping to America (Stout 1961). The mosaic panels were installed at the museum around 1902 and grouted directly to a concrete slab about 10 cm in depth. The slab was poured on a foundation of bricks, which in turn rested on the marshy earth, with no underlying support. Given the character of the site, the four sides of the museum had been constructed on deeply driven wooden piles, but the courtyard was not provided with any such reinforcement.

As early as 1937, just 34 years after the museum opened, there was concern over the sinking of the mosaic, and yearly measurements were taken to record its level. A series of 1946 letters, from the museum's first director, Morris Carter, to Professor Casagrande of the Harvard Graduate School of Engineering, request advice on whether there should be further provision to support the mosaic or if the sinking would eventually come to an end on its own. Professor Casagrande counselled Carter that the "primary compression of the underlying soil had ended before 1937 and the settlements observed since 1937 were the so-called secondary compression which would continue for many years at a very slow rate with no objectionable effects compared with the primary compression" (Casagrande 1946). The most dramatic subsidence had indeed taken place by this time, however it was observed that the mosaic was continuing to sink at a rate of about 0.6 cm per year. Two photographs, taken in 1903 and 1956, reveal the drastic change in the level of the mosaic (Fig. 4 and 5).The yellow arrows in figures 4 and 5 indicate the top step, used as the reference point for the annual measurement and recording of the level. In the 1956 photograph additional steps have been added for the descent into the courtyard, compensating for its overall subsidence. By 1960, it

Fig. 4. Mosaic, showing original level, 1903 (ISGM, photo Thomas E. Marr and Son)

was estimated that the mosaic had sunk a total of 0.9 meters since installation (Stout 1961).

Conservation-restoration by George L. Stout in the 1960s

George L. Stout was a pioneer applying modern scientific methods to art conservation. In the early 1930s he established the conservation laboratory of the Isabella Stewart Gardner Museum. In 1955 he became the second director, a position he held until 1970, while simultaneously serving as chief conservator. Stout quickly identified the problematic condition of the mosaic and by 1960 had consulted with engineering and construction firms,

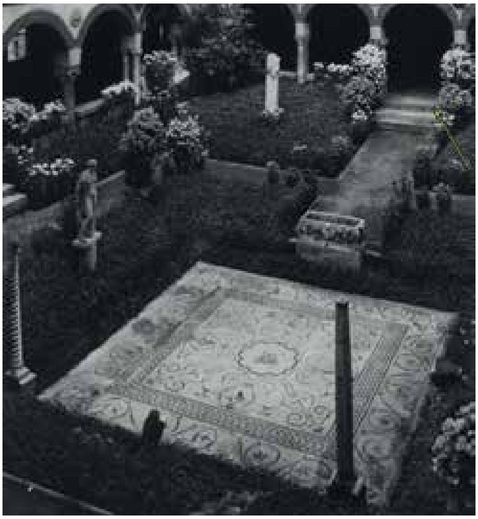

Fig. 5. Mosaic, showing level of subsidence and addition of courtyard steps, 1956 (ISGM, photo J. B. Pratt)

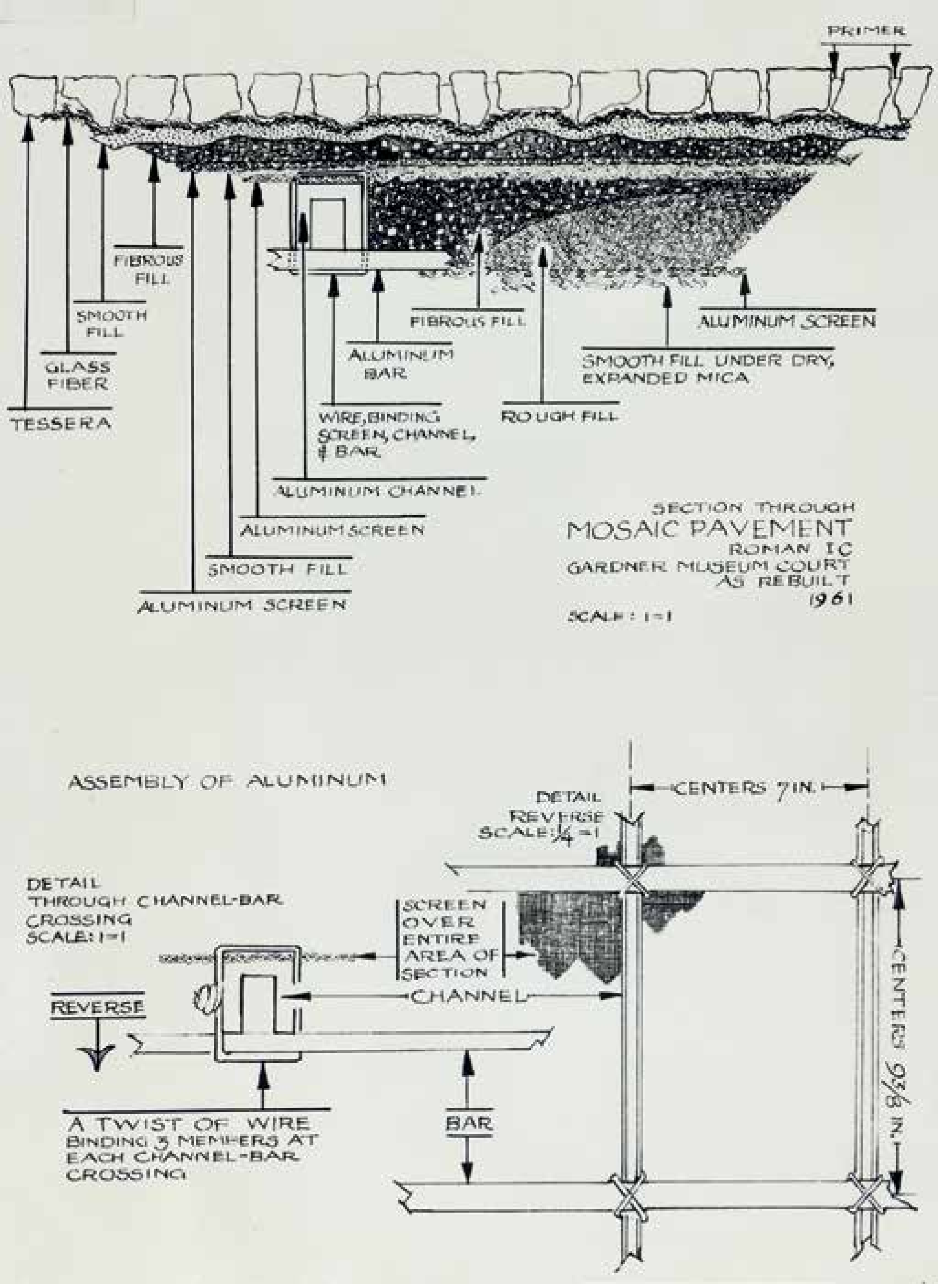

Fig. 6. Cross-section of mosaic rebuilt with new backing layers and assembly of embedded aluminium structure, 1961 (ISGM, illustration G. L. Stout)

in search of solutions to the structural problems. He developed and implemented a plan for treatment of the mosaic, including prevention of further sinking, and in 1969 he published an account of the work entitled *A Roman Mosaic Pavement Rebuilt*, in the journal *Studies in Conservation* (Stout 1969). The description that follows is summarised from the original report.

Mosaic conservation

The mosaic was first surface cleaned with solvents and a mild detergent in water. Accretions were scraped off and losses were puttied. The edges were faced with linen gauze and animal glue, then separated along the joints using a power saw and chisels. The sections were then pried away from the underlying concrete slab and fully faced using two layers of linen with animal glue. When dry, each section was padded out with felt and bolted between two pieces of plywood. These assemblies were transferred to a nearby gallery, used as a workroom for the duration of the treatment. The panels were flipped face down and the cement backing was cut away. What remained of the antique mortar bedding was removed, exposing the clean backs of the tesserae. Loose tesserae were fixed into position with an aqueous adhesive; many black tesserae, prone to disintegration, were replaced. Uneven edges were straightened with gesso or a spackling compound. Strips of heavy paper impregnated with cherry rosin and beeswax were melted into place around the edges of the panels, followed by strips of wood. These were attached to create forms for holding the new backing layers.

Stout's 1969 article beautifully illustrates the backing system designed for the mosaic, involving multiple layers of epoxy resin bulked with inert fillers of expanded mica, fibreglass and kaolin (Fig. 6). The bulked epoxy layers were called *rough*, *smooth* and *fibrous,* depending on the proportions of fillers used. In addition, Stout incorporated aluminium mesh screening and a grid system of aluminium bars and U-channels wired together for rigid support. When the backing system was completely set, each section was trimmed and labelled. The facing material was removed with warm water and scrubbed with triple fine pumice. The panels were then dried in the sun or under infrared lights and coated with a synthetic resin for saturation of the surfaces.

Structural support and installation

In the courtyard Stout supervised construction of the new foundation system. Four steel-reinforced concrete columns were sunk to firm ground, about 7.6m below surface (Fig. 7). A steel-reinforced concrete platform was poured, cambered at the edges for drainage. The system of piling and platform was designed to return the mosaic to its original level, estimated by reference to historic photographs. The individual mosaic sections were placed and levelled on nine cement pads, that in turn rested on the surface of the concrete platform; Stout was insistent on ventilation between the back of the mosaic panels and the platform below (Fig. 8). In the gaps between sections he stuffed fibreglass insulation, to a level just below the mosaic surface. He then created restoration tesserae using plaster or spackling compound,

Fig. 7. Construction of mosaic foundation, 1961 (ISGM, photo J. B. Pratt)

Fig. 8. Levelling mosaic panels on cement pads, 1961 (ISGM, photo J. B. Pratt)

but left the dark areas of the design open, knowing that the viewer's eye would easily the results over the shadows of the void. In this way he achieved an even greater percentage of open surface area, for drainage and ventilation. The restoration project was completed in 1961.

THE MOSAIC'S CONDITION, 56 YEARS LATER

56 years after the extensive work by George L. Stout, the museum's conservators re-evaluated the condition of the mosaic as part of long-range planning for conservation and potential re-treatment. Given the rich documentation left by Stout and his successors, we were able to repeat the measurements used to track the subsidence of the mosaic using a laser level, measuring tape, and the same courtyard step as the reference point. These measurements revealed that across its surface, the mosaic was on average only about 3.8 cm lower than in 1964. While it would be more reassuring to report absolutely zero subsistence since 1964, it should also be noted that several factors could introduce error in the results. Among these, the step used as the marker is not flat, and the exact position of the 1964 reference point is unknown. In addition, the individual mosaic panels rock slightly on the cement pads, affecting the evenness of the mosaic surface. Finally, Stout did not have access to modern laser instrumentation in 1964, and his measurements may have been subject to variation. However, our process put in place an accurate system for ongoing annual measurements, tracking any potential changes.

In addition to confirming of the stability of the underlying structures, the condition of the mosaic panels was also addressed. This revealed a number of minor condition issues requiring resolution. The panels rock, indicating that the connections between the panel backs and the cement pads (in turn attached to the concrete platform) are broken. The surface of the mosaic is no longer planar and many of the individual panels sit at slightly different heights or angles in relation to one another. Most of the restoration tesserae have been lost over time, making the geometric joint lines quite visible where these cross design elements. The plaster restoration tesserae that remain are dirty and deteriorating, due to constant water-

Fig. 9. Reverse side of the lower proper left corner mosaic panel, showing corroded aluminium bar and lifting section of epoxy, 2017 (photo J. Chloros)

ing of the adjacent plantings. Some mosaic panels also exhibit staining.
The lower proper left corner panel of the mosaic was removed to assess the aging of the epoxy backing, potential corrosion of the aluminium, and the condition of the cement pads and reinforced concrete platform, we removed the lower proper left corner panel of the mosaic. It was immediately apparent that some of the aluminium bars are corroding, cracking, and thus lifting the final smooth layer of epoxy, becoming visible at regular intervals (Fig.9). When one of the failing sections of epoxy was lifted the perfect impression of the width of the bar and the cavity below, containing only the powder of the completely corroded aluminium was observed. However, at the edge of this panel there is an exposed area of the perpendicular aluminium U-channel that is in perfect condition. The reasons for the severe corrosion of the aluminium bars running in one direction, while the U-channels perpendicular along the same edge remain pristine, is unclear. It may be a consequence of different alloy compositions or varying exposures to moisture. The epoxy backing also exhibits "ghosting" where the panel rests on the nine cement pads. The locations of the corroded aluminium bars and lifting epoxy in some cases correspond with their positioning on the cement pads, which contributes to the panels sitting at varying heights.
The cement pads and concrete platform were examined, and as suspected, it was found that many of the pads were no longer adhered to the platform. In some cases they could be easily lifted, or were cracked and crumbling. The presence of dark, damp patches on the concrete platform indicated that water is infiltrating this level to some degree. However the platform is free of cracks and generally appears in excellent condition.

Conclusions

During in the years 1960-1961, George L. Stout and his team accomplished a remarkable technical feat to rectify the sinking of the *Mosaic Floor: Medusa*. The foundation they created is still sound and in excellent condition. It would be ideal to lift several more mosaic panels to better understand the extent of corrosion of the aluminium bars and the potential of this causing problems in other panels. It could be necessary to remove part of the epoxy backing system to address the aluminium corrosion. A new system must be devised to replace the cement pads, serving as the support for the mosaic/epoxy panels. Some initial ideas include the use of individual mini jacks which could be re-adjusted as necessary, or the creation of a bed of sand on which the panels could be set and infinitely adjusted as needed by adding or removing sand. Lastly, the aesthetic issues of soil and staining must be addressed, as well as the loss and failure of the plaster fills, for better integration of the overall design. The *Mosaic Floor: Medusa* is the focal point of the courtyard and the courtyard is the focal point of the museum created by Isabella Stewart Gardner. The previous generation of conservators did a masterful job of caring for this work and it is now our turn to do the same.

References

Casagrande A. 1946. Letter to Mr. Morris Carter. 20 June 1946. Archives of Isabella Stewart Gardner Museum.

Marucchi O. 1892. "Di un Pavimento a Mosaico con Figure Egizie Scoperto presso la Via Flaminia." *Bullettino della Commissione Archeologica Comunale di Roma*, Series 4 (April-June): 160-174.

Stout, G. 1961. *Mosaic Pavement, Roman, I Century, Record of Repair and Reinstallation*. Boston: Isabella Stewart Gardner Museum.

Stout G. 1969. "A Roman Mosaic Pavement Rebuilt". *Studies in Conservation* 14: 165-169.

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REINSTALLATION OF A ROMAN MOSAIC AT THE METROPOLITAN MUSEUM OF ART

Carolyn Riccardelli
Beth Edelstein
Dorothy H. Abramitis

Abstract

An ancient mosaic pavement, excavated north of Rome in 1892, entered The Metropolitan Museum of Art's collection in 1945. Two decades later, the mosaic was divided into 30 sections, and a concrete backing applied before installing it in a gallery displaying unrelated frescos. In 2006, in preparation for a major gallery reinstallation, the mosaic was removed to reinstall it in a more appropriate gallery. The concrete backings were in good condition and were utilised to attach a new system of composite panel supports. The new mounting system is versatile, providing the option to install the mosaic on the floor or the wall.
Keywords: mosaic, Roman, concrete, backing, composite panels

History

In the last decade of the 19th century at Montebello, about 10 km north of Rome, an ancient building complex containing seven floor mosaics was discovered on an estate belonging to Cavaliere Alessandro Piacentini. Three of these mosaics were described as noteworthy in *Notizie degli Scavi di Antichità* (Marchetti 1892). One of these mosaics, after being lifted from the site, was acquired by the private collector Susan Dwight Bliss, who installed it in her home on East 68th Street in New York City. It remained there until 1945, when it was offered as a gift to The Metropolitan Museum of Art in New York. We know from publications associated with this mosaic that the lower right corner was in poor condition when excavated (Fig. 1). At some point, perhaps before it came to New York, the areas of loss were restored. The current article describes the history of the mosaic after The Met's acquisition, primarily focusing on treatment and reinstallation executed from 2014 -2015, when it was removed from a gallery installation and prepared for a new display context. It is interesting to note that in 1897, Isabella and Jack Gardner acquired a second mosaic from the Montebello complex. This work was divided into squares and shipped to Boston, where by 1902 it was incorporated into the central courtyard of the Isabella Stewart Gardner Museum (Oliver 1965). This second mosaic is discussed in another article in this same volume.

The *Mosaic floor with Egyptianizing scene* (Metropolitan Museum accession number 45.16.2) is executed in black and white limestone and coloured glass tesserae and is dated between 130 and 150 AD. The lifted pavement, approximately three metres square, is largely filled by symmetrically arranged patterns of geometric and floral forms. A square central panel bounded by a guilloche pattern shows a figurative scene,

Fig. 1. The Met's Roman mosaic in situ, ca. 1892. Courtesy of Isabella Stewart Gardner Museum

composed using tesserae in black and white limestone and vibrant shades of red, yellow, blue and green glass as well as some gold glass tesserae (Fig. 2). In the scene there are two figures, both wearing Egyptian dress. The one standing on the left has been identified as a priest making an offering to the seated figure on the right, tentatively identified as the goddess Isis; however the interpretation of the scene remains uncertain. The Roman fascination with Egyptian culture is reflected in the inclusion of iconographic and aesthetic aspects in the architecture, statuary, frescoes, and other decorative arts of the empire. The depiction at the centre of our mosaic may therefore be a Roman interpretation of a scene intended to imbue the original building space with Egyptian ambience. On the other hand, the motifs surrounding this central panel consist of characteristically Roman geometric and floral patterns. At each side of the central square there is a large octagonal element, containing a rosette of orange, red, yellow, deep blue, turquoise blue, and green tesserae. Joining these octagons, at the corners of the floor, are L shaped sections of double guilloche ornament. In the spaces between the octagons and the central panel, and in the border to the exterior of the corners, are diamonds and triangles containing floral and spearhead forms (Oliver 1965).

The mosaic entered the collection of The Metropolitan Museum in 1945, but it was not until the early 1960s that it was placed on exhibit, as the floor of a new

Fig. 2. *Mosaic pavement with Egyptianizing scene*, Roman, ca. 130–150 AD, stone and glass, 295 × 297 cm, Gift of Susan Dwight Bliss, 1945 (45.16.2) (photo Paul Lachenauer, The Metropolitan Museum of Art)

gallery designed to represent a *cubiculum*, with frescoed walls. The frescoes used in this display originated from a Roman villa at Boscoreale, just north of Pompeii, built shortly after the middle of the 1st century BC , some 200 years before the mosaic floor under discussion (Lehmann and Bloch 1953). In preparation for installation, a local contractor divided the mosaic into approximately 30 small sections based on its geometric design, and applied concrete backings. The sections were then installed on a concrete subfloor and secured with cement grout between the sections. Photographs taken at the time of excavation of the Boscoreale *cubiculum* show that the original mosaic floor of this space was executed in plain white tesserae. During planning for the reinstallation of the Greek and Roman collections, in 2006, Met curators therefore decided that the two unrelated artworks should be exhibited separately.

Treatment

Condition and deinstallation

In 2006, the Boscoreale fresco panels were removed from the galleries for conservation, allowing a thorough examination of the Roman mosaic. The mosaic was found to be in stable condition, with deterioration and wear of the stone and glass tesserae commensurate with its age. The surface was covered with a layer of dirt, grime, and possibly modern wax or resin, and we observed various campaigns of grouting, including a black resinous layer that in many cases obscured the edges of tesserae. Examination and historic photographs revealed that the mosaic was backed and installed in multiple sections that, for the most part, followed and bisected the double black lines of the geometric design. A test cut through the cement grout revealed that the sections were only loosely bonded to the gallery subfloor, and could be carefully separated with a pry bar. The mosaic was then cut along the 1960s grout lines using a circular saw and handheld angle grinders. A protective facing of nonwoven polyester fabric applied with Paraloid B-72 was effective in retaining tesserae along edges and corners that inevitably became detached or delaminated during the deinstallation.

After lifting, we observed that the concrete backings were approximately 3.8 cm thick, applied in two layers. The installation could be dated by writing found on the reverse of one of the panels: "Luvera Lazration Const Corp AD 1963." Each section was in stable condition overall, and most of the tesserae were well attached to the concrete backing. There were no visible traces of original mortar. Some of the larger panels (primarily the octagons and central panel) had a crack pattern visible on the verso, corresponding to what appeared to be locations of internal metal reinforcing bars. These cracks were largely superficial in nature and did not compromise the structural integrity of the backing. In summary, we concluded that the technique of mounting on cement had been well devised and executed for its time.

Consideration of concrete backing removal

At this point, the mosaic was stable and in storage, but not yet displayable. By mid-2014 the necessary budgets, personnel, and workspaces had been convened for work on the project. Initially, consideration was given to removing the concrete from the sections and creating a new lightweight backing system for the entire mosaic. Further visual and computed X-radiography examination revealed that the backings had been prepared with metal reinforcements embedded in the concrete: ferrous metal bars linked with copper wire for the large square and octagons, and wire mesh for the smaller sections. In a few places where delamination had occurred along the edges it was possible to observe a fibrous woven material between the concrete layers. The radiographs did not reveal any associated structural damage or deterioration of the metal or concrete, and the metal components exposed during the dismounting process were found to be free of corrosion.

In addition to this evidence of stability, we took into consideration the significant risks and expense involved in removing the concrete backing. We investigated related projects carried out at other institutions, such as the treatment of the mosaics at La Basilica Ritrovata (San Severo a Classe) in Ravenna, which used a grid-cutting technique followed by careful removal of the final backing layers with micro-impact tools (Racagni 2010). Another approach considered was to grind away the backing, as was done for the Gerasa mosaic of the Yale University Art Gallery, but the expense of their high-tech method was beyond the resources for our mosaic (Snow *et al.* 2017).

While concrete backings are generally heavy and unwieldy, we were fortunate that our pavement was backed in small, manageable sections. Importantly, we also knew that the mosaic with its concrete backing would remain in the stable environment of The Metropolitan Museum of Art, which had so far preserved the metal and other components in very good condition, and could continue to do so. Considering all these factors, we concluded that the risks did not outweigh the benefits of removing the backing, and that rather than remove the concrete we would use it as part of a new support system for the mosaic.

Considering the size and weight of the assembled mosaic, we proposed that the pavement be divided into nine sections, each mechanically attached to backing panels. These smaller sections could be more easily handled by small groups of people and enabled safe transport within the museum.

Analysis of tesserae

In addition to the structural inspection we also performed an analysis of the tesserae. One of the aims was to compare the nature of the materials used in the restoration of the lower right corner with those of the rest of the mosaic. Non-invasive open air surface analyses were performed by Research Scientist Mark Wypyski using a portable Bruker Tracer III-SD X-ray fluorescence (XRF) spectrometer operated at 40 kV, 12.50 μA.

All of the glass analysed is of soda-lime-silica composition with relatively low potassium content. There are several shades of blue glass (opaque dark blue, medium blue, dark and light turquoise) which are coloured with varying amounts of cobalt, copper, and the white opacifier antimony oxide. Light blue tesserae contain copper, cobalt, and antimony as well as traces of tin. All blue tesserae have small amounts of lead present. Turquoise tesserae contain traces of iron. Differences between light and dark turquoise appear to be due to varying amounts of manganese oxide. Dark and light green tesserae have similar composition to the turquoise glass but the antimony present is likely in the form of lead antimonate. Yellow tesserae also contain lead antimonate with varying amounts of copper depending on the shade. Red tesserae contain iron, copper, lead, manganese, and small amounts of zinc, tin, and antimony. Orange tesserae are similar to the red composition, but they contain more lead and tin, as well as greater amounts of iron, zinc, and copper. All of the glass tesserae examined were found to be consistent with Roman glass of the early first millennium. There is no evidence to indicate a modern origin of any glass tesserae on this mosaic (Wypyski 2015).

From these analyses, we concluded that the restoration to the lower right corner of the mosaic was not accomplished using modern tesserae. It is quite possible that enough ancient tesserae were recovered during the excavation for reconstruction of the pattern in the missing areas. However, no records of this work have been found.

Cleaning and stabilisation

Treatment began with removing the facings that were applied during the deinstallation, using acetone poultices and cotton wipes. Facings over unstable and detached tesserae were left in place during cleaning. The layers of surface dirt were removed using a solution of water, ethanol, and Orvus WA paste applied with stencil brushes and cotton wipes. A dental steam cleaner worked well to remove ingrained dirt and old restoration materials covering the stone tesserae. Any deteriorated glass was avoided during steam cleaning. Removing decades of grime revealed the beautiful colours of the stone and glass, greatly improving the contrast between the coloured tesserae.

To stabilise any damage incurred during deinstallation, loose fragments were reattached with 40% B-72 in acetone. Deep undercuts along the edges were filled with B-72 bulked with 3M glass bubbles K15 (microballoons) and cellulose powder (1:2 ratio), and this same mixture was used to stabilise tesserae, as needed. After each area of stabilisation was completed, any remaining facings were removed with acetone. In a very few places, primarily in the figures, missing tesserae were replaced with replicas made with Epo-Tek 301-2 epoxy resin tinted with Orasol dyes.

Backing

The 28 sections of mosaic resulting from the disassembly of the 1960s mounting were mostly small and fairly convenient to move around, but too numerous and cumbersome for an efficient gallery installation. Conversely, mounting the mosaic on a single large panel would have created an object that was dangerously heavy and too large to move within the museum. We decided to group the small sections comprising the corner areas of the mosaic into four panels. These, together with panels for the four octagons and central square, resulted in a total of nine sections of approximately the same size and weight (Fig. 3). Mounting the sections on rigid composite panels also increased their versatility, enabling installation of the mosaic on either on a floor or wall.

Design and fabrication

We chose to attach the nine mosaic sections to their new backing panels by means of system of bolts and threaded inserts embedded in the existing concrete backings, making the backing easily system removable. We designed the backing panels for a floor installation of the mosaic, but also included design features to provide the option of vertical mounting using a channel strut system.

The backing panels are composed of aluminium skins (1.6 mm thick) with a rigid core of T90-100 structural foam [1], resulting in an overall thickness of 1.9 cm. We chose the rigid foam core based on recommendations from Carol Snow, Conservator at Yale University Art Gallery, who used a similar material for the backing panels of the Gerasa mosaic (Snow *et al.* 2017).

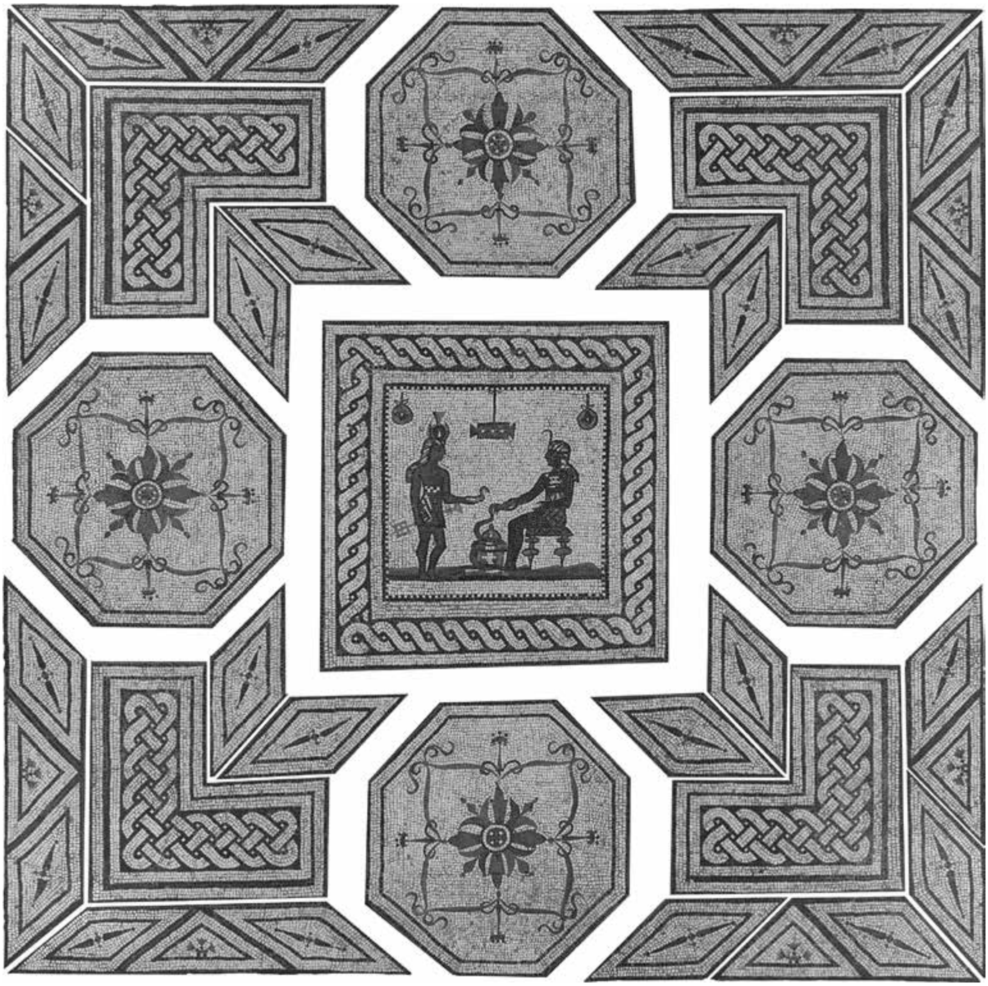

Fig. 3. The mosaic was divided into nine sections to be backed with composite panels. The corner sections are each composed of 5-7 small pieces (diagram C. Riccardelli, The Metropolitan Museum of Art)

T90-100 foam has excellent dimensional stability in fluctuating temperatures, and the continuous nature of the foam core provides slightly more shear strength in the panel than the equivalent thickness of aluminium honeycomb (Brad Wesley, e-mail to author, April 6, 2015). The composite panel of each section was fabricated with a 5 cm-wide poplar frame embedded around its circumference, and several internal poplar blocks placed at pre-determined locations within the foam core. These blocks were inserted by the fabricator where each threaded insert would be embedded into the concrete backing; their function is to help prevent localised crushing of the composite panel when tightening the bolts. At our request, the fabricator pre-drilled holes in these "tapping blocks," saving significant time for the conservators. Each of the panels also has a pair of internal aluminum blocks with threaded holes, serving as the attachment points for lifting eyes. Finally, each panel was equipped with four T-nuts, which accept the levelling feet.

The design and fabrication of the nine backing panels was executed in collaboration with Composite Panel Solutions [2]. The company provided excellent support, considering our specific needs and approved the designs in relation to the weight and size of the different mosaic sections. We made Mylar templates indicating the overall shape of each section, the size of the composite panel (slightly smaller than its mosaic section), the locations of any metal reinforcing elements in the concrete, and the desired locations for threaded inserts. On the template, we spaced the insert locations evenly across the panel to distribute the loads well below the shear and compressive tolerances of the hardware and composite panel. The Mylar templates were then shipped to the fabricator, who standarised the panel shapes to facilitate manufacture. The panels took several months to design and fabricate, but once delivered, were ready to attach to our mosaic.

Preparation and mounting

The corner sections were the most complex to mount as they were composed of up to seven pieces each. The separate sections were placed face-down on a table with a Plexiglas top, allowing visibility of the face of the mosaic to ensure proper alignment (Fig. 4). The edges of the section were then braced using blocks and clamps. This step helped to maintain alignment of the pieces while holes were drilled into the concrete backings. Preparation of the remaining centre panel and octagons proceeded the same way as the corner sections, but without the need to align component parts.

Each composite backing panel was positioned on the back of its corresponding section and clamped in place; then pilot holes were drilled into the concrete with a twist bit, using the pre-drilled holes in the tapping blocks as a guide. Next, the panel was removed, and rebar-cutting drill bits were used to enlarge the holes in the concrete backing. These drill bits cut through any metal wire we might encounter in the drilling, and produced a flat-bottomed hole for easy insertion of the threaded inserts (Fig. 5). After cleaning the holes of dust and debris from drilling, the surfaces were consolidated with 10% B-72 in acetone. Also at this time, brass threaded inserts (tapping inserts for hardwood) were prepared by sealing one end with a thin window of five-minute epoxy to prevent the embedding epoxy from flowing into the threads of the insert in the next step.

The following day, the base of each brass insert was set into the concrete backing by first placing a thin layer of Araldite 2014 epoxy into the bottom of each hole using a syringe. The inserts were pressed down gently, allowing the epoxy to rise to about half the height of the insert. The composite panel was then placed on the back of the mosaic and properly aligned. A bolt was inserted into each hole, and screwed down gently into the corresponding insert until the bolt head just touched the top of the panel. This step effectively fixed all of the threaded inserts into parallel positions, guaranteeing trouble-free removal of the panel.

Fig. 4. Alignment of small corner sections on Plexiglas table top (photos C. Riccardelli, The Metropolitan Museum of Art)

Fig. 5. Beth Edelstein and Rebecca Gridley drill holes using the composite panel as a drilling template (photos C. Riccardelli, The Metropolitan Museum of Art)

After the epoxy cured overnight, the bolts were unscrewed and the panel removed. The space remaining around each threaded insert within the concrete hole was filled with the same Araldite epoxy, taking care to completely surround each insert with adhesive. Syringes equipped with wide-gauge, blunt-tipped adhesive applicators enabled us to get the viscous epoxy into the small spaces neatly.

For the final assembly, a sheet of Volara foam was laid on the back of the mosaic as an interfacing layer, and then the aluminium panel was bolted into place. Fender washers were placed on both sides of each hole to further distribute pressure of the bolt head on the composite panel before tightening with a ratchet wrench (Fig. 6).

Once fully attached to their aluminium panels, the corners could be flipped upright so we could fill in the gaps between each of the mounted sections. To simulate grout, the gaps were filled using 60% B-72 in acetone bulked with glass micro-balloons and cellulose

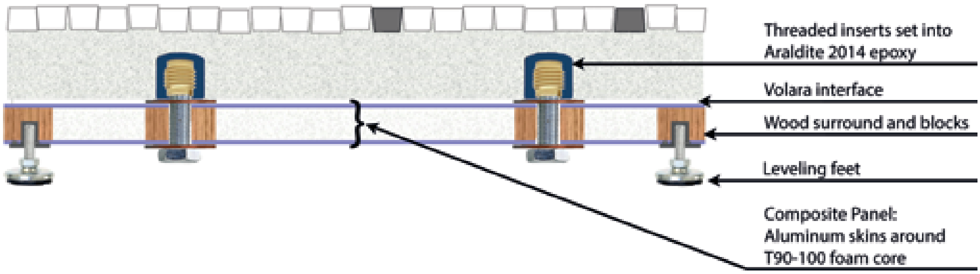

Fig. 6. Cross section of the mosaic backing scheme (not to scale) (diagram C. Riccardelli, The Metropolitan Museum of Art)

powder, mixed to a stiff putty-like consistency. The mixture was tinted with rottenstone to simulate the colour of the restoration grout found elsewhere on the mosaic.

Installation

Once the mosaic sections had been mounted onto their composite panels, the process of installing them in the gallery was relatively straightforward. Each of the backing panels was fabricated with four threaded T-nuts to accept levelling feet, situated near the edges of the panel (Fig. 7). These levelling feet allowed us to account for the slight variation in thickness between the nine sections. The panels were laid onto the gallery floor and slid into place to check their relative heights and levels. The mosaic sections were levelled relative to one another using a pry bar to lift a portion of the panel, and a wrench to adjust the length of the levelling feet. Starting with the centre panel, work progressed around the mosaic, adjusting one panel at a time. As panels were deemed level, they were temporarily marked with low-tack tape (Fig. 8).

While every effort was made to make the panels fit together as tightly as possible,

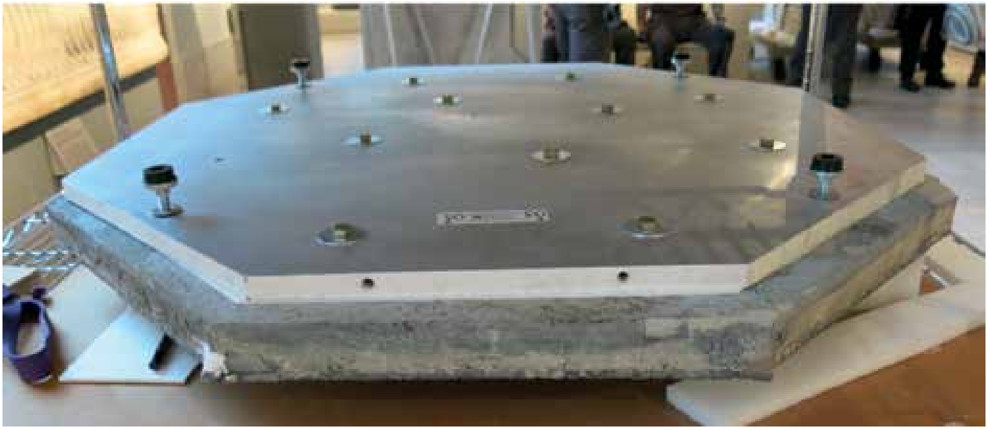

Fig. 7. Composite panel attached to octagon section, showing levelling feet (photo D. H. Abramitis, The Metropolitan Museum of Art)

Fig. 8. Installing the mosaic, using levelling feet to align the panels (photo D. Sastre, The Metropolitan Museum of Art)

the spaces between them varied in width. The same bulked B-72 mixture was used to fill the spaces, with strips of Volara foam inserted beneath for the larger gaps. After the mosaic was assembled, a thin wooden frame was added by museum carpenters, and the project was complete. The mosaic is on display in the John A. and Carole O. Moran Gallery, now surrounded by art of the later Roman Empire (Fig. 9).

Conclusion

While many innovative backing removal techniques have been developed in recent years, this project illustrates an approach that preserves a stable concrete backing utilizing it to enhance the functionality of the support.

The Met's Roman mosaic has concrete backings applied in the early 1960s that were prepared in 28 sections of different sizes. The backings exhibited neither deterioration or warping of the concrete nor corrosion of internal metal reinforcements. The state of the concrete backings is due

Fig. 9. The completed mosaic installed in the John A. and Carole O. Moran Gallery at The Metropolitan Museum of Art in 2017. (photo D. H. Abramitis, The Metropolitan Museum of Art)

in large part to being stored consistently within a stable museum environment. Our approach to assemble the mosaic's 28 separate sections into nine manageable panels of approximately similar size and weight. Converted an unwieldy multi-part object into one that can be easily moved within the museum. This also allowed us to complete the entire treatment of the panels in the conservation studio, requiring only minimal time for installation and closure of the gallery to the public.

Acknowledgements

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Notes

1. AIREX T90 is a closed-cell rigid polyethylenterephtalate-based foam used as core material for structural sandwich applications. It has high fatigue resistance and is chemically and thermally stable. The 100-designation indicates density (110 kg/m^3). Manufactured by Airex/Baltek, High Point NC, USA.
2. Composite Panel Solutions, Cattaraugus, NY, USA, manufactured custom laminated panels from a wide variety of materials. Contact: Bradley Wesley.

Technical notes

Paraloid B-72
Manufactured by Dow Chemical Company
http://www.conservationresources.com
Orvus WA paste
http://www.conservationresources.com
Max Steam 5 dental steam cleaner
http://www.maxsteam.it/en/products.php
3M Glass Bubbles K15 ('microballoons')
https://www.3m.com/3M/en_US/company-us/
Epo-Tek 301-2 epoxy
http://www.epotek.com
Orasol dyes
http://www.museumservicescorporation.com
Volara closed cell polyethylene foam
http://www.sekisuivoltek.com/
Araldite 2014 Structural Adhesive
http://www.huntsman.com/advanced_materials

References

Lehmann P. W. and Bloch, H. 1953. *Roman Wall Paintings from Boscoreale in the Metropolitan Museum of Art, Monographs on Archaeology and the Fine Arts*. Cambridge, MA: Archaeological Institute of America.

Marchetti, D. 1892. "IV. Roma: Via Flaminia." In *Notizie degli Scavi di Antichità* 17 (January): 112-115.

Oliver, A. 1965. "The Montebello Mosaics". *American Journal of Archaeology* 69 (3): 268-270.

Racagni, P. 2010. *La Basilica Ritrovata: I Restauri dei Mosaici Antichi di San Severo a Classe, Ravenna*. Bologna: Ante quem.

Snow, C., DeBlock, J., Harlow, B., Philips, T. and Florio, A. 2017. "The Yale Gerasa Mosaic Project: Innovative Methods to Replace

Reinforced Concrete Backings." In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions. The 11th conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 447-458. Florence: EDIFIR-Edizioni Firenze.

Wypyski, M. 2015. Examination and Analysis Report for 45.16.2, Department of Objects Conservation, The Metropolitan Museum of Art, New York (Unpublished report).

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THE LONG ROAD OF MOSAICS CONSERVATION: CLEAR PROGRESS, A VIEW TO THE FUTURE

Roberto Nardi
President, ICCM Foundation

Abstract
The paper reviews the status of the heritage and management of mosaics, with particular emphasis on the Mediterranean basin, comparing to the observations of a similar analysis conducted in the early 1990s, and looking back to the era of the founding of the International Committee for the Conservation of Mosaics in 1977. A key moment occurred with a restatement of the ICCM strategies following the 1990s review. Great strides have been made towards the resolution of seven criticalities, particularly as concerns documentation, the planning and range of intervention methodologies, in training, and in the selection of intervention materials. Progress is also being made in preventive conservation, communication and public involvement. However, great challenges remain in almost all of these areas, among these: conservator/restorers continue to use inappropriate materials; the training of our collaborating professionals, such as archaeologists, is inadequate for what it concerns conservation, protection and presentation; the area of law and regulation appears confused and unresolved; the insertion of sheltering structures has been particularly problematic.
Keywords: mosaic, preventive conservation, conservation, restoration, ICCM, Mosaikon

The contradiction of mosaics and the founding of the ICCM
Mosaic, more than any other historic decorative technique or material, has experienced a reality of great contradictions: mosaics have been ignored, decontextualised, vandalised, sold on the black market, badly restored, not maintained and, at the same time, been the subject of international exchange and scholarly study. The reasons for this antinomy are probably to be found in the very nature of the material, with its problems of apparent fragility, and its qualities as a bearer of historic and aesthetic messages. These characteristics have led to numerous cases in which the mosaic has been ripped from its context and transformed into a portable aesthetic icon or vehicle of economic speculation, with the complete loss of its original functional and architectural-decorative roles. (Fig. 1)
This double fate of mosaics was very precisely summed up in the title of the sixth ICCM conference of 1996 in Cyprus: "Mosaics make a site" (Michaelides 2003), communicating the idea that mosaic floors, together with wall paintings (which even more rarely survive excavation), are the elements that more than all else characterise the site and remain in the visitor's memory, making the place an attraction and promoting its protection. In contrast, this same conference also laid bare that too often, to "protect" them, the mosaics were stripped from their sites and buildings, which were then left in neglect. Instead, it was argued, mosaics could play the role of

Fig. 1. The problem of mismanagement of mosaics is widely spread all over the Mediterranean region. You can see here examples of mosaics from Italy, Spain, Tunisia, Turkey and Syria which have been decontextualised, vandalised, badly restored, not maintained. They are representative of more wide situation "without borders" (photo C.C.A. Centro di Conservazione Archeologica)

Fig. 2. Rome, ICCROM, 1978. The foundation meeting of ICCM. You can recognise in the picture Laura and Paolo Mora (first on forth from left), Bernard Feilden (second from left) and Giorgio Torraca (first right) (photo ICCM Foundation archive)

the chief defender of *in situ* archaeology, and so should be the first focus of defence and protection in their original contexts. This was in fact one of the principles embedded in the founding of the ICCM, the International Committee for Mosaic Conservation, in 1977. The founding of the committee took place within the larger context of conservation-restoration, at a moment when Laura and Paolo Mora at the Istituto Centrale per il Restauro (ICR), and Paul Philippot and Giorgio Torraca at ICCROM, operating primarily in the area of wall paintings, and proceeding from school of thought and practice founded by Cesare Brandi, Giovanni Urbani, Licia Vlad Borelli and Harold Plenderleith, had advanced from the theoretical aim of limiting detachments and achieved the first substantial successes in techniques of *in situ* conservation. And so it was that Gaël de Guichen of ICCROM found fertile ground for the organisation of a meeting in Rome, the result of which was the founding of the new body dedicated specifically to the conservation of mosaics: the ICCM, with Paolo Mora elected president (Fig. 2).

A first review of the heritage and its management

Some 15 years later, in the early 1990s, I had the opportunity to prepare a review of the state of the heritage assets and management of mosaics in the Mediterranean basin, and share this with my fellow archaeologists and conservators. For this analysis, I drew on the results of a number of studies carried out at the end of the 1980s, particularly within the context of initiatives coordinated by Gaël de Guichen of ICCROM and Alessandra Melucco of the ICR (Melucco *et al.* 1990; Nardi 1994a; Nardi 1994b).

The picture that emerged was one dominated by a series of critical issues:

1. **No documentation** was produced to accompany the interventions on mosaics.
2. The **options for intervening were very limited** and, effectively, the only solution was detachment.
3. The materials used were **only cement and plaster**.
4. The operations were carried out by **craftsmen** without formal training, applying techniques descended solely from **empirical knowledge**.
5. The **operators worked in isolation**, without exchange of information.
6. There were **no legal or regulatory frameworks** for the sector.
7. Interventions were conducted with **no advance study or planning**.

As we inquired further into this distressing panorama, we began to understand the reasons for these criticalities:

1. The **lack of a culture of planning** (managing all under conditions of emergency);
2. **Little conception of the indivisible unity of archaeological contexts** (stripping the sites of frescoes and mosaics);
3. **Lack of consideration of the end user** (information is not transmitted to the public; failure to conduct the main functions of archaeology, of providing new knowledge and education);
4. **Insufficient training, using inadequate tools** (continuing in the same theoretical-methodological paradigms that had produced the contemporary disasters).

The ICCM strategy

In view of this overall scene, the ICCM determined that although its 1977 statement of aims remained valid, the time had come to guide the available resources towards several strategic objectives:

1. **Training Conservator-Restorers**, based on sharing of the full range of existing experiences, and so enabling them to draw from a diversity of intervention approaches and techniques;
2. **Informing Archaeologists**, assisting them to recognise the irreplaceable values of the undivided context, resulting in decreasing practices of detachment and increasing *in situ* conservation;
3. **Updating Administrators**, so that they recognise the values of the mosaic heritage and act in planning and supporting its conservation;
4. **Involving the Public**, so that they can enjoy the heritage through active roles in its protection.

These strategies advanced the same aims that the ICCM had stated at its founding, more than 40 years ago.

A second review, 30 years later

Now, looking back down all the road travelled, we can clearly see the successes of the ICCM in bringing together, organising, cooperating, networking, advancing knowledge, communicating and education – even in the "simple" fact of having organised 13 international conferences, generally seated in the Mediterranean basin but bringing participation from far beyond. Each congress has been followed by publication of the proceedings, sharing new approaches and experiences with methods, techniques and local realities, and complemented by our ongoing newsletters (Fig. 3). The ICCM has been a partner in the Mosaikon project, which has included three meetings of the Directors General of Antiquities of the member Mediterranean countries, and developed a professional network of more than 350 members from 35 countries (Teutonico *et al.* 2014; Teutonico and Friedman 2017; Nardi 2017). And the ICCM continues, with the publication of the most recent international congress in Barcelona, arrangements well advanced for the next, scheduled for Plovdiv in 2021, and also under way for the 2023 event, as well as for a new meeting of the national Directors-General scheduled for 2022, after those of Ravello 2014, Venice 2017 and Rome in 2019.

But today, almost 30 years after the overview study of the early 1990s, and the refocus of our energies, what is the situation in regards to the seven critical issues that were identified? Point by point, we can compare to the current situation, identifying both our progress and some of the remaining and new criticalities.

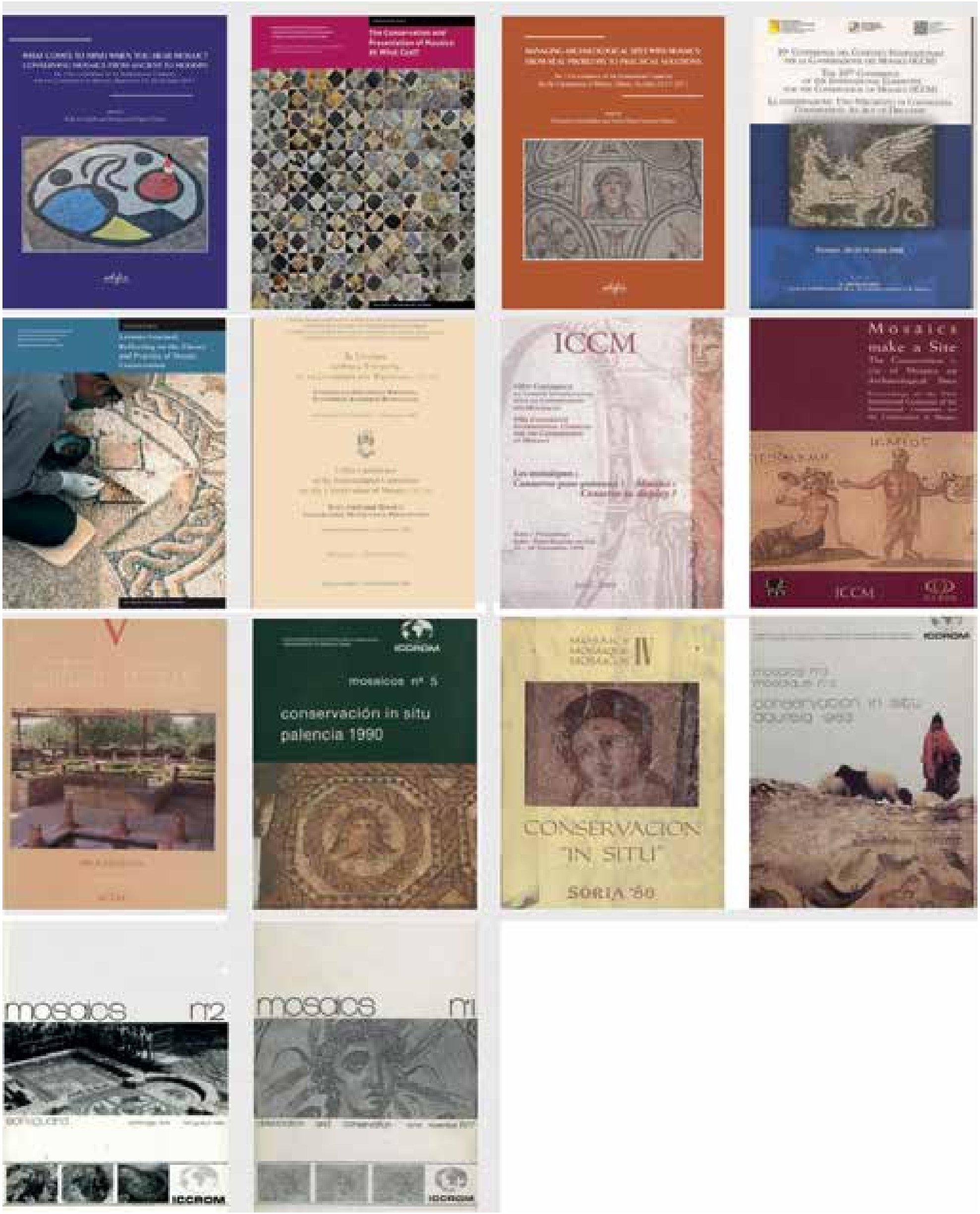

Fig. 3. ICCM organised international conferences and published the proceedings of all of them, sharing new approaches and experiences with methods, techniques and local realities

Documentation

Documentation of the mosaic and its intervention is now confirmed. Documentation is seen as integral to the conservation intervention, and indeed determines its quality. It is codified in the technical literature of many languages, not least in Arabic. Public administrations obligate documentation, and provisions for the necessary expertise and practices are included as specific items in budgets. Digital technologies have given a phenomenal boost, making advanced documentation practices accessible to all, at low cost (Costanzi Cobau and Nardi 2017).

Intervention methodologies

As late as the 1990s, intervention continued to almost automatically mean detachment of the mosaic (although not necessarily investments for reapplication to panels, and potentially for museum presentation). However, in the last two decades, we have seen the development of technical knowledge and capacities for *in situ* consolidation of both wall and floor mosaics, to the extent that these practices can normally be applied with success (Figs. 4-7) (Nardi 1997). The developing knowledge in the area of consolidation has been backed in more recent years by great strides in planning and applying *in situ* preventive conservation measures, including monitoring and maintenance, but also backfilling and the construction of sheltering roofs (Stanley Price *et al.* 2004). However in the matter of constructing roofs, it appears that we must better communicate the need for great caution, from all points of view. No matter what the profession or administrative position, our ultimate goal must be the conservation of the

Figg. 4-5. In 1993 the CCA carried out an in-situ conservation campaign in the Termae of Cisiarii in Ostia Antica. That was the time when the lime was successfully experimented as medium for the deep and superficial consolidation (photo C.C.A. Centro di Conservazione Archeologica)

mosaic in context, and it has become clear that the installation of the most carefully thought roofing (not to mention the more reckless events) unavoidably alters and even

Figg. 6-7. The first large-scale *in situ* consolidation program was carried out by CCA in Zippori, in the House of the Nile Festival. Here 250 square meters of mosaic were conserved *in situ* by using lime-base mortars. A recent survey (2019) showed the pavements in sound conditions, 25 years after the intervention (photo C.C.A. Centro di Conservazione Archeologica)

devastates that very context (Aslan *et al.* 2018). When we choose an intervention on a mosaic we have learned to think twice before proceeding; in designing a roof, it would be better for all involved to think four times, studying all the potential impacts of the structure, including in matters of current costs and those for the future maintenance of these realisations.

Materials

Where plaster and cement were once the only materials used in mosaics restoration, today we can say that some 40 years from the first experimentation, aluminium honeycomb panels (Aerolam) have most certainly entered into common use as the basis for practices in the construction of new supports. The costs for this material are still high, but trending downwards, and it presents clear advantages of ease of processing, rigidity, strength, lightness, and above all, long-term stability. As far as the bedding layer in new supports, lime-based mortars have gradually and almost entirely replaced the past usages of cement and plaster. However, in some countries, the habits of using synthetic resins such as polyurethane or epoxy resins for bedding the tiles, or even as the structural support, have continued. And we can still witness the persistence of using gypsum as a bedding layer, despite the repeated, evident precedents demonstrating the inadequacy of the material, for its content of soluble salts, hygroscopic character, rigidity and fragility. Based on misconceptions of the difficulty of processing, lack of durability, and ineffectiveness of lime based mortars (which may indeed be ineffective when one is unable to process them), some are still choosing to use synthetic resins in direct contact with the original tesserae, and an entire generation of mosaic restorers appears bound for the struggle against the legacy of this practice, in much the same way as we currently struggle against the ill effects from reinforced concrete, plaster and resins.

Training

Enormous progress has been made in response to the problem of poorly trained craftsmen who, applying only empirical knowledge, devoted themselves to mosaics restoration. Thanks to the initiatives of ICCROM and ICCM, the panorama of qualifications and the numbers of available operators are now potentially in line with the sectoral needs. These results are also undoubtedly due to another great initiative of past 10 years: the Mosaikon project. Born from an idea of Jeanne Marie Teutonico of the Getty Conservation Institute, and with support from Joan Weinstein of the Getty Foundation, the GCI, the Getty Foundation, the ICCM Foundation and ICCROM launched a program bringing the vast human and economic resources of the Middle East and North Africa regions to focus on their great riches in mosaics, an area that had long suffered from a lack of skills and resource allocations. In 10 years, the different Mosaikon projects have trained 60 conservator-restorers employed in the departments of antiquities from eight countries, and 54 site managers from 11 countries. In total, more than 200 professionals from 20 different countries have taken part in the Mosaikon initiatives. These individuals represent a new generation of administrators and technicians, around which the governments of a good share of these countries are structuring their services for mosaics conservation and restoration.

However, across the global panorama of training for the professionals involved in mosaics conservation, the weak point of the chain still seems to lie in the area of archaeology. Too many students of archaeology complete their education without sufficient preparation concerning the degradation of materials, the risks of excavation, the damages resulting from poor or absent planning and the lack of preventive conservation. Even today one can become a professional archaeologist without having the slightest knowledge of how the excavated materials should be protected and enhanced. The negative results of this situation continue to accumulate in our sites and repositories, in evident manner.

Communication

This is another area where we have achieved important results over the last few decades, both within the professions and beyond, in particular towards the public. Today, it is increasingly common practice to organise conservation worksites that are open to the public. The media, individual visitors and student groups are all considered important in planning conservation interventions, so that the enormous potential of these different stakeholders can be exploited through increasingly participatory roles in the operations. As far as the professions are concerned, the networks developed through the ICCM and by the Mosaikon project have resulted in spheres of interchange far beyond what we previously new, with consequent exchanges of information and spontaneous continuous updating.

Law and regulation

The results in this area seem ambiguous. Many colleagues, especially from the scientific area, have been involved for years in codifying procedures to be applied in the restoration of cultural heritage. Apart from the real applicability of procedures spelled out in the laboratory or agreed at table, I feel obliged to point out that these are not the kind of standards that we need in areas of managing and conserving sites with mosaics. What is really needed is legislative and administrative regulation of the sector. Who is it that decides the future of a mosaic? Based on what principles? Is it the archaeologist alone, directing a site, who can impose their personal opinions for the choice between detaching a mosaic or *in situ* conservation? What power does the professional conservator have to assert their competences in the crucial choices over the future of an artefact or even an entire building? Little has been done on this front and indeed everything is still left to the common sense of the administrators and operators. The expectation seems to be that in the absence of regulations, individuals selected for their training and good sense will carry the day, making the correct choices between good and harm. Unfortunately, this is not always the reality.

Figg. 8-9. The mosaics of the Roman villa of Santa Liberata, near Grosseto in Italy, were conserved during 2019. At the end of the conservation process the mosaics were reburied on the base of a seasonal calendar. The reburial was made by applying a stratum of Delta-Vent Plus sheets, consisting of a tear-resistant, breathable Goretex in direct contact with the mosaic, covered by bags of stitched geotextile filled with fired clay. Completed the covering system a 1:1 photograph of the mosaics printed on polyester fabric laminated with PVC (photo by C.C.A. Centro di Conservazione Archeologica)

Preventive conservation

Although still not universally practiced, we have accumulated a series of cases in which the planning of interventions and management of mosaics heritage has produced demonstrable results. Administrators and operators are slowly realising the potentials of preventive conservation, among the strategic tools for heritage conservation in general and mosaics in particular. Today, the choice of technical solutions such as the permanent or seasonal reburial, development of protective walkways, construction of shelters, and programmed maintenance are no longer isolated events (Figs. 8-9). The managers of important sites, with massive influxes of visitors, increasingly engage with the needs for ongoing conservation and management, attentive to the good of both the visitors and the archaeological structures. Just as it is increasingly common to find cultural initiatives aimed at informing and involving the public, the schools, fully in line with the strategies of preventive conservation.

Conclusions

Looking back over the seven criticalities identified in the 1990s, we can see the positive results from the long contributions supporting the cause, most obviously by the ICCM, ICCROM, the GCI and Getty Foundation, but also from many others, including the Centre for Archaeological Conservation (CCA), who have worked effectively for the protection of the mosaic heritage both through direct intervention and through the different indirect strategies. We clearly see that what has been preached for years is now yielding results, and that the culture of emergency and restoration is giving way to the idea of management based on the principles of preventive conservation. We have reasons for optimism that we have a framework for continued progress. But we can also see weaknesses requiring greater work, particularly in the definition of *curricula* for archaeologists and administrators, and in legislation and regulation for the sector. As well as pressing forward, we must defend our precious results against the constant possibility of "backsliding", with which we are all familiar. We must extend the culture of preventive conservation from mosaics to archaeological structures and contexts, from contexts to sites, and from archaeological sites to the surrounding environment, so that the actions of heritage protection and good management contribute to an intelligent global system.

References

Aslan Z., Court S., Teutonico J.M., Thompson J. (eds.). 2018. *Protective Shelters for Archaeological Sites: proceedings of a symposium, Herculaneum, Italy 23-27 September 2013*. London: British School at Rome.

Costanzi Cobau A., Nardi R. 2017. "Documentation for mosaics: a conservation technique". In *Managing archaeological sites with mosaics: from real problems to practical solutions Proceedings of the 11th Conference of the International Committee for the Conservation of Mosaics (ICCM) Meknes (Morocco), October 24-27, 2011* edited by Demetrios Michaelides and Anna-Marie Guimier-Sorbets,71-81. Firenze: Edifir.

Melucco A., de Guichen G., Nardi R. 1994. "Conservation of archaeological mosaics: the state of the problem, in the light of a recent international course". In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, ed. ICCM and ICCROM, 333-340. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Michaelides D. (ed.). 2003. *Mosaics Make a Site: The Conservation in situ of Mosaics on Archaeological Sites, 24-28 October 1996 Nicosia, Cyprus, Proceedings of the VIth Conference of the International Committee for the Conservation of Mosaics*. Rome: ICCM, Getty Conservation Institute, ICCROM.

Nardi R. 1994a. "Conservazione preventiva del mosaico nei siti archeologici". In *Atti del I Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico, Ravenna, 29 April-3 May 1993*, edited by Raffaella Farioli Campanati, 743-749. Ravenna: Edizioni del Girasole.

Nardi R. 1994b. "Critical review of the specialized literature in mosaic conservation". In *Mosaicos, no. 5: Conservación in situ: Palencia, 1990: IV Conferencia general del Comité internacional de mosaicos*, ed. ICCM and ICCROM, 341-352. Palencia: Excma. Diputación Provincial, Departamento de Cultura.

Nardi R. 1997. "The treatment of mosaics *in situ*". *Conservation, The GCI Newsletter*, vol. 12, n.1: 18-19

Nardi R. 2017. "Mosaic Conservation Course (MCC) 2011-2016, a program of the MOSAIKON initiative: mid-program review". In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et la préservation des mosaïques: Á quel coût? Actes de la 12e Conference de l'ICCM, Sardinie, 27-31 October 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 250-256. Los Angeles: Getty Conservation Institute.

Stanley Price N., Burch R., Matero F.G. (eds.) 2004. *Reburial of Archaeological site*, selected papers from the colloquium, Santa Fe, New Mexico, 17-21 March 2003. CMAS 6, Number 3-4.

Teutonico J. M., Bouchenaki M., and Michaelides D. 2014. "MOSAIKON: A regional programme for the conservation of mosaics in the Mediterranean (2008-2012)". In *Conservation: An Act of Discovery*: *Proceedings of the 10th Conference of the International Committee for the Conservation of Mosaics, Palermo October 20-26, 2008*, edited by Demetrios Michaelides, 424-435. Palermo: Regione Siciliana.

Teutonico J. M., Friedman L. 2017. "The MOSAIKON Initiative for the conservation of mosaics in the Mediterranean region: an update on activities". In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: Proceedings of the 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 365-374. Firenze: Edifir.

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THE MOSAIC AND TRENCADÍS ART OF THE PALAU DE LA MÚSICA CATALANA

Cristina Martí Robledo

Abstract

Catalonia preserves a wealth of Modernist buildings of great artistic value, including the Palau de la Música Catalana in the heart of Barcelona. The approach of the architect, Lluís Domènech i Montaner, was to develop ornamentation thorough integration of the arts and crafts. In this case, ceramic is the key material element, decorating the entire building while simultaneously coating and protecting the underlying metallic structure. In Catalonian *modernisme*, the classic mosaic technique using small tesserae was enriched with the new method of *trencadís*, in which irregular pieces of randomly fragmented tile are applied in an "abstract" manner.

Keywords: *Modernisme*, Lluís Domènech i Montaner, conservation, restoration, Barcelona

Introduction

The Palau de la Música Catalana is situated at the junction of the Sant Pere més Alt, Amadeus Vives and Sant Francesc de Paula streets in the heart of Barcelona's *Ciutat Vella*. The building is emblematic of the Modernist era, and was placed on the Barcelona Register of Sites of National Interest in 1971 and on the World Heritage List in 1997 (Fig. 1). The building was erected on the site of the former Monastery of Sant Francesc de Paula, demolished in 1902, by the architect Lluís Domènech i Montaner, one a series of great names of Catalan *modernisme*. Although he is perhaps better known for other creations, such as the Hospital de la Santa Creu i Sant Pau, also in Barcelona, or the Institut Pere Mata in the city of Reus, many historians regard the Palau de La Música Catalana as the finest synthesis of his work. Domènech i Montaner began the

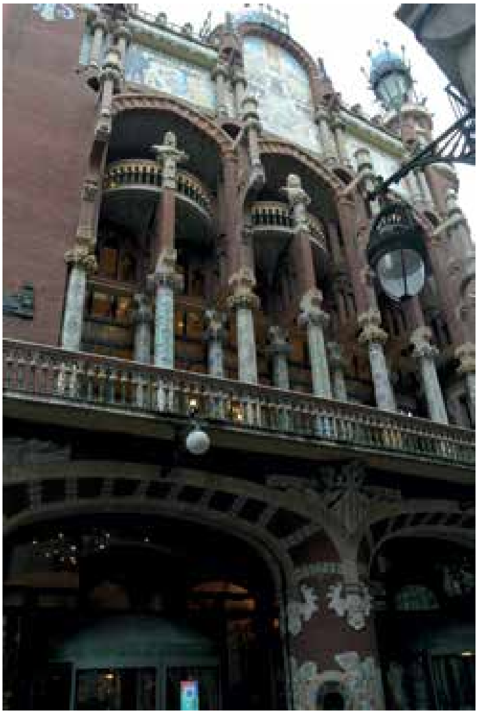

Fig. 1. Façade of the Palau de la Música Catalana (photo C. Martí)

design of the Palau de la Música in 1904 and construction was carried out between 1905 and 1908, however it was not until decades later that the building gained universal appreciation.

El Palau de la Música Catalana

The Modernist movement rejected the academic historicism of the 19th century and sought to correct the effects of industrialism and urbanisation, creating a new style based on the use of simple materials for development asymmetric sinuous lines, incorporating plant-like forms and light. In Catalonia the ornamental programme was driven by a conception of total integration of the arts, developed through constant communication between the architect, builder and artisans. Lluís Domènech i Montaner, the architect of the Palau de la Música, thus worked in what we would now call an interdisciplinary group, including stonemasons, blacksmiths, and mosaicists such as Pau Gargallo (1881-1934), Mario Maragliano (1864-1944), Lluís Bru (1968-1952) and Eusebi Arnau (1863-1933), among others. The understanding between the different specialists enabled the use of materials considered to be of quite low quality in creating great works of art. In this way, ceramic, glass, iron and exposed brick were given importance. The Palau de la Música contributed to the establishment of the movement, and is now considered an architectural masterpiece, however at the time it was considered so pompous and ornamentally overloaded that it was labelled the “Trinket Palace” (Permanyer 2008), and there were public demands that it be demolished.

Ceramic had long been a popular aspect of the Valencian architectural tradition, and proved ideally suited to the principles of *modernisme*, given its hygienic qualities, functionality and economy, as well as opportunities for aesthetic expression. Among the major producers, the Pujol i Bausis [1] company was particularly important in conducting research in modern ceramics (Subias 2002). The company also developed formats and pieces designed by some of the greatest architects of the time, such as Domènech i Montaner and Puig i Cadafalch.

In the case of the Palau de la Música Catalana, ceramic covers almost the entire building. It can be found in regular shapes, produced in moulds, in smooth and relief tiles, used as cladding, as well as in the form of mosaics, in a constant play of shapes and compositions. One of the questions posed by the current conference is “What is a mosaic?” Indeed the Palau de la Música offers an excellent example of the different ways of conceiving of a mosaic, given its uses of different materials, shapes and colours. The conventional shapes of small format tesserae lie next to tiles cut in specific shapes and forms, composing large-scale figurative sections produced from drawings, as well as sections worked in randomly broken pieces called *trencadís*. Mosaic tiles were prepared in both ceramic and glass, such as in the case of concert hall partitions and the Sala Lluís Millet. The dresses of the muses of the concert hall are executed in varied colours and tones, achieving exceptional effects of volume and movement.

Although the exterior and interior of the Palau de la Música Catalana offer many types and combinations of mosaic compositions, what we find most are tesserae, or tiles in relief, placed in a surrounding of *trencadís* technique. The tesserae mosaic

Fig. 2. The feet of a muse, executed in tesserae with background *trencadís* (photo C. Martí)

Fig. 3. Monochrome and polychrome tesserae, cut in quadrilateral and petal shapes (photo C. Martí)

Fig. 4. Monochrome ceramic pieces, cut in desired shapes (photo C. Martí)

Fig. 5. Tesserae mosaic flanked by monochrome tiles with smooth and relief surfaces (photo C. Martí)

is prevalent everywhere, using both small monochrome (Fig. 2) and polychrome glazed pieces (Fig. 3), as can also be found on the benches in the central square of Parc Güell, and the chimney stacks of the Puig i Cadafalch house in Argentona. There are also mosaics made using tiles cut in planned shapes, contributing in specific manner to the compositional forms (Figs. 4-5). The *trencadís* technique, a distinctive trait of Catalonia *Modernisme*, involved the fragmentation of glazed tiles into irregular pieces, which could then be composed in an "abstract" manner to create the mosaic. An excellent example at the Palau de la Música is the monochrome background surrounding the 18 muses of the stage and their ancillary decorations.

The mosaics of the concert hall stage

The semi-circular stage of the Palau rises at the front of the rectangular auditorium, before a small *platea*, surrounded by two levels of elliptical balconies and stalls, and is surmounted by a central skylight. The curving rear wall of the stage features 18 muses, representing the different musical arts (Fig. 6). The stage is seen through the opening of the highly sculptural *proscenium*, the work of Pau Gargallo, which also serves as the access route to the stalls.

The main technique for the stage decoration was mosaic. At the centre is the national emblem of Catalonia, crowned with the crest of King James I the Conqueror, the work of Lluís Bru, with nine

Fig. 6. Final state of the right side of the chamber of the concert hall after restoration intervention (photo Josep Blanco)

muses to each side, at alternating higher and lower levels. Eusebi Arnau sculpted the head, torso and arms of each of the 18 muses in stone. Below the sculpted components are the stylised lower figures of the muses, with flared skirts executed in tesserae mosaic, establishing the stability of the figures. The personages are linked by garlands of roses, also in tesserae, and the whole is inserted in a background of *trencadís* executed in a play of monochrome brown hues.

The 18 muses represent the music of the Greek cithara, flute, tambourine, pipes, triangle, lyre, castanets, drum, German lyre, psaltery, voice and trumpet, harp, violin, *guembri*, pan flute, lute, *flabiol* and *tamborí* [2], and lastly an *aulos*. Marta Saliné (2015) comments on the instruments and clothing of the sculptures, pointing out the relationships of each one with their instruments, lands and eras of origin.

It is the tesserae mosaics, representing the dresses of the muses and their joining garlands, that establish the decorative richness of the stage. These are composed of glazed pieces and glass paste tesserae, the latter in colours of lilac, black, purple and green. The colours complete the upper-body forms of the sculptures, providing movement. The choice of smaller tesserae or large-sized ceramic pieces is used to emphasise the folkloric and character values of the different muses. For example in the cases of the *Tambourine*, *Pipes* and *Lyre* muses, the legs and feet are created using lighter-coloured ceramic tiles cut in curved forms, establishing the anatomy. A comparison of the muse of the *Lyre* (Fig. 7) and that of *Voice and trumpet* (Fig. 8) is illustrative: although the two figures are similar in the upright posture of their body forms, the aesthetic features

Fig. 7. The lyre's muse before restoration (photo J. Blanco)

Fig. 8. The voice and trumpet's muse, before restoration (photo J. Blanco)

are remarkably different. The muse of the *Lyre* seems happy, as we see her bare legs in movement through her open skirt; the *Voice and trumpet* is endowed with gravitas by the straight and heavier lines of the skirt, revealing a glimpse of the greaves and feet of a suit of armour that cover her lower limbs. These representations correspond to the instruments of the two muses: the lyre, associated with dancing and festivity, and the voice and trumpet, the latter associated with formality and solemnity. We can also note that the skirt of the *Voice and trumpet* bears the cross of Saint George, patron saint of Catalonia.

The mosaics of the dresses and garlands were evidently prepared in a workshop on nets, which could then be readily transported to the construction site. Here, these large prepared sections could be inserted in place and surrounded with the background *trencadís*, mounted along with the stone sculptures and the fascia of ceramic tile, completing the lowest level of the stage. During the restoration of the interiors of the Palau, an example of this procedure was found in the tesserae mosaics decorating the central parts of the structural columns. These had been prepared on nets and then placed on the columns using quick-drying cement. This can be clearly discerned from the joints between the edges of the large sections, in which there are irregularities in the fit between the tesserae, along lines which at some points do not correspond with those of the drawings.

Conservation status of the mosaics

At the time of its creation, the Palau de la Música Catalana was not a well accepted artistic production, nor was it attributed the importance that it now holds. Its alleged extravagance made it the target of hostile attempts to minimise the decoration. The stage in particular has thus been witness to different aggressive actions. For example, from photography and documentation, it has been established that the sculptures of the stage were not painted at the time of the building's opening in 1908, yet they were found painted during the most recent restoration works. From the photographs held by the Historical Archive of the City of Barcelona and documents provided by the administrators of the Palau de la Música [3], backed by the results from analyses by Grup Patrimoni of the University of Barcelona, we were able to conclude that there were at least four interventions through the history of the stage decoration (Fig. 9). A first coat of paint had been applied to the sculptural elements during an intervention dating to 1929. In 1948 this was followed by a second intervention, in which a further coat of paint was applied to the stone and a first coat to the mortar joints of the *trencadís,* using alkyd paint, which had first been commercialised in the 1930s. During a further intervention in 1972, sporadic paint work had been carried out on the stone to create effects of volume, and on the mortar joints of the mosaic, this time using synthetic paint characteristic of the 1960s. During the fourth intervention in 1995, the last one to be documented, the construction company Natursystem [4] had cleaned the stone muses with their instruments.

Ultimately, in 2007, Restauracions Policromia SL carried out the restoration of all the elements on the stage, returning the works as much as possible to their original state, under criteria of minimum intervention and maximum integrity (Fig. 10). The coats of paint applied to the stone and the ceramic had altered the perception of the decorative ensemble, eliminating texture, variation in colour, and effects of volume. The stone had been painted brown, and the mosaic tiles with yellow, red and green paints, in some manner corresponding to the original colours. The mortar joints of *trencadís* had been painted in a uniform red tone, similar to the tiles, creating a flat and featureless effect in the background.

Fig. 9. The stage area seen in 1911, with the muses unpainted (photo courtesy of Historic Archives of the City of Barcelona, Photography Archives)

The Palau de la Música had also been in continuous use for concerts and cultural acts since its opening in 1908. This had resulted in countless blows and damages due to the constant coming and going of people, and the movement of large pieces of equipment. Adhesive tape had been used to run cables along the ceramic, leaving residues and creating a dirty appearance. The joints between ceramic pieces had lost mortar due to blows, but also from boring holes and attaching items over the years. In gen-

Fig. 10. Image of the chamber in 2007, before restoration intervention (photo J. Blanco)

eral it is clear that the works had suffered from many years without a preservation strategy and procedures.

Restoration intervention

The restoration intervention for the decorative ensemble of the stage of the Palau de la Música was based on criteria of maximum reversibility of products, minimal intervention, and conservation and integrity in presentation of the original artwork. Given these premises, in consultation with the management team [5] responsible for the overall building restoration, we decided to remove the layers of paint from the all of the stone and ceramic surfaces, and so recover the original appearance of the ensemble.

The conservation-restoration work was carried out in August, at the same time as the works on the stalls, so as to limit the period of closure to the public [6]. The first step was to mechanically remove the added elements, such as wooden cleats, nails, pieces of plastic, as well as mortars and cements from previous restorations.

Next, supported by the analyses of Grup Patrimoni of the University of Barcelona [7], tests were carried out, leading to the selection of the most suitable products and methodologies for cleaning and removal of all the paint layers, distinguished for the stone and ceramic surfaces.

When it comes to the tiles, mosaic tesserae and *trencadís*, the superficial grease and dirt were removed using neutral soap, rinsed with distilled water. The residues encrusted on the surfaces were removed using soft nylon brushes. Scalpels were used in the most difficult cases, as well as for the removal of the paint applied to the mortar joints, which had also covered the perimeters of the glazed tiles of the dresses and garlands. Adhesive tape was removed by softening with ethanol and then using a scalpel.

Next, the mosaic areas and pieecs showing structural cohesion loss were consolidated using epoxy resin, and the areas with damaged glazing using acrylic resin. Mechanical procedures were also used to clean the mortar joints what had been repaired using cement that also covered parts of the resserae and *trencadís* peaces Finally mortars were used to close any interstitial gaps and ensure stability of the pieces, as well as to close the holes left from the years of improvised attachments. This process was carried out using lime mortar and mixtures of sand and gravel in different colours, matching the surrounding tones of mortar (Fig. 6).

Conclusions

The conservation-restoration of the mosaics and *trencadís* of the Palau de la Música Catalana has resulted in the recovery of a great work of art and modernist gem. The project involved first retrieving the original work, then its conservation. As for any heritage building, a regulated program of preservation and maintenance is now needed to safeguard its continuity, so that its historical and artistic value continues to be appreciated. We must preserve and maintain heritage, to avoid its degradation, and therefore limit any future intervention to the minimum necessary.

Note

1. The *Pujol i Bausis* ceramic factory was the most important of the latter 19th and early 20th centuries. The Spanish *Modernisme* movement was interrelated with its creations.
2. The *flabiol* is a Catalan woodwind instrument of the whistle family. A *sardane* dance played by a traditional *cobla* band would begin with an introduction from the *flabiol*, and end with a single tap of the *tamborí*.
3. Marta Grassot, head of Orfeó Català Documentation Centre, and Raquel Rodríguez, head of Palau de la Música Catalana guided tours.
4. "Informe de restauració de les escultures d'Eusebi Arnau a l'escenari del Palau de la Música Catalana," received from Millà, J., Gabas, A., Rossell, X, August 1995, natur@natursystem.com.
5. Construction was managed by the architects Òscar Tusquets and Esther Villanueva, with Carles Díaz as coordinator and Susanna Pavónas as technical architect.
6. The conservation-restoration works were carried out by *Arcovaleno Restauro SL* in collaboration with *Restauracions Policromia SL.*
7. "Informe Palau de la Música. Pinturas de la Sala d'espectáculo," received from info@fempatrimoni.cat, 1998.

References

Permanyer, Ll. 2008. "Cien años del templo modernista de la música.". *Journal La Vanguardia*. Magazine, 56-63. Barcelona, February 3.

Saliné i Perich, M. 2015. "Muses, dones i petits secrets al Palau de la Música Catalana". In *CDF II coupDefouet International Congress, Breaking the Art Nouveau Glass Ceiling Barcelona 25-28 June 2015*. Barcelona

http://www.artnouveau.eu/admin_ponencies/functions/upload/uploads/Saline_Marta_Paper.pdf. Accessed: 2019 August, 3.

Subías, P. 2002 "Paviments, mosaics i rajoles." In *El Modenisme a l'entorn de l'arquitectura.*", volume II, 276-277. Barcelona: Edicions Isard.

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100 YEARS OF CONSERVATION-RESTORATION OF MOSAICS AT THE ARCHAEOLOGICAL MUSEUM OF CATALONIA

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Abstract

The organisation of the Reconstruction and Restoration Workshop of the Archaeological Research Service in 1916, later subsumed in the Archaeological Museum of Catalonia (MAC), the personnel who worked in the Workshop over the course of more than a century, and the work of this unit, seem to receive little interest today. However the contexts and considerations that shaped the unit's work remain of great current importance, since it was responsible for the detachment and subsequent interventions of many mosaics of Spain, as well as the conservation-restoration of many remaining *in situ*. The unit was engaged not only on sites under the direction of the MAC, but also those of other museums and administrations. The work of the unit was greatly influenced by changing museographic aims and considerations, as these developed through the decades. The current paper briefly reviews the history and activities of the unit, and the considerations that entered into their techniques of mosaics conservation and restoration. These factors are still embodied in the mosaics as we see them today, and influence the perception and opinions of the general public, of heritage professionals, and of contemporary conservator-restorers themselves.

Keywords: Archaeological Museum of Catalonia, Spain, Barcelona, mosaics, conservation

Introduction

The names of the great historians and archaeologists of the past have never been forgotten, and dozens of articles and books are published each year, reconsidering their works. Instead, in the field of conservation-restoration, we would have difficulty even recovering the identity of our predecessors from the institutional archives or collective memory. In the Iberian peninsula, it is only now that we have begun to document our past, and we still have much to do. Indeed it is rare that we have studied the figure of any individual conservator in a substantial way.

Why would it be necessary to know our history? The archiving, organisation and study of old records could seem of lesser importance and interest compared to inquiries applying modern methods, such as the characterisation of materials using SEM and DR-X, to think of just one avenue of research. However, the study of our past is both complementary and essential. In the same way that we cannot understand Catalan archaeology of the 20th century without studying the persons of Bosch Gimpera or Almagro Basch, we cannot understand Catalan archaeological conservation without studying Francisco Font, Jaume Mayas and Jose Pedro Moya, to name just a few. Our historiography serves as the basis for current and future research, for the characterisation of works, and the interventions. In the case of the conservation of mosaics, we gain a more global and complete vision, enabling avoidance of misinterpretations, poor choices, and more confident decision making.

For these kinds of reasons, the current article provides an introduction to the first conservatives-restorers of the Archaeological Research Service and the Archaeological Museum of Catalonia-Barcelona.

A template of conservators-restorers

The Reconstruction and Restoration Workshop was created in 1916 as part of the Catalan Service for Archaeological Research (SIA), and in 1933 was subsumed within what would become the Archaeological Museum of Catalonia (MAC), where it still continues today.

Although those of us who are active in the field will inevitably witness thousands of pieces restored by the workshop over the course of more than 100 years of existence, from ceramics to archaeological glass, bone and metal, we have very little published information on the structure or operations of these institutional units. The lack of documentation extends to the area of mosaics restoration, where there was a history of intense activity, to the point of leadership and reference throughout the entire peninsula.

The founding of the workshop came at a historic moment in Catalonia and the larger peninsula, in which the professions, including those learned with a phase of apprenticeship, were gaining recognition. Public museums were being enlarged and newly created. Conservation-restoration techniques were being developed and formalised. This exciting phase also involved the area of mosaics conservation, where investigations and learning proceeded in many directions: from conservation *in situ,* to techniques for removal of mosaics, cleaning and consolidation on new supports, and more. It is true that some mosaics had already been extracted, consolidated and restored prior to the creation of the SIA and its workshop, and so professionals with relevant knowledge existed, but this would be the first formation of a specific, stable team, dedicated to archaeological conservation- restoration, including for mosaics.

Before inquiring into the principles and methodologies applied, we should consider the authors of these conservation-restoration works, since the experience of the individual is a fundamental in the way each restorer understand and approaches their work, even within the context of shared principles.

The size of the workshop team has fluctuated over the years, in terms of both staff professionals and the entry of external resources, when the needs and conditions arose. If we look only at fixed staff, which we can divide the organisational history into a first and second period.

First Period, 1916-1957

The first technician assumed for the Reconstruction and Restoration Workshop, in 1916, was the sculptor Francisco Font Contel. Font Contel directed and trained the rest of the personnel, as these were gradually added: in 1920, Lorenzo Alomar; in 1925 Francisco's son, Agustín Font Contel entered as a very youthful apprentice; 1934 and 1935 saw the arrivals of Alejandro Tomillo Najarro and Emilio Joaquin Alcalá Flores (Fig. 1).

We can provide some brief notes on these figures, as follows.

Fig. 1. The Reconstruction and Restoration Workshop of Archaeological Museum of Catalonia (Barcelona), 1940. First row: Emilio Joaquin Alcalá Flores, Alejandro Tomillo Najarro, Lorenzo Alomar Guillamet; second row: Agustín Font Contel Rodríguez, Francisco Font Contel (MAC-Barcelona Archives)

Francisco Font Contel [1] (1894-1957)

Font Contel graduated in 1912 from the School of Fine Arts of the Llotja, in Barcelona, with a specialty in Sculpture (Gracia, Fullola, Vilanova 2002: 102). In 1916 he won the silver medal of the Provincial Academy of Fine Arts, granted in competition between students of each specialty with a standing of "excellent", in his case for *Sculpture of the natural* (La Vanguardia 1916: 2-3). In the same year he joined the SIA as a sculptor-reconstructor, where he would assume the direction of the reconstruction-restoration workshop. He retained this position until death, in 1957.

Lorenzo Alomar Guillamet [2] (1907-1963)

Guillament began in 1920 as an apprentice, then became an assistant to Francisco Font. He remained a part of the workshop team until his death in 1963.

Agustin Font Contel Rodríguez [3] (1919-2011)

Augustin began as an extremely youthful apprentice, in 1925, and we can discern that he remained a part of the restoration team until the beginning of the 1940s. From this moment we have been unable to trace him, and do not know precisely when or why he left the museum.

Alejandro Tomillo Najarro (1911-?)

Tomillo Najarro worked at the MAC from

1934 until 1947, when he won the competition for a position as guardian in another institution.

Emilio Joaquin Alcalà Flores (1914-1992)

Alcalà Flores was employed in the MAC workshop from 1935 to 1956, when he left for another museum.

Second Period, beginning 1956

The death of Francisco Font Contel in 1957 brought an end to the initial period of 50 highly fruitful years. At that point there remained only one staff member, Lorenzo Alomar, who had been with the workshop for 30 uninterrupted years, beginning at age 20. The needs of the MAC remained constant, and so Alomar was authorised to recruit new staff. The new team was initially very heterogeneous, with previous training in the areas such as sculpture, drawing, graphic arts, or even electricity. By engaging them in the daily tasks of restoration and training Alomar developed the group as a team of complementary specialists, including in the area of mosaics conservation. Alomar died in 1963. Once again, we can at least cite the names of the team members and the years of their participation (Fig. 2).

Pedro Sunyer i Julià [4] (1904-?)

In March of 1917, Sunver entered the workshop of the sculptor Francisco Socies as an apprentice. He also studied drawing at the Ateneo Obrero of Barcelona. He en-

Fig. 2. The Conservation and Restoration Workshop of Archaeological Museum of Catalonia (Barcelona), 1980 (MAC-Barcelona Archives)

tered the MAC as a model maker in 1933, later moving to the Recconstruction and Restoration Workshop, of which he was director from 1958 to 1969.

Antoni Llopis

A sculptor, Llopis was employed in the MAC workshop from 1958 to 1996.

Jaume Mayas Prim

Mayas Prim entered the workshop in 1963, having studied artistic drawing at the Workers' Athenian, and drawing and altarpiece technique at the Massana School of Barcelona. Although beginning as a subordinate, he succeeded Pedro Sunyer as director of the restoration workshop and held this position until retirement in 1992.

José Pedro Moya

Pedro Moya began as an apprentice specialised in mosaic restoration, in 1963, and was the last of this era to retire, in 2004.

Other persons known as part of the team include Fernando Sancho Segura, Juan Gómez Rebollo, Ramon Grau Ferreras and Carlos Herrera Calvo.

Relations between museography and mosaics interventions

In 1933, the team of Reconstruction and Restoration Workshop restorers moved to new quarters in the Catalonia Museum of Archaeology, in Barcelona, for which inauguration was scheduled in 1935 (Gracia 2003).

At this time, in the first third of the 20th century, there was a change in the conceptual and functional expectations of archaeological museums, so that the MAC would not develop simply on the basis of gathering and reorganising the collections of the preceding Provincial Antiques Museum (founded 1879) and the Museum of History (1888), but instead with the concept of creating a new kind of archaeological museum, which would change the social context of this science. To achieve its goal, the design of the facilities, exhibitions, and selection of archaeological pieces was considered in terms of visual and didactic expectations. The opening of the new museum implied a great deal of advance work: the design of the project itself, the transfer of the pieces to the new headquarters, all the restorations necessary for proper display of the pieces, and the creation of the new museography.

The mosaics were expected to play a very important role in creating a powerful museography, as they are a focus of more ready understanding, attraction and fascination compared more common archaeological types, such as ceramics. Indeed society in general probably perceives mosaics in a manner more similar to artistic production, rather than as aspects of archaeology.

Around this time about 20 mosaics were placed in exhibition within the museum. One of the concepts of the new museography was that of "living displays", meaning that the various spaces of public and private Roman life were reconstructed in an ideal way: an atrium, a winery, a kitchen, a *triclinium*, a tomb, a columbarium, a temple hall, a burial necropolis. The mosaics would be especially important in creating an immersive atmosphere for the atrium and the religious hall, however the general museographic objectives had a strong influence in determining the criteria for reintegrating the 20 mosaics. The following paragraphs note some examples of the work carried out by the restorers.

Fig. 3. Recreation of a Roman atrium in the MAC prior to 1987; on the wall is a mosaic originally from Badalona (no. 22056); on the floor is its copy, within the recreation of an ideal *impluvium* (MAC-Barcelona Archives)

The atrium was formed using materials and numerous mosaics from the *domus* of Carrer Lladó of Badalona, detached by the MAC team during the 1927 excavation campaign. The atrium room of the museum included an *impluvium* with a fountain of water descending on a copy of one of the extracted mosaics, while the original (no. 22056) was displayed on a wall (Fig. 3). The other original mosaics from the *domus* excavations (nos. 24590, 24592, 24593, 24596, 24598 28683, 24597) were installed in the remaining atrium galleries, with the floors completed by replicating *opus caeminticium*, using ceramic and marble tiles (Almagro 1942: 44).

In the recreation of the Roman temple hall, the mosaic of the *Ictiocentaurium* [5] (no.19042), was inserted within an area of very large dimensions (15.6m x 9.7m). However there were large lacunae in this mosaic, having been used for centuries as the pavement of a Christian church, meaning that it had lost one of the four edges

Fig. 4. Recreation of an ideal Roman temple in MAC, prior to 1987; on the floor is the mosaic of the *Ictiocentaurium*, including restored segments (MAC-Barcelona Archives)

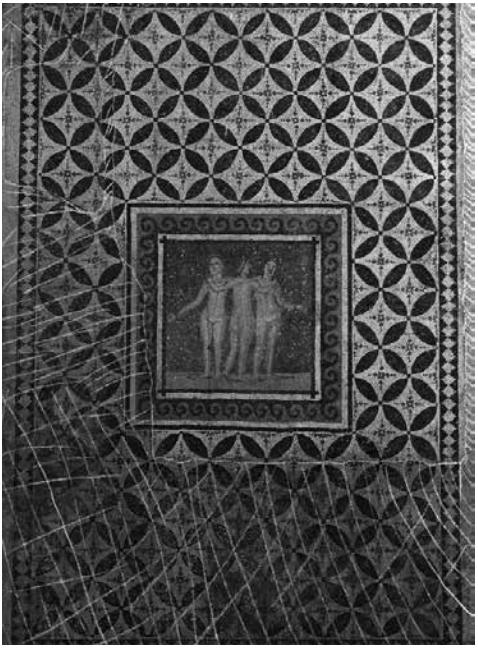

Fig. 5. The mosaic of the "Three Graces" with the 1930s (pre-1987) illusionist restoration; the white marks indicate area of reintegration (MAC-Barcelona Archives)

Fig. 6. The great renovation of the MAC in 1987: conservators prepare the mosaic of the *Ictiocentaurium* for a new intervention (MAC-Barcelona Archives)

Fig. 7. The great renovation of the MAC in 1987: conservators removing the reconstructed atrium with mosaic no. 22056, extracted from Badalona (MAC-Barcelona Archives)

and the whole central part. In preparation for installation in the new exhibition the mosaic was completed and restored in a manner that permitted ready distinction from the original, an approach which was rare at the time (Fig. 4). The decoration was completed with cement and is limited to quite simple infill. The new exhibitions saw the installation of the mosaic of the Three Graces [6] (no.19019) (Balil 1958) on the wall of the same room. In this case, unlike the mosaic of the *Ictiocentaurium*, the losses are restored in a manner mimicking the original, likely considering that the mosaic is essentially geometric and repetitive, and so not requiring the invention that would have been necessary for the figures of fabulous animals of the *Ictiocentaurium*. In any case the illusionist restoration of the Three Graces, was realised by imitating the effect of tiles using pictorial retouching, making it easy to discern the original from the reintegration (Fig. 5).

The initial exhibition setting of these mosaics persisted until 1987, when the institution implemented a great remodelling of the rooms and museography. The mosaics were exhibited in new positions, in a much more neutral museography, with all recreations eliminated (Figs. 6-7). With the elimination of almost all the infills of the

Fig. 8. The mosaic of the *Ictiocentaurium* as seen in the museum today (MAC-Barcelona Archives)

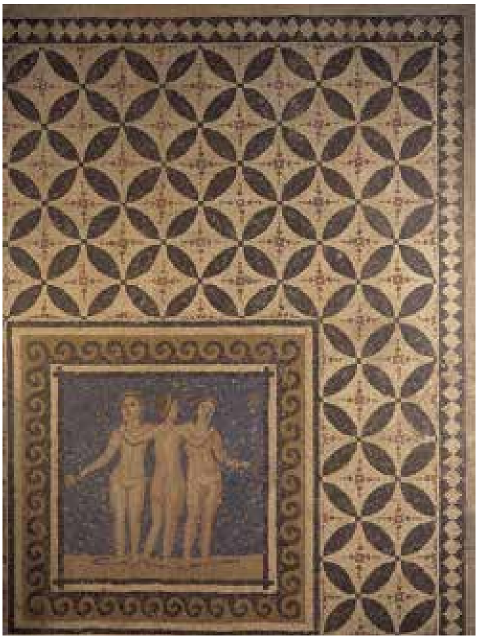

Fig. 9. The mosaic of the "Three Graces" as seen in 1990 (MAC-Barcelona Archives)

lacunae in the Three Graces and *Ictiocentaurium* by the MAC restorers, this meant that in the case of the *Ictiocentaurium* the different figures were now divided and separated from each other, and today only two large fragments are exposed (Fig. 8). In the case of the Three Graces, the elimination of the left side reintegration meant that the emblemata shifted from a central to a lateral position within what remains, and the total measurements decreased from 2.60 x 4.40 m to 2.7 x 1.88 m (Fig. 9).

As we can see, the change in conceptions of the value of these mosaics through the course of the 20th century, and so the changes in museography, have repeatedly influenced the criteria for excavation, restoration and reintegration of the works. This leads to very interesting questions about how these changes in the model of restoration have affected the visitor's perceptions and understanding, within the museum context. Such a complex discussion will have to be left for future publications.

MAC CONSERVATORS ON ARCHAEOLOGICAL SITES

The MAC conservators were always very active beyond their many tasks within the museum itself. From the outset, the workshop was active throughout Catalonia, particularly in excavations and other contexts involving Roman mosaics, carrying out all kinds of interventions: cleaning, consolidation, reintegration, and also extraction. Some of these interventions were in sites directly managed by the MAC, over the course of decades of annual campaigns, such as at the Empúries archaeological site in the province of Girona. The continuing presence of the conservator-restorers allowed annual review of the status of the *in situ* mosaics, and design of consolidation campaigns suited to the specific needs. Some of this work has been summarised in a previous publication (Llobet 2017: 91-107).

In other cases, the MAC organised campaigns of one or two months in response to emergency situations of threatened sites, or as part of archaeological projects of lesser duration. In these cases the interventions more typically involved extraction, unlike the cases of years of continuing involvement. Some examples are the sites of Premià de Mar (Barcelona), and the Roman mosaics of the villas of Vilagrassa (Lleida), Lladó (Badalona) and of Theseus and Ariadne (Girona), to give some examples (Fig. 10).

A third type of case was that where other museums or institutions requested help from the MAC for mosaics under their custody, as occurred in 1939 for a series of mosaics held by the National Archaeological Museum, or in 1942 for the mosaics of the Villa Fortunatus, for the Museum of Zaragoza. For this third category, the intervention criteria, including the decision or whether or not to extract, would be agreed with the custodian institution (Gracia 2009).

Fig. 10. MAC conservators lifting the mosaics of Premià de Mar (Barcelona), in 1969 (MAC-Barcelona Archives)

The following list provides our first attempt at compiling a list of all the sites where MAC conservators were active, although we are convinced that with continued research we will be able to add further information on the sites, mosaics and years of operation.

– 1916-1990s, mosaics of Neapolis (Empúries, Girona)
– 1926 , mosaic of the of Roman village of Vilagrasa (Lleida)
– 1927, five mosaics of the domus of Lladó (Badalona, Barcelona)
– 1928-1929, Palma of Sant Just (Barcelona)
– 1932, mosaic of the Circus (Bell Lloch, Girona)
– 1937, mosaic of Iphigenia (Empúries, Girona)

– 1937, mosaic Bellerophon and the chimera (Bell Lloch, Girona)
– 1939, mosaic of the Nacional Archeological Museum (Madrid)
– 1941, mosaic of Theseus and Ariadne (Bell-Lloc, Girona)
– 1941, mosaic of the Roman village Vila Vella (Tossa de Mar, Girona)
– 1942, mosaics of the village of Fortunatus (Fraga, Zaragoza)
– 1950, mosaics of the hermitage of Parets Delgadas (Selva del Camp, Tarragona)
– 1961, mosaic of El Reguer, Puigverd (Agramunt, Lleida)
– 1964-1966, mosaics of the Roman village of Albesa (Lleida)
– 1964, mosaics of the Roman villa of Espelt (Igualada, Barcelona)
– 1969, mosaics of Premià de Mar (Barcelona)
– 1970, mosaics of the Roman village of Can Xammar (Mataró, Barcelona)
– 1975-1976, extraction of the mosaic of the Altar of Santa Maria (Ripoll, Girona)
– 1982, reinstallation of the mosaic of the Altar de Santa Maria (Ripoll, Girona)
– 1986-1987, three mosaics of the roman villa of Torre Llauder (Mataró, Barcelona)
– 1987-1988, Roman mosaics of the Monastery of Sant Bartomeu (Granollers, Barcelona)

The workshop gained such a reputation within the world of mosaics management that the technique they used to lift the mosaics was known as the "Font method", after Francisco Font Contel, head of the workshop from 1894 to 1957, and in a scientific publication it was noted that there were only two teams in all Spain with the means and skills necessary for the task: "the other museums of Spain lack the elements and the organisation of ours" (Almagro 1942: 81; Moreno Martínez *et al.* 2014).

Conclusions

The conservation-restoration laboratories of the 20th century played an influential role in the decisiosn and practices regarding management of museum collections, including mosaics, and for those still in archaeological contexts. The study of the genesis and evolution of these laboratories provided a more complete understand of the history of the mosaics and the forms and conditions in which we now observe them.

The enormous work of the past is the source of much or our knowledge of the techniques and principles that that we specialists follow today, and by studying this past we can improve our modern decision making. The study of past conservation-restoration can also help the heritage professions in general, in understanding the importance of restoration criteria in museography and the perceptions of the visitors to our museums. Apart from conserving the mosaics, the criteria of intervention have strong impacts on the perception the public and also of other researchers, since most of the information we process arrives directly from sight, without consideration of other factors.

The selection of conservation-restoration criteria is not limited to the physical matter of the object, but extends to influences on how the public understands the past. This means that museum technicians have great responsibility when it comes to decisions about the interventions on the mosaics that we preserve and exhibit. Our decisions may concern pieces still *in situ,* or only recently extracted from the excavations, but in fact most often concern pieces that have been subjected to previous restorations. Today, a very high percentage of the mosaics in custody have been subject to intervention under a completely different perspective, and as professionals we must understand how these interventions condition our own perceptions, and so interact with the necessary new conservation systems and interventions.

Note

1. Historical Archive of the Diputació de Barcelona (AHDB), expedient Font Contel: Q-606, EXP. 18; bundle Q-809, exp. 11; Q-607, exp. 61, signature 2607; AHDB S-766.
2. AHDB Lorenzo Alomar Guillamet expedient Q-561, Exp.8
3. AHDB Agustin Font Contel Rodríguez expedient S-766
4. AHDB Pedro Sunyer i Julià expedient Num. 105, signature S41
5. Roman mosaic excavated beneath the modern level of the Church of Saint Michael (Barcelona) in 1868
6. Roman mosaic detached from the Convent de l'Ensenyança (Barcelona) in the 19th century

References

Almagro M. 1942. "Museo Arqueológico de Barcelona" *Memorias de los Museos Arqueológicos Provinciales 1941*: 35-55.

Balil, A., 1958. "El mosaico de las Tres Gracias de Barcelona" in *Archivo Español de Arqueología, XXXI* (1958), 63-95.

Gracia Alonso F. 2009. *La arqueología durante el primer franquismo (1939-1956)*. Barcelona: Bellaterra arqueologia.

Gracia Alonso F. 2003. "Pere Bosch Gimpera i la formació de l'Escola de Barcelona (1917-1939)". In *L'Arqueologia a Catalunya durant la República i el franquisme (1931-1975)* edited by Josep Barberà i Joaquim García i Rosselló, 31-92. Mataró: Museu de Mataró.

Gracia Alonso F., Fullola Pericot J. M., Vilanova F. 2002. *58 anys i 7 dies, Correspondència de Pere Bosch Gimpera a Lluís Pericot (1919-1974)*. Barcelona: Universitat de Barcelona.

La Vanguardia (19/06/1916), Año XXXV Número 15655, Barcelona, pp. 2-3
http://hemeroteca.lavanguardia.com/edition.html?bd=19&bm=06&by=1916&x=61&y=5
Accessed 2019, October 11

Llobet S. 2017. "The Empúries mosaics: from initial restoration to today's needs and problems". In *Managing archaeological sites with mosaics: from real problems to practical solutions. Proceedings of the XIth Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27 2011* edited by D. Michaelides and A.M. Guimier-Sorbets, 91-107. Firenze: EDIFIR-Edizioni Firenze.

Moreno Martínez I., Llobet i Font S., Colonna-Preti K. 2014. "A la redécouverte de la restauration des mosaïques au Museu d'Arqueologia de Catalunya: le cas du Romeral". In *La conservazione: uno strumento di conoscenza-Conservation: An Act of Discovery. Proceedings of the Xth Conference of the International Committee for the Conservation of Mosaics, Palermo 20-26 October 2008* edited by D. Michaelides, 353-364. Palermo: Regione Siciliana - Assessorato dei Beni Culturali e dell'Identità Siciliana.

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Isabel Moreno Martínez is a conservator-restorer and archaeologist, serving for 13 years as the head of the Conservation-restoration Laboratory at the Archaeological Museum of Catalonia, and for 20 years as a member of the Research Group in Protohistoric Archaeology of the University of Barcelona. Her research has focused on the degradation and techniques of conservation-restoration of archaeological materials, and on the protohistoric archaeology of the north-eastern Iberian Peninsula. She has directed conservation-restoration and archaeological operations for over 20 years, including for sites such as La Ferradura, Aldovesta, La Carrova and Sant Jaume. She is the author of scientific articles in publications such as the *Journal of Mediterranean Archaeology* and *Rivista di Studi Fenici*.

'ARCHAEOLOGY IN BOX': FROM EXCAVATION TO EXPLANATION IN A ROMAN BUILDING LOT

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Abstract

The static restructuring and consolidation of a large real estate complex on Piazza Albania, at the south side of the Aventine Hill of Rome, was accompanied by three campaigns of archaeological survey and excavation beginning in December 2014. The surveys demonstrated that there had been frequentation of the area since at least the fourth century BC, in the Republican era, continuing to the sixth century AD. The research revealed the presence of a rich *domus* of late imperial age (late second-early third century AD) with mosaic floors. Various rooms of the *domus* had been severely damaged by the construction of three buildings of the Banca Nazionale del Lavoro during the 1950s. It was the current renovation project for these same buildings that led to the choice of relocating almost all the mosaic floors, for prevention of further loss and to prepare a new presentation that would be able to retain the appearance and archaeological context of the structures as they were found. The decision was that the floors and portions of the masonry would be relocated and presented, without alteration, in a sort of "archaeological box", suspended over the excavation area.

Keywords: Rome, Aventine, mosaics, museum displays, I century BC – IV century AD, conservation methodologies

The archaeological and modern context

The mosaics presented here pertain to a complex of ancient structures found in a site on the south side of the Aventine hill of Rome, below the buildings of the former Banca Nazionale del Lavoro on Piazza Albania. The huge work of renovating these modern structures, including "earthquake proofing", led to the provision of a series of geo-diagnostic surveys and three campaigns of archaeological investigations at the basement level of the central bank building, beginning in April 2014 [1]. The location is on the south slope of what is known as the Aventino Maggiore, at one time united with the smaller relief of the Aventino Minore, but now separated by the modern Viale Aventino. The area features important archaeological remains, including as a small section of the Servian Wall of the fourth century BC, situated at the southwest corner of the bank property. By the end of the second century BC the Aventine had become a highly favoured area for the construction of patrician residential buildings, as evidenced by the remains of various *domus* still preserved below the current ground level and streets. The three buildings of the Banca Nazionale del Lavoro, totalling about 10,000 square metres in plan view, were built in the 1950s, further altering the historically modified hill topography and impacting the ancient structures below ground. A preliminary reading of the results from the Piazza Albania excavations suggests that

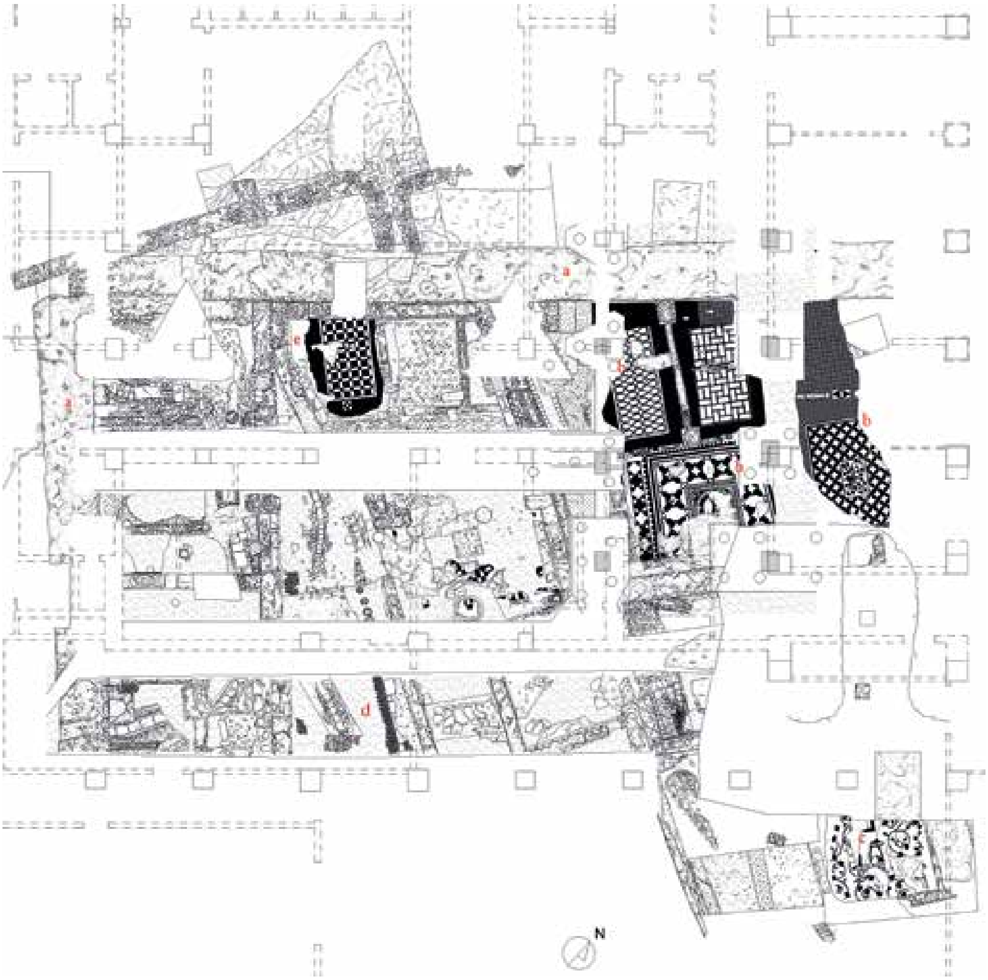

Fig. 1. General plan of excavations (processed drawing Roberto Narducci, Rilievi LAND srl)

the Aventine hill, originally characterised by steep slopes, had been urbanised and heavily transformed by the mid to late Republican era. The archaeological survey brought to light parts of the neighbourhood dating from the earliest habitations of the fourth to third centuries BC to the last phases of occupation, referable to the fifth century AD (Fig. 1) [2].

One of the most important building phases dates to the end of the second century BC, when the hill was cut and reshaped by means of massive masonry terracing in *opus incertum*, creating an L-shaped substructure of two metres thickness (Fig. 1a). This structure remained in use and was still the object of renovations in the late Imperial era. Within the perimeter of this massive containment wall the excavations brought to light part of a large *domus* of Imperial age. The series of stratigraphic layers in close succession demonstrated numerous

Fig. 2. Failure of the floor level (3D rendering Simone Gianoglio)

interventions for transformation of the villa rooms and terraces, involving an almost constant increase in floor height. Although it would be quite common for a villa, in this case the works seem to have been dictated by structural problems. In particular, the excavations revealed the presence of rooms in the eastern sector that showed significant failures at the floor level, in correspondence with large lesions in the mosaic surface (Fig. 2) [3].

The domus and its mosaic floors

The *domus* is structured around a large quadrangular space. On the north side of this are two cubicles; on the eastern side the large space communicates with another area divided in two by a small wall septum. The floors in these areas are executed in black and white *tesserae* in geometric and vegetal motifs, with the insertion of a polychrome pseudo-ensemble with plant and animal representations, in glass paste on a white background (Fig. 1b) [4]. Apart from these main environments the *domus* structure appears to have included further residential spaces on the south side, as demonstrated by the remains of a room with a mosaic floor in black and white with the representation of a *kantharos* with two emerging vine shoots (Fig. 1c). However, it was not possible to confirm a direct stratigraphic relationship between this room and the main spaces. Another series of environments on the south side seems to refer to a part of the *domus* used for storage and related activities, based on the observable structural characteristics (Fig. 1d) [5]. The remains of a mosaic floor were also found in the north-western part of the investigated areas, featuring a black and white lattice of monochrome bands with small squares at the crossing points in con-

Fig. 3. Mosaic flooring (photo Mario Letizia with graphic elaboration of Roberto Narducci)

trasting colours, surrounded by a broad border composed of an interior white monochrome band and an exterior band of rectilinear rows, also in black and white *tesserae*, but arranged in the disorderly "salt and pepper" motif (Fig. 1e and 3e) [6].

The renovations of the reinforced concrete bank structures included provision for anti-seismic consolidation of the sections impinging on the eastern sector of the excavation, most of which corresponded to the imperial era *domus*. Given that conservation *in situ* would no longer be possible, it was necessary to prepare a plan to remove the ancient floors. The work proceeded in stratigraphic layers, eventually revealing a total of six floors. The first step was to remove the uppermost floors (Fig. 3a), followed by excavation of the preparatory layers and the preceding stratigraphic layers. Proceeding in a similar manner a further five floors were exposed, within a total of just over 80 cm of stratigraphic thickness. The excavation methodology succeeded in recovering fundamental data for the dating of the individual phases [7], and also confirmed the recurrence of the ground subsidence phenomenon noted through all the levels, from the first one to that of the most recent floor.

The floors of the second level (Fig. 3b) were only fragmentary, but seemed to present a tessellated two-tone geometric pattern in the same alignments as the upper level [8]. The third level (Fig. 3c), which presented a tessellated bichrome mosaic in geometric motifs, was preserved only in a section where it had served as the foundation for a wall. However this was an important fragment, since it preserves the central part of an inscription that relates to three personages, apparently members of a college of priests, who had paved this building space at their own expense (Rustico *et al.* 2018) [9]. The fourth and fifth levels consisted of unadorned cementitious flooring over a clay base, perhaps related to service environments [10]. The sixth level (Fig. 3d) consisted of two floors: one in bichrome tessellation with geometric hexagon decoration, the other a cementitious flooring with stone inserts [11].

The decision for public presentation

Although it was a construction project that had forced the entire removal of these floors, the excavations also constituted a unique opportunity to learn about the history of an Imperial era *domus* on modern-day in Piazza Albania. The property owners agreed to project for restoration and development the archaeological finds, including the detached mosaic floors, which will be relocated and placed within a dedicated architectural container, accompanied by a museum-type interpretive presentation [12].

One of the unique aspects of the site was in fact the sequence of floors constructed one after the other, at intervals of as little more 20 years, for purposes of filling in the subsidence that continuously emerged in the same area. This led to the choice to reposition the mosaics in an "archaeological box", just as they emerged at the time of discovery [13]. This entailed a complex work of removing the mosaic surfaces using a series of fibreglass counterforms and wooden backing frames, allowing their respective removal and repositioning just as they came to light.

The conservation project

The same procedure was used to remove all floor layers. Thematic tables were prepared for each decoration, indicating

Fig. 4. Reverse of the lifted mosaic on its counterform, backed by the temporary wood structure (photo E. Montanelli)

the constituent materials, conservation status, deterioration morphologies, and providing of the sections to be removed and the necessary fibreglass counterform. The mosaics were first cleaned of their loose deposits, then the loose *tesserae* were pre-consolidated and the edges were contained along the perimeters of the fragments and the interior gaps. The entire mosaic surface was then covered with a double layer of gauze *velatino* and vinyl adhesive. To fully support the shape of the surfaces, including the deformations, the fibreglass counterform was then created in direct contact with the floors, anchored and positioned in relation to the *velatino* by means of plastic "mapping targets". The counterform was then stiffened by the addition of wooden backing structure, which also established a uniform planar level and could later be removed. This entire assembly of the mosaic floor and its top-side supporting structures was then moved to the restoration laboratory (situated within the bank buildings), where the wood and fibreglass structures were dismantled and then reassembled on the underside of each floor, thus creating a support for the mosaic surfaces (Fig. 4). At this point the mosaic sections had been removed and repositioned on the negative side of the support structure so as to reconstruct all the floor, in line with the plastic targets previously fixed on the *velatino*. As this operation was completed, the original bedding mortar was reduced, loose deposits were removed with the aid of a vacuum device, and the consolidation with ethyl silicate on the back of the *tesserae* was carried out. A hydraulic mortar was applied to the reverse side of the mosaic sections. Some of the mosaics were maintained in the form of their original topography: for these, polyurethane supports were prepared in 3D relief, and then fixed with epoxy resin. The flat sections were instead mounted on Aerolam© (aluminium honeycomb) panels.

The architectural-archaeological communication project: from problem to opportunity

Given the artistic and documentary value of the discoveries, the working group [14] tasked with the protection and enhancement of the entire archaeological area was faced with the question of how to design a solution in which architecture and archaeology could enter into 'non-conflictual' dialogue. What could be the means of operation for our case?

In fact, the archaeological area had been discovered within a modern building complex, involved in a renovation which had not in any way considered the remains, since these were initially unknown to the project architects and engineers. The level where the remains were found corresponded roughly to the modern basement floor, within a volume intended

Fig. 5. Plan of the first version of the 'archaeological box' (processed drawing Stefano Borghini)

for use as a parking garage. The structural engineering for this area included many pillars and other elements that would have interfered with the archaeological context. Indeed, one of the most important mosaic floors, including the depiction of a parrot, was the site for the planned construction of a stairway, requiring the execution of numerous micro-piles for anti-seismic stabilisation, and so the destruction of these particular mosaics.

Once the structural engineers had verified the lack of alternative solutions enabling the preservation of all the mosaic floors *in situ*, the only possibility was to accept the task of relocating some of the remains.

Our approach at this point was to turn a painful decision into a new opportunity for development of the archaeological resources. Following the unexpected discovery of the site, the building project managers joined with the archaeologists in participating in a new architectural design, aimed at preserving and presenting the original materials for educational and enjoyment purposes. In this case, the inevitable detachment of some of the mosaic floors became functional to the communication of the entire archaeological context. One of our guiding principles was to keep the portions to be detached as close as possible to their original positions. We also identified a central area where, by sacrificing a limited number of parking spac-

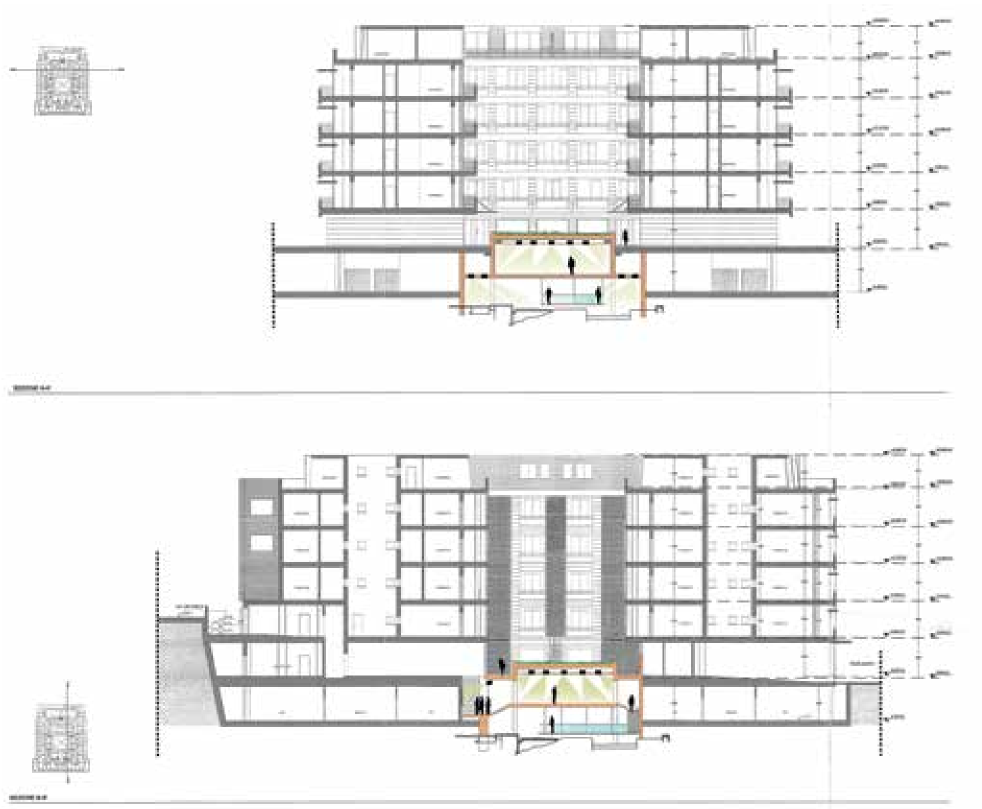

Fig. 6. Elevation, first version of the archaeological box (processed drawing Stefano Borghini)

es, it would be possible to maintain part of the remains *in situ*. Our further aim was to relocate the detached mosaic floors to this space, still maintaining their original orientations and deformations, thereby showing the original conditions of the excavation as much as possible.

Once these guiding principles had been established it was possible to develop an initial project design (Fig. 5), which contemplated the construction of a closed, suspended volume within the archaeological area, into which the mosaics could be relocated, still with their original deformations. The interior walls and floor of this suspended "box" could then be used as surfaces for projection, for presentation of a virtual reality of the archaeological excavations, which would then also transform with the virtual reconstructions of the ancient villa spaces and their decorative elements. In this first proposal the box was designed so that visitors could walk below it along a walkway, over an important part of the *in situ* archaeological remains. Other portions of the *in situ* mosaics could also be admired from the parking garage, through large areas of glass flooring.

The elevation drawings (Fig. 6) clarify the vertical levels involved in the original project design, and the relationships between the box, archaeological remains and walk-

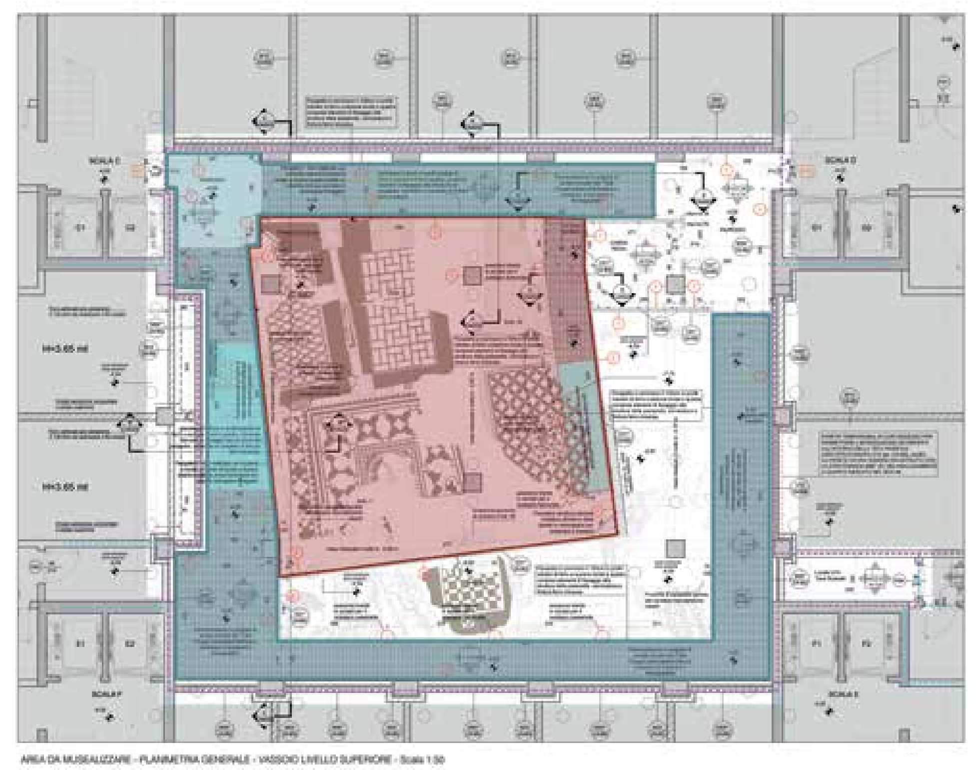

Fig. 7. Plan of the final proposal: in red the archaeological box, in blue-gray the walkway (drawing Progetto Intertecno S.p.A. for BNP Paribas)

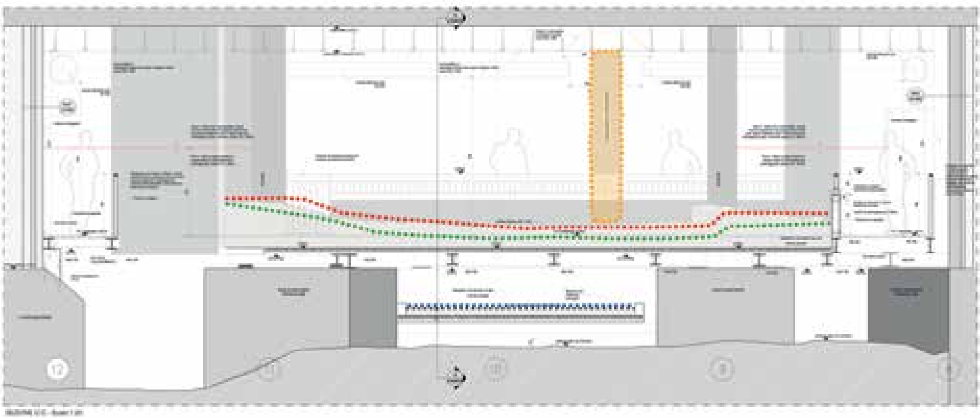

Fig. 8. Elevation, final proposal, with mosaic floor level illustrated (drawing Progetto Intertecno S.p.A. for BNP Paribas, with graphic elaboration of Stefano Borghini)

Fig. 9. Render of the exhibition area from the walkway (Studio Tecnico Riva)

Fig. 10. Render of the archaeological box interior (Studio Tecnico Riva with graphic elaboration of Stefano Borghini)

way above the ruins. The idea was that the suspended box could also be constructed so as emerge in the inner courtyard of the modern building, as a sort of a metaphor of archaeological emergence, bringing with it the form of object to be interpreted. However, this slight elevation from ground level would have resulted in an increase of the overall building volumes, which are strictly regulated under urban plan and would have required a complex revision of the whole modern building project.

Because of this we prepared a new project design in which the 'archaeological box' is lowered and shifted into a structural area free of archaeological remains. The new design once again retains the walkway, at about the same level of the box, for viewing of the *in situ* archaeological structures (Fig. 7). Four levels of mosaic floorings were detached and are now being relocated to the exhibition area, as follows: the first two levels (red and green in Fig. 8), with substantial deformations, will be placed in the archaeological box, in their original stratigraphic relationship (also illustrated by illustrating stratigraphic cross-sections along the outer walls of the box); the third level (including the mosaic with fragment of inscription: yellow in Fig. 8) will be exhibited on a wall; the fourth (with hexagonal pattern: blue in Fig. 8) will be exhibited underneath the footbridge in its original orientation.

Stepping onto the walkway, the visitor will first encounter the remains of the archaic drywall masonry and the mosaic with vines, of the southernmost villa room (Fig. 9); then the floor with black squares, still *in situ*. Finally the visitor enters the archaeological box: on its inner surfaces are the virtual reality projections, enriched with lighting effects, illustrating the relationships between the different excavation levels and the stratigraphic history of the site, from its initial uncovering to the reconstruction hypotheses (Fig. 10).

An archaeological box, therefore: a sort of modern *wunderkammer*, not only for the wonderful objects inside, but also for its archetypal shape and modern solutions to the challenges of preservation, communication and enjoyment.

Notes

1. The excavation and salvage project were first coordinated by Alessandra Capodiferro, then by Roberto Narducci, both staff archaeologists of the former Special Superintendency for the Coliseum and the Central Rome Archaeological Area of the Italian Ministry for Cultural Heritage and Activities and for Tourism. The excavations were conducted by LAND Srl of Rome. This current article owes much to Viviana Forte, responsible for graphic documentation, Mario Letizia, for photography, and Stefano Bonaguro, for archaeological operations. The study of materials was curated by Marco Ricci.
2. This earliest phase (fourth-third century BC) is represented by a drywall masonry structure in rectangular tuff blocks of non-uniform sizes, found in the central area. The mosaic of vine shoots, seen in the space pictured in Fig. 1c, dates to the last phases of late ancient occupation.
3. A hypothesis is that the reason for the lesions and subsidence may have been the presence of cavities related to quarrying activities prior to the fourth century BC.
4. Late Nerva-Antonine era (i.e. late second century AD).
5. The hypothesis of storage or warehousing activities is based on the presence of hydraulic plasters on the walls and a portion of flooring in *opus spicatum*, as well as the peripheral location relative to the noblest spaces of the residential building.
6. This black and white mosaic was found in environment 5b, measuring 3.60 m in length and 2.44 m in width. It is not yet clear whether the floor pertains to the same *domus* as documented in Fig. 1b or to another separate building.
7. The flooring phases identified range in date from late first century BC to late second century AD.
8. Era of Hadrian (i.e. 117-138, first half of second century AD).

9. The inscription is arranged on seven lines, within a quadrangular form at the centre of the floor. Based on a hypothetical reconstruction of the missing portions, it records the repaving of the building space at the expense of three members of a priestly college (L. Rustico, R. Narducci, G.L. Gregori).
10. Dated between the reign of Nero and the late Domitian era (i.e. mid to late first century AD).
11. The orientation of the latter two floors (of the Augustan era) is different from those of the upper stratigraphic levels.
12. The original conception for the presentation and interpretation project was by the architect Stefano Borghini, of the former Special Superintendency for the Coliseum and the Central Rome Archaeological Area.
13. The works for the museum-interpretive project are by Enrico Montanelli (company name: Conservazione e Restauro di Beni Culturali e di Opere d'Arte), under the scientific direction of Alessandro Lugari of the former Special Superintendency for the Coliseum and the Central Rome Archaeological Area.
14. In addition to including the authors, the working group also benefitted from the ideas and proposals of the archaeologists Alessandra Capodiferro, Martina Almonte and Paola Quaranta.

References

Rustico L., Narducci R., Gregori G. L. 2018. "Il complesso archeologico di piazza Albania all'Aventino II. Pavimentazioni a motivi geometrici e in cementizio lacerto musivo con iscrizione". In *Atti del XXIII Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico* (Narni, 15-18 Marzo 2017), edited by Claudia Angelelli, Chiara Cecalupo, Marco Emilio Erba, Daniela Massara, Federica Rinaldi. Roma: Edizioni Quasar.

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THE PROBLEM OF "INVISIBLE MOSAICS": CONSERVATION-RESTORATION AND VISITOR PRESENTATION OF ARCHITECTURAL DECORATION AT THE STOBI EPISCOPAL COMPLEX

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Abstract

Major excavation campaigns carried out in the archaeological site of Stobi (Macedonia) in different stages beginning in the 1920s and extending to the 1990s revealed some 500 m^2 of mosaics and 100 m^2 of wall paintings, pertaining to successive early Christian basilicas and a baptistery. Some of the overlying mosaics were detached, and others were removed in consideration of their unstable condition and lack of protection from the elements. Although the site was famous for its mosaics, this resulted in a frustrating situation in which visitors found these works to be "invisible". In 2008 the Government of Macedonia created a National Institute for management of the site. With the strategic aim of both conserving the mosaics and once again making them "visible", the institution began a series of projects in 2011. Thus far, 160 m^2 of detached mosaics from the Old Basilica have been remounted and installed recreating the original floor level. The floors of the baptistery have been consolidated and are protected under a shelter. The wall paintings of the Old Basilica and mosaic floors of the New Basilica have been stabilised, cleaned and remounted on panels, awaiting future site installation following development of a larger structural shelter. The communication and enjoyment of the site for visitors has been greatly increased, with positive impacts for tourism.
Keywords: floor mosaics, *in situ* conservation, mosaic detachment, display

Introduction

Beginning in the 4th century AD the city of Stobi, capital of the Roman province of Macedonia Secunda, saw the construction of an Episcopal basilica and a large four-lobed baptistery. By the 6th century a series of building phases had led to the replacement of the so-called Old Basilica with a New Basilica, raised above the first one.

Archaeological campaigns carried out in the 1920s, 1970s, 1980s and 1990s (Hoddinott 1963, Wiseman 1978, Blaževska and Tutkovski 2012, Tutkovski 2018) uncovered the remains of these three structures. The various excavation stages are known to have revealed at least 500 m^2 of floor mosaics and sectile pavements. The excavations of the 1980s also brought to light around 100 m^2 of *in situ* preserved paintings on the walls of the Old Basilica. Unfortunately, by 2012, the entire Episcopal complex retained only one of these decorative features, which was the mosaic floor of the baptistery.

500 m^2 of invisible decoration

The details of the detachment of the decorative systems of the basilica complex are not entirely recorded, however what is certain is that when the excavation campaign of the 1970s was launched in the New Basilica, it began with the

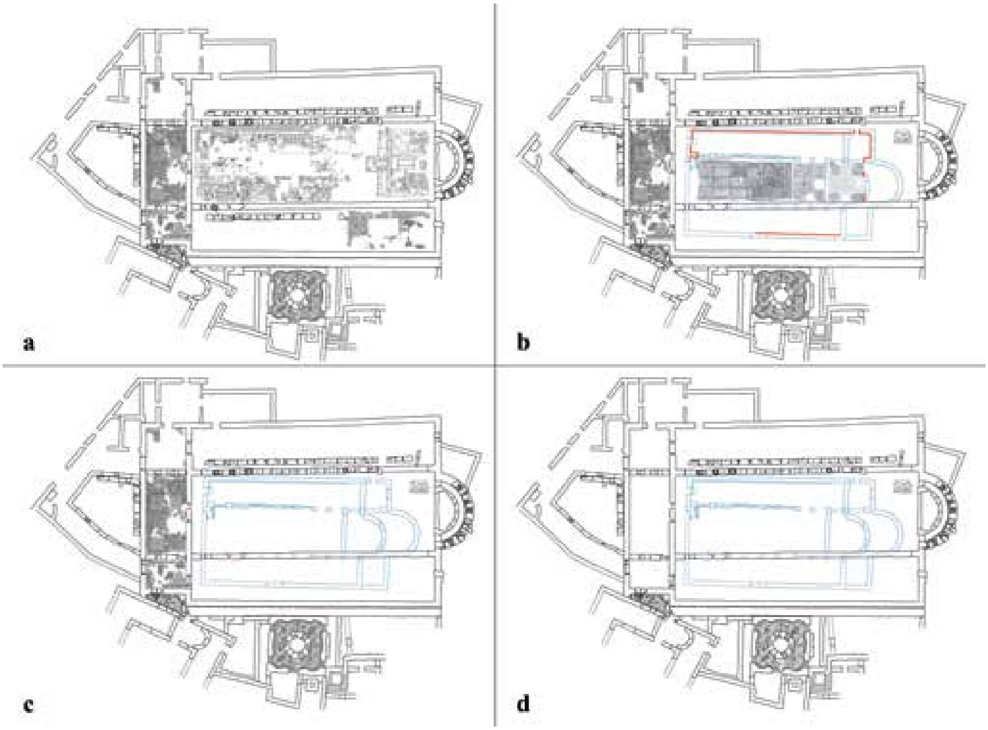

Fig. 1. Ground plan of the Episcopal complex with detachment phases (drawings T. Mitrova, M. Tutkovski)

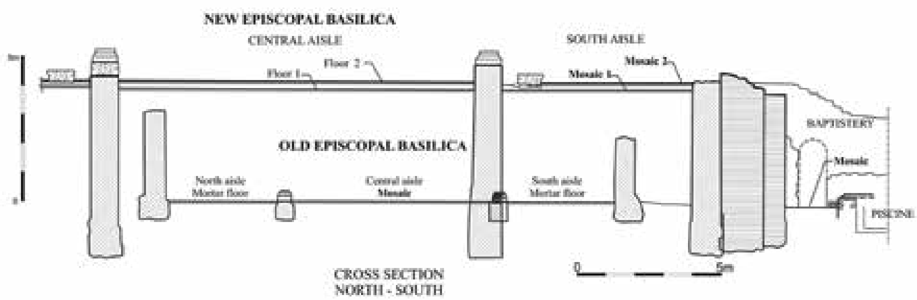

Fig. 2. Cross section of the Episcopal complex (drawing T. Mitrova, M. Tutkovski)

systematic removal of those in the south aisle (Fig. 1a). As the excavations in the nave and south aisle proceeded they revealed small parts of an older building, about 4 to 4.5 metres below, with floor mosaics and intact wall paintings (Wiseman 1978). Soon after, in the 1980s, it was decided to remove all the architec-

Fig. 3. Detached mosaic and wall painting sections in the storage room (photos M. Tutkovski)

tural and decorative features from the nave and south aisle of the New Basilica, in order to further explore the significance of this older building (Fig. 2) (Aleksova 1997, Kolarik 1987). It was at this time that the location, structural design and decoration of the lower building suggested its identification as the Old Basilica: an identification confirmed by an epigraph of Bishop Eustatios discovered on the mosaic floor of the nave. Apart from these mosaics in *opus tessellatum*, all the surviving walls of the Old Basilica were decorated with wall paintings, still largely preserved (Fig. 1b).

Yet by the beginning of the 1990s the mosaics from the Old Basilica had also been detached, as had earlier happened to most of the New Basilica; by 2004 the wall paintings had also been removed.

In 2008 the Government of Macedonia created the new National Institute for Management of the Stobi Archaeological Site (NI Stobi). At that point, we found the only mosaics visible were those of the baptistery and narthex of the New Basilica (Fig. 1c), however by 2011 the advanced degradation of the narthex floors required their removal, leaving only the floors of the baptistery. Given this long story of removals, the Episcopal complex had taken on the appearance of an empty monument (Fig. 1d). At the same time, the detached mosaics and wall paintings rested in storage areas, and the paintings

Fig. 4. Photomontage showing reassembled frescoes on the north wall of the Old Episcopal Basilica (M. Tutkovski)

taken up in 2004 were in desperate condition, at risk of complete loss (Fig. 3a). As a result of improper storage conditions there was remarkably heavy damage to the *secco* paintings: loss of components, breakage, large cracks, discolouration, accumulations of fungus and damage by rodents, reptiles, birds and insects.

Yet it was precisely the fame of the rich decorative systems that was one of the factors attracting people to visit the site. NI Stobi could tell visitors about these works, yet our words left much to be desired. Clearly, in leaving visitors to their imaginations, there was disappointment and frustration.

Given all this, in 2011 the NI Stobi launched a long-term project for conservation, restoration and presentation of all the detached and *in situ* mosaics and wall paintings of the Episcopal complex. The overall project was subdivided in several smaller ones, discussed in the following sections.

1. Conservation-restoration of the Old Basilica wall paintings

Given the severe deterioration and ongoing threats to the detached wall paintings, their conservation was identified as the highest priority.

The works started with light cleaning of the painted surface and consolidation of structures from the rear, followed by fixing of all the sections on new Aerolam panel supports, using cork as an intervening layer. Next, the paintings were further consolidated from the front by means of mortar injection and protective coating of certain damaged parts. The lacunae and cracks were filled with mortar. The last stage of the process was retouching small voids using reversible watercolours in reduced shades with respect to the originals. The treatment was then concluded by application of a protective coating to the paint layer (Tutkovski 2012).

The treated sections of wall painting are currently in storage, until a new protective shelter can be built over the Episcopal basilica and proper conditions are secured for their safe remounting in their original positions (Fig. 4).

2. Conservation-restoration of the Old Basilica mosaics

The planning and experimental phases of the project for restoration and display of the floors from the nave of the Old Episcopal Basilica were particularly challenging. The floors were laid at the same level in three different phases over the 4th and 5th centuries (Kolarik 1987, Tutkovski 2019). The first and second phases are in *opus tessellatum*, while the third phase is a combination of *opus sectile* and *opus tessel-*

Fig. 5. Nave of the Old Episcopal Basilica during the restoration project (photos M. Tutkovski)

latum. In 1991, not long after their discovery, the mosaics were detached, and in 1998 the mortar preserved on the reverse of the *tessellatum* was removed. The sections, totalling a surface area of about 160 m^2, were placed on plywood panels with strong wooden frames. These were stored in one of the buildings on the Stobi archaeological site. In the meantime, limited trench excavations were conducted to a level below the level of the mosaic floors (Fig. 5a), and detected remains from still older buildings (Aleksova 1997). These were the last activities concerning the Old Episcopal Basilica, after which its condition remained unchanged for more than 20 years.

In developing a plan for re-laying or other display for the mosaics it was necessary to first survey and further explore the strata underlying the former floor locations, for identification of the preservation conditions and archaeological context. The excavations and recording for this purpose were completed in 2012, and established:

– the strata underlying the northern half of the nave, from top to bedrock are constantly exposed to moisture;
– the excavations detected some isolated older constructions, which could not yet be fully defined or evaluated;
– the surface of the excavated areas, as of 2012, descended from one metre below the mosaic level on the west to three metres below mosaic level at the eastern end of the Old Basilica nave.

With this information in hand we addressed the problem of selecting a suitable method for re-laying the mosaics in their original positions.

Fig. 6. Orthophoto of the Old Episcopal Basilica mosaic after restoration (photo M. Tutkovski)

The option of laying the sections directly into fresh mortar, in an attempt to accurately reproduce their condition "as excavated" was immediately dismissed, in part because of insufficient descriptive, technical and photo documentation of the detachment in 1991. In addition, pouring a concrete slab in the nave of the basilica would have required first filling an area of 180 m^2 with around 300 m^3 of soil and gravel, compacted layer by layer. This irreversible process would have sealed the underlying layers, negating any opportunity of further excavation to understand the underlying structures. The weight of the system could have caused static problems with the remains of the basilica walls, and the effects from drainage problems, formation of ice, and development of vegetation, micro-organism and salt problems appeared difficult. Such a project would also have been costly in funds and time (estimated at six months), and would still require annual reburial.

Instead, we decided to back the mosaic sections on Aerolam panels, and mount these on a supporting steel structure to be built inside the basilica. This freestanding platform would be positioned over piers dug into bedrock, leaving the surrounding archaeological structures and identified remains undisturbed. The advantages of air circulation and ground drainage would negate problems of humidity, vegetation, micro-organisms and salts. Annual reburial would not be necessary, and in the event that the platform was ever dismantled even the material could be sold and recycled.

The platform consists of three subsystems: the concrete bases, the primary steel structure with "∏" shape, and a secondary horizontal grid, also in steel (Fig. 5b) (Tutkovski 2019). All the steel sections were coated in double layers of anti-corrosion paint prior to assembly, and then another layer after assembly. The construction of the entire platform was finished in just 15 days. The mosaic sections were laid over the secondary construction (Fig. 5c-d), adjusted for placement and attached. Finally, the joints were retouched for improved aesthetic presentation (Fig. 6).

3. Conservation and restoration of the mosaics from the narthex of the Episcopal basilica

The third project concerned the mosaics from the narthex of the New Episcopal Basilica, originally revealed during the excavations of the 1930s. Following a period of reburial they were re-opened in the 1970s

Fig. 7. Orthophoto of the mosaic of the New Episcopal Basilica narthex after restoration (photo M. Tutkovski)

(Kolarik and Petrovski 1975). In both the 1930s and 1970s the mosaics were subjected to interventions such as cleaning, edge repairing and filling of the lacunae. Following the exposure in the 1970s the mosaics were again covered with sand and then left without monitoring or intervention. In 2011 they were once again uncovered, revealing a considerable amount of structural damage caused by the lack of maintenance over the four intervening decades, aggravated by the application of improper techniques and materials (Portland cement) during the previous interventions. By this time the entire mosaic had also been infested by growth of vegetation and roots, thriving between the *tessellatum* and *nucleus* and causing separation of the layers. Although attempts were made using herbicides and other interventions, these did not succeed in controlling the vegetation and the vigorous growth posed risks of immediate loss of the mosaics. Therefore, soon after 2011, the detachment of the entire mosaic of around 100 m^2 was performed, as the only possible means of saving the work. The almost complete loss of adhesion between the *tessellatum* and the underlying mortar made the lifting operation relatively simple.

Over the course of 2014-2015 all the detached sections were mounted on Aerolam panels, following which the mosaic surfaces were cleaned and stabilised. As with the Old Basilica, preparatory archaeological excavations were conducted beneath the mosaic *statumen* prior to the re-laying operations. The entire floor area was then filled and prepared, first with a layer of mixed soil and crushed stone, then a 10 cm layer of finer crushed rock, and finally another 15 cm thick layer of somewhat coarser stone. This last coarse serves as the new "*statumen*" of the mosaic, on its Aerolam panels. Over this a mortar was applied, consisting of 1 part binder (90% slaked lime and 10% white cement) and 3 parts aggregate (1 part crushed brick and 2 parts sand). The intention of preparing the mortar base using lime mortar with the addition of white cement was to achieve sufficient strength while avoiding harmful reactions involving the remains of the surrounding walls.

Once the mortar had hardened sufficiently, in about three months, we began re-laying the mosaic. The sections were fixed in their original position using aluminium "G" profiles against the Aerolam panels. To complete the securing of the panels, the remaining joints and lacunae were filled and integrated using a thin mortar. Detached tesserae were used to complete the designs, but only in the areas where the pattern was known and had been documented and then lost because of subsequent events and conservation-restoration procedures. Finally, the lacunae and gaps between the mosaic and the narthex walls were filled with mortar (Fig. 7).

This re-laying stage of the project was completed in 2016, bringing us one step closer to restoring visibility for the Stobi mosaics.

4. Conservation of the baptistery mosaic

The mosaic in the baptistery was discovered during excavations in 1971 (Wiseman and Mano-Zissi 1972). Activities on the monument continued through the 1980s, when mosaic and structural conservation-reconstruction were done, including some recording and photographic documentation. During this period the surrounding walls and the central pool were also partially reconstructed and a protective shelter was constructed over the baptistery. This was followed by some minor protective interventions over the years, however without any documentation.

The analysis of the mosaic condition established that the prior conservation and restoration interventions had involved filling of lacunae and consolidation of edges, injecting, grouting and retouching using cement mortar. These interventions had caused significant harm to the mosa-

Fig. 8. Baptistery mosaic before conservation (photo M. Tutkovski)

ic structure, which showed deteriorated, dislodged, and detached tesserae, new lacunae and cracks, decohesion between the mosaic layers, bulges and depressions (Fig. 8). The analysis revealed in particular that the separation of layers extended throughout the entire mosaic, and presented the greatest risk for further deterioration.

The plan for treatment involved three procedures, depending on the presence of the different types of damage:

1. Removal of cement infills and edging, followed by consolidation (5% of the mosaic surface);
2. Grouting voids between mosaic layers (85% of the mosaic surface);
3. Detachment and re-laying of mosaic sections that cannot be efficiently treated by procedures 1 and 2 (10% of the mosaic surface).

The following sections outline the progress in these interventions as of 2017, when the project was still in progress.

Removal of cement infills and edging; consolidation

This stage involved removal of the cement used in previous interventions and replacement with mortar using the original ingredients. The opening of the lacunae also allowed inspection of the mosaic layers, revealing the relatively good condition of the *statumen* and *rudus* unlike the heavily deteriorated condition of the *nucleus*, which had lost cohesion and become separated

Fig. 9. Consolidation of baptistery mosaic by injection of mortar (photos M. Tutkovski)

from the bedding mortar. The bedding mortar and *tessellatum* generally formed a more stable and cohesive structure. This information assisted us in planning the at our disposal, it was possible to set out the other two procedures of the intervention.

Grouting voids between mosaic layers

Grouting the mosaic was most labour-intensive and important part of the conservation process. Injection points were identified over the entire surface at spacing of about 10-15 cm, where single tesserae could be extracted and the underlying crumbled mortar and dirt could be cleaned. This procedure developed a network of canals in the *nucleus* where fluid mortar based on NHL 2 could be injected (Fig. 9). The diffusion of the mortar through all the gaps was assisted by tapping on the *tessellatum* surface with rubber hammers and by inserting awls, in both cases to vibrate the structure and encourage passage of the fluid.

Removal and relaying of mosaic sections

Around 10% of the mosaic had suffered separation and greater deterioration of all the mosaic layers. In these cases detachment was carried out using a facing of gauze and burlap with animal glue. After the *tessellatum* was removed, the remaining structural layers were removed and injection and consolidation were carried out on the mosaic areas surrounding these gaps. The mosaic structure was then reconstructed using identical materials to the original ones, and the lifted *tessellatum* was re-laid and levelled in the top layer of fresh mortar.

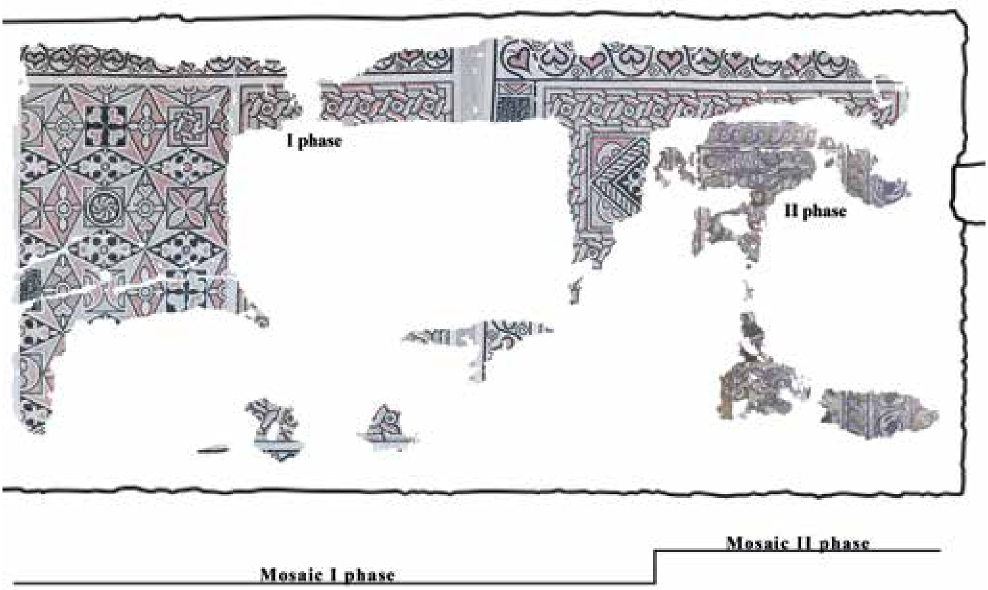

Fig. 10. Ground plan and cross section of proposed display of mosaics from the south aisle of the New Episcopal Basilica (NI Stobi)

5. Restoration of the mosaics from the south aisle of the Episcopal basilica

At the date of presentation of this paper (2017) this project was scheduled for the following year. As explained in the introductory sections, two mosaic layers were detached from the south aisle of the New Episcopal Basilica in the 1970s (Kolarik and Petrovski 1975; Kolarik 1981) and removed to storage rooms. The lifted sections are not well consolidated and are exposed to detrimental conditions (Fig. 3 c-d). To prevent further deterioration, the sections will be mounted on supports made of Aerolam.

In this case the recreation of the original position for presentation of the mosaics would be very difficult, as the ground has been excavated away to a depth of four metres, reaching the level of the Old Episcopal Basilica below (Fig. 1). One option for presentation (Fig. 10) could be to prepare another steel framework, similar to the one used in the Old Episcopal Basilica but at a higher level.

The tentative date for concluding the protection and presentation of the mosaics from the south aisle of the Episcopal Basilica is 2019.

Final considerations

The conservation-restoration projects completed thus far at the Stobi archaeological site, on the three largest mosaics (baptistery, the narthex of the Episcopal Basilica and the nave of the Old Episcopal Basilica), have significantly improved the appearance of the ancient building complex, greatly enhancing the communication of meanings and the enjoyment of the site for visitors, and incrementing the related tourism potentials.

However the future still holds major projects. As of 2017, planning was under way for treatment of the detached mosaics from the south aisle of the basilica, and for development of a presentation plan. Once that project is completed the focus will turn to designing and constructing a protective structure over entire Episcopal complex. As well as protecting the mosaics and structural remains, the achievement of the shelter will also permit the eventual reattachment of detached frescoes from the walls of the Old Episcopal Basilica. At the same time, there will also be a focus on developing visitation paths and informative panels.

References

Aleksova B. 1997. *Loca Sanctorum Macedoniae, The Cult of Martyrs in Macedonia from the 4th to the 9th Centuries,* 111-139. Skopje: Inst. for Old Slav Culture-Prilep, Macedonian Civilization.

Blaževska S. and Tutkovski M. 2012. "Episcopal Basilica in Stobi". In *Early Christian Wall Paintings from the Episcopal Basilica in Stobi – exhibition catalogue,* 9 - 20. Stobi: National Institution Stobi.

Hoddinott R. F. 1963. *Early Byzantine Churches in Macedonia and Southern Serbia*, 161-167. London: Palgrave Macmillan UK.

Kolarik R. and Petrovski M. 1975. "Technical Observations on Mosaics at Stobi". In *Studies in the Antiquities of Stobi*, edited by James Wiseman, Vol. II, 76-105. Beograd: Boston University and the National Museum of Titov Veles.

Kolarik R. 1981. "The Episcopal Basilica at Stobi". In *Studies in the Antiquities of Stobi*, edited by Blaga Aleksova and James Wiseman, Macedonian review editions Titov Veles, Vol. III, 61-81. Macedonian Academy of Arts and Science and the National Museum of Titov Veles.

Kolarik R. 1987. "Mosaics of the Early Church at Stobi", *Dumbarton Oaks Papers*, Vol. 41 (1987): 295-306.

Tutkovski M. 2012. "Conservation and Restoration of the Wall Paintings from the Episcopal Basilica". In *Early Christian Wall Paintings from the Episcopal Basilica in Stobi – exhibition catalogue*, 37-40. Stobi: National Institution Stobi.

Tutkovski M. 2019. "Restoration and display of the mosaic from the Old Episcopal basilica in Stobi". In *Patrimonium Mk*, Vol.17 (2019): 75-86.

Tutkovski M. 2018. ""Paintings in the Old Episcopal Basilica in Stobi: Analyses of the Technical-Technological Characteristics", In *Folia Archaeologica Balkanica*, Vol. IV (2018): 377-403.

Wiseman J. and Mano-Zissi Gj. 1972. "Excavations at Stobi, 1971", *American Journal of Archaeology*, Vol. 76, No.4 (1972): 420-424.

Wiseman J. 1978. "Stobi in Yugoslavian Macedonia: Archaeological Excavations and Research, 1977-78", *Journal of Field Archaeology* (1978), Vol. 5: 391- 429.

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RESTORATION OF THE ROMAN PAVEMENTS OF VILLA CORNELIUS, L'ÈNOVA, VALENCIA: INNOVATIVE DISPLAY SOLUTIONS

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Abstract

The Restoration Laboratory of the Museu de Prehistòria de València has been responsible for interventions on three mosaics and a floor executed in marble slabs, from excavation of the Villa of Cornelius in L'Ènova (municipality of Valencia). The treatments were developed on an experimental basis, in keeping with criteria of reversibility and minimum intervention, in preparation for public presentation in museum contexts. The system for the marble floor was particularly innovative, executed without rigid backings and using only loose marble grit as fill for the joints and lacunae. Other innovations included the use of natural mortars with low specific weight, and the manufacture of custom laminate supports under vacuum.

Keywords: Villa Cornelius, mosaic, conservation, restoration, support

Villa Cornelius: discovery and impending destruction

The town of l'Ènova in the municipality of Valencia was the site of a Roman country villa, owned by Publius Cornelius Junianus, dedicated to farming and processing flax and esparto grass. The villa, built towards the end of the 1st century AD, was within the *territorium* of the city of Saetabis (modern Xàtiva). By the mid-6th century it was no longer in use (Albiach *et al.* 2013). Unfortunately, the modern discovery of the villa was related to one of the obligatory decontextualisations that often befall our archaeological heritage, rather than *in situ* preservation. In this instance the site was intended for construction of a high-speed train line which would cover the entire archaeological area.

From 2004 to 2006 a substantial quantity of materials were removed from the site and transferred to the stores of the Museu de Prehistòria de València. Among these were a marble pavement and the remains of three polychrome *opus tessellatum* mosaics. The museum restoration laboratory carried out the works on all these pieces with the aim of their inclusion in a temporary exhibition opened in November 2013, entitled *Villa Cornelius: Rural life in the Roman period*. The intervention carried out on these materials is a good example of shared effort.

Mosaic and marble floors: preliminary assessments

Three polychrome *opus tessellatum* pavements were uncovered, decorating the different rooms of the villa. A small fragment was found in what was considered the noblest area of the site, although the poor structural preservation made it difficult to discern the precise function of the room. The only surviving fragment of mo-

Fig. 1. Mosaic of the room tentatively identified as *triclinium* (source: Museu de Prehistòria de València)

Fig. 2. Fragments of *opus tessellatum* with geometric-floral decoration in the hallway of the main bedroom (Museu de Prehistòria de València)

saic was situated near a wall. The quality of this small area, showing vegetal decoration, floral motifs and part of a small bird, suggests an elegant setting.

The second of the mosaics, located on what was possibly the *triclinium,* features geometric and plant designs framed with borders (Fig. 1). At 0.8 cm per side, the tesserae are the smallest of those in the

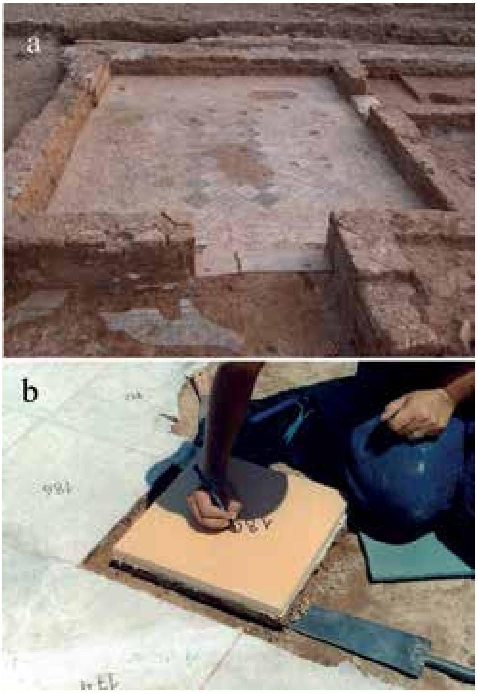

Fig. 3. a) Marble pavement of the main bedroom; b) Lifting operations (Museu de Prehistòria de València)

three works. The mosaic was found in a highly deteriorated state, covered by thick calcium carbonate concretions, with burnt areas, deformations caused by roots, and considerable losses due to the later excavation of ditches and an irrigation canal. A similar decoration of geometric-floral combinations was observed in the third of the mosaics: an *opus tessellatum* in the hallway of what was considered main bedroom, from which three dispersed fragments remained (Fig. 2).

A fourth and final pavement was considered the most noteworthy of the site: the marble floor of the supposed main bedroom (Fig. 3a). The pavement measures about 6.24 x 4.76 m and is composed of slabs quarried at Buixcarró, some 30 km from the villa. The marble pieces were laid in a manner creating two distinct decorative areas, over bedding layers of natural mortar. There were no traces of the stone or pottery fragments typically used for levelling marble slabs. At least two mortar could be distinguished, consisting of 70 to 80% calcite, as well as quartz, dolomite and amorphous solids, including charcoal in one of the layers. The slabs of this pavement were severely fragmented, and the condition was generally very deteriorated.

All the pavements were covered with a thick, hard calcareous concretion, which in many cases concealed the original polychrome stone. Also evident were areas affected by bonfires, likely corresponding to the final occupation of the villa.

In situ: pre-treatment, lifting and removal to museum

Preliminary cleaning was carried out on site, in phases: an initial, mechanical cleaning with a scalpel and suction to remove soil deposits and loosely adhered residues; a second phase of steaming and subsequent cleaning with soft brushes and sponges, applying distilled water to 5% New Des® surfactant soap.

Next, facing bandages were applied, preparatory to removal of tesserae from the base mortars. For this we used hydrophilic gauze applied in two layers, with an adhesive of solid polyvinyl acetate resin, 25% K-60® in ethanol. The detached mosaic sections were transported to Museu de Prehistòria de València, where they were packed in custom-made boxes for storage, until the start of the restoration processes.

The lifting operations for the large marble pavement of the main bedroom involved methodological differences, given that the 230 marble slabs still maintained their original shapes, rather than being reduced to isolated fragments. The cleaning processes and application of facing bandages proceeded as for the mosaics, however at this point a rigid styrofoam panel was attached to the bandages of each of the design modules using double-sided tape, serving as a cushioning and supporting base (Fig. 3b). Each of the 230 slabs was numbered and then removed, turning them over one by one and placing them on a carrying module for transport to the museum.

Laboratory: conservation-restoration and exhibit presentation

The pavements remained in museum storerooms until 2009, when restoration work for the exhibition project began, culminating in November 2013 (Pasíes 2014: 389-400). As conservator-restorers, the project represented an opportunity for research, application of innovative methodologies, and demonstration that our profession is not rigidly conformist or satisfied with known practices, but instead open to reflection and imagination, to solving problems in a simple way without being wasteful (Pasíes 2016).

It is worth noting that the mosaic originally decorating the *triclinium*, which was the *opus tessellatum* with the largest conserved surface area (in spite of numerous mutilations and severely deteriorated condition), is the only one to remain in the original boxes, without restoration, as it was not included in the 2013 exhibition project.

Marble pavement

Given the size and heavily deteriorated state of the marble pavement, the intervention was a complex task requiring careful advanced planning. Initially we considered a "traditional" intervention, in which the slabs would be positioned on a laminated base with an aluminium honeycomb interior. However, we soon questioned whether the use of added support materials was truly necessary. We realised that each slab, after suitable consolidation and reconstruction, could be well conserved and managed as an independent piece, without any type of adhered support, thereby also achieving considerable financial savings. For the assembly of the marble slabs in display, we proposed building a large sandpit, where the slabs could be placed after restoration, in a manner perfectly compensating the uneven thicknesses of the pieces.

Having determined the plan of intervention, the treatment phases were recorded photographically for each slab. A number was applied directly, along with marks of positioning relative to the adjoining pieces. The accumulated documentary archives assist in the assembly and avoids any possible errors in interpreting or placing the slabs.

First the styrofoam protective material applied in the detachment stage was removed, using mechanical means, followed by the gauze facing with vinyl resin, with assistance from the steam cleaner. Given the severely degraded, fragmented state of the majority of slabs, the physical-mechanical cleaning treatments were carried out in parallel with reconstruction (Fig. 4).

The adhesive selected for reassembly of the small fragments was Mowital®-B60HH, 20% in ethyl alcohol. The same material, combined with Fluoline®-A resin, was used for consolidation of areas with cracks. The application of an epoxy adhesive, always

Fig. 4. Cleaning and reconstruction of marble slabs (Museu de Prehistòria de València)

with a reversible intermediate stratum, was limited to the joints of the heaviest marble slabs and where the poor bonding of fragments called for greater strength.

Following reconstruction of all the marble slabs, we began the final cleaning of the hard calcareous concretions covering the surfaces and penetrating some of the cracks, using a micro-air-abrasive system in a low pressure range. Finally, the cleaned surfaces were protected using 60% ethyl silicate in white spirit.

The plan for the exhibition called for the insertion of the marble floor as the centrepiece of the interpretive discourse. Several months before the November 2013 opening we oversaw the installation of specially designed platform, serving to raise the marble pavement to the level of the two stone thresholds, also brought from the Villa Cornelius. A walkway was constructed around the entire assembly, providing good viewing. With these installations prepared we began to position the stone slabs, assembling the "puzzle" of the entire work. Each of the numbered pieces was laid on a base of silica sand, about 8 cm deep, and properly levelled relative to the surrounding slabs (Fig. 5).

Fig. 5. Positioning and levelling of the numbered marble slabs on sand (Museu de Prehistòria de València)

Fig. 6. Filling lacunae and joints with marble grit in seven different tones (Museu de Prehistòria de València)

Fig. 7. The exhibition room with display of the pavements (Museu de Prehistòria de València)

As the assembly progressed, the lacunae and interstices between slabs were filled with loose marble grit in specific grain sizes, in seven different tones. This very simple and completely reversible system recreated the appearance and colours of the stone, achieving very appropriate visual effects, including the completion of the geometric motifs (Fig. 6). In effect we could "paint" with a material corresponding to the original stone, varying the textures and colour gradations, as we applied the grit to the surface. This system achieved excellent aesthetic results, compatible with the original work and easily reversible, requiring only easy and minor maintenance over time (Fig. 7).

Mosaic with geometric-floral motifs

The intervention on the tessellated fragments from the hallway of the main bedroom began with placement on a lightweight support prepared using an industrial laminate of aluminium, fibreglass and resin. The laminate was first coated with a layer of perlite mixed with epoxy resin, establishing grip for the mortar. Both the support and the reverse of the original mosaic were coated with two layers of natural mortar, prepared using pure Saint-Astier natural hydraulic lime and a mixture of natural inert materials of low specific weight (Intopore®AR). A first layer of sifted, more fluid mortar applied to the reverse of the mosaic achieved good conformity with the irregular surface. The second layer was thicker and more levelled (Fig. 8). The same sequence of layers was applied to the industrially manufactured support. During these preparatory steps the mosaic fragments were rested on a wooden base. This initial base was now substituted with a new one of plastic-covered wood, affixed with straps, serving to turn the fragments over

Fig. 8. Use of natural mortars with low specific weight for attachment of support to a fragment of *opus tessellatum* (Museu de Prehistòria de València)

and gradually slide them over the laminate support prepared with mortar. Once the correct placement was achieved the fragment was levelled and the mortar surfaces were adjusted.

At this point we could continue the restoration of the *tessellatum*, first removing the gauze facings using a steam cleaner, then cleaning the surfaces. After an initial mechanical cleaning, we removed the hard calcareous concretions using an abrasive air system, as had been done for the marble pavement.

After preparation and treatment of the individual fragments, we could then place them appropriately in the exhibition hall, again using marble grit for the resolution of the lacunae. In this case the grit was selected in different shades of a neutral tone, achieving visual effects complementary to the original colours.

Mosaic fragment with figurative motif

The last of the mosaics to undergo intervention was the small fragment of polychrome *opus tessellatum* with a vegetal motif and representation of a small bird (Fig. 9a). The aim was to create a reversible support specific to the piece, which could fit perfectly against the uneven back, thereby enabling conservation of the remaining original mortar. The system selected was that of a support of laminated and aluminium honeycomb, applied using vacuum pressure, which could also minimise the weight of the overall piece (Fayos 2012). The industrial supports commonly used in the mounting and transport of mosaics and wall paintings clearly have advantages of stability, resistance and low weight, however they also present considerable limitations in the offer of sizes and thicknesses, the substantial costs, and the fact that the surfaces are always smooth (Carrascosa and Pasíes 2004). The conservator can create laminated constructions using the same products and methodologies as those of industry, but with the choice of specific materials, thicknesses and sizes adapted to the characteristics of the artefact being mounted. The conservator can design the custom-produced panel to conform perfectly with the irregularities of the original surfaces, thereby requiring less mortar and so achieving reductions in weight and cost (Borzomati and Iaccarino 2007: 607-614).

Given that the production of such a support would be an experimental approach for our team, we decided to prepare a replica of the reverse of the mosaic, to check the fit of the new support against the piece and ensure its reversibility.

The reverse of the mosaic fragment retained two substantial part of the original mortar layers. The earth adhering to these was carefully removed using a scalpel, brushes and aspirator. The remains of the original mortars were then consolidated by injection of PLM®-SM type mortar

Fig. 9. a) Mosaic fragment of mosaic with figure of a small bird and floral-vegetal motifs; b) application of natural mortar to the reverse; c) preparation of new support of fibreglass laminated with aluminium honeycomb under vacuum (Museu de Prehistòria de València)

into the cracked and highly fragile areas, also ensuring proper adhesion to the facing bandages. The small lacunae and the perimeter of the *tessellatum* were filled with a temporary synthetic mortar, readily reversible with water (10% polyvinyl alcohol at 10% with Sikadur®-501), for consolidation and protection of the edges. Then, as for the geometric-floral fragments, a natural Intopore®AR mortar was applied to the reverse of the areas of bare *tessellatum*, serving as an intermediate layer for fixing the support (Fig. 9b). The mortar was prepared using ground and sifted aggregate, then applied in a layer of a few millimetres on the dampened reverse, achieving adhesion to naturally uneven surface.

At this point we could also prepare the replica of the reverse side of the original. First we applied a thin layer of Rewultex®-MR latex rubber, to enable separation of the latex mould. The replica was then cast in dental plaster.

Both the replica and original fragment were prepared to receive the new laminated support. The materials used for manufacture of the support were:

– plastic film - to create the vacuum bag;
– absorbent cloth - to take up the excess resin in the vacuum compacting processes;
– separating film - perforated plastic film, assisting in even distribute of the resin and separation of the layers;

Fig. 10. The small fragment of *opus tessellatum* with custom-built laminate mount, in an exhibition showcase (Museu de Prehistòria de València)

– 'peel ply', or releasing agent – soft polyester fabric placed over the uppermost layer of the new laminated support, with chemical characteristics inhibiting adhesion of resin to the mould, enabling separation and making it possible to achieve a correctly textured finish;
– carbon-fibre fabric: 193gr/m^2;
– aluminium honeycomb, 5mm thickness;
– EPO-150® epoxy resin;
– sealant – for airtight closure of the vacuum bag.

The plastic film composing the bottom of the vacuum bag was placed on the table, with the consolidated mosaic on top. Plasticine was applied to the sharper edges of the mosaic, which could have cut the plastic during the pressure of the vacuum stage. The reverse side of the mosaic was prepared with a layer of film, enabling perfect separation later on. On top of this, the rest of the layers were placed one by one (Fig. 9c). A piece of Japanese paper was also placed between the carbon fibre and the core of the aluminium honeycomb to increase the contact surface of the resin.

With all the layers in place, the bag was closed using the sealing tape and the vacuum treatment was carried out for a period of 24 hours, after which the preparatory materials were gradually removed until the new laminated base was free. The latter was thin, extremely light (150 gr), and conformed perfectly to the irregularities of the mosaic reverse.

For the layer adhering the support to the mosaic fragment we chose an easily

removable acrylic resin gel (30% Paraloid®-B72 in acetone, with micronised silica). The surfaces of the support and the reverse of the mosaic were first waterproofed, using a layer of 10% Paraloid®-B72 in acetone. The combined "sandwich" of support, gel and mosaic was then quickly returned to the vacuum bag, operated for a further 24 hours, to achieve optimal adhesion.
The operations for preparation of the laminated base and adhesion to the mosaic had first been carried out on a test basis on the dental plaster replica. Using a small diamond grinding disc, a fragment of one of the corners was cut to verify the fully satisfactory fit and adhesion to the mosaic reverse. To check the reversibility of the operations, acetone was injected through several perforations in the laminated base: as expected, separation was possible after a few minutes.
Once the piece was positioned on the new lightweight support, we could begin the interventions on face of the mosaic. We removed the facing bandages of the extraction process and the provisional reinforcements carried out with polyvinyl alcohol adhesive. The excess perimeter areas of the laminate base were removed using a thermo-cutter. The *tessellatum* interstices, which conserved hardly any original mortar, were filled with a new natural mortar, also used to fill the small lacunae to a level slightly lower than the original surface. The entire perimeter of the laminated base was covered with a natural mortar, reinforced with Acril®-33 acrylic resin, with the exception of a small area left in sight as witness to the intervention technique (Fig. 10).

Continuing use of the restored pavements

The Villa Cornelius exhibition was open to the public from November 2013 to June 2014, in the temporary exhibition galleries of the Museu de Prehistòria de València. The pieces were then dismantled and stored in a warehouse. However, in 2015, we were very pleased to learn of a request from the Municipal Council, for exhibition of the entire set of conserved works. As of the date of this report the pavements were on display at the Museo del Almodí in Xàtiva, the former Roman city of Saetabis, undoubtedly the administrative centre for the ancient area of Villa Cornelius.

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Technical notes

New Des®: https://www.ctseurope.com/en/scheda-prodotto.php?id=471
K-60®: https://www.ctseurope.com/en/scheda-prodotto.php?id=119
Mowital®-B60HH: https://www.ctseurope.com/en/scheda-prodotto.php?id=2432
Fluoline®-A:https://www.ctseurope.com/en/scheda-prodotto.php?id=137
Intopore® AR:http://www.tcscalce.it/it/prodotto/intopore-ar
PLM®-SM:https://www.ctseurope.com/en/scheda-prodotto.php?id=298
Sikadur®-501: https://esp.sika.com/es/group.html

Rewultex®-MR:http://www.ctseurope.com/en/scheda-prodotto.php?id=178
EPO-150®: http://www.ctseurope.com/en/scheda-prodotto.php?id=72
Paraloid®-B72:http://www.ctseurope.com/en/scheda-prodotto.php?id=24
Acril®-33:http://www.ctseurope.com/en/scheda-prodotto.php?id=4

References

Albiach R., Gallego A. and García-Prosper E. 2013. *Villa Cornelius. La vida rural en época romana*. Valencia: Museu de Prehistòria de València.
http://mupreva.org/pub/846/va

Borzomati A., Iaccarino, A. 2007. "Materiali e metodo innovativi per il montaggio di un dipinto murale strappato su nuovo supporto". In *V Congresso Nazionale IGIIC - Lo Stato dell'Arte 5 (Cremona, Palazzo Cittanova 11-13 Ottobre 2007)*. Florence: Nardini Editore.

Carrascosa B., Pasíes T. 2004. *La conservación y restauración del mosaico*. Valencia: Universidad Politécnica de Valencia.

Fayos H. 2012. "Revisión crítica de soportes para mosaico: estudio e intervención de un fragmento de *opus tessellatum* de la villa de Cornelius (L'Ènova, Valencia)". Trabajo de investigación del Master en Conservación y Restauración de Bienes Culturales. Universidad Politécnica de Valencia.

Pasíes T. 2014. "La Villa de Cornelius (l'Ènova, Valencia): trabajos de conservación y restauración para un proyecto expositivo". *Archivo de Prehistoria Levantina,* Vol. XXX, Valencia: Museo de Prehistoria de Valencia.
http://mupreva.org/pub/30/es

Pasíes T. 2016. *Villa Cornelius: conservación y restauración de mosaicos*. Valencia: Museo de Prehistoria de Valencia.
http://mupreva.org/pub/925/va

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INCRUSTATIONES: CONSERVATION, RESTORATION AND RECONSTRUCTION

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Abstract

This paper provides a brief overview of the history of conservation methodologies applied to *sectilia*, followed by an outline of the main processes of modern conservation procedures, and a description of a recent innovation in this context. Modern procedures characteristically feature the first aspect of *in situ* conservation of marble wall decorations and the surviving preparations, meaning the imprints of the slabs and the holes for staples. Through the comparison of these elements with known geometric diagrams, it is possible to propose modular reconstructions. A second aspect of modern procedures is the restoration of fallen and movable fragments, and the search for their points of attachment, leading to the simultaneous research and reassembly of the 'modules' of original execution, based on objective data. The research for this reconstruction includes the qualitative and quantitative statistical analysis of the recorded elements. Finally, the paper concludes with the description of an experimental involving the use of magnets applied to the rear of the marbles, allowing the proposal of different hypothetical reassemblies in a totally reversible manner.

Keywords: Roman wall marble decoration, wall *sectile*, *incrustationes*, conservation methodologies

Historic and current methodology

The study of marble parietal decorations (*incrustationes*) has developed only in recent decades (Guidobaldi 2003; Guidobaldi and Angelelli 2005; Giuliani 2006; Lugari 2014), however scholars now agree almost unanimously on their techniques of construction and execution. The knowledge of the construction method of an artefact is fundamental to its correct conservation. Whereas both *incrustationes* and floor *sectilia* may at one time have been considered only as "surfaces", these are now analysed in terms of their stratigraphic process of execution. For a long historic period the reconstructions of these decorative works were carried out in summary and even arbitrary manner, using unsuitable materials such as cement and iron staples. However, in recent years it has been accepted that the preservation of parietal marbles requires a series of steps starting immediately during excavation.

A visit to the most important archaeological sites of the Roman area, such as the Republic and Imperial Forums and Ostia Antica, will quickly reveal how the problem was dealt with in the past, where the fragments were collected and reapplied to the wall without philological criteria, sometimes in an "antique" manner. The workers involved in these tasks were often good artisans, who "stitched together" the fragments in an attempt to reconstruct circumscribed areas by reassembling materials from the excavated environment, often creating what were effectively fakes,

Fig. 1. Ostia Antica, House of Augustali, 20th century restoration (photo by A. Lugari)

Fig. 2. Rome, Villa of Quintili: porch garden, central area, during the excavation (photo by A. Lugari)

Fig. 3. Rome, Villa of Quintili: porch garden, central area, after conservative intervention (photo by A. Lugari)

in an attempt to communicate how a wall covered with marble would have appeared in general and with no consideration of the different measures of materials in the succession of decorative registers (Fig. 1). Excluding the reconstruction of the nymphaeum of the so-called Domus Transitoria, as drawn by Boni at the beginning of the last century (Carettoni 1949; Lugari and Guidobaldi 2013), it was not until Becatti addressed the monumental work of conserving the *opus sectile* from a building near Porta Marina (Ostia, Rome) at the close the 1960s, that we would find a methodologically and philologically correct work (Becatti 1969; Arena Taddei and Carruba 2006). This period in fact marked the true beginning of the study of marble wall decorations, and so also the modern conservation methodology. The conservative praxis concerning the *incrustationes* has therefore evolved over time, as archaeologists and scholars devoted attention to this decorative typology and developed studies on the constructive methodology. The history of their conservation follows a logical thread parallel to that of the analysis of the constructive and decorative typologies.

Typical of entire field of archaeological conservation, we can also divide the conservation methodology of the *incrustationes* into two broad types. The first of these is *in situ* conservation – designed to preserve the monumental artefacts with all the annexed decorations, through application of a standard series of working procedures beginning during the excavation and then continuing up to the ultimate

Fig. 4. Arcinazzo Romano, Villa of Emperor Trajan: room XXV during excavation (photo by A. Lugari)

Fig. 5. Rome, Palatine Hill, so-called *Domus Transitoria* (room A4, corner SO) (photo by A. Lugari)

aim, which is the opening of the site for public access, communication and enjoyment. The second broad methodological type is *ex situ* conservation – the involvement of an entire team of professionals in collecting and cataloguing the artefacts found during stratigraphic excavation, with the subsequent virtual or physical reconstruction of the materials recovered. For *in situ* conservation of *incrustationes*, conservators guide the excavation operations alongside the archaeologists, firstly for the immediate safeguard of the (generally very small) fragments surviving on the walls (Figs. 2-3), and in a second stage for repositioning of the collapsed parts where there is the certainty of correctness and proper conservation.

This current article does not consider the details of the different conservation operations of materials, such as consolidation, identification of attachment points, bonding of fragments, cleaning, aesthetic presentation, and protection, since these are now standardised. The intention of this current contribution is instead to deal with the second aspect of *in situ* and *ex situ* work,

Fig. 6. Roman Forum, Temple of Venus and Rome, north wall in chamber of Rome (photo by A. Lugari)

meaning the management of fragmentary materials collected during the stratigraphic excavation. The first process of this second stage concerns the collection of collapses, proceeding by sector and stratigraphic layer, immediate searching for the attachments during the excavation and removal of the artefacts (Fig. 4). This process then continues through precise assessment and cataloguing of every single fragment. At the same time as the collection of all materials is under way, the study and analysis of both the *in situ* and removed elements begins, for purposes of hypothetical reconstruction of the decoration. The elements that allow

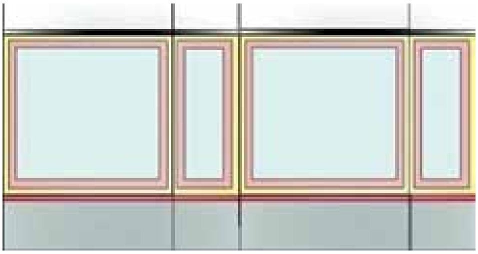

Fig. 7. Rome, Villa of Quintili, residential area corridor: graphic reconstruction of the marble parietal decoration (A. Lugari)

us to draw up a reconstructive hypothesis are the directly observable data, present on the walls, which we can divide into two groups: a) primary (imprints on the mortar and surviving fragments on the walls) (Fig. 5) and b) secondary data (the metal staples and the holes for their insertion) (Fig. 6). Through the detailed analysis of all these elements it is often possible to have a graphic hypothetical reconstruction of the decorative scheme, divided into registers, panels and frames (Fig. 7). The next step is the statistical analysis of the fragments found in the excavation, subdivided by material (lithotype), and form (slab, frame element, three-dimensional frame element, capital, architectural element, etc.) and dimensions, keeping in mind the position of collapse and of discovery. By statistical analysis we mean the counting of the quantities of the various types such as, for example, the large panels, the frames of a certain thickness, the complete elements, etc. These calculations enable the proposal of hypotheses of the quantities of the various elements to be reconstructed, using the collected fragments. All these data are necessary in the long work of reconstructing the decoration of the various registers, beginning during the stratigraphic excavation operations.

Innovative techniques of reassembly and public presentation

In the case of the Villa of the Emperor Trajan at Arcinazzo the excavations recovered some tens of thousands of marble fragments. Given this, the aims of the reconstruction were to optimise the conservation of the materials and at the same time make the conservation work accessible to visitors. The first stage of the reconstruction process was to identify the attachment points among the recovered fragments, leading to a substantial reconstruction of the constituent decorative elements in the first two registers of the west wall (Fig. 8). Each reassembled and restored marble element was first prepared with an intervening layer and then 'tiled', using a hydraulic mortar applied to the back side, thus obtaining the same thickness for all the elements, for facilitation of the subsequent reassembly process. The next step was to apply magnets to the back of each element, chosen in relation to the weight and thickness of each piece. Subsequently to these operations a temporary steel wall (Fig. 9) was constructed and installed, of the same size as the wall

Fig. 8. Arcinazzo Romano, Villa of Emperor Trajan: room XXV, trial reconstruction of the parietal decoration (photo by A. Lugari)

Fig. 9. Arcinazzo Romano, Villa of Emperor Trajan: *antiquarium*, construction of the steel wall for the west wall of room XXV (photo by A. Lugari)

of the environment to be rebuilt. This allowed us to provisionally recompose the decoration of the first three registers of the *sectile*, in a completely reversible manner, since each element was easily removable from the iron wall. The base of the marble decoration had been largely preserved *in situ*, where it was reassembled and consolidated: this portion was 'replicated' on the steel wall by means of a life-size photograph (Fig. 10).

The importance of the reconstructive methodology described here lies in its ease of implementation, reversibility, and its practicality for purposes of proceeding with the work of hypothesising and reconstruction. The technique simplified the steps involved at the Arcinazzo villa site, and at the same time allowed visitors

Fig. 10. Arcinazzo Romano, Villa of Emperor Trajan: *antiquarium*, reconstruction of the marble decoration, Room XXV (photo by A. Lugari)

to enjoy this masterpiece during the entire work of reassembly. Another advantage of this technique concerns the issue of costs and budgets, given that the funds available for a restoration project arrive are often allocated at long intervals. With the technique described, the reassembly work can be carried out in stages, suspended and resumed, thereby avoiding problems during development of the archaeological site and reducing waste to a minimum.

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References

Arena Taddei M. S., Carruba A. M. 2006. *L'opus sectile di Porta Marina*. Roma: Soprintendenza per i Beni Archeologici di Ostia.

Becatti G. 1969. *Edificio con opus sectile fuori Porta Marina*. Scavi di Ostia 6. Roma: Istituto Poligrafico e Zecca dello Stato.

Carettoni G. 1949. "Roma (Palatino). Costruzioni sotto l'angolo sud-occidentale della Domus Flavia (triclinio e ninfeo occidentale)". *Notizie Scavi d'Antichità*, vol. 3, 1949: 48-79.

Giuliani C. F. ed. 2006. *L'edilizia nell'antichità,* 2ª ed. Roma: Carocci editore.

Guidobaldi F. 2003. "*Sectilia pavimenta* e *incrustationes*: i rivestimenti policromi pavimentali e parietali in marmo o materiali litici e litoidi dell'antichità romana". In *Eternità e nobiltà di materia. Itinerario artistico fra le pietre policrome* a cura di Anna Maria Giusti, 15-76. Firenze: Polistampa.

Guidobaldi F., Angelelli C. 2005. "I rivestimenti parietali in marmo (*incrustationes*). La tecnica di fabbricazione e posa in opera come base del progetto di conservazione". In *Wall and Floor Mosaics: Conservation, Maintenance, Presentation. Proceedings of the VIIIth Conference of the International Committee for the Conservation of Mosaics, Thessaloniki, 29 October-3 November 2002* edited by Charalambos Bakirtzis, 33-43. Thessaloniki: European Centre of Byzantine and Post-Byzantine Monuments, Ephoreia of Byzantine Antiquities of Thessaloniki.

Lugari A. 2014. "Alcune ipotesi sulle tecniche costruttive dei sectilia parietali". In *Conservation: An Act of Discovery. Proceedings of the Xth Conference of the International Committee for the Conservation of Mosaics, Palermo, 20-26 ottobre 2008*, edited by Demetrios Michaelides, 709-713. Palermo: Regione Siciliana, Assessorato dei Beni Culturali e dell'Identità Siciliana, Dipartimento dei Beni Culturali e dell'Identità Siciliana.

Lugari A., Guidobaldi F. 2013. "I rivestimenti marmorei pavimentali e parietali delle residenze di Nerone sul Palatino alla luce dei recentissimi restauri". In *Atti del XVIII Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico (AISCOM)*, 613-626. Tivoli (Roma): Edizioni Scripta Manent.

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AN OUTSTANDING 19TH CENTURY RESTORATION: THE MOSAIC PAVEMENT OF NEPTUNE AND AMPHITRITE FROM CONSTANTINE, ALGERIA (LOUVRE MUSEUM)

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Abstract

The Neptune and Amphitrite mosaic is one of the highlights of the Louvre mosaics collection. It arrived in the collections of the museum in 1845, soon after its discovery by the French colonial forces and its removal under the direction of Captain Delamare, a member of the Committee for Scientific Exploration of Algeria. The central part of this vast pavement was on permanent display in different locations of the Louvre from 1850 to 2007. At the time of its removal from the gallery wall it revealed an unusual structural support, providing significant insight into the conservation-restoration techniques carried out by the Louvre workshops in the 19th century. Archival research, two preliminary studies and the x-ray imaging of the pavement and its support provided a clearer understanding of the original restoration work. On this basis it was possible to design a 21st-century conservation treatment which preserved the entire work, including the structure and the other features deriving from the 19th century interventions.

Keywords: Constantine (Algeria), mosaic restoration, nineteenth century, Louvre museum

Introduction

The mosaic pavement depicting Neptune and Amphitrite [1] (Fig. 1) is a masterpiece of the Louvre Department of Greek, Etruscan and Roman Antiquities (Baratte 1978: 28-40; Mison 2010). It was one of the first mosaics to be added to the Louvre collections, arriving in 1845 soon after being discovered in the vicinity of Constantine, Algeria and removed from its

Fig. 1. The Neptune and Amphitrite mosaic from Cirta (Contantine, Algeria), circa 315-325 AD; marble, limestone and glass tesserae, 310 x 196 cm; Department of Greek, Etruscan and Roman Antiquities, Louvre Museum, Paris (May 1880) (photo Musée du Louvre/Hervé Lewandowski)

original site. Only the central panel has ever been displayed: in 1850, in the Algerian Gallery; in 1895 it was moved to the African Gallery, which in the 1930s was converted as the Mosaics Gallery. In 2007, when this enormous pavement was detached from the wall, it proved particularly interesting for what it revealed of the various restoration interventions undergone in the Louvre workshops during the preceding centuries. Archival research, two preparatory studies, and an x-ray of the pavement resulted in a better understanding of these previous interventions and a reconsideration of the approach in planning the conservation intervention eventually conducted in 2016.

The discovery

In 1837, in parallel with the military expeditions engaged in the conquest of Algeria, the Académie des Inscriptions et Belles Lettres created a Committee for the Scientific Exploration of Algeria (Dondin-Payre 1994a) with one of the aims being the facilitation of individual initiatives for the study of the Roman remains of the country. There was evidently a desire to generate interest in Algeria's cultural heritage, but also to carry any portable antiquities to Paris for purposes of making them known to the general public and the scholarly world. The members of the committee were appointed by the Ministry of Public Instruction and Fine Arts. In November 1839, Adolphe Delamare (Dondin-Payre 1994b), an artillery captain in the Third Regiment of African Chasseurs who had lived in Algeria from 1830 to 1835, was seconded to the committee. On 1 July 1841 he was appointed a full member, which he remained until 1850. Although he was best known for his drawings of picturesque scenes and landscapes, he was also interested in Roman remains and inscriptions.

In May 1842, while clearing a field on the hill of Coudiat-Aty two kilometres south of Constantine, the Third African Chasseurs discovered the remains of a wall, and following excavation of a metre of overlying soil, they uncovered a mosaic pavement. Captain Delamare was resident in Constantine at the time, and immediately attended the site to draw the finds and assess their value. The best-preserved pavement, depicting Neptune and Amphitrite, aroused particular admiration and interest. In a report to General Négrier on 24 June 1842 [2], Delamare wrote:

> The entire mosaic was produced by skilful artists. It is a magnificent equivalent of a carpet: the composition which occupies the lower part of the rectangle is extremely important, reminding me of some of the paintings of Raphael and his master Perugino: there is the same simplicity in the composition, the same nobility in the figures. This image surely throws new light on the history of painting in antiquity.

Delamare organised the full excavation of the pavement and continued his studies, producing several very meticulous site drawings. At this time he also proposed a date for the production of the mosaic, at between the mid-2nd and mid-1st century BC: a date subsequently revised by François Baratte, based on stylistic criteria, since stratigraphic information was no longer available (Baratte 1978: 39-40). According to this more recent analysis, the work can be dated to the first quarter of the 4th century AD.

Fig. 2. Technical drawing of the Neptune and Amphitrite mosaic, originally in Delamare 1850, pl. 141-142

The discovery and the contemporary reports attracted the attention of the authorities. At the same time the mosaic was made known to the general public through magazine articles, especially those providing lithographs based on Delamare's studies. Among these was the *Magasin Pittoresque* of 1843 [3], which recounted the discovery, the methods of removal, and provided a description of the work. More scholarly publications such as the *Revue Archéologique* [4] presented the findings as early as 1845, at the same time reporting that the work would compose part of a new gallery of North African art to be developed by the Louvre, along with other "ancient fragments collected in the province of Constantine". In 1850 Delamare published *L'exploration scientifique de l'Algérie* (Delamare 1850). This work, containing nearly 200 plates, included the plan of the immense excavated room (8.36 x 7.14 metres), paved entirely in the mosaic of Neptune and Amphitrite, as well as site drawings in black-and-white and colour, and colour details of the central panel and geometric surround (Fig. 2).

Shortly after being completely uncovered, Delamare directed the lifting of the pavement from the site, supported by the architect Lebas. Within a matter of months it was shipped from Algeria to France for presentation to King Louis-Philippe, who placed it in the Musée Royal. Once arrived in the Louvre the figurative central panel underwent interventions in preparation for exhibition, while the rest of the pavement, cut into some 60 pieces, entered storage.

The Neptune and Amphitrite mosaic

The pavement depicting Neptune and Amphitrite would have adorned the floor of a reception room. Most of the surface is composed of linked geometric patterns: 36 octagons framed by laurel wreaths contain an enormous variety of motifs, with only three being repeated, and those occurring only twice each. The interlaced designs, simple geometrical shapes, *peltas*, rosettes and other features are all characteristic of the workshops of the cities of Hippo and Cuicul (e.g. House of Bacchus). The iconography of the central panel, showing the triumph of Neptune and Amphitrite, is amply documented in the provinces of Roman Africa.

Poseidon, the Greek god of the sea, of springs, sometimes even of earthquakes, was worshipped in the African-Roman world under the Latin name of Neptune, and equated with the Phoenician god Melqart. In this mosaic, which draws on classical literary references, he appears in the company of Amphitrite, one of the hundred daughters of Nereus and Doris, and in Greek mythology the consort of Poseidon and Queen of the Sea. In some classical accounts, Amphitrite was dancing with her sisters near Naxos one day when Poseidon saw and abducted her. In another version of the myth, Poseidon fell in love with the Nereid Amphitrite, who rejected him and hid in the depths of the sea. She was found by dolphins and returned to the god in grand procession, who then married her.

In the mosaic from Constantine the two divinities stand side by side, facing forward on a chariot pulled by four sea-horses, who seem to leap from the waves. Neptune is seen to the right, holding his trident with his left hand and looking at Amphitrite, who rests her left arm on the god's shoulders and extends her right hand towards him. A large sail swells in the wind above the heads of the divinities, held by two cupids. Below the chariot are two sailboats, each carrying two *putti*, one of whom fishes while standing up, as the other holds the rudder in the stern. In the foreground, above a sea teeming with fish, two Nereids rest on the backs of dolphins. The background is filled with fish and marine animals.

The central panel, in highly classical style, shows superior execution and a rich chromatic palette featuring brilliant highlights, such as the sail with red accents, and Neptune's hair and beard with blue accents. The dating of the work to the first quarter of the 4th century, by Baratte (1978) is based in particular on his analysis of certain stylistic details, among these Amphitrite's hairstyle, evoking that of the princesses of Constantine, the representation of the sea by "wiggly" parallel lines, the composition in several registers, and the design of the decorative medallions.

The mosaic at the Musée du Louvre

The Neptune and Amphitrite mosaic was exhibited as early as 1850 in the Algerian Gallery [5] (Fig. 3) a narrow gallery running along part of the eastern wing of the Cour Carrée, which as a whole houses the Egyptian Museum. The gallery was designed by the architect Felix Duban:

> …to house the Antiquities brought back from Algeria in 1845 by Captain Delamare's mission. Enclosed within the Egyptian Museum, this Algerian Gallery, which was accessed through a door opening in the middle of the Henri IV Gallery, was inaugurated on 8 July 1850. Visitors could admire statues, a score of busts and a great number of bas-reliefs, cenotaphs and capitals, as well as a very beautiful mosaic depicting the triumph of Neptune and Amphitrite (Aulanier 1961: 82).

The mosaic panel was indeed one of the highlights of the gallery, which by displaying the findings from the excavations conducted by the Committee for the Scientific Exploration of Algeria sought to emphasise the links between the local populations and Western culture, and so legitimise the conquest. Only the central panel was placed on display. The numerous pieces composing the geometric surround remained in their packing crates and are still in storage today.

In 1895 the Algerian Gallery was superseded by the so-called African Museum

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fantasies of the Ogyval style; and two capitals, one of which, especially, is extremely elegant.

We give a view of the Gallery in the Louvre containing the Algerian antiquities. In the foreground is a copy of a beautifully wrought mosaic, found in the province of Constantine, in 1842, by the soldiers of the 3d Regiment of Chasseurs d'Afrique in a plot of ground which they cultivated. It was lying buried about three feet deep in the soil, among ruins of ancient buildings, and was recovered in fragments, and restored with the greatest care. It measures about 30 feet square, and is rectangular. It represents the Triumph of Neptune and Amphitrite, and is enriched with a profusion of details, referring to the sea and to the mythology it illustrates. In symmetry of piece-work and careful execution this mosaic may contrast with the most perfect specimens.

On the left, under this important fragment, is a bas-relief—given by the Duke of Orleans, eldest son of Louis Philippe—representing Hercules overcoming the Lion, and the same hero felling the Chimera. Above this bas-relief is placed a stone, apparently detached from an altar, decorated with a bird resembling an owl, and with a row of ovolos across its width. A modern inscription on one side commemorates its finding by the 10th Regiment of Artillery. To the right, and as a pendant to the bas-reliefs, is a very nice Bacchanal. The god, crowned with vine-leaves, presses the juice of grapes into a horn placed in the mouth of a satyr. A female figure plays cymbals; and, on the other side, Silenus, intoxicated and staggering, supports a figure which it is not easy to divine.

The funereal monuments in the second Illustration are the two stele mentioned above. The inscriptions are finely cut in relief. They are in white marble, in very good preservation.

Between the above is a very fine arabesque, cut into the marble. It is an exquisite specimen of the ornamentation of the Arabs, and seems a detached fragment of the decoration of some edifice, as it was no particular character, which would make it assignable to a different purpose.

Another of the capitals mentioned above gives an idea of the style of architecture which prevailed in Africa, subsequently to the Roman domination.

On the right is a very fine antique vase, also found in Africa. It is not possible to confound its elegant form and skillfully-treated details with the Roman period. It is evidently a production of Greek art, and must have been brought to Africa after the Roman occupation; for nothing in the ruins, discovered hitherto, resembles it in style or magnificence. It is not improbable that this exquisite relic had been captured by the Algerine corsairs, in more modern times: and being afterwards abstracted from the rapacity of the masters of the country, may have been abandoned and forgotten. But, certainly, in our judgment, this vase cannot have belonged to the Roman epoch; for the absence of all remains which can at all come near this, in purity of taste and perfection of form, we think fully authorises such a decision. On the left are some ancient tomb-like relics; and above the whole is a fragment of an antique frieze in marble.

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MUSÉE ÉGYPTIEN.

COUR DU LOUVRE.

Fig. 3. The Algiers Gallery at the Louvre Museum, wood engraving published in The Illustrated London News, 30 October 1852 October, reproduced in Aulanier 1961, fig. 56

(Héron de Villefosse 1921), installed in a gallery in the Denon Pavilion, between the Cour du Sphinx and the Cour Visconti, within the Museum of Antiquities. This new space traced the progress of French colonisation in North Africa, gathering collections brought from Algeria, Tunisia, Tripolitania and Cyrenaica, and featured the mosaics of the region, including those from Utica and Constantine. In the 1930s the African Museum was converted as the Mosaics Gallery, in the course of the overall reorganisation of the Louvre collections. It was most probably at this time that the central mosaic panel was inserted in the gallery wall and surrounded by a plaster frame. It was not until 2007 that the mosaic was dismounted from this position (Fig. 4) in the course of refurbishment of the façade of the Cour Visconti. At that point a wood-

Fig. 4. Removal of the Neptune and Amphitrite mosaic from the wall of the Mosaics Gallery in 2007 (photo Musée du Louvre/Cécile Giroire)

Fig. 5. Aluminium frame reinforcing the wooden cradle of the 19th-century restoration (photo Atelier de conservation-restauration, Musée départemental Arles antique)

en cradle was discovered on the back of the mosaic (Fig. 5).

Preliminary studies

In 2014, the central panel of the mosaic was the subject of a preliminary study [6], with the objectives of assessing the state of preservation of the ancient *tessellatum*, identifying the character and stratigraphy of the modern support, and verifying whether the entire mosaic was firmly attached to the support, so that the work might eventually be loaned to other museums. The results of this study, including study of archival documentation on the 19th-century lifting and restoration interventions, were presented to the conservation committee of the Louvre. The committee then directed a supplementary investigation conducted in 2016 [7], intended to further verify the feasibility of preserving the modern support, in particular the remarkable oak cradle, while still maintaining the integrity of the ancient mosaic. This second study took into account the observations made in 2014, supplemented by some archival documents throwing light on the 19th-century interventions, and also drew on x-ray imaging of the entire mosaic, carried out by the Centre de Recherche et de Restauration des Musées de France (Fig. 6) [8].

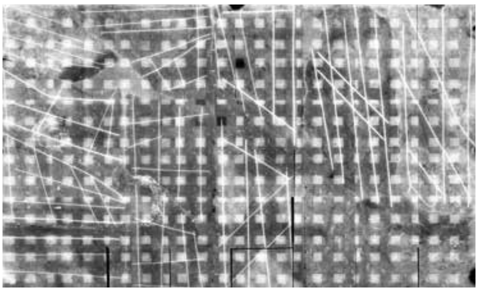

Fig. 6. x-ray image of Neptune and Amphitrite mosaic by Elsa Lambert, Imaging Group of the Centre de recherche et de restauration des musées de France (C2RMF), 2016 (credit C2RMF/Elsa Lambert)

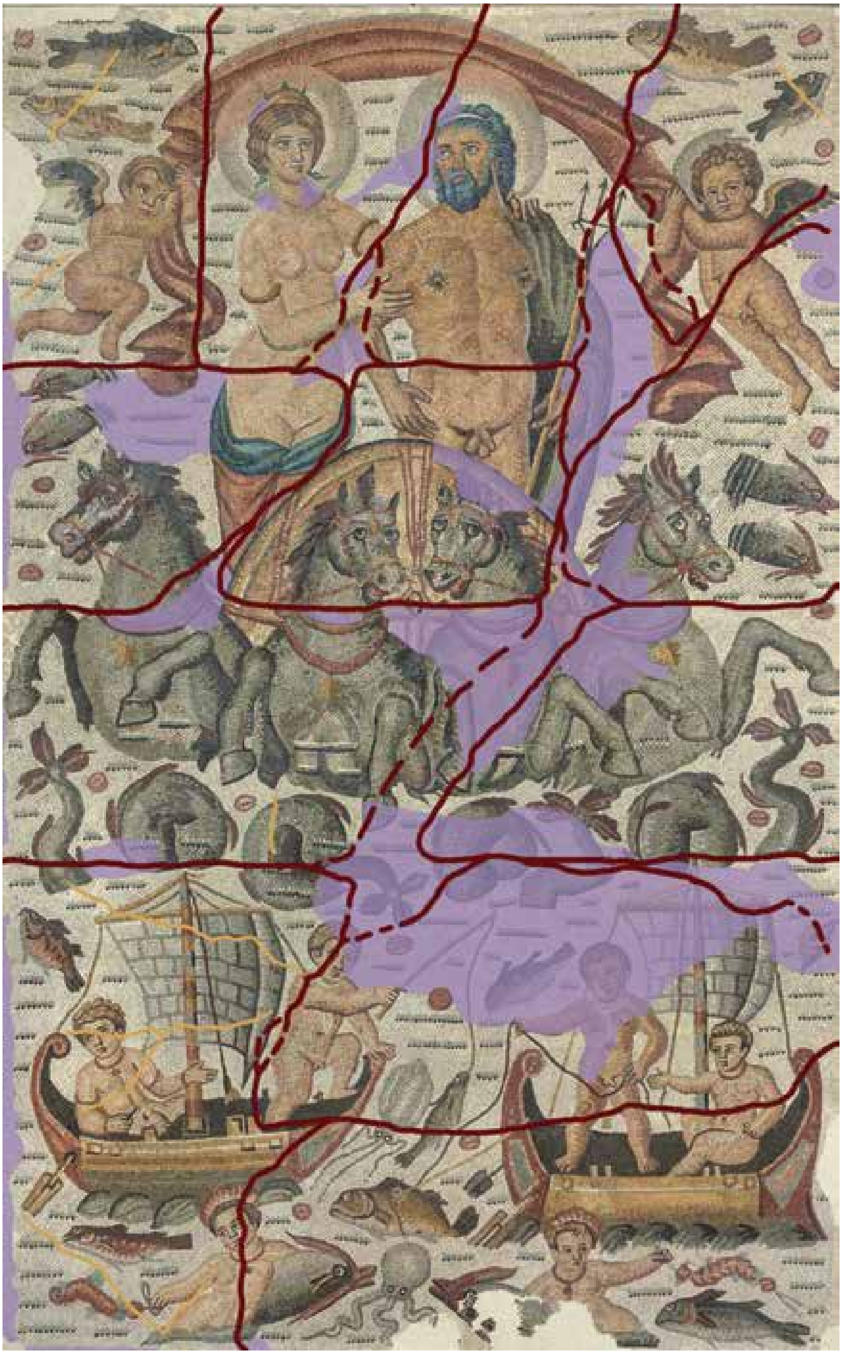

Fig. 7. Drawing showing the edges of the antique fragments in red and the areas of 19th-century restoration in purple (Atelier de conservation-restauration, Musée départemental Arles antique)

The x-ray results were of great help in understanding the modern support. The images reveal that the density of the panel varies considerably, and also makes it possible to determine the original position of at least 12 of the fragments of antique pavement lifted from the original site, placed on the mortar bedding and *nucleus*. These were readily identifiable due to the presence of interior metal reinforcements and the observation of dark lines delimiting the fragment edges (Fig. 7), except for a fragment in the lower left corner which does not contain any metal reinforcement, probably because it was sufficiently sound. The superimposition of these lines shown by the x-rays on the surface of the pavement also assists in revealing the areas reworked during the 19th-century reconstruction of the pavement in the Louvre's workshops enough, which evidently correspond to areas that were already missing at the time of the recovery of the antique mosaic. A careful examination of the *tessellatum* reveals further clues indicating the areas reworked during the reconstruction of the pavement, in particular the patterning, type and positioning of the tesserae. In addition to the metal armatures, the x-ray imaging also indicated the presence of a large number of nails used to more firmly fix the backing plaster to the wooden structure. All these elements were taken into account in planning the contemporary conservation protocol.

In this way, through archival research, examination of the mosaic surfaces and structure, the modern plaster support, and the mapping of the metal elements unexpectedly discovered inside the plaster, we achieved a much fuller understanding of the recent history of the Neptune and Amphitrite panel and the different interventions it has experienced. In its present state, it consists of twelve antique fragments reassembled on a plaster base consolidated by armatures of metal and wood. This original assemblage was later reinforced by the attachment of an oak cradle to the rear. The missing areas in the surface of the *tessellatum* have been filled by modern reconstructions. The knowledge gained concerning the material composition of the mosaic enabled us to envisage the preservation of the modern support, and then arrive at the technical solutions for achieving such a proposal.

The conservation treatment

The objectives of the conservation treatment [9] were threefold:

1. To preserve the pavement on its 19th-century support;
2. To ensure attachment of the *tessellatum* to the support layers, by means of the addition of an aluminium frame;
3. To improve the legibility of the work in the spirit of the 19th-century pictorial treatment, in particular by filling cracks with wax, tinted to match the colours of the surrounding tesserae (Figs. 8-9).

Treating the support

The 19th-century support required reinforcement of the structural cohesion between the wood, plaster and metal materials. Consolidation was achieved by injecting a grout selected for qualities of high adhesion and minimal water content, to avoid further deterioration of the plaster structure and oxidation of metal elements. On the basis of testing, the grout selected was Primal® E330S acrylic resin

Fig. 8. Drawing showing the areas with tinted joints from the 19th-century restoration (Atelier de conservation-restauration, Musée départemental Arles antique)

Fig. 9. Joints filled with tinted wax (photo Atelier de conservation-restauration, Musée départemental Arles antique)

with equal parts of calcium carbonate ($CaCO3$), injected in the total amount of 25 kg. The consolidation was carried out in part from the rear, by removing 151 plaster blocks from the interstices of the oak cradle (Fig. 10), which had become loose over time. In this manner we were better able to disperse the injected solution. For the approximately 185 blocks still firmly fixed, narrow diameter holes were drilled for passage of a syringe, used to inject the grout at the plaster/wood interface. The loose blocks were then reattached using the same grout solution. Finally, the wooden cradle was sponge cleaned using equal parts water and ethanol. The four edges of the overall pavement block were also consolidated, particularly in the areas where the installation of hanging hardware (clips, etc.) had left gaps allowing accessibility. The oxidised nails were first covered with acrylic resin (Paraloid® B72) in low concentration. Following the consolidation procedures the edges were smoothed through repeated applications of acrylic resin and inorganic filler, allowing drying between applications.

As had been proposed in the 2016 study, an aluminium frame [10] (Fig. 5) was designed to prevent the mosaic from buckling, and to lock together the *tessellatum*, plaster support and oak cradle. The choice of aluminium ensured that the total weight of

Fig. 10. Injecting grout for consolidation of the support (photo Atelier de conservation-restauration, Musée départemental Arles antique)

the framing system was limited to 200 kg. Since the weight of mosaic and backing is estimated at one ton, this does not seriously alter the conditions for handling. A system of diagonal cables and adjustable turnbuckles at the back of the mosaic provides added rigidity and strength. Two removable steel rings were installed on the upper crossbeam (with the mosaic in vertical position), to facilitate the manoeuvres required for further conservation treatment, such as lifting or laying down.

Treating the surface

Consolidation was required to ensure the adhesion of the tesserae to the ancient mortar beds of the 12 antique fragments, and also in the areas where the 19th-century conservation treatment had involved application of tesserae to the backing plaster. This was achieved by injecting an acrylic resin with a syringe, gradually increasing the concentration from 5% to 40% and varying the degree of penetration in specific areas.

The *tessellatum* was warped in three areas. These sectors were flattened by removing and repositioning some of the tesserae using a mixture of acrylic resin (Primal® E330S) and calcium carbonate (CaCO3), and in one case by also applying weights.

The aim of the cleaning process was to unify the entire decoration by elimination accumulations of soil that had resulted in yellowed and darkened areas, and by slightly thinning the wax on the tesserae surface, taking care not to alter the tinted wax filler, which it was decided should be preserved. Following testing, the chosen method was to clean using ethyl acetate and cotton swabs over the entire surface. This improved the legibility and achieved greater luminosity.

Also for the sake of legibility and continuity of the decoration, the cracks and a very few unsealed areas were filled using a tinted putty, which was then retouched with watercolour and pigments. Finally, some areas of mortar used to fill missing areas during the previous conservation treatment (firmly attached to the backing by means of numerous embedded upholstery tacks) were cleaned out and replaced with new lime-based tinted mortar.

Conclusion

The date of its discovery and the subsequent interventions make the Neptune and Amphitrite mosaic a very interesting case of conservation treatment. This was undoubtedly one of the first cases of the lifting of an entire large pavement and transfer onto a new support. This means that the 19th century operations, from lifting to restoration and mounting for purposes of museum exhibition, were conducted purely empirically, and that those concerned had no significant experience or competence in the techniques. The intervention carried out in 2016 went beyond mere conservation, engaging with the material history of the pavement in modern times and seeking to understand and reconstruct it as far as possible. Once the history of the mosaic had been essentially retraced, it seemed appropriate to maintain the 19th-century state of the central panel, since this could be done without jeopardising its preservation. This famous mosaic from the Louvre collection is also an instructive example of the history of conservation-restoration treatments carried out on mosaics.

Notes

1. Louvre Museum, Department of Greek, Etruscan and Roman Antiquities, May 1880
2. Archives nationales d'Outre-Mer, F[80] 1595.
3. *Le Magasin pittoresque* 1843, p. 149.
4. *Revue Archéologique*, 1845, II, vol. I, p. 313.
5. As shown on the wood engraving published in *the Illustrated London News*, 1852 October 30th reproduced in Aulanier 1961, fig. 56.
6. Carried out by Patrick Blanc and Marie-Laure Courboulès, of the Mosaic conservation and restoration atelier, Musée Départemental Arles Antique.
7. Carried out by Amélie Méthivier, sculpture conservator, and Julien Assoun, wall painting conservator.
8. By Elsa Lambert from the imaging group of the Department of Research.
9. A public procurement process resulted in the selection of the mosaic conservation and restoration workshop of the Musée Départemental Arles Antique. The conservation treatment was carried out by Marie-Laure Courboulès, Michel Marque and Marion Rapilliard. The subcontractors Amélie Méthivier, sculpture conservator, and Julien Assoun, wall painting conservator, provided the treatment for the support, and the company Réparation-Grue-Bras-Hydraulique SAS designed and fabricated the metal frame.
10. Designed and produced by Gregor Poutrel, of Réparation-Grue-Bras-Hydraulique SAS.

Technical notes

Paraloid® B72, thermoplastic acrylic resin with soft film-forming capabilities
Dow Chemical Company
https://www.dow.com
Primal® E330S, acrylic emulsion polymer
Dow Chemical Company
https://www.dow.com

References

Aulanier C. 1961. *Histoire du Palais et du musée du Louvre. Le musée Charles X et le département des Antiquités* égyptiennes, VIII. Paris: Éditions des Musées Nationaux.

Baratte F. 1978. *Catalogue des mosaïques romaines et paléochrétiennes du musée du Louvre*. Paris: Éditions de la Réunion des Musées Nationaux.

Delamare A. 1850. *Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842, 1843, 1844 et 1845*. Paris: Imprimerie Nationale.

Dondin-Payre M. 1994a. *La Commission d'exploration scientifique d'Algérie. Une héritière méconnue de la Commission d'Égypte*. Paris: Mémoires de l'Académie des Inscriptions et Belles-Lettres, XIV.

Dondin-Payre M. 1994b. *Le capitaine Delamare. La réussite de l'archéologie romaine au sein de la Commission d'exploration scientifique d'Algérie*. Paris: Mémoires de l'Académie des Inscriptions et Belles-Lettres, XV.

Héron de Villefosse A. 1921. *Musée africain du Louvre. Musées et collections archéologiques de l'Algérie et de la Tunisie.* Paris: Éditions Ernest Leroux.

Mison D. 2010. *La mosaïque de Neptune et Amphitrite de Constantine. De sa découverte à sa présentation dans les salles du musée du Louvre*, École du Louvre, study conducted as part of the Master's 1 program under the direction de C. Jouys-Barbelin (unpublished).

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SESSION V:
EDUCATION AND TRAINING

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MOSAIKON 2008-2018: OBJECTIVES, OUTCOMES, OPPORTUNITIES

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Abstract

Building on the expertise of its partner institutions (the Getty Conservation Institute, the Getty Foundation, the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), and the International Committee for the Conservation of Mosaics (ICCM)), the MOSAIKON initiative was launched in 2008 to improve the conservation and management of archaeological mosaics in the southern and eastern Mediterranean region, both those on site and those in museums and storage. Since then, MOSAIKON has trained over two hundred people and has reached thousands more through network building and dissemination. This paper will discuss the major achievements of the initiative and what can be done to ensure the sustainability of those outcomes over the long-term. It will also consider lessons learned that might be applied to similar endeavours in the future.

Keywords: capacity building, training, conservation, southeast Mediterranean, mosaics

Introduction

The Mediterranean region possesses an extraordinary archaeological heritage, including a vast number of mosaic pavements from classical antiquity. Some of these ancient mosaics remain on sites in their original locations (*in situ*), while many others have been lifted and placed in museums and storage.

The conservation of this rich mosaic heritage presents considerable challenges. Mosaics are at risk from both natural and human factors including exposure to the elements, intentional destruction and looting, and limited resources for conservation and maintenance. Mosaics that have been lifted can suffer from inappropriate, often damaging, previous conservation interventions, as well as poor storage conditions. As a result, significant mosaics continue to be lost.

To address this situation, the Getty Conservation Institute (GCI), the Getty Foundation, the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), and the International Committee for the Conservation of Mosaics (ICCM), joined forces in 2008 to create MOSAIKON, a strategic regional program aimed at improving the conservation and management of archaeological mosaics in the Mediterranean region, with a particular focus on the countries of the southern and eastern Mediterranean where needs are perhaps the greatest (see Dardes *et al.* 2010; Teutonico *et al.* 2014; Teutonico and Friedman 2017; and MOSAIKON web page for additional information about the MOSAIKON initiative). Ten years after its inception, as the MOSAI-

KON initiative nears completion, it is a moment to stop and reflect. What are the major achievements of the initiative and what can be done to ensure the sustainability of those outcomes over the long-term? What have been the successes, the challenges, and the lessons for the future?

Objectives and Outcomes

The objectives of the initiative were developed at its start in consultation with heritage professionals and decision-makers from each country in the region where MOSAIKON sought to have impact. Through a series of inter-related activities, MOSAIKON has aimed to:

- improve the knowledge and skills of those who care for mosaics;
- develop locally available and affordable conservation practices;
- strengthen the network of professionals concerned with the conservation and management of archaeological mosaics; and
- disseminate and promote the exchange of information.

Based on ongoing monitoring and evaluation activities, as well as continued consultation with the established advisory group, these objectives have been revisited at key points throughout the life of the project. Evaluation and monitoring tools, including a Logic Model and a Performance Measurement Framework, were developed to help define the desired outcomes of the initiative and to measure progress against defined indicators (Fig. 1). This has been

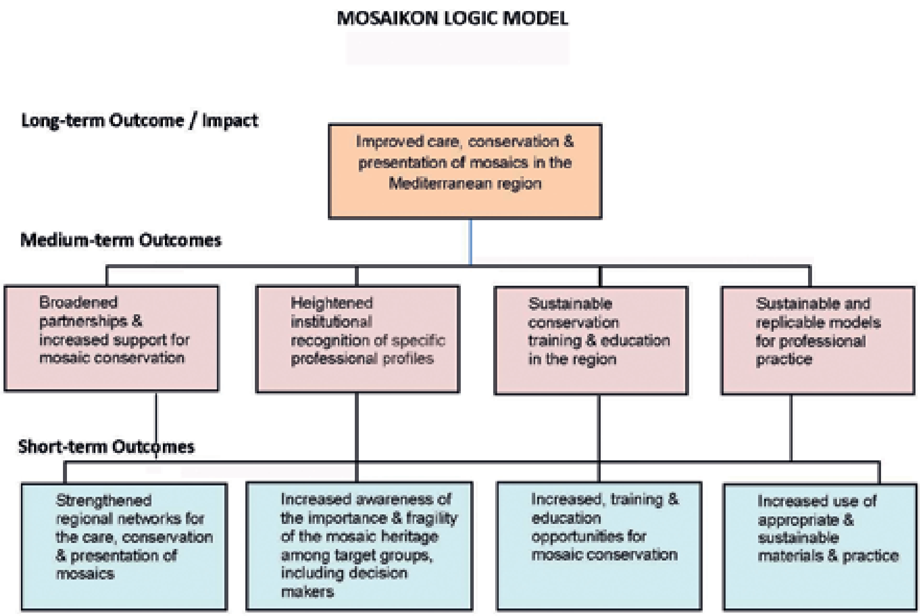

Fig. 1. The MOSAIKON Logic Model was developed at the outset of the initiative to clearly define the project objectives and to establish indicators of success (© J. Paul Getty Trust)

extremely useful, especially as changing conditions in the region have demanded modifications in our approach and in the delivery of various aspects of the program.

Building Capacity

The first objective of the initiative – to improve the knowledge and skills of those involved in the conservation of mosaics – was addressed primarily through training. In this, MOSAIKON has focused on two main groups: conservation technicians who work on both *in situ* and lifted mosaics, and archaeological site managers who are charged with the overall stewardship of archaeological sites with mosaics.

For conservation technicians, the GCI has taken the lead in delivering training for the conservation of *in situ* mosaics. The first regional course of this type was held from 2012-2014 at the site of El Jem, Tunisia, for twelve mosaic conservation technicians from countries in North Africa, including Algeria, Libya, Morocco and Tunisia. A second, national course will conclude at the end of 2018 for ten conservation technicians from Morocco, at the site of Volubilis. These courses are organised as a series of four modules that take place over a two-year period, between which trainees carry out supervised practical work in their home countries (Fig. 2). A number of trainees have now been identified for more advanced training in order to strengthen existing skills and build local teams in each country.

For technicians dealing primarily with lifted mosaics, a series of courses were delivered by the Centro di Conservazione Archeologica (CCA) in Italy through a major grant from the Getty Foundation. The courses trained twenty-eight participants from Syria, Jordan, Tunisia, and Libya, with fifteen participants completing more advanced training to enable them to become trainers themselves (Fig. 3) (see Nardi 2017).

Fig. 2. Two participants examining and documenting detachment during a training course for *in situ* mosaic conservation technicians at the site of Volubilis, Morocco, 2017 (Photograph by Livia Alberti, ©J. Paul Getty Trust)

Fig. 3. Participants in the MOSAIKON technician training course on the conservation of lifted mosaics, led by the Centro di Conservazione Archeologica (CCA), Belmonte, Italy, 2014 (Photograph by Araldo De Luca, ©J. Paul Getty Trust)

A similar course has been offered at the Museé départemental Arles antique in the south of France, made possible with support from the Getty Foundation, for

Fig. 4. Participants examining a mosaic during a technician training course on the conservation of lifted mosaics, held by the Museé départemental Arles antique, Arles, France, 2016 (Photograph by David Pinzon, © Museé départemental Arles antique (MDAA), Atelier de conservation et restauration)

Fig. 5. Group exercise and discussion about the condition of a mosaic at the site of Paphos, Cyprus, during the second Regional Training Course on the Conservation and Management of Archaeological Sites with Mosaics, 2014 (Photograph by Scott Warren, ©J. Paul Getty Trust)

twelve participants from Algeria, Lebanon, and Egypt (Fig. 4). Advanced training for this group has already taken place in Lebanon, and a final module of advanced training will take place in Algeria in 2018.

At the end of these courses, approximately sixty conservation technicians (some who participated in multiple courses) will have received training in the conservation of both *in situ* and lifted mosaics. These individuals will possess the knowledge and skills needed to care for mosaics, including how to:

- identify different mosaic typologies;
- understand past interventions and current state of condition;
- implement best practices for conserving mosaics on a day-to-day basis using appropriate preventive or intervention treatments; and
- produce accurate written and graphic documentation.

For archaeological site managers – the second principal group targeted by MOSAIKON – the GCI worked with various partners to deliver three regional courses in different locations and languages. The first in this series took place at Tyre, Lebanon, in 2010 and was attended by fifteen site managers from Algeria, Egypt, Lebanon, Morocco, Syria and Tunisia. A second course was held at the site of Paphos in Cyprus in 2014 for twenty site managers from eleven countries, including representatives from the Balkans (Fig. 5) [1]. A third course for nineteen French-speakers began in spring 2017 at the site of Volubilis, Morocco [2]. Following a similar format, each course is approximately one year in length and consists of three distinct phases: first, an intensive three-week workshop located at an archaeological site in the region during which a range of topics from documentation, material deterioration, condition assessment, and site presentation are taught; second, a long-distance mentoring phase during which participants implement projects at their home sites, while guided remotely by course instructors; and third, a follow-up workshop at another site to review key concepts, discuss the mentoring projects, and compare other management approaches (see Dardes *et al.* 2017; Friedman 2011; Friedman *et al.* 2014; Friedman *et al.* 2017 for additional information about MOSAIKON training courses for archaeological site managers).

Ultimately, a regional network of almost sixty young professionals has been created. Each site manager should be competent to:

- understand fundamentals of conservation history and theory;
- develop systems for managing archives and documentation;
- assess conditions and understand deterioration phenomena;
- understand a range of preventive measures and intervention treatments; and
- create and implement prioritised, holistic site conservation and management plans.

Similar to the courses for site managers, MOSAIKON also delivered a regional course for museum professionals responsible for mosaic collections. Led by ICCROM —with funding from the Getty Foundation— this course was held in Amman, Jordan. Nineteen participants from nine countries were taught topics ranging from preventive conservation and collections care to presentation and international legal frameworks.

In addition to these longer training programs, MOSAIKON carried out a few shorter training workshops. In Libya, nearly sixty people participated in two short workshops on conservation and site management, led by King's College London with support from the Getty Foundation. And in 2013, again with Getty Foundation funding, MOSAIKON partnered with the Herculaneum Conservation Project and the British School at Rome to host an international symposium on protective shelters for archaeological sites at Herculaneum in Italy. Over the course of five days, practitioners from across the region discussed how to decide when sheltering is the right solution, what factors to consider in shelter design, and how best to maintain and evaluate shelters once in place.

There will be a publication from the symposium and, longer term, the GCI is working with partners at the Israel Antiquities Authority and Historic England to develop practical guidelines for the design, construction, and maintenance of protective shelters for archaeological sites in various contexts.

To date, over 200 people from almost twenty countries have been trained through the collaborative efforts of the MOSAIKON initiative. One of the most significant accomplishments of this effort is the creation of a regional network of young professionals who can now rely on each other for advice and support, as well as a complete set of didactic materials (in English, Arabic, and French) that other educators can access and use.

Sustainable Conservation Practices

In order to ensure that these training efforts are sustainable, it is essential to develop locally available and affordable methods for both *in situ* and museum conservation. To this end, MOSAIKON initiated two parallel activities, one focused on *in situ* mosaics and the other on lifted mosaics in museums and storage.

The first was a model conservation project at the site of Bulla Regia in Tunisia, led by the GCI in partnership with Tu-

Fig. 6. The archaeological site of Bulla Regia in northwest Tunisia, showing an overview of the Maison de la Chasse and the Maison de la Nouvelle Chasse, two of the most significant buildings at the site containing many mosaics, 2011 (Photograph Scott Warren, ©J. Paul Getty Trust)

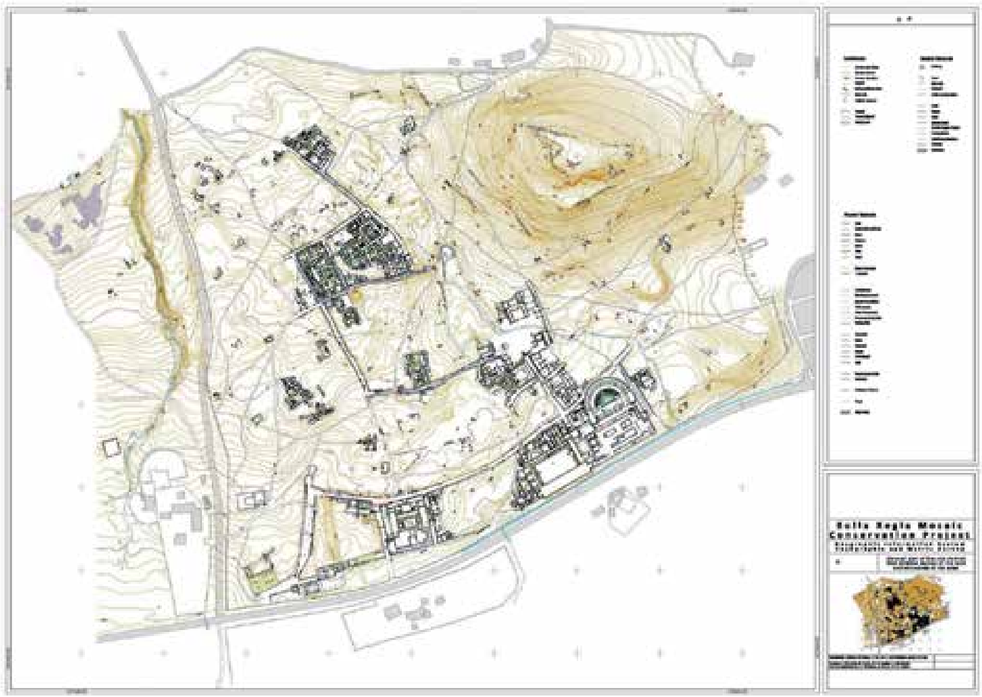

Fig. 7. Topographic and site map of Bulla Regia (taken from the site's GIS) showing archaeological features such as ancient roads and aqueducts, and in particular the locations of the approximately 400 excavated mosaics (Survey and drawing by Akhet s.l.r., ©J. Paul Getty Trust)

nisia's Institut National du Patrimoine. This project included the development of a geo-spatially based conservation plan for the over four hundred excavated mosaics at the site, as well as the complete conservation and presentation of one of the site's most important Roman villas (Figs. 6-7). The demonstrated approaches will serve as models of best practice at Bulla Regia and at other sites in the region with large collections of *in situ* mosaics (see Roby *et al.* 2012, 2017a, 2017b; Roby and Friedman 2013; and the paper by Roby *et al.* in this volume for a more complete description of the Bulla Regia project).

For lifted mosaics in museums and storage, the greatest challenge to sustainability is the lack of effective approaches to backing lifted mosaics that utilise locally available and inexpensive materials as an alternative to methods employing costly materials like honeycomb aluminium panels. To address this, the GCI developed a research project to examine more cost-effective methods and materials for backing lifted mosaics. It is hoped that some of the more promising methods to emerge from the research will be tested in the field (see Bicer-Simsir and Taciroglu 2017 for additional information about the alternative backing research project).

Strengthening the Professional Network

A third key objective has been to strengthen the network of professionals in the region so that a support system remains in place for those trained through MOSAIKON. As one of MOSAIKON's first actions, the Getty Foundation provided a grant to the ICCM to improve its governance and to enhance the organisation's website as an information hub

Fig. 8. Group photo during the 2014 ICCM conference in Sardinia (©ICCM)

with more publications available online. The Foundation also supported delegates from under-represented countries to attend ICCM's triennial conferences, and sponsored alumni of MOSAIKON training programs to participate in specialised grant-writing workshops where they could share experiences and learn new skills. All of this has created a more secure, robust, and representative organisation that can better support the interests and needs of the conservation community (Fig. 8).

Significantly, the Getty Foundation also provided support to bring together decision-makers and senior heritage professionals from each of the MOSAIKON partner countries at various times throughout the life of the project. The first meeting was held in 2008 at the start of the initiative to assess the region's needs and priorities. The second and third meetings, held as the project progressed, enabled MOSAIKON to adapt to new challenges and re-assess priorities. A last meeting is planned for the end of the project during which outcomes will be assessed, and discussions will focus on ways that each partner country can sustain the achievements made to date and move the work forward.

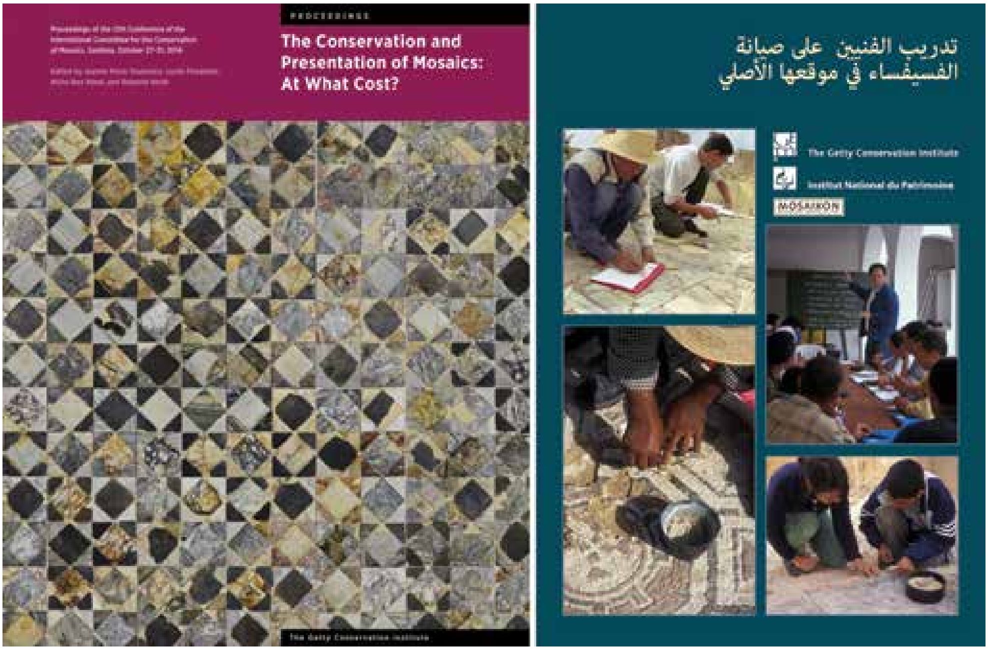

Fig. 9. The image on the left shows the proceedings of the 12th ICCM conference in Sardinia, 2014; the image on the right is the Arabic version of the GCI's didactic manual, *Technician Training for the Maintenance of In Situ Mosaics* (©J. Paul Getty Trust)

Dissemination and Information Exchange

Dissemination and information exchange are crucial to a large-scale project such as MOSAIKON. Since 2011, we have produced an e-bulletin in both English and Arabic that is sent to over one thousand heritage professionals in the region. Nearly all of the ICCM conference proceedings are now available for free on MOSAIKON partner websites, as are didactic materials from various courses (Fig. 9). With funding from the Getty Foundation, ICCROM is also leading a project to translate key texts on mosaic conservation into Arabic. The result will be an important body of conservation literature available for free online, thus creating a critical resource for the Arabic-speaking world.

Next Steps

To date, MOSAIKON has created a critical mass of trained individuals; replicable models of best practice; publications and didactic materials in English, French, Italian and Arabic; and strong communication networks for practitioners. As the initiative enters its final phase, the focus now is on transitional activities that will reinforce and sustain these achievements.

In the area of capacity building, a number of follow-up activities are planned, including leadership training for select individuals that will target future decision-makers. Also under consideration are the creation of several conservation workshops for lifted mosaics in the region, and various field schools, which could provide advanced training in the area of *in situ* mosaic conservation and site management. Finally, we are working on a system to provide needs-based technical advice in the region.

As regards strengthening professional networks, the Getty Foundation will fund the final regional advisory meeting and will also offer travel support for delegates to attend the next ICCM triennial conference in 2020. For its part, the GCI is providing the new ICCM board with additional training regarding governance and fund raising.

In the area of dissemination, ICCM conference proceedings will continue to be made available online. We are also considering the creation of a series of guidance notes in multiple languages that will provide technical advice on a range of topics regarding the conservation of *in situ* and lifted mosaics.

Finally, with an initiative of the size and complexity of MOSAIKON, it is important to carry out a formal evaluation at the conclusion of the project. Much has changed since the project was launched in 2008, including very large shifts in the social and political landscape. In response, MOSAIKON adapted and developed new strategies to meet changing circumstances. The evaluation will have two main objectives: first, to guide our transition activities to ensure maximum sustainability of achievements to date; and second, to better understand lessons learned that might be applied to similar activities in the future.

The summative evaluation will build on past monitoring and evaluation activities that have already informed our work. These include surveys of course participants that influenced the content and format of our training courses; questionnaires answered by senior government officials in each partner country that have provided data about needs and priorities; and a robust contact database that helps us keep abreast of the MOSAIKON participants.

Lessons Learned

As we near the project's completion, certain lessons have already emerged. Flexibility and adaptability to very large shifts in the social and political landscape have been critical to the overall success of the MOSAIKON initiative. In terms of capacity building, it is evident that effective training requires significant investments of time and resources. Building professional networks and communities of practice help to ensure sustainability, and it is crucial to engage in-country leaders throughout the life of the project. The partner countries must now take an active role to ensure the long-term impact of progress made to date. Specifically, they must recognise specialised conservation skills and establish requisite job profiles, guarantee that adequate funds are annually budgeted for conservation and maintenance, and promote capacity building from within.

MOSAIKON was born from an ambitious and aspirational goal: simply stated, to significantly improve the conservation, presentation, and maintenance of archaeological mosaics in the Mediterranean region. Despite the extremely challenging political, social, and economic times we live in, MOSAIKON has continued to operate in the region and has made considerable progress towards achieving this goal. In the end, its success will be measured in great part by the professional relationships that the initiative has been able to create and maintain. In the long-term, we hope that these efforts will reap substantial benefits —not just for mosaics but for the preservation of the Mediterranean archaeological heritage in general.

Acknowledgements

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Notes

1. Countries represented included: Albania, Bulgaria, Cyprus, Egypt, Greece, Israel, Jordan, Lebanon, Libya, Palestine, and Tunisia.
2. Countries represented include Algeria, Cyprus, Lebanon, Mali, Morocco, and Tunisia.

References

Bicer-Simsir B., Taciroglu E. 2017. “Alternative Backing Methods for Lifted Mosaics: A Project of the MOSAIKON Initiative”. In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et la préservation des mosaïques: Á quel coût? Actes de la 12e Conference de l’ICCM, Sardinie, 27-31 octobre 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 259-269. Los Angeles CA: Getty Conservation Institute.

Dardes K., Teutonico J. M., Antomarchi C., and Aslan Z. 2010. “Building capacity for the conservation of mosaics in the Mediterranean: The MOSAIKON Initiative”. In *Conservation and the Eastern Mediterranean: Contributions to the Istanbul Congress, 20-24 September 2010*, edited by Christina Rozeik, Ashok Roy and David Saunders, S30-34. Studies in Conservation 55 (Suppl. 2). London: International Institute for Conservation of Historic and Artistic Works.

Dardes K., Friedman L., Roby T., and Aslan Z. 2017. “Training of archaeological site managers: MOSAIKON’s approach to the conservation and management of mosaics at archaeological sites in the Mediterranean region”. In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 603-608. Firenze: Edifir edizioni.

Friedman, L. 2011. “Paving the Way: Mosaic Conservation Training in the Mediterranean Region.” *The Iris: The Online Magazine of the Getty* (November 21, 2011). http://blogs.getty.edu/iris/paving-the-way-mosaic-conservation-training-in-the-mediterranean-region/.

Friedman L., Dardes K., Roby T., Teutonico J. M. 2014. “The MOSAIKON Initiative: Building capacity at a regional level in the conservation of archaeological mosaics”. In *ICOM-CC 17th Triennial Conference Preprints, Melbourne, 15–19 September 2014*, edited by Janet Bridgland, art. 1105. Paris: International Council of Museums.

Friedman L., Teutonico J. M., Roby T., Demas M., and Michaelides D. 2017. “Conservation and management of archaeological sites with mosaics: A training program of the MOSAIKON Initiative”. In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et la préservation des mosaïques: Á quel coût? Actes de la 12e Conference de l’ICCM, Sardinie, 27-*

31 octobre 2014, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 237-245. Los Angeles CA: Getty Conservation Institute.

MOSAIKON website: http://www.getty.edu/conservation/our_projects/education/mosaikon/

Nardi R. 2017. "Mosaic Conservation Course (MCC) 2011-2016, a Program of the MOSAIKON Initiative: Mid-Program Review". In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et la préservation des mosaïques: Á quel coût? Actes de la 12e Conference de l'ICCM, Sardinie, 27-31 octobre 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 250-256. Los Angeles CA: Getty Conservation Institute.

Roby T., Friedman L., Alberti L., Caldi C., Carbonara E., and Chaouali M. 2012. "Mosaic conservation planning and implementation at the site of Bulla Regia, Tunisia". In *The Decorative: Conservation and the Applied Arts, Contributions to the IIC Vienna Congress, 10-14 September 2012,* edited by Sharon Cather, Austin Nevin, Joyce H. Townsend, Marika Spring, Jo Kirby Atkinson and Dinah Eastop. S374-75. Studies in Conservation 57 (Supp.1). London: International Institute for Conservation.

Roby T., Friedman L. 2013. "Getty Voices: Inside the Bulla Regia Model Field Project." *The Iris: The Online Magazine of the Getty* (November 19, 2013).

http://blogs.getty.edu/iris/inside-the-bulla-regia-model-field-project-getty-voices/

http://www.youtube.com/user/gettyconservation?feature=watch

Roby T., Friedman L., Rhouma-Ghmari H., Chaouali M., Alberti L., Carbonara E., Caldi C., D'Andrea A., and Sepio D. 2017a. "Conservation planning for excavated mosaics at the site of Bulla Regia, Tunisia: A component of the MOSAIKON Initiative". In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et la préservation des mosaïques: Á quel coût? Actes de la 12e Conference de l'ICCM, Sardinie, 27-31 octobre 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 151-161. Los Angeles CA: Getty Conservation Institute.

Roby T., Alberti L., Caldi C., Carbonara E., Chaouali M., Friedman L., and Rhouma-Ghmari H. 2017b. "Mosaic conservation planning and implementation at the site of Bulla Regia, Tunisia". In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 327-331. Firenze: Edifir edizioni.

Teutonico J. M., Bouchenaki M., and Michaelides D. 2014. "MOSAIKON: A regional programme for the conservation of mosaics in the Mediterranean (2008-2012)". In *Conservation: An Act of Discovery*: *the 10th Conference of the International Committee for the Conservation of Mosaics, Palermo October 20-26, 2008*, edited by Demetrios Michaelides, 424-435. Palermo: Regione Siciliana.

Teutonico J. M., Friedman L, on behalf of the MOSAIKON partners. 2017. "The MOSAIKON Initiative for the conservation of mosaics in the Mediterranean region: An update on activities". In *Managing Archaeological Sites with Mosaics: From Real Problems to Practical Solutions: The 11th Conference of the International Committee for the Conservation of Mosaics, Meknes, October 24-27, 2011*, edited by Demetrios Michaelides and Anne-Marie Guimier-Sorbets, 365-374. Firenze: Edifir edizioni.

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THE CONSERVATION PLAN FOR MOSAICS AT BULLA REGIA: A COMPONENT OF THE MOSAIKON MODEL FIELD PROJECT

Thomas Roby, Leslie Friedman, Moheddine Chaouali,
Hamida Rhouma-Ghmari, Livia Alberti, Ermanno Carbonara

Abstract

This paper presents the results of conservation planning for a Roman and Byzantine site in Tunisia with almost 400 excavated mosaics. The program of mosaic conservation activities is based on the number of trained conservation technicians currently working at the site, and is divided into three phases over 20 years. The first phase involves temporary protection of high priority mosaics over ten months; the second involves stabilisation of all mosaics and other pavements, as well as surrounding walls and wall plasters over 17 years; and the third phase involves maintenance of mosaics over a year, and walls over two years.

Keywords: conservation planning, archaeological sites, mosaic stabilisation, mosaic protection, reburial

Introduction

The MOSAIKON Model Field Project at Bulla Regia, an important Roman and Byzantine period city in north-western Tunisia, has sought to demonstrate best practices in the conservation and presentation of mosaics on sites by developing a conservation plan for all of the almost 400 excavated mosaics of the site, and by carrying out conservation interventions for one entire building with mosaics. This paper presents the Bulla Regia Conservation Plan for the site, which follows on the publication of the methodology of information gathering and assessment used to produce the plan (Roby *et al.* 2017). The plan is divided into three phases over 20 years. The length of time was determined primarily by the number of Getty Conservation Institute-trained mosaic conservation technicians at the site (four), and takes into account the continual presence of a team of four masons and workers.

The planning was carried out by a team of conservators who are also specialists in mosaic conservation. A Rapid Survey Form was developed by the team to collect data about each of the many excavated mosaics at the site. The information collected in 2012-2013 included an assessment of condition, significance, and degree of exposure or risk, which leads to a weighted calculation producing a priority ranking for conservation treatment, as well as an estimate of the amount of technician work time needed to stabilise each mosaic. The survey data has been transferred to the site GIS developed by the project, which enabled the production of different thematic site maps, including the location of overall priority mosaics.

A Building Planning Form was also developed to collect data from each of the site's 57 ancient buildings related to rooms with other types of pavements, and other architectural remains such as walls and columns and other carved stones. This information

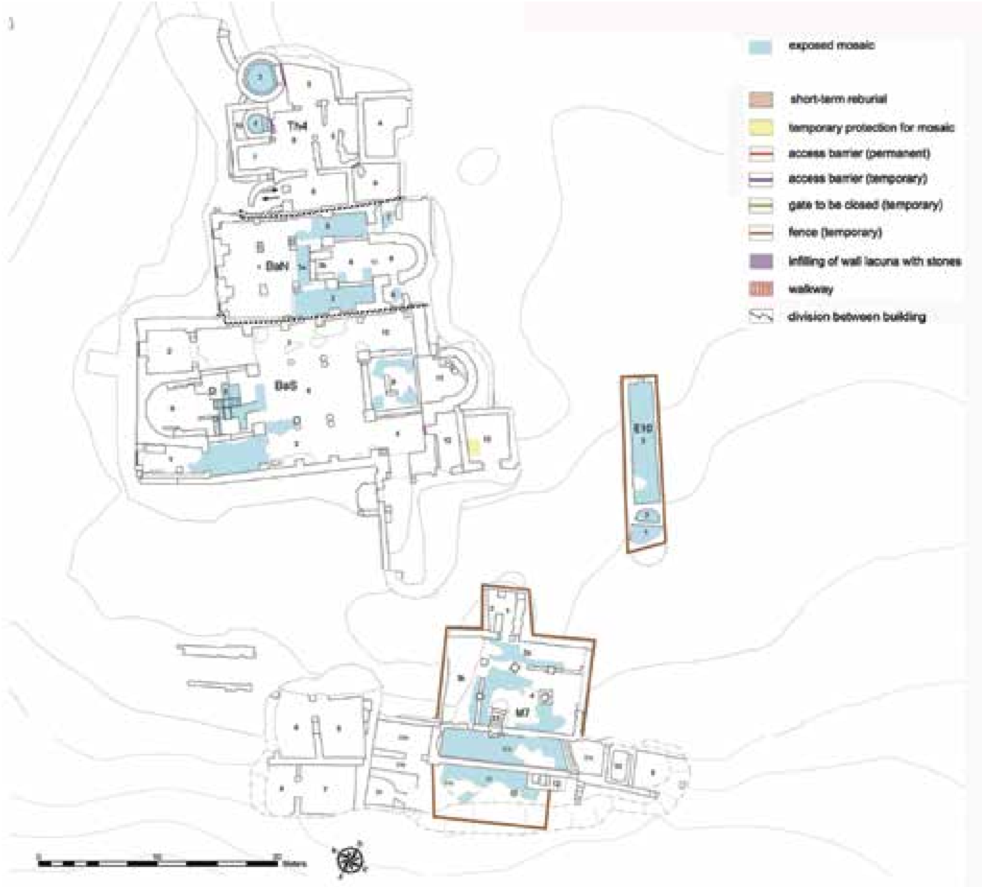

Fig. 1. Map of Temporary Protection Measures, Phase 1 (map by E. Carbonara)

allowed an estimate of the amount of work time and materials required to stabilise and protect the entire building, calculations made according to whether or not the building will be presented to visitors in the future. Approximately half of the ancient buildings were decided to be presented. This decision-making involved an assessment of overall building significance, condition, typology, and its location within the site and in proximity to proposed visitation routes. All the information about the buildings and their mosaics compiled on both these forms has been collected in a geodatabase of the GIS developed for the site by consultant Akhet S.r.l.

Conservation Planning Principles

The conservation planning was carried out following three principles: 1) visitation of the site without walking on mosaic surfaces, 2) protection of mosaics by shelters and reburial, as well as 3) regular maintenance of those left unprotected in the open air. These principles constitute a

PHASE 1 - TEMPORARY PROTECTION - CONSERVATION PROGRAM

MOSAIKON - BULLA REGIA MOSAIC CONSERVATION PROJECT

Area	Buildings with mosaics by area	T = Technicians W = Workers		Work days by area: Material Transport and Worksite Organization	Local Temp. Protect. and Short-Term Reburials	Maintenance Cycles	Wall Plaster Stabilizat. + First Aid Interventions	Temporary Access Barriers	Temporary Fences
A	MA, MA-S, M15, ThV, ThS	T	1	0	0	12			
		W	2					7,3	15,2
B	MNC, MNC-S, MC, MC-S, MPa, MPa-S	T	1	2,0	20 MC	0			
		W	1					2,8	7,7
C	MP, MP-S, M8, M9, M10, M14, E12	T	1	1,9		17			
		W	2					18,5	0,0
D	Ba4, Ba5, Th4, M7, E10, M2, M2-S, M7, M7-S	T	1	1,7	4 Ba5	16			
		W	2					5,0	18,1
E	M1, M1-S, E11, M3, M3-S, E9	T	1	3,3	2 M1	0			
		W	1					1,0	1,5
F	ThM, E6, E7, E8, E16, T1	T	1	7,3		9			
		W	1					11,3	6,8
G	E01, TAp, B1, E13, E14, E15	T	1	13,1		0			
		W	1					0,8	6,1
H	M04, M05, E02, Mar, E03, Th1	T	1	2,0	4 M4	8			
		W	1					16,0	0,0
I	Th, Th2	T	1	0		14			
		W	1					11,0	4,1
J	E04, Th3, EM2, E05, Ny1	T	1	1,1		14			
		W	1					13,7	0,0
	TOTALS			23	30	30	90	87	60

PHASE 1 - 10 MONTHS: 1 2 3 4 5 6 7 8 9 10

(16,5 days per month, 200 days per year)

TECHNICIAN SCHEDULE (Team of 4 technicians)
- Local temporary protection and short-term reburial
- Maintenance cycle
- Wall plasters stabilization + First Aid interventions

WORKER SCHEDULE (Team of 4 workers)
- Material transportation and work site organization
- Temporary access barrier preparation and installation
- Temporary fence preparation and installation

Table 1. Program of Temporary Protection Measures, Phase 1 (table by L. Alberti)

significant change from current practice, where there are no shelters on the site, and visitors (and animals) are allowed to walk throughout the site, except in a few underground locations where gates are locked to prevent access. Through a variety of proposed protection measures – access barriers, reburials and occasionally walkways, visitors will view mosaics without walking on them. Information panels at the entrance to the site are proposed which will explain this policy to visitors.

Despite the lack of local precedents, the Plan proposes 38 new shelters over selected mosaics where reburial is not advisable. Such mosaics include those located in basins, those on reinforced concrete panels, and those with structural problems. The proposed shelters are intended to provide a protective function only, without an interpretive or reconstructive function, in order to limit their visual impact on the site and their cost.

There are a number of mosaic reburials already at Bulla Regia and at other sites in Tunisia, and many more are proposed in the Plan, as it is the most effective and least costly measure of protecting mosaics from the environment and from visitors walking on them. 186 additional reburials are proposed following stabilisation of the mosaics. This will allow the current technician workforce to more quickly complete the mosaic stabilisation work, since experience has shown that pre-reburial stabilisation takes approximately 30% less time than stabilisation of a mo-

Fig. 2. Map of Stabilisation Interventions, Phase 2 (map by E. Carbonara)

saic to be left exposed and maintained. Subsequent maintenance time is also reduced because less time is needed to maintain a reburial. Less than half of the square metres of mosaics on site will be left unprotected from the environment by either shelters or reburials, and their preservation will rely on maintenance by the mosaic conservation technicians of the site.

Phase 1 - Temporary Protection

The first phase of the Bulla Regia Conservation Plan aims to temporarily protect all mosaics from visitors (and animals) walking on them, by installing temporary access barriers and mosaic coverings, by erecting fencing around an entire excavated building or part of a building, and by carrying out short-term reburials (Fig. 1). These temporary protection interventions are estimated to require ten months to implement, given the presence of the 4 technicians, plus 4 workers to install fencing for buildings, and access barriers for rooms (Table 1). A cost estimate of labour and materials for the technician and worker activities and localised temporary protection measures of Phase 1 was calculated, based on previous project experience on site. All labour, both staff salaries and external daily wages, would cost about 34,000 Tunisian dinar (TD), and materials would cost nearly 11,000 TD, for a total of almost 45,000 TD or approximately 15,000 euros for the first phase.

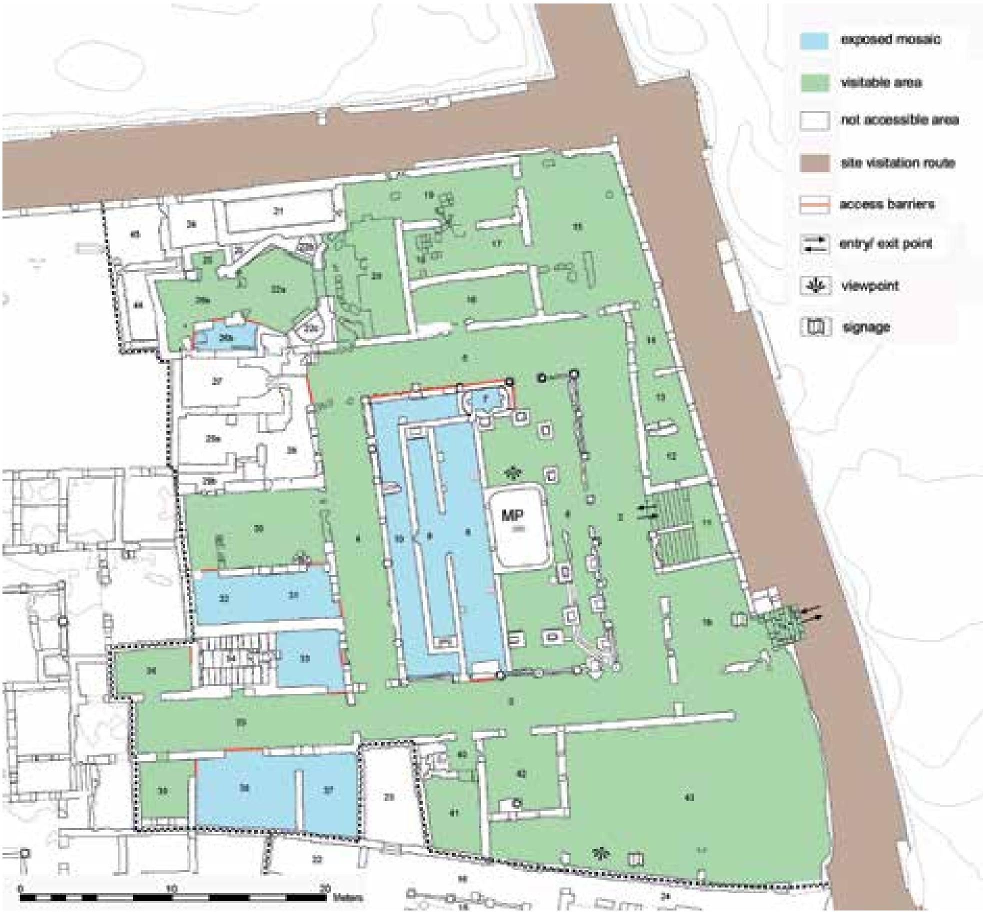

Fig. 3. Map of Visitation Access, Phase 2 (map by E. Carbonara)

Phase 2 - Stabilisation

In the second, multi-year phase of the Plan, all mosaics and other pavements, as well as walls and other building remains across the site will be stabilised (Fig. 2). Those buildings to be presented to visitors will be done in a controlled manner, protecting mosaics long-term by a combination of access barriers and reburial, and occasionally by walkways (Fig. 3). Calculations of work time for stabilisation followed by maintenance have been summarised in a planning data table which led to the production of a timeline of the conservation program (Table 2). During this phase, every 6 years, a condition survey of each mosaic will be made again, using the Rapid Survey Form over a 3-4 month period, and the Conservation Plan modified as needed to program any new first-aid or emergency treatment work.

The entire estimated time required to achieve stable conditions is 17 years for all mosaics and other architectural remains; during which initial stabilisation treatments are carried out, and then each mo-

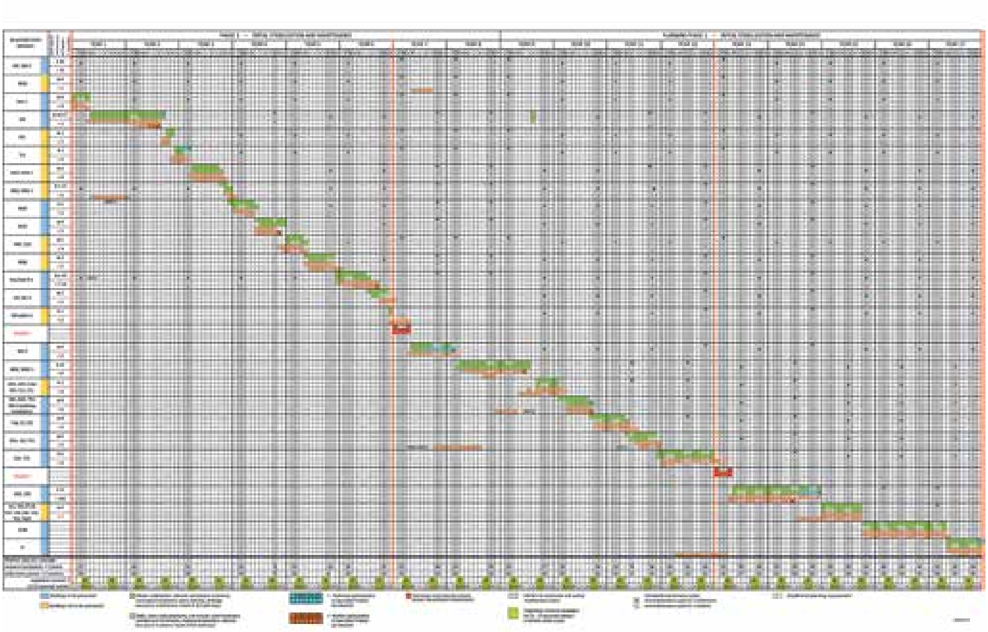

Table 2. Program of Conservation Interventions, Phase 2 (table by L. Alberti)

saic is maintained once a year, until only maintenance is required. The considerable length of time, as mentioned above in the introduction, is based on the number of conservation technicians currently working at the site on conserving mosaics and other pavements and wall plasters. It also is based on the presence of two masons and two workers to stabilise walls and rooms without mosaics, and to assist the technicians with large mortar infillings of pavements, treatment of *cocciopesto* pavements, as well as mosaic drainage and reburial interventions. Vegetation control at the site has been planned based on two campaigns per year, in March-April and September-October, requiring a group of 12-15 seasonal workers.

PHASE 2 - STABILIZATION - CONSERVATION PROGRAM - Specialist Projects

		PROTECTION MEASURES			CONSERVATION	STRUCTURAL WORK and HYDROLOGY				SITE PRESENTATION				
	BUILDINGS TO BE PRESENTED	Access barrier	Walkway	Shelter design and construction	Conservation treatment	Structural assessment / masonry stabilization	Structural assessment / mosaic depression stabilization	Structural assessment / in situ column stabilization	Hydrological assessment/ intervention	Info panel	Pavement treatment	Column or other architectura element repositioning	Lapidarium organizat.	Archaeological investigation
1	B1 - Basilique du forum	x							Flooding problems related to the natural stream	x				
2	BaN - Basilique Chrétienne du Nord	x		Room 02 Room 03 Room 04 Room 05				Room 03a		x		x	x	
3	Ba3 - Basilique Chrétienne du Sud	x		Room 03 (sept. fort)				x		x		x		

Fig. 4. Specialist Conservation Projects, Phase 2 (by L. Alberti)

PHASE 2 - STABILIZATION - COST ESTIMATE - Phase 2 Totals

BUILDINGS WITH MOSAICS		MOSAIC STABILIZATION			WALL STABILIZATION			MOSAIC MAINTENANCE			WALL MAINTENANCE			VEGETATION CONTROL			PRIORITY INTERV.				
		Cost LABOR mosaic stabil. by area	Cost MATER. mosaic stabil. by area	TOTAL cost Phase2 LABOR and MATER. by area	Cost LABOR wall stabil. by area	Cost MATER. wall stabil. by area	TOTAL cost Phase2 LABOR and MATER. by area	Cost LABOR Phase2 by area	Cost MATER. Phase2 by area	TOTAL cost Phase2 LABOR and MATER. by area	Cost LABOR Phase2 by area	Cost MATER. Phase2 by area	TOTAL cost Phase2 LABOR and MATER. by area	Cost LABOR Phase2 by area	Cost EQUIPMENT Phase 2	TOTAL cost Phase2 LABOR and EQUIPMENT	Work time during Phase 2	1 month/2 techn. TD 1800 TOTAL cost Phase2 LABOR	TOTAL LABOR PHASE 2	TOTAL MATERIALS PHASE 2	PHASE 2 TOTAL
		sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	sqr TD	months	sqr TD	TD	TD	TD
MC MC-S	Maison de la Chasse - gr. level Maison de la Chasse - undergr.l.	0	0	0	0	0	0	20880	10679	31079	9950	5191	14581	11077,2							
MO4	Maison 4	0	0	0	7500	350	7.850	4080	989	5069	1700	741	2441	5650,4							
MA-S	Maison d'Amphitrite - undergr.l.	10800	1680	12.480	7500	682	8.182	3840	2880	6720	3200	1363	4563	734,4							
MP	Maison de la Pêche - ground level	43200	5402	48.602	34500	1110	35.610	7566	5117	12683	3900	1803	5703	12117,6							
E01	Edifice sud-ouest Temple Apollon	7200	1318	8.518	6000	86	6.086	840	214	1054	3400	151	3551	1621,8							
Th2	Thermes à l'est du Théâtre	10800	1365	12.165	10500	424	10.924	1680	683	2363	2100	742	2842	4590							
MO3 MO3-S	Maison 3 - ground level Maison 3 - underground level	23400	5660	29.060	24000	658	24.658	3120	889	4009	2600	1070	3670	10465,2							
MO1 MO1-S	Maison 1- ground level Maison 1 - underground level	7200	1653	8.853	19500	1191	20.691	1152	358	1510	4200	2085	6285	8996,4							
MO9	Maison 9	18000	2727	20.727	10500	281	10.781	2940	821	3761	1300	456	1756	2509,2							
M10	Maison 10	21600	2995	24.595	15000	373	15.373	2880	1284	4164	1800	559	2359	3671							
MO7 E19	Maison 7 - ground and undergr.lev. Edifice au nord de la Maison 7	12600	3154	15.754	15000	498	15.498	1440	414	1854	1800	748	2548	3794,4							
MO8	Maison 8	19800	3755	23.555	21000	993	21.993	2160	544	2704	3000	1899	4899	4406,4							
BaS BaN Th4	Basilique Chrétienne du Sud Basilique Chrétienne du Nord Thermes nord-ouest Basiliques	23400	2455	25.855	24000	650	24.650	3600	2054	5654	3944	1221	5165	3794,4							
MT MT-S	Maison du Trésor - ground level Maison du Trésor - undergr. level	12600	1386	13.986	6000	266	6.266	1080	1042	2122	900	299	1199	2937,6							
MPa MPa-S	Maison du Paon - ground level Maison du Paon - undergr.level	3600	462	4.062	7500	234	7.734	540	32	572	900	263	1163	2815,2							
MP-S	Maison de la Pêche - undergr.l.	30600	1065	31.665	12000	995	12.995	2160	1112	3272	2250	1120	3370	2570,4							
MNC MNC-S	Maison Nouvelle Chasse - gr. lev. Maison Nouvelle Chasse - undergr.l.	52200	5265	57.465	21000	860	21.860	6000	3358	9458	1750	751	2501	3794,4							
MO2 MO5 M14 E09 E11 E12	Maison 2 - ground level Maison 5 Maison 14 Edifice au sud de la Maison 3 Edifice carrefour entre M3 et M7 Edifice coin sud ins. de la Pêche	14400	1626	16.026	22500	729	23.229	1260	209	1469	1400	608	2008	11815,6							
MA M15 ThV	Maison d'Amphitrite - gr. level Maison 15 Thermes des Venantii	23400	2860	26.260	25500	907	26.407	1440	686	2126	2400	680	3080	11567							
TAp B1 E02	Temple d'Apollon Basilique du Forum Edifice dans le coin sud du Forum	21600	1311	22.911	21000	990	21.990	1440	578	2018	1500	743	2243	11995							
Mar E03 Th1	Marché Edifice au nord-est du Marché Thermes nord-ouest du Théâtre	18000	1981	19.981	30000	969	30.969	1200	558	1758	5250	606	5856	20180							
E04 Th3	Edifice nord de la II Esplanade Thermes nord-ouest II Esplanade	36000	2692	38.692	15000	467	15.467	1920	937	2857	600	294	894	4896							
EM2 E05	Deuxième Esplan. Monumentale Edifice ouest de la II Esplanade	54000	6706	60.706	39000	2117	41.117	1800	890	2690	3000	534	3534	35435							
Ny1 E06 E07 E08 E13 E14 E15 E16 T2 ThS	Nymphée 1 Edifice est des Th. Iulia Memmia Edifice nord Monum. Opus Retic. Edifice ouest Monum. Opus Retic. Edifice au nord de la source Edifice nord-est Temple d'Apollon Edifice au sud de la colline Edifice à l'ouest du Temple 1 Temple ouest Th. Iulia Memmia Thermes du nord-est	29200	5480	34.680	30000	1365	31.365	240	204	444	400	341	741	11648							
ThIM	Thermes de Iulia Memmia	46800	7412	51.912	43500	6026	49.526	0	0	0	0	0	0	29441							
Th	Théâtre	21600	2428	24.028	34500	5082	39.582	0	0	0	0	0	0	20808	9520	251.229	12	21600			
	TOTALS	576000	70588	646588	562500	28223	590723	74478	36231	110709	54044	23782	78426	241709	9520	251229	12	21600	1.470.931	168.345	1.639.276

PHASE 2 TOTAL	1.639.276

Table 3. Cost of Labour and Materials, Phase 2 (table by L. Alberti)

Phase 2 also includes conservation interventions and protection measures which cannot be carried out by current site personnel because they require different professional training and profiles, such as architects, engineers and conservators. Specialist projects site-wide have been included in the conservation plan following four main categories of intervention: protection measures, such as shelters; conservation, such as wall painting and carved stone treatments; structural and hydrological interventions; and site presentation, such as design and installation of information panels (Fig. 4).

As with Phase 1, work time estimates for technician activities, and cost estimates of labour and materials for initial stabilisation work and maintenance, per building, have been calculated. The cost of Phase 2 labour, mainly staff salaries, is estimated at 1.5 million TD, and materials at 168,000 TD, for a total of about 1.6 million TD or 560,000 euros, which comes to about 33,000 euros (96,000 TD) per year (Table 3).

Phase 3 - Maintenance

This final phase of the Conservation Plan begins when all of the mosaics and structures have been stabilised, which is estimated to take place in the 18th year. In this phase the site is divided into ten areas, rather than by building, so that the work is less dispersed across the site, and is carried out more efficiently. The complete maintenance cycle of the site can be completed over two years, based on the same number of personnel as in the previous phases, as well as 12-15 seasonal workers for vegetation control. During this phase, the future rotation of exposed and reburied mosaics will be considered, and made part of future maintenance plans. The exposed mosaics (1,350 m²), and those protected by reburial, under a shelter or under an ancient structure (1,670 m²) can be maintained during one year, while the walls (10,000 linear metres, or 38,500 m² of wall surface) can be maintained over two years. Shelters and other protection measures are maintained twice each year in the spring and fall, during an estimated one and a half months. Vegetation control, as in the second phase, is based on two months of work each spring and fall (Table 4).

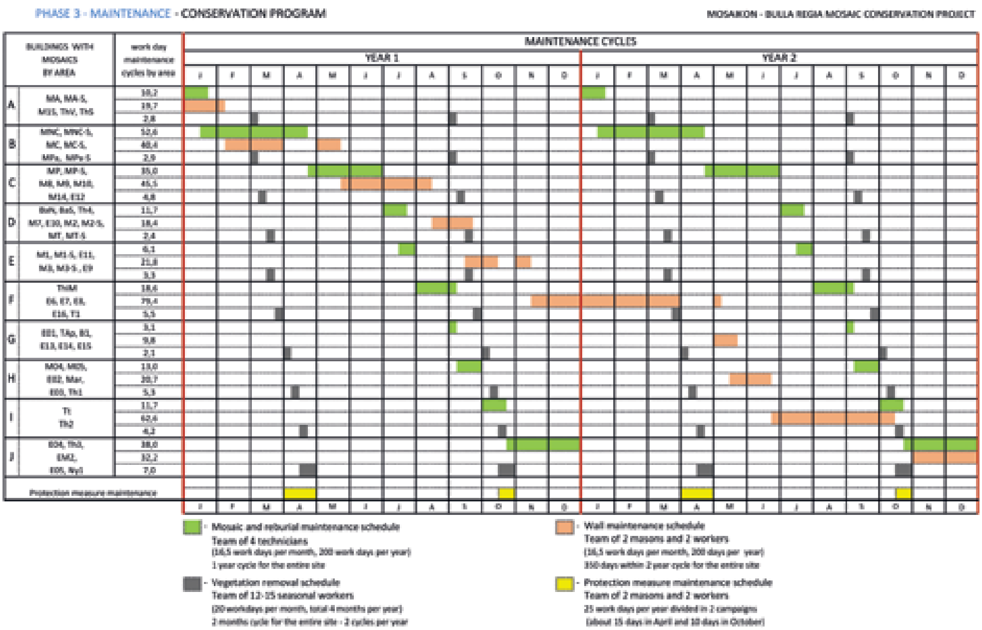

Table 4. Program of Maintenance Activities, Phase 3 (table by L. Alberti)

Cost estimates for labour and materials for maintenance of mosaics, walls and protection measures, and vegetation control site-wide has been calculated, as in the previous phases. The total cost of labour for Phase 3 is about 117,000 TD, and materials about 16,000 TD, for a total of about 133,000 TD or 45,000 euros, or about 23,000 euros (67,000 TD) per year.

Conclusions

The calculations of conservation work time at Bulla Regia have shown how much more time is needed to stabilise mosaics in poor condition than to subsequently maintain them. With four technicians available, it will take 17 years of stabilisation followed by maintenance cycles to reach a point where the technicians can maintain all the mosaics over one year. Given the total Conservation Plan costs and time, it is evident how much greater the cost of labour is compared to materials (about 30,000 euros per year compared to about 3,000 euros per year) (Fig. 5). Therefore, it is in the best interest of conservation authorities to have a level of staff sufficient to stabilise and then maintain a site in the long-term, rather than contracting out to external labour.

Experience at Bulla Regia has shown that the site requires a range of profiles and personnel numbers to carry out such a conservation plan effectively. Under the direction of a site manager/director, the site needs an administrator, a conservator to supervise 4 conservation technicians, a foreman to supervise two masons and two workers, and 10-12 guards. Workers could be hired externally and seasonally for site vegetation control.

Unfortunately, the conservator profile is the one profile still lacking at Bulla Regia, as it is in the region generally. Government cultural heritage authorities need to officially recognise the conservator profile and encourage the training of conservators in multi-year programs, for now, mostly outside the region. With more trained conservators employed at sites in the region, more significant advances can be made in conservation planning and implementation for mosaics on archaeological sites in the future, and this planning example can be a useful point of a reference.

Although outside the scope of this current project, it is our intention that implementation of the plan, or a revised version of it, will begin to be undertaken at Bulla Regia by the Tunisian authorities in 2018. The planning has taken into consideration the personnel and budgetary resources

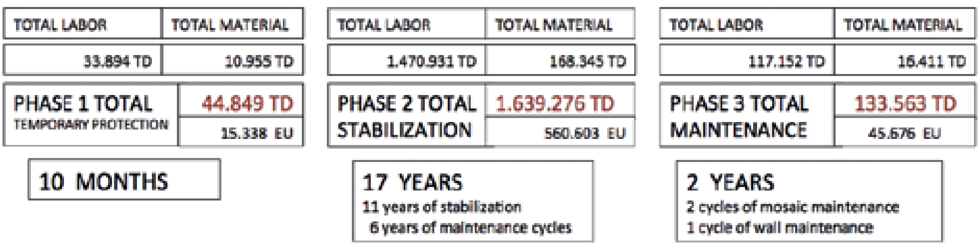

Fig. 5. Cost of Labour and Materials, all phases

of the Institut National du Patrimoine (INP) in order for its implementation to be feasible and sustainable, and not rely on special project funding from outside the government. If site staffing and budgets cannot meet the work programming of the plan, it remains a flexible management tool which the INP can adjust according to their future resource constraints.

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References

Roby T., Friedman L., Rhouma-Ghmari H., Chaouali M., Alberti L., Carbonara E., Caldi C., D'Andrea A., and Sepio D. 2017. "Conservation planning for excavated mosaics at the site of Bulla Regia, Tunisia: A component of the MOSAIKON Initiative". In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014 = La conservation et préservation des mosaïques: A quel cout? Actes de la 12e Conférence de l'ICCM, Sardinie, 27-31 octobre 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aicha Ben Abed and Roberto Nardi, 151-161. Los Angeles, CA: Getty Conservation Institute.

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WORKSHOP FOR MOSAICS CONSERVATION AT STOBI: AN EXAMPLE OF A SUSTAINABLE PLATFORM FOR INTERNATIONAL COLLABORATION, EDUCATION AND SITE MANAGEMENT

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Balkan Heritage Field School [1]

Abstract

The Workshop on Conservation and Documentation of Roman and Late Roman Mosaics has been organised on annual basis since 2012 at the site of Stobi, capital of the Roman province Macedonia Secunda, within the modern Republic of Macedonia (FYROM). This educational workshop is one component of the Balkan Heritage Field School (BHFS), a major program of Balkan Heritage Foundation (Bulgaria) which encourages sustainable heritage protection and site management in south-eastern Europe. The workshop supports the objectives of the National Institution for Management of the Stobi Archaeological Site (NI Stobi): to introduce students to the contemporary standards of conservation, restoration and documentation for mosaics, and to develop their understanding of the mosaics in the context of the Roman and Late Roman history and archaeology of Stobi, through theoretical training and practical hands-on experience. At the same time it advances the broader aims of the BHFS, regarding the world-wide promotion of Balkan heritage, contribution to sustainable development and cultural tourism, and fostering awareness of cultural heritage in local communities, as well as international professional networking.

Keywords: Stobi, Roman mosaic, preventive conservation, workshop in mosaic conservation, field school

The context of the Stobi archaeological site

The ancient city of Stobi is situated near the village of Gradsko, approximately 70 km from Skopje, capital of the modern Republic of Macedonia (FYROM), and is one of the country's most important archaeological sites (Fig. 1). Excavations conducted over the course of the past 100 years have exposed a total of 26 ancient buildings, and since 2012 the site has been listed on the World Monuments Watch list [2]. Approximately 1560 square metres of the excavated areas are covered with complete or fragmentary mosaics, dating mainly between the 2nd to 6th century AD and found within public and residential Roman and late Roman buildings. These include: the Episcopal Basilica, the Extramural Basilica, the Theodosian Palace, Synagogue II, the Casino [3], the House of Peristeria and the House of Polycharmos. The techniques of execution of these floors include *opus barbaricum*, *opus vermiculatum*, *opus sectile* and *opus tessellatum,* the latter of which display a variety of geometric, floral and animal motifs.

The conservation interventions on the Stobi mosaics began in the 1930s and continued sporadically over subsequent decades. Some of the mosaics were left *in situ* while others were lifted and moved to on-site storage. The fate of the lifted mosaic fragments varied, for example some were placed on a new backing (usually

Fig. 1. General view of the archaeological site of Stobi (photo NI Stobi)

concrete), while others were not. In 2009 the Stobi National Institution for Management of the Stobi Archaeological Site (NI Stobi) began a long-term program for the complete conservation and exhibition of the site mosaics. At that time most of these works were in urgent need of treatment and preventive conservation due to decades of damage from outdoor exposure and lack of proper maintenance [4]. In 2012, for purposes of bringing to bear greater financial and organisational resources, NI Stobi entered into agreement with the Balkan Heritage Foundation of Bulgaria, initiating a new project, called the Workshop for Conservation and Documentation of Roman and Late Roman Mosaics at Stobi. This partnership has resulted in long-term operational collaboration, and serves as an exemplary case of an educational initiative in the area of archaeology and conservation. The project aims to offer basic theoretical and hands-on experience in mosaics conservation for international students and volunteers, involving them in selected activities of the ongoing conservation projects of NI Stobi. The workshop is part of instead included within the main educational program of the Balkan Heritage Foundation, the Balkan Heritage Field School, and is also included in the academic curriculum of the New Bulgarian University.

Two partners of the Workshop

National Institution for Management of the Stobi Archaeological Site (NI Stobi)

The ancient city of Stobi is the most significant Roman and Late Roman site of the Republic of Macedonia, and has been designated as Protection category I by the national government. The responsibility for the site initially lay with the National Museum in Veles, but in 2001 it was transferred to the Institute for Protection of the Cultural Monuments of the Republic of Macedonia (later renamed the National Conservation Centre) [5]. In 2008 the Government of Macedonia issued a decree founding the National Institution for Management of the Stobi Archaeological Site (NI Stobi), as an independent institution under the Ministry of Culture. The institution is charged with the management of the site and its mission includes three main aspects: research, protection, and presentation.

Balkan Heritage Foundation (BHF)

The Balkan Heritage Foundation (BHF) is a non-profit, non-governmental Bulgarian public organisation, established in 2008 with the mission of supporting the study, preservation and promotion of the cultural heritage of south-eastern Europe. The Balkan Heritage Foundation collaborates at both regional and global levels with universities, museums, research institutes, media, business companies, and governmental and non-governmental organisations. It raises funds and reallocates these to projects in benefit of cultural heritage, implemented by research teams, institutes, universities, museums, municipalities and local communities.

The broader framework of the Balkan Heritage Field School: aims and objectives

In 2008 the Balkan Heritage Foundation initiated the Balkan Heritage Field School (BHFS), an ongoing program for practice-oriented educational courses in the fields of archaeology and conservation, for individuals seeking specialised pre-career and early career training. The courses are taught in English and are open to both academic and non-academic audiences from around the world. All BHFS courses are associated with research and conservation projects conducted by partner heritage institutions in southeast Europe, and qualify for credit hours with the New Bulgarian University, Queen's University (Canada), or Connecticut College (USA). The program is funded through participation fees and donations. Currently, the BHFS is collaborating with archaeological and conservation projects in Bulgaria, Greece, the Republic of Macedonia and Montenegro. Over the past decade, the BHFS has conducted 86 field schools, attended by approximately 1500 students and 160 professionals from 57 countries, and has supported 17 multi-annual heritage projects through funding, volunteer labour (over 70,000 man-hours), and promotional activities.

The main aim of the BHFS is to develop and enhance accessible practice-based education in the fields of archaeology and heritage conservation, with an emphasis on Balkan cultural heritage. The specific objectives are:

1. To supplement academic education, volunteer training, pre-career and early career training through short-term practice-based field schools;
2. To encourage involvement of students, scholars and volunteers in the study, preservation and promotion of the cultural heritage of the Balkan region;
3. To provide BHFS students with theoretical and practical experience, as well as an understanding of the historical, archaeological and cultural context of their project;

4. To support research and conservation projects concerning cultural heritage in south-eastern Europe;
5. To present and promote Balkan cultural heritage, worldwide;
6. To contribute to sustainable development through utilisation of cultural heritage for education and enhancement of cultural tourism in south-eastern Europe;
7. To foster awareness of cultural heritage in local communities.

The BHFS enhances the exchange of specialists among the Balkan countries and between the region and the rest of the world, thereby supporting a continually growing network of experts from different professional contexts. All this contributes to improvement in the quality of the research projects and the professional reputation of the different heritage institutions of south-eastern Europe. In this regard, it should be noted that image of the Balkan region in the global context is difficult, and that between the countries within the region there can be mutually negative prejudices. The BHFS training activities and internships for graduate and postgraduate students and junior specialists from south-eastern Europe are among the first steps in building trust and hope for successful regional integration.

Objectives and Activities of the Stobi Workshop for Mosaics Conservation and Documentation

The objective of the BHFS mosaic conservation workshop is to introduce students to the contemporary standards of conservation, restoration and documentation for mosaics, and to develop their understanding of the mosaics in the context of the Roman and late Roman history and archaeology of Stobi.

The planning, operation and completion of all conservation projects, including the workshop training, relies on the input of the NI Stobi team and the affiliated experienced conservators from external local and foreign institutions. These personnel manage the course lectures, presentations and on-site instructions and supervision. The theoretical part of the course is based on the most recent publications recommended by Getty Conservation Institute.

The course has been held over a period of two or three weeks, every year since 2012. The precise nature of the conservation work requires constant supervision of the students, and the workshop has therefore been limited to seven to 12 students. The content is primarily designed for students in art or archaeological conservation, archaeology, anthropology, history, art history, and the related scientific fields, and is suitable for undergraduate students and more experienced professionals who wish to gain knowledge in the field or upgrade and further develop their existing skills.

The high number of mosaics at the site, preserved both *in situ* and detached, ensures flexibility in selecting projects that are suitable to newcomers to conservation, each year. Depending on the number of the participants in the course, the practical training can be conducted in the framework of a large ongoing NI Stobi mosaic conservation project, or the institution can design a smaller project consistent with the capacities of the participating individuals.

The workshop utilises three teaching methods:

1. theoretical lectures & instructions;
2. practical hands-on experience in different conservation treatments;

Fig. 2. Condition assessment, mosaic fragment from 'Casino' (photo Mishko Tutkovski/NI Stobi)

Fig. 3. Technical documentation, 1:1 drawing (photo Mishko Tutkovski/NI Stobi)

3. study excursions to other regional sites with mosaics.

Prior to their arrival at the Stobi conservation workshop, each student receives a preparatory handbook summarising the methods, practices and techniques to be applied, a glossary of terms, and a reading list on conservation treatments and the mosaic context. The handbook contains information on the health and safety requirements of conservation laboratories and worksites, and the attention to this theme continues throughout the workshop.

All groups or individual participants, whether assigned to projects for *in situ* or detached treatment, receive instruction and practice in the essential mosaic documentation activities, including condition assessment, measurement, damage mapping, drawing, drawing at 1:1 scale, photography and computerised documentation (Figs. 2-3).

Fig. 4. General view of the Theodosian palace (photo Mishko Tutkovski/NI Stobi)

The students of the first two years (2012, 2013) of the workshop participated in the conservation of two mosaic pavements of one of the most representative building at Stobi, called the Theodosian Palace, which dates to the 4th-5th centuries AD (Fig. 4) [6]. The 2014 and 2015 workshops were devoted to the conservation of the mosaics of the narthex and the naos of the Episcopal Basilica, considered to be the oldest Early Christian monument in the territory of Republic of Macedonia (mid-4th-6th century AD) [7]. In all four of these years the projects involved detachment of mosaic or treatment of previously detached fragments and sections, incorporating the main conservation process: application of protective facing and/or backing on the mosaics; detachment from the existing supports, cleaning and consolidation of the reverse side of the mosaics; transfer to a new movable support; removal of the facing, chemical and mechanical cleaning of the mosaic surface (Figs. 5-6).

Fig. 5. Cleaning of the reverse side of a mosaic section (photo Mishko Tutkovski/NI Stobi)

Fig. 6. Transfer of mosaic section to a new support (photo Mishko Tutkovski/NI Stobi)

Fig. 7. Mosaic cleaning (photo Mishko Tutkovski/NI Stobi)

Fig. 8. Consolidation of mosaic fragment *in situ*, the "Casino" (photo Mishko Tutkovski/NI Stobi)

Fig. 9. Edge repair of *in situ* mosaic fragment, the "Casino" (photo Mishko Tutkovski/NI Stobi)

The focus of the 2016 and 2017 workshops was instead on the preventive *in-situ* conservation of the floor mosaic fragments in two of the rooms of the late antique palace known as the "Casino" dating to the late 4th century AD. The students performed the following conservation procedures: vegetation removal, cleaning of the mosaic surface, filling interstices between the tesserae, infilling lacunae and repair of the edges, filling cracks in the mortar layers, removal and resetting of loose tesserae (Figs. 7-9).

General Outcomes and Impact: 2012-2017

Since 2012, a total of 54 students have participated in six workshops on mosaic conservation at Stobi. As a result, approximately 93 m^2 of mosaics have beensuccessfully

Year	Number of Students	Working Venue	Approx. Conserved sq meters
2012	7	Theodosian Palace (sections)	20 sq. m
2013	12	Theodosian Palace (sections)	15 sq. m
2014	8	Episcopal Basilica (sections & fragments)	16 sq. m
2015	9	Episcopal Basilica (sections)	10 sq. m
2016	10	"Casino" (fragments in situ), Episcopal Basilica (sections)	24 sq. m
2017	8	"Casino"(fragments in situ), Episcopal Basilica (sections)	8 sq. m

Table 1. Statistical data on the Workshop for Mosaics Conservation and Documentation at Stobi, 2012-2017

Fig. 10. International students in the 2017 workshop: baptistery of the Episcopal Basilica (photo Krassimira Frangova)

conserved to the benefit of all stakeholders, in particular the students and volunteers (see Table 1), the NI Stobi team, the Balkan Heritage Foundation, and the people and governments of the Republic of Macedonia and the larger region. Seven years following the launch of the project, we can say that this seemingly modest initiative has become a catalyst for change in the mindset of these same stakeholders, concerning modes of cooperation, alternative sources for funding, and exploring paths to sustainability beyond the conventional ones. The workshop has introduced a new type of cross-institutional collaboration, illustrating a balanced model of partnership between state and non-governmental organisations, while making concrete progress towards preservation of the cultural heritage and increasing awareness in the local community. Working together for the sake of cultural heritage builds trust and cooperation in pursuit of higher professional standards, and helps overcome historical difficulties between our nations, instead promoting the conception of our common World heritage (Fig. 10).

Notes

1. The author writes on behalf of the National Institution for Management of the Stobi Archaeological Site and the Balkan Heritage Foundation (BHF), the two partner institutions in the Workshop for Conservation and Documentation of Roman and Late Roman Mosaics at Stobi.
2. World Monuments Fund. 2012. "Stobi. 2012 World Monuments Watch.". Accessed

02/27/2018 https://www.wmf.org/project/stobi

3. The name derives from the character of the apsidal hall of this structure, with mosaic floor and octagonal fountain.
4. Balkan Heritage Field School. 2018."Workshop for Conservation of Roman Mosaics". Accessed 02/27/2018. https://www.bhfieldschool.org/program/roman-mosaics-conservation-course
5. Archaeological Site Stobi. National Institution Stobi. 2010. "National Institution for Management of the Archaeological Site of Stobi.". Accessed 02/27/2018. http://www.stobi.mk/Templates/Pages/StandardPage.aspx?page=266
6. Archaeological Site Stobi. National Institution Stobi. 2010. "The Theodosian Palace". Accessed 02/27/2018. http://www.stobi.mk/Templates/Pages/Excavations.aspx?page=168
7. Archaeological Site Stobi. National Institution Stobi. 2010. "The Episcopal Basilica". Accessed 02/27/2018. http://www.stobi.mk/Templates/Pages/Excavations.aspx?page=163

References

Archaeological Site Stobi. National Institution Stobi. 2010. "National Institution for Management of the Archaeological Site of Stobi.". Accessed 2/27/2018. http://www.stobi.mk/Templates/Pages/StandardPage.aspx?page=266

Archaeological Site Stobi. National Institution Stobi. 2010. "The Episcopal Basilica". Accessed 2/27/2018.
http://www.stobi.mk/Templates/Pages/Excavations.aspx?page=163

Archaeological Site Stobi. National Institution Stobi. 2010. "The Theodosian Palace". Accessed 2/27/2018.
http://www.stobi.mk/Templates/Pages/Excavations.aspx?page=168

Balkan Heritage Field School. 2018."Workshop for Mosaics Conservation of Roman Mosaics.". Accessed 2/27/2018.
https://www.bhfieldschool.org/program/roman-mosaics-conservation-course

World Monuments Fund. 2012. "Stobi. 2012 World Monuments Watch.". Accessed 2/27/2018. https://www.wmf.org/project/stobi

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SESSION VI: CONSERVATION AND MANAGEMENT OF SITES WITH MOSAICS

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Maria Papathanasiou
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Dimitris Chrysopoulos
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CONSERVATION AND PUBLIC ACCESS AT THE ARCHAEOLOGICAL SITE OF SAINT PATAPIOS IN VERIA GREECE

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Abstract

The paper describes the conservation of floor mosaics and overall restoration work carried out on the archaeological site of Agios Patapios, at the centre of Veria, one of the most important byzantine cities of Northern Greece. Excavations confirmed human presence on site since the 2nd century BC, and that the locality was the centre of Roman and Christian Veria up to the late post-Byzantine period. Excavations in the immediate environs of the post-Byzantine church of Saint Patapios revealed a large three-aisled basilica, built in the 5th century over an earlier 4th century complex. The beautifully decorated mosaic floors attest to the skill and artistry of the region's craftsmen. The remains of a 4th century Christian baptistery was also found just below the basement level of an adjacent contemporary building. A project for conservation and public presentation was prepared and funded by the 3rd European Community Support Framework, with the double objective of providing for the long-term presentation of the antiquities and at the same time opening them to visitation as a vibrant aspect of modern urban life. The conservation of the mosaics included cleaning, consolidation, securing loose tesserae, reinforcing damaged edges, and repairing areas of subsidence. Two areas of mosaics in poor condition were removed, conserved, re-backed, and returned to their original positions on a newly laid preparatory layer. The paper describes the extensive project measures for long-term public access.

Keywords: Byzantine, mosaic, Veria, restoration-conservation, public access

Introduction

Veria was already a fortified settlement during the Hellenistic era and became a great city under Roman rule. Thanks to its strategic location and the fertility of the surrounding lands, it evolved as an prominent administrative, military and ecclesiastical centre during the Early Byzantine (4th to 6th century), blossoming with splendid religious and secular buildings in witness to the urban changes of the new age. The excavations at the Church of Saint Patapios, in the centre of the modern town, represent the city's only "open" archaeological excavation. The topographic research and the excavations of accumulated ruins reveal that the location served as the city's devotional centre throughout the Roman and Christian era, beginning in the 2nd century BC and continuing uninterrupted to late post-Byzantine period (Petkos and Papakyriakou 2001).

The post-Byzantine Church of Saint Patapios was built in the 16th century and presents important frescos from the 16th to 18th centuries (Papazotos 2001:198-199; Petkos 2001:9). Between 1987 and 1996, construction activity in the surrounding area provided an opportunity for extensive archaeological excavations, conducted under the authority of the Ephorate of Byzantine Antiquities. These

Fig. 1. The St. Patapios Archaeological Site with excavations in progress (photo 11th Ephorate of Byzantine Antiquities)

Fig. 2. *Kolymbethra* (pool) of the early Christian Baptistery (photo 11th Ephorate of Byzantine Antiquities)

brought to light major finds from the Late Roman and Early Christian periods (Petkos 1993a: 97-109) (Fig. 1). Among these was an early Christian baptistery (4th century), with tetra-conch *photisterion* ("place of enlightenment") and octagonal masonry *kolymbethra* (pool) (Fig. 2), as well as a *domus*. Above the ruins of the baptistery were the remains of a large three-aisled early Christian basilica with double transept, built in the 5th century. North and south of the basilica are a succession of

Fig. 1. Ground plan of the monumental complex of St. Patapios (drawing 11th Ephorate of Byzantine Antiquities)

square and rectangular areas, as well as a long east-facing apsidal structure divided in two parts, identified as the bishop's residence (Fig. 3). All these religious buildings were splendidly decorated, with marble revetments, *opus sectile* work and mosaic floors with a variety of geometric motifs, demonstrating the quality of artistic-technical production in the region (Petkos 1993b: 11-12).

The Hellenic Ministry of Culture recognised the importance of these finds and expropriated parts of the site. The core excavation area, totalling 500 m² is now a protected archaeological area, closed to new construction. Some of the antiquities, in particular the 4th-century baptistery, are also preserved within the basement levels of the adjacent modern building. The conservation-restoration works for the archaeological site, including the mosaic floors, were carried out in accordance with project plans approved by the Ephorate of Antiquities (Kaltapanidou and Karagianni 2009) [1]. The 411,000 euro budget for the project was co-funded by the European Union.

The difficulties of the proposed archaeological project were recognised from outset, given the location within an area of dense urban construction, in some parts immediately adjacent to modern multi-storey buildings, and largely without exploratory investigation. This meant that invaluable new information was gained as the excavations advanced, but also that the new findings necessitated greater or lesser revision of the project already in course. Moreover, the steady streams of worshippers using the Church of Saint Patapios in the centre of the area, the constant flow of traffic in the adjacent urban pedestrian area and walkway linking two main streets, and the continued tenant use of the buildings on the east side, meant that the area could not be closed to the public for undisturbed work. Finally, the project required the simultaneous presence of different teams, in particular for restoration of the structural monument, the excavations, and the conservation works, necessitating careful planning, organisation and co-ordination in the execution of the different operations.

The first task was to fence the area, remove the accumulated surface debris and clear the overlying soil. Work then began on developing the west entrance to the archaeological site and creating a visitors' viewing platform. The excavation work revealed part of the floor of the centre aisle of the early Christian basilica. Subsequent to the destruction of the Early Christian basilica, the area, during the so called: "Dark Ages" (7th-8th c.), had been used as a cemetery [2]. The original floor of the centre aisle was largely missing, however the imprints remaining in the mortars demonstrated that there had been work in *opus sectile* and from the preserved parts it was possible to identify that the main decorative motifs had been continuous and intersecting zones of white, black and red marbles. The excavations also uncovered part of the south aisle, including the continuation to the east of the floor mosaic, which had been uncovered by excavations in previous years.

The overall complex of antiquities described were found at different stratigraphic levels and represented different historical phases. For this reason the main aims of the project were to consolidate the masonry and floors and to make the archaeological site as easy as possible for the general public to understand.

The conservation of the two groups of floor mosaics, in the 4th-century build-

Fig. 4. The 4th-century mosaics during conservation works (photo 11th Ephorate of Byzantine Antiquities)

Fig. 5. 4th-century mosaics subsequent to restoration work (photo 11th Ephorate of Byzantine Antiquities)

ing complex and the lateral aisles of large 5th-century basilica, accounted for much of the work of site consolidation and visitor presentation. The techniques of execution and the current conditions of the two flooring types were different, therefore the conservation methods also differed.

The 4th-century mosaics were executed in white, black, ochre and rose-coloured tesserae, around 1 cm square, cut unevenly and laid irregularly within the pattern outlines. The surviving sections were in very good condition, with the preparatory layers showing exceptional stability and cohesion. Wherever the bedding layer was lost and the tesserae were detached, these were re-laid with new mortar and the gaps were filled with original tesserae found nearby. The depressed parts were lifted and re-laid on new mortar (Fig. 4). Voids in the preparatory layers were detected acoustically and treated by injecting fluid mortar. All free edges of the mosaics were covered with mortar, from the surface of the mosaic to the full depth of the *statumen* (Fig. 5).

The construction and state of preservation of the floors in the north and south aisles of the early Christian basilica (5th century) were remarkably different. Here the tesserae were 2 to 5 cm square, cut in irregular shapes, except 1 to 1.5 cm square in the area of the central image. Different kinds of white, black, dark green, rose and

Fig. 6. The 5th-century mosaics during conservation works (photo 11th Ephorate of Byzantine Antiquities)

brown stone had been used and most of the tesserae were arranged in horizontal lines. The condition of these floors was particularly unstable. Ground movement had caused rises and depressions in the surface level. The preparatory layers and bedding mortar were badly deteriorated and the tesserae had lost adhesion. The surface of the previously excavated floor was covered with earth and low vegetation, and in places with a layer of dark sediment. The black and green tesserae were severely deteriorated, with cracking and exfoliation.

Given the observed conditions, the decision was made to lift the 5th-century mosaics, treat them in the laboratory, re-lay them. The first steps in this process were thorough surface cleaning, temporary fixing of the tesserae along the edges of the surviving sections, and treatment of the crumbling green, black and ceramic tesserae with a consolidating agent. The boundaries of each section to be lifted were defined following the existing cracks and damaged parts, and each section was numbered. Strips of gauze were applied to the edges to secure them. Layers of loose and then densely woven fabric were used with an adhesive to face the entire surface. The number of each section, the points of contact with adjacent sections, survey measurements and orientation were marked on the fabric. The lifted sections were transported to the conservation laboratories of the Byzantine Museum of

Fig. 7. 5th-century mosaics subsequent to restoration work (photo 11th Ephorate of Byzantine Antiquities)

Veria, where the rear of the *tessellatum* was cleaned, the detached tesserae were replaced and the deteriorated ones were consolidated. All the sections were then placed face down on a flat surface, for the application of the new mortar. Copper strips were temporarily placed between the pieces in order to keep them separate, and lead strips were placed at the perimeter. Two layers of mortar were applied with an intervening layer of fine stainless steel mesh, for increased stability and cohesion (Fig. 6). The mosaic sections were then returned to the site and laid on a new substrate prepared using crushed stone, tiles and then mortar, and varying from 35 to 50 cm in depth. The substrate was covered with a layer of sand to provide the final level surface. Once the sections were re-laid, the last steps were to fill the joints, seal the perimeter with mortar and provide a final surface cleaning (Fig. 7). A small part of the mosaic had been conserved *in situ*, serving as an example of the original construction and as a contact surface for re-laying the lifted pieces.

All the masonry remains of the ancient buildings were consolidated and restored using traditional materials compatible with the original. Where too little remained of the walls, these were rebuilt to a height sufficient to restore the morphological unity of the monument [3]. The exposed faces created by the difference in height between the two different levels of the site were reinforced with stone revetments, which were then treated in a manner to recreate the stratigraphy prior to the intervention. Steps were built for visitors to descend from the level of the basilica to the lower part of the site, on the northwest side [4]. The considerable difference in height between the modern roadway and the west side of the archaeological site made it necessary to build a retaining wall. The foundations of this wall were designed with particular care to avoid damaging the antiquities and the *opus sectile* of the basilica nave, and therefore did not follow the lines of the original plan. The wall is in reinforced concrete, topped by metal railings and flower planters. The exposed foundations of the modern building abutting the north side of the archaeological site were covered to achieve greater aesthetic integration [5]. A low stone parapet was built abutting the north and west foundations of the Church of Saint Patapios, for protection and reinforcement [6].

Fig. 8. Protective shelters covering the mosaics on the St. Patapios site (photo 11th Ephorate of Byzantine Antiquities)

Fig. 9. Wooden boardwalks leading visitors through the archaeological site (photo 11th Ephorate of Byzantine Antiquities)

Fig. 10. Transparent glass corridor over restored mosaics (photo 11th Ephorate of Byzantine Antiquities)

The 4th century mosaics were protected by shelters of semi-transparent sheeting on metal frames (Fig. 8) [7]. Specially designed wooden boardwalks lead the visitor through the archaeological site (Fig. 9), with transparent glass panels where they pass over restored mosaics (Fig. 10). Steps provide access to the different levels of the site. A metal footbridge providing access to the southwest side unifies the archaeological site. Where the mosaic floors of the Early Christian basilica have been restored, the footbridge and walkway floors are replaced with glass panels.

On the east side of the archaeological site, where excavations had brought to light the eastern axis of the early Christian basilica, another metal footbridge was constructed to provide access to the adjacent modern buildings [8].

The basement of the building containing the remains of the 4th-century baptistery with *kolymbethra* was cleared and cleaned [9]. A partition wall was erected to separate the antiquities from the rest of the space, and steps and a ramp were installed to join the lower, excavated level with the main basement. Lighting systems and a system of underground pipes were installed, with manholes, for drainage of rainwater.

The final step in preparing the site for visitors was the publication of a guide in two languages and the installation of an information panel.

Between 2011 and 2015 the Ministry of Culture, with the support of funds from regional co-financing programmes, carried out restoration work on the marble revetments of the structural remains of the early Christian basilica and baptistery, and on the frescoes, mortars and plasters of the post-Byzantine Church of Saint Patapios.

Conclusions

The conservation project has responded successfully to the double objectives designed from the outset:

– to protect the monumental complex, the city's only "open" archaeological site, preserving the material evidence of the past and safeguarding this cultural heritage for the future;
– to integrate the antiquities into the life and fabric of the contemporary city, making this a living part of its history that can serve as an educational and cultural core, optimally positioned in the urban setting of present-day Veria.

In terms of the technical aspects of the conservation approach, the methods of lifting and reinstalling the severely deteriorated mosaics on new backing and preparatory layers can be considered very satisfactory.

Notes

1. The Ministry of Culture prepared and approved a series of projects, in particular a Land Survey Study, Building Survey Study, Structural Design Analysis, electromechanical studies, and architectural and restoration projects. The excavations were carried under the direction of Antonios Petkos, Director of the 11th Ephorate of Byzantine Antiquities, in collaboration with the archaeologist Flora Karagianni. The structural restoration works were carried out under the direction of the architect Vasiliki Kaltapanidou-Pyrovetsi; the archaeological conservation works under the conservator Elpida Christoforidou.
2. Fifteen pit graves were found, some of which were cist tombs and a few were tile-covered. They burials included one body in a supine position and one grave containing the bodies of two children. The fact that all the burials were without funerary objects, and also that they were opened in the floors of the basilica very soon after its destruction, indicates a dating of around the 7th to 8th century.
3. The western part of the southern external masonry walls of the basilica were raised and suitable mortar bedding was laid for installation of the mosaic floor. In the eastern part, the joints in the lower parts of the walls of basilica apse were filled and the height was raised. The joints and upper part of the northern stylobate were cleaned; the excavation was extended, revealing the continuation of the stylobate to the west. Since the northern stylobate is the limit of the *opus sectile* floor of the nave, it was considered necessary to raise the height of its masonry almost 20 cm. higher than the floor, serving as a level of protection for the ancient construction.
4. The steps are in concrete, covered by rectangular schists.
5. Brickwork was installed up to the level of the pavement, covering the foundations. A drainage channel was incorporated behind the brickwork, preventing the flow of water onto the archaeological site.
6. The foundation of the post-Byzantine basilica had been uncovered during the course of the excavations in the central nave of the early Christian basilica. Prior to construction of the parapet walls, the lower parts of the foundation were first prepared by deep joint-filling and the addition of masonry stones, where necessary.
7. The parts of the archaeological site without antiquities were prepared by installation of bedding similar to that of the re-laid mosaic floors.

8. In the initial stages of the project, access to the modern buildings was maintained by leaving a corridor of land at the height of the modern street. In a later stage the corridor was also excavated, revealing the entire eastern part of the early Christian basilica. At the same time a new metal footbridge was constructed, maintaining the access to the modern buildings.
9. The use of the basement has been transferred by the owners of the building to the Ministry of Culture, with notarial deed.

References

Kaltapanidou V., Karagianni Fl. 2009. *Ανάδειξη του αρχαιολογικού χώρου Αγίου Παταπίου στη Βέροια*. Πρακτικά 3^{ου} Εθνικού Συνεδρίου: «Ήπιες επεμβάσεις για την προστασία των ιστορικών κατασκευών. Νέες τάσεις σχεδιασμού», (Θεσσαλονίκη, 9-11 Απριλίου 2009), 143-150. Θεσσαλονίκη

Papazotos Th. 1994. *Η Βέροια και οι Ναοί της (11ος – 18ος αι.)*. Αθήνα

Petkos A. 1993a. *Δύο κτιριακά συγκροτήματα του 4ου και 5ου αιώνα στη Βέροια*. Αρχαιολογικό Έργο στη Μακεδονία και Θράκη 7.

Petkos A. 1993b. *Ψηφιδωτά δάπεδα Βεροίας και των περιοχών ελέγχου και επιρροής της (2ος – 6ος μ.Χ. αι.)*, Δυτικομακεδονικά Γράμματα, τόμ. Δ', Κοζάνη.

Petkos A. 2001. *Τα μνημεία της Βέροιας*. Αθήνα

Petkos A., Papakyriakou Chr. 2001. *Ο αρχαιολογικός χώρος του Αγίου Παταπίου Βεροίας*, Αρχαιολογική μελέτη. Βέροια

Authors

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THE CONTRIBUTION OF THE LOCAL COMMUNITY TO MOSAICS RESTORATION AT THE MOSES MEMORIAL, MONTE NEBO, JORDAN

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Abstract

In 2007 the entities responsible for archaeological site of the Moses Memorial began a project for the construction of a new shelter over the archaeological site of the ancient basilica, with the aim of improving the preservation, restoration and presentation of the beautiful mosaic floors. The conservation-restoration project was developed as a continuous on-site workshop, resulting in substantial beneficial impacts on the citizens of the nearby village of Faysaliyyah. Young men from the village developed understanding and skills in the full range of mosaics restoration phases, using of new and traditional techniques and materials, and a full understanding of the historical and artistic value of the heritage.

Keywords: Studium Biblicum Franciscanum, mosaic restoration, Mount Nebo, local community, Byzantine

Dedication to Father Michele Piccirillo

"Art is peace… Intelligence is dialogue!"

During the summer of the last year of his life, Father Michele Piccirillo (1944-2008) noted these words in his diary, summing up the conviction of his mission and more than thirty years of work with the Franciscan Archaeological Institute, Jordan.

History of excavation, restoration and shelter of the Basilica

On 13 July 1933, Father Sylvester Saller of the Studium Biblicum Franciscanum undertook the first excavations of the Basilica on Mount Nebo. Following the campaigns of 1933, 1935 and 1937, activities continued in subsequent decades under the direction of Father Bellarmino Bagatti, Father Virgilio Corbo, and finally Father Michele Piccirillo, beginning in 1976.

The first restoration program was entrusted to Father Virgilio Corbo in 1963, who, in addition to various interventions of *strappo* (lifting) and repositioning the mosaics on reinforced concrete, had a temporary cover built for the entire basilica in iron and asbestos panels. The shelter was prefabricated by an industrial company in Oxford, England and assembled on site by the Ferreria (iron works) San Salvatore of Jerusalem under the technical direction of Fra Nazareno Moretti (Corbo 1967; 1970).

The works were interrupted by the advent of the 1967 Arab-Israeli war, then resumed in the summer of 1976 under the direction of Father Piccirillo, with the technical collaboration of the architect Cesare Calano of the University of Rome 'La Sapienza'. The various excavation campaigns from 1933 to 1976 brought to light over 700 m^2 of mosaics. These represent only a part of the original decorations, most of which have been lost, such as for example the wall mosaic of the apse and floor mosaic of the central nave (Piccirillo 1997). The

Fig. 1. The basilica before the restoration intervention (photo Franco Sciorilli)

basilica also underwent a series of modernisations over its four centuries of life, which led to the overlapping of multiple levels of mosaics that came to light with the *strappo* of the upper levels. During the summer campaigns directed by Father Piccirillo between 1976 and 2008, the excavations, restoration and maintenance works for the mosaics continued. Over this period the most frequently adopted system for the lifted mosaics was to mount them on reinforced concrete. Although it became clear that this system was certainly not the best, it was still judged as the best possible one given the context of the site within Jordan.

In the first years of activity, among the professionals and collaborators who provided important assistance to Father Michele, mention should be made of the architects Giorgio Ortolani, Lino and Massimo Benedettucci, and the master mosaic restorer Antonio Cassio. Giorgio Ortolani in particular provided for the structural interventions on the archaeological area of the Basilica, while Antonio Cassio offered technical advice for the first conservation interventions on excavated mosaics. Lino and Massimo Benedettucci, together with Padre Piccirillo, elaborated the methodological approaches to restoration that would characterise the work of the coming years. In particular, in 1982, at the invitation of the Department of Antiquities of Jordan, they proposed some ideas for the restoration of the area of the Roman *cardo*, in the centre of the city of

Fig. 2. The basilica after the restoration intervention (photo Franco Sciorilli)

Madaba, and also proposed the founding of a true conservation-restoration laboratory. These suggestions led, some 10 years later, to the establishment of the Madaba Institute for Mosaic Art and Restoration, under the technical direction of the architect Claudio Cimino.

As of the early 1990s the archaeological site was protected by a simple structure, however landform events, including the presence of a large longitudinal fracture between the new Baptistery and the Theotokos Chapel, indicated the necessity of a new structure. Beginning in 1993, the architect Vito Sonzogni began the first conceptions of the conservation, aesthetic and functional elements requiring consideration, in his various letters and drawings. In 2002 an architectural competition was announced for the study and design of a new roof to protect the sanctuary, leading to the submission of 10 project proposals for the Moses Memorial, published in the volume *"Un progetto di copertura per il memoriale di Mosè"* (Piccirillo 2004). The feasibility studies continued over the next four years, in particular in relation to the territory and the possibilities of the Jordanian domestic market. Restoration work began in 2007, supported by the geological investigations of Pierluigi Malesani of the University of Florence. In that same year the roof of the old shelter was demolished. October 2016 saw the inauguration of the new Moses Memorial, with roof and restoration of the entire ancient basilica, including the architectural structures and mosaics (Figs.1-2).

Mosaics restoration for the new Moses Memorial

The restoration of the mosaics was begun in April 2008, relying on the citizens of the nearby village of Faysaliyyah, engaged through the administrative and educational structure of a site school program. This effort in fact continued on a history of collaboration initiated in the 1930s, in some cases with the grandparents of the modern participants. At the time the collaboration had been established by Father Girolamo Mihaic, who in 1932 negotiated the purchase for the area of the archaeological site on Mount Nebo, on behalf of the fraternity of the Custody of the Holy Land.

The 700 m^2 of excavated mosaics, dating from the late 4th to 7th century had all been lifted and placed on a bed of reinforced concrete with a thickness of about 5-6 cm, with the exception of the ancient Diaconicon Baptistery and some rooms decorated with white mosaic, left *in situ* (Figs. 3-4). The initial phase of restoration work concentrated on the mosaics embedded on reinforced concrete, which was first subjected to mechanical surface cleaning and removal from the cement backing. The mosaic bed was then re-established using three layers of mortar based on slaked lime and stones. The teaching and application of the slaked lime technique was considered highly important to the Mount Nebo communities, in particular from 2009 onwards, when we began to produce the material locally, buying quicklime from a local firm and carrying out the slaking in tanks for a minimum of six months. The materials used for the mortars are local aggregates, such as sand, stone and marble powder, bound together by hydraulic lime, slaked lime and hydrated lime.

Once removed from the cement, some of the mosaics were applied to the lime mortar bedding within the original chapels, while in other cases the mounting was executed on aluminium honeycomb panels that could then be displayed on the walls of the new roofed structure.

The interventions on the archaeological walls and other structural elements included removal of the cement from the joints between stones, replacing it with lime-based mortar, and important structural consolidations carried out on columns and architraves using epoxy resins.

We were also able to restore the *in situ* mosaic of the ancient Diaconicon Baptistery, thanks to funding fund made available through the UNESCO office in Amman. In this regard, mention must be made of Anna Paolini of UNESCO and Gaetano Palumbo, specialist in conservation and site planning. The intervention consisted of mechanical cleaning and consolidation of the various swellings through injections of lime-based grouts. The restoration of the baptismal font was also completed as part of this overall project. As the mosaic inscription mentions, the font was originally covered by an elegant ciborium. In this case the intervention consisted mainly of re-adhering the pink-coloured finishing plasters to the basic structure of stone blocks, and protecting the edges, in all cases using lime-based mortars.

The design of the activities carried out in collaboration with the local team has attempted to cover the full range of actions

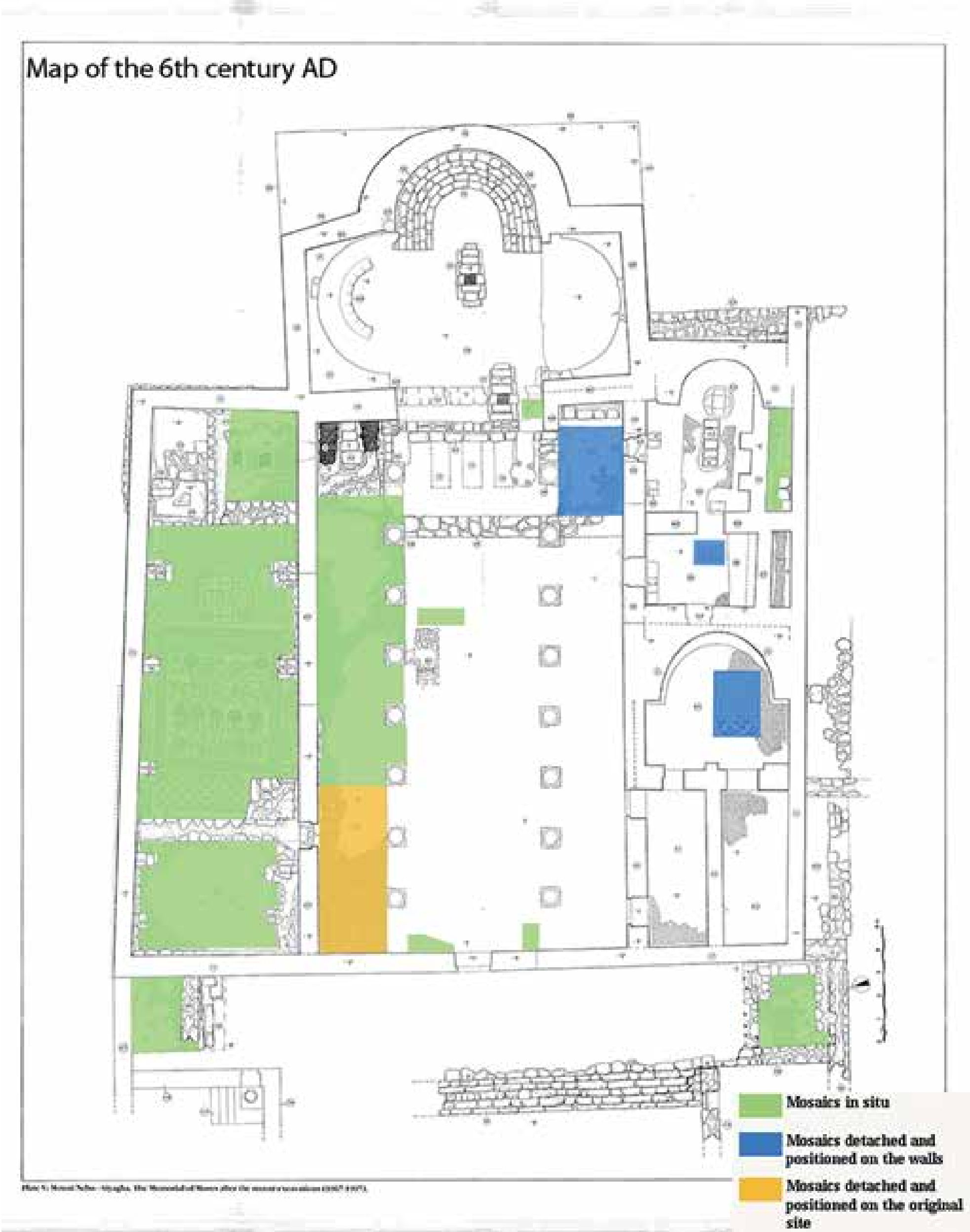

Fig. 3. Map of the 6th century mosaics: *in situ* and relocated (by Franco Sciorilli)

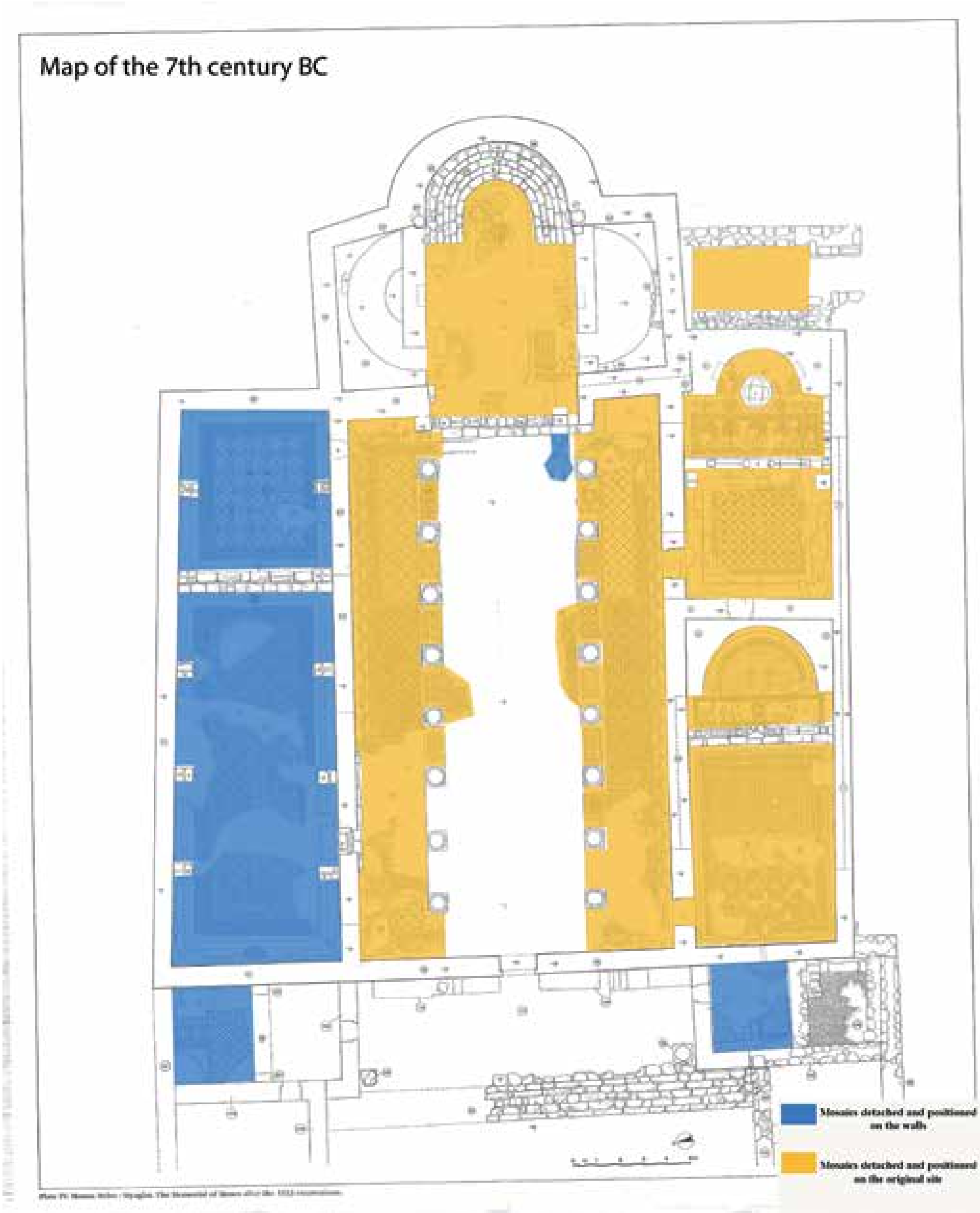

Fig. 4. Map of the 7th century mosaics: *in situ* and relocated (by Franco Sciorilli)

Fig. 5. Mechanical cleaning of the mosaic (photo Franco Sciorilli)

Fig. 6. Application of two layers of canvas on a mosaic section (photo Franco Sciorilli)

Fig. 7. Removal of the cement from the back of the mosaic (photo Franco Sciorilli)

Fig. 8. Consolidation by injection of the mosaic of the Diaconicon Baptistery (photo Franco Sciorilli)

inherent to a correct approach to conservation-restoration and display. Particular attention has been devoted to the phases of documentation and analysis of the state of conservation, followed by mechanical and chemical cleaning, removal of cement, re-bedding using original materials, and reconstruction of joints with original tesserae (Figs. 5-8).

The projects for development of exhibits included important aesthetic work on the mosaics in the original locations and on those exposed on the vertical walls, while coping with cramped spaces and considering the full visibility of the mosaics by the visitor. The local community made extremely valuable contributions to the project through their availability over more than eight years, and their demonstrated abilities in learning a trade that is not typical for Jordan. During the course of the project they have developed understanding and practical skills in caring for heritage materials, and most importantly a full understanding of the historical and artistic value of this particular heritage – a funda-

Fig. 9. General view of the *in situ* mosaic of the Diaconicon Baptistery after restoration (photo Franco Sciorilli)

Fig. 10. General view of detached mosaics fixed on the walls (photo Franco Sciorilli)

mental benefit that will certainly be passed on to future generations (Figs. 9-10).
Throughout this period the overall projects were directed by the archaeologists of the Custody of the Holy Land, in particular Father Michele Piccirillo, Father Carmelo Pappalardo, Father Eugenio Alliata, and Davide Bianchi, assistant and disciple of Father Eugenio. The archaeological restoration work was directed by Franco Sciorilli and Antonio Vaccalluzzo, with the technical support of Francesco Clemente, and involving the people of the nearby village of Faysaliyyah, in particular Kaled at Wekhyan, Marwan Jammaleyeh, Hamza Moustapha, Taher Yousef and Mohammad Abadallah, but also many others over the years. In conclusion, acknowledgement is due to for the financial support allocated by the Custody of Holy Land, UNESCO Amman, and from private donors.

References

Corbo V.C. 1967. "Nuovi scavi archeologici nella cappella del battistero della basilica del Nebo (Siyagha)". *Liber Annuus* 17: 241-258.

Corbo V.C. 1970. "Scavi archeologici sotto i mosaici della basilica del Monte Nebo (Siyagha)". *Liber Annuus* 20: 281-318.

Piccirillo M., ed. 2004. *Un Progetto di copertura per il memoriale di Mose'. A 70 anni dall'inizio dell'indagine archeologica sul Monte Nebo in Giordania (1933-2003).* Jerusalem: Franciscan Printing Press.

Piccirillo M. 1997. *La montagna del Nebo*. Amman: Franciscan Printing Press.

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Franco Sciorilli is an Italian restorer specialised in mosaic and stone structure conservation and a member of the Studium Biblicum Franciscanum missions, dedicated to the restoration of Byzantine mosaic floors of the Memorial of Moses in Mount Nebo. Throughout his career he has been constantly engaged in the restoration and conservation of Jordanian cultural heritage. In 2016, in recognition of his commitment, he was awarded the honour of Knight of the Order of the Star of Italy by the President of the Italian Republic.

AKROTIRI VILLAGE, DISTRICT OF LEMESOS: MULTIDISCIPLINARY AND COMMUNITY COOPERATION FOR PREVENTIVE CONSERVATION THROUGH REBURIAL

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Abstract

The ecclesiastical complex at the *Katalimata ton Plakoton* locality in Akrotiri village, district of Lemesos, is one of the major archaeological discoveries in Cyprus in recent years. Given that preliminary surveys had indicated the presence of mosaics, the director of excavations immediately requested the presence of conservators for the planned excavations, and the protection and conservation of the mosaics thus became a major priority during the planning of the excavations. The excavation and conservation teams worked in unison, with the latter being given the responsibility of unearthing the mosaics and providing first response to the potential problems that might be encountered. The excavation process continued smoothly, while documentation of all archaeological information, and simultaneous identification of the deterioration mechanisms, was undertaken for greater understanding and response to the conservation problems. The current paper reports in detail on the archaeological-conservation cooperation and the preventive conservation operations for the mosaics over a 10-year period, including vegetation control, reburial, management of the site during 'non-excavation' seasons, drainage, and cooperation with the local community.

Keywords: Cyprus, mosaic conservation, *Katalimata ton Plakoton*, reburial

Archaeological and site management context

Excavations were recently conducted at the site of an ecclesiastical complex in the locality *Katalimata ton Plakoton* in Akrotiri village, district of Lemesos, by a multidisciplinary team under the direction of Dr. Eleni Procopiou, Senior Archaeological Officer at the Cypriot Department of Antiquities. The site is located in a forest, on the west coast of the Akrotiri peninsula (Fig. 1), and has been known since 1954.

The excavations revealed an important pilgrimage complex of the early Byzantine period, the full extent of which is yet to be revealed (Procopiou 2015). The excavated parts of the complex consist of two monumental ecclesiastical structures adjoining the west and east sides of an atrium (respectively known as buildings A and B), surrounded by several further installations to its south and north sides. The total length of the main structures is over 100 m. Building A is a transept basilica oriented to the west, linked through three door openings (*tribelon*=τρίβηλο) to the atrium (Procopiou 2014). A narthex connects the eastern portico of the atrium with the second, three-aisled basilica (building B). This second basilica has been the subject of the most recent excavations. The scale of these structures, their architectural arrangement, the funerary character, as well as the floor and wall decorations in mosaic, are indicative of the importance of the site, and indicate that *Katalimata* must have been a significant centre. The archi-

Fig. 1. Sites with mosaics in Cyprus

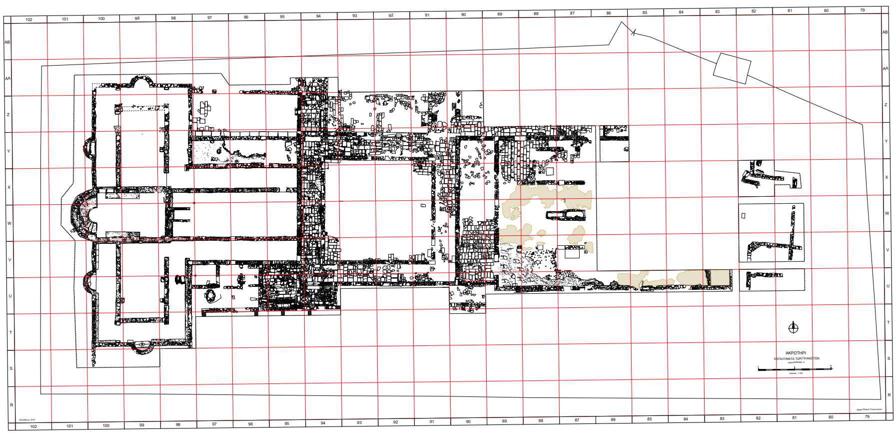

Fig. 2. District of Limassol/Lemesos: Akrotiri-*Katalymata ton Plakoton* site (©Archive Department of Antiquities of Cyprus)

tectural type of the monument, which is unique, is a landmark in the history of architecture of the Early Christian period in Cyprus (Fig. 2).
The Director of the Department of Antiquities responded positively to the senior archaeological officer's request for the constant presence of conservators during the field work at the site. The mosaics conservation team therefore played a key role in the excavation process, focusing on the protection and conservation of mosaics, over the period between 2007 to 2017.

Fig. 3. Excavation of the mosaics (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

Conservation-restoration strategy

The main problems encountered at the *Katalimata* site are as follows:

1. *Presence of permanent vegetation leading to root growth between the substrata, with lifting and loss of material (Figs. 3-4)*
   The forest vegetation covering the site consists mainly of *juniperus* bushes of the cypress family, whose roots spread near the surface, causing significant damage to the mosaics.
2. *Deposition of organic residues on the mosaic surfaces (Fig. 5)*
   Much of the mosaic surfaces are affected by a layer of organic deposition, resulting from the long use of the area and the subsequent decomposition of organics on the deteriorated mosaics layers.
3. *Deposition of lime remains from the dissolution of mortars used in masonry (Fig. 6)*
   Large parts of the mosaic were covered by a crust of deposited lime, derived from the deterioration of mortars in the wall masonry. These calcareous crusts had in fact played an important beneficial role in restricting the action of the roots, at the same time acting as grout-

Fig. 4. Roots between substrata, causing lifting and loss of material (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

Fig. 5. Deposition of organic residues on mosaic surfaces (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

Fig. 6. Deposition of dissolved lime from masonry mortars (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

ing agent that had kept the tesserae in place.

4. *Salt efflorescence*

   The phenomenon of salt efflorescence was contributing to the gradual destruction of mosaics. One of the measures adopted by the conservation team to address this problem was to reveal the mosaics gradually, with the aim reducing the loss to a minimum.

The main conservation measures employed are as follows:

1. *Desiccation and removal of vegetation*

   On the basis of advance planning on the part of the excavation director, the overlying vegetation was desiccated and removed in the year prior to excavations. This essential measure was enabled through good cooperation. As the excavations proceeded the roots could then be removed, the tessellated layer stabilised, and the substrata consolidated with mortar.
2. *Excavation and stabilisation of the mosaics, in stages (Fig. 7)*

   The mosaics were revealed and conserved in stages. The conservation team was divided in two groups; one for unearthing the mosaics and the other one for dealing with the stabilisation tasks:
   i. Mechanical cleaning of depositions;
   ii. Chemical cleaning of organic remains and salt efflorescence;

Fig. 7. Exposure and stabilisation of mosaics (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

iii. Reburial of mosaics with temporary constructions.

The preventive conservation operations composed a significant part of the overall excavation program. The conservation team remained on the site well after the completion of the main excavation season, concentrating largely on the prevention and conservation measures for the mosaics. This work involved the completion of the stabilisation tasks described above, the cleaning of the various spaces within the site, including removal of loose architectural elements to storage, the site reburial and further preventive measures for the provision of rainwater drainage.

For areas where reburial was not yet possible or would be insufficient as a preventive measure, temporary constructions were made of easily accessible and inexpensive materials, such wooden supports, plastic sheeting and geotextiles, for protection of the site from flooding (Fig. 8). These constructions have a lifespan of approximately one year. Through constant communication and cooperation with the site director we were able to ensure that the excavations were planned not only on the basis of archaeological research objectives, but also in consideration of the needs and aims of preventive conservation.

Fig. 8. Temporary constructions for purposes of water drainage (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

The program of preventive conservation works over the 2007 to 2017 period was as follows.

2007 OPERATIONS:

1. Preparation of the excavation site, desiccation and removal of vegetation;
2. Excavation of mosaics;
3. Rescue conservation;
4. Completion of reports and documentation of the mosaics;
5. Protection and reburial of excavation areas;
6. Archaeometric research and study of the mosaic techniques of execution and mechanisms of deterioration, including tesserae materials substrata mortars.

2008 OPERATIONS, REBURIAL TECHNIQUE:

The site was prepared for further excavation by removal of the improvised constructions and sand that had been used for shelter and reburial at the close of the previous excavation year. After these tasks, requiring approximately one week, the team proceeded with further desiccation and removal of vegetation, for purposes of facilitating the following year's excavation and for continued excavation of the mosaics. This year was also occupied with the continuation of rescue conservation: cleaning of the joints, grouting, consolidation of the substrata, cleaning of tesserae and stabilisation.

The first layer of reburial consists of a net with 85% mesh, covering the entire mosaic (Fig. 9). The net separates the excavation

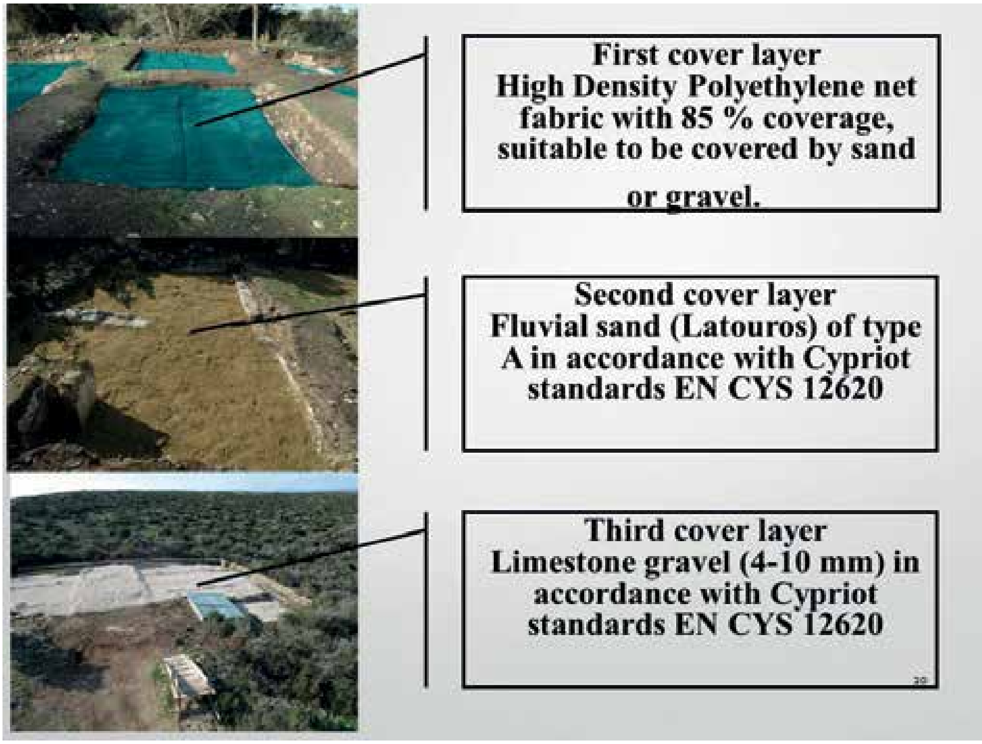

Fig. 9. Reburial stratigraphy (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

surfaces from subsequent layers and blocks the development of vegetation, but is permeable to rising moisture. The second layer consists of 10 to 15 centimetres of sand, of low salt content and free of seeds. This protects the mosaic from rainwater, provides mechanical protection and stabilisation, as well as protection from frost. The third layer is ten to thirty centimetres of gravel, once again protecting the mosaics from mechanical stresses but still permitting rising moisture. The reburial solution is considered to have a duration of four to seven years, at which point there would again be the risk of salt incrustation. During the reburial period the mosaics are monitored constantly and protected from vegetation.

2009 operations:

In this year the project included collaboration with the Aristotle University in Thessaloniki for colorimetric analysis of the tesserae, using a Konica Minolta CM-2600d spectrophotometer (Charalambous 2012). The colorimetry results assisted in characterising the composition of the *tessellatum*. In collaboration with the same university we also conducted a technological and compositional study of mortars, for assistance in determining the composition of the mortar to be used in the conservation process (Charalambous 2009).

2012 operations:

In this year the site director and project teams decided that the entire excavation should be reopened for purposes of full documentation and photogrammetric documentation, as well as for conservation operations. The conservation team monitored the substrata over the entire site and identified with precision those parts where vegetation roots were growing. The entire procedure lasted three weeks and revealed the generally very good conservation status of the mosaics, free of any new factors of deterioration. In the areas of very small damages from new roots the tesserae were stabilised using mortar, following removal of the vegetation itself. Other conservation activities included further mechanical and chemical cleaning of the mosaics; removal of decomposed roots from vegetation killed during previous years; filling of gaps created by the root removal; stabilisation and grouting of the mosaics and the consolidation of the substrata. Team members also restored wall remnants in the northern part of building A, considered important for preservation of the mosaics in this area and in the northern aisle, where otherwise only the foundations of the walls have been preserved, below floor level. In this areas the mosaics were further protected by means of a temporary construction made of wood and stones. All stages of the works were documented in detail.

It should also be noted that the planning of the reburial also provided for drainage of rainwater away from the monument. To this end the width of the reburial was be taken into account.

Testing of the reburial material revealed that it continued to have a low salt content, so the previous procedures and materials were again used for the reburial operations. The reburial operations for the entire monument, comprising 600 m^2, required one week of time for a team of four people, assisted by a fork lift truck, representing labour costs of around 4000 euros and 3500 euros for materials and consumables. It should be noted that if these mosaics had not been reburied, the costs for conserving and monitoring them would have been much higher.

Conclusions

The aim of covering the mosaics is to provide protection and slow down the deterioration processes. The archaeological officer in charge of excavations, comprehending the significance of the application of immediate measures for its protection, remains constantly open to dialogue with the other specialists, including the possible future provision of further types of light structural shelters. The conservation team has recommended reopening of the mosaics after a period of ten years, for monitoring and preventive operations, and in particular to prevent the risk of salt encrustations.

The monument is monitored by the Department of Antiquities at frequent intervals. The local community at Akrotiri also plays an important role in monitoring and preserving the site. During the excavation and conservation operations our team attracted the interest of the community through the organisation of frequent information days and tours, including after completion of each year's operations, as well as with presentations and lectures at the local cultural centre. The development of local interest and good relations has proven extremely useful, making the locals

Fig. 10. General view of excavations, Akrotiri-*Katalymata ton Plakoton* (building B) (photo by C. Eleftherios/©Archive Department of Antiquities of Cyprus)

literally the guardians of the monument. The most valuable guardian is in fact the neighbouring shepherd, who is immensely interested in the history and care of the site. On three occasions the inhabitants have informed us of illegal excavations in the area, including attempts to open the site.

In conclusion, the successful implementation of a site conservation and protection plan requires cooperation among various stakeholders: the site archaeologists and excavation director, the team of other specialists, and the local community. The conservation of the Akrotiri mosaics demonstrates important results, serving as a paradigm for future cases (Fig. 10).

References

Charalambous E. 2012. Τεχνολογία Κατασκευής των Επιδαπέδιων Ψηφιδωτών της Κύπρου. Λευκωσία: Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, Πολυτεχνική Σχολή.

Charalambous E. 2009. Η γεωλογία της Κύπρου και ο ρόλος της στην ανάπτυξη του επιδαπέδιου ψηφιδωτού (δημιουργία βάσης δεδομένων). Επιστημονική επετηρίς του Τμήματος Αρχαιοτήτων Κύπρου.

Procopiou E. 2015. "The Excavations at Akrotiri-Katalymata ton Plakoton 2007–2014". In *Medieval Cyprus – a Place of Cultural Encounter. Conference in Münster, 6–8 December 2012* edited by Sabine Rogge and Michael Grünbart, 185–218. Münster: Waxmann.

Procopiou E. 2014. "The Katalymata ton Plakoton: New light from the recent archaeological research in Byzantine Cyprus". In *Cyprus and the Balance of Empires: Art and Archaeology from Justinian I to the Coeur de Lion* edited by A. Stewart, Thomas W. Davis and Annemarie W. Carr, American Schools of Oriental Research Archaeological Reports 20. Cyprus American Archaeological Research Institute Monograph Series 5, 69–98. Boston: American Schools of Oriental Research.

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A LATE ANTIQUE HOUSE IN ANTAKYA WITH FIGURATIVE MOSAICS: EXCAVATION, DOCUMENTATION, CONSERVATION

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Abstract

A late antique house was discovered during construction works for a funicular station in Antakya, Turkey. The 2012-2013 and 2016 excavations revealed the *triclinium,* the *atrium,* and additional rooms. The mosaic floors of the *triclinum* and one of the rooms present figurative mosaics showing bathing and *convivium* scenes indicative of daily life for the Roman elite, and typical of the iconography in Antioch during the 3rd to 4th centuries. The conservation problems of deeply buried archaeological sites can be encountered in similar contexts of development of modern urban infrastructure. The fate of these particular mosaics has been debated, between the choices of removal for museum display or conservation *in situ.*

Keywords: Antioch, *triclinium*, Late Antique*, convivium*, Psyche, exhibition

Introduction

Antioch (at the location of the modern city of Antakya) is known to have been a prominent centre of intellectual institutions and cultural richness from its foundation in 300 BC until Late Antiquity. The entire area of the old city has been designated as a third degree archaeological protection zone. The rescue excavations concerning the mosaics reported here were conducted between 2012-2013 and in 2016 in the Affan Mahallesi quarter, one of the oldest and most densely populated of the city (Fig. 1), in response to an application by the Hatay Metropolitan Municipality to the Department of Antiquities for permission to construct a station for a funicular railway linking the old city with Mount Silpius.

The excavations were carried out in an area measuring 30 m by 35 m and to a depth of about 4.4 m, extending from the modern settlement to the level of the 3rd to 4th centuries AD. They confirmed the presence of construction and settlement extending from the modern era through the Ottoman, Medieval, Crusader, Byzantine and the Late Antique periods, with the potential presence of Early Roman material. The upper layers had been se-

Fig. 1. Aerial view of the excavation area in 2016 (photo Hatay Arkeoloji Müzesi)

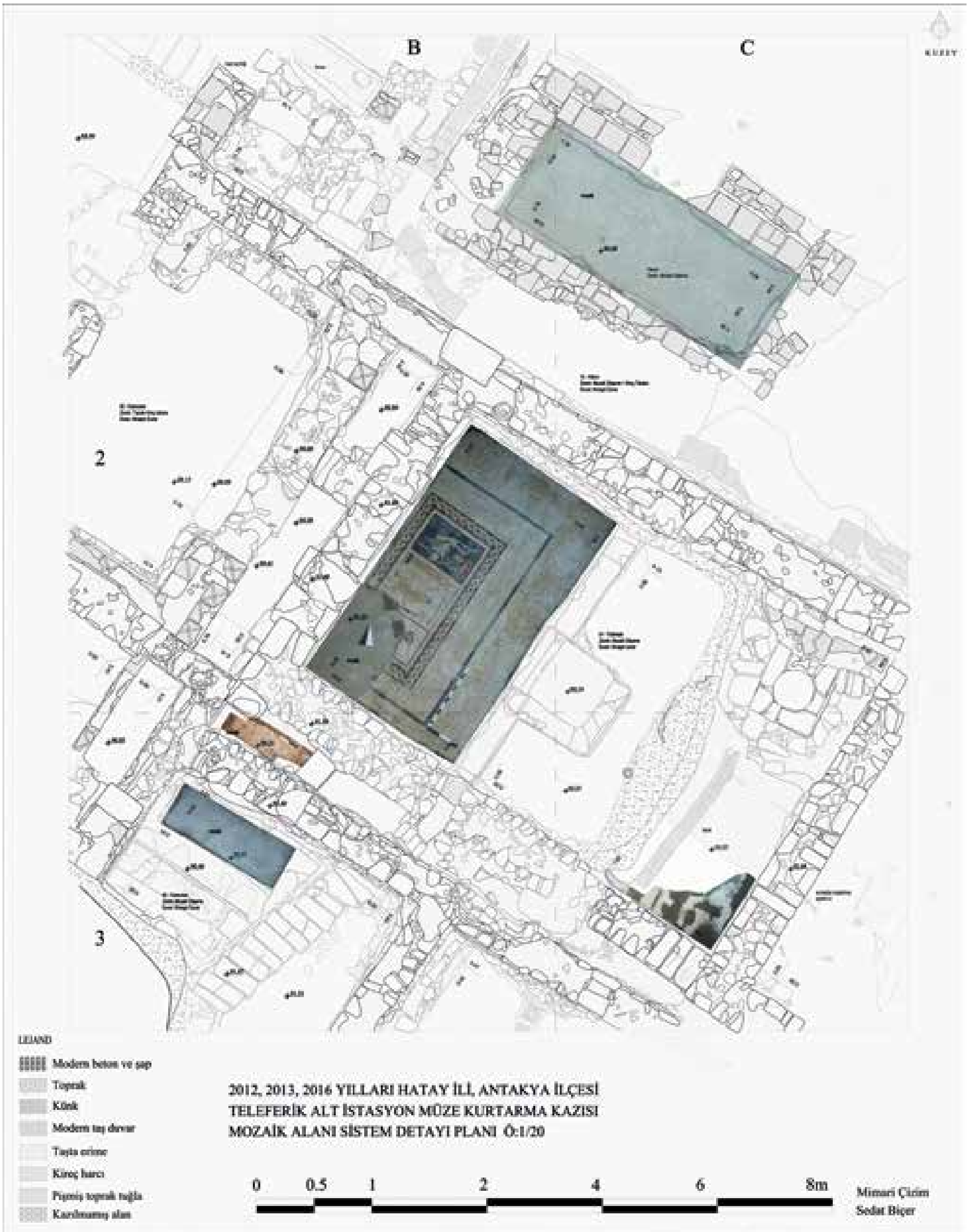

Fig. 2. Ground plan of the house and location of the mosaic pavements (Hatay Arkeoloji Müzesi)

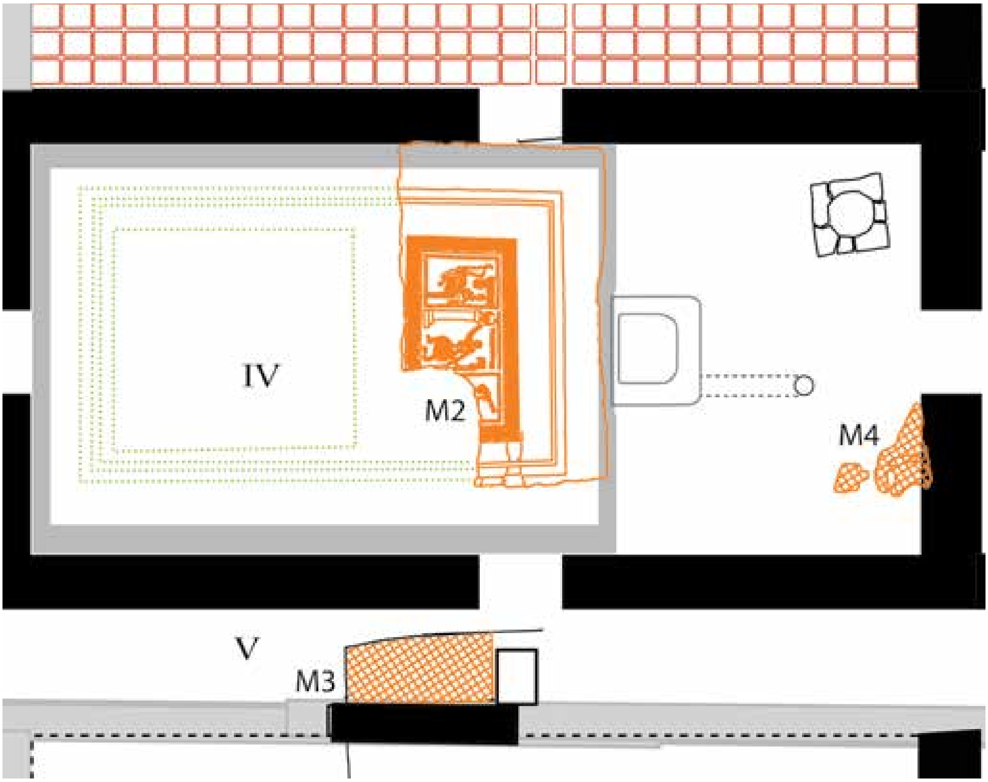

Fig. 3. Plan of the house (walls marked in grey are hypothetical). I, II, VI and VII = rooms, III = atrium, IV = *triclinium*, V = corridor or part of the back rooms, M2 and M3 = figurative mosaics (drawing from Pamir and Sezgin 2016, Fig. 9)

verely disturbed by subsequent construction activities. The lowest confirmed level, attributed to the 3rd century AD, revealed the ground plan of a house with four partially preserved mosaic floors (Fig. 2). The material culture, including mosaics and architectural remains, were first documented and analysed based on the 2012-2013 campaigns. In 2016, the original 900 m^2 excavation area was extended southward, to expose the mosaics covered by later walls.

The plan of the house is symmetrical around a central atrium and dining hall, with rooms in east and west wings. The rooms belonging to the original construction phase are identified as the *triclinium*, the *atrium*, two rooms to the east, and the rooms to the south of *triclinium* (Fig. 3). This original plan was altered and damaged by later construction. The house has a total area of 308.89 m^2, and conforms with typical designs of the 2nd to 3rd century AD (Stillwell 1961). The archaeological evidence, including coins, indicates that the construction and occupation of the house dates to between 276 AD and 337 AD (Pamir and Sezgin 2016).

The presence of a figurative mosaic floor in the dining room (room IV) demon-

Fig. 4. Aerial view of the mosaics (photo Hatay Arkeoloji Müzesi)

strates that this was the most important part of the house. The later excavation of a drainage canal has divided room IV in two parts (Fig. 4). Although the floor of the western part is completely destroyed it is possible that it was paved with mosaic. The surviving eastern part of the room presents a shallow pool with an adjacent figurative panel. The pool is connected to a well by a pipeline and can be identified as a *nymphaeum*, a typical element of dining halls in Antiochene houses (Stillwell 1961, Dobbins 2000).

In particular, the houses known from Antioch, Seleucia Pieria and Daphne typically contain a *nymphaeum* pool on one side of the dining room, or *triclinium*, which was paved with figurative mosaic panels. By the time of the 3rd century AD the *triclinium* typically consisted of a main dining room, an intermediate space and the *nymphaeum*, which was a small pool with a fountain (Stillwell 1961, Dobbins 2000).

The mosaics decorating the *triclinium* and an adjacent *cubiculum* were found to be in good condition (Figs. 3-4). A doorway leads from the *triclinium* to an open space to the north, which is paved in square tiles. In the centre of this space is a rectangular pool paved with a mosaic of white tesserae, also in good condition and measuring 4 x 1.28 m (Fig. 3). This space is interpreted as the semi-open inner courtyard, or *atrium*.

Documentation and interpretation of the mosaics

The first figurative mosaic, at a level of 90.17 m above sea level, was excavated in an area extending 4.41 m along an approximately north-south axis, to a maximum width of 2.62 m, however the mosaic also extended to the western and southern sides, where it could not be excavated because of the presence of overlying walls. The exposed northern and eastern sides of the mosaic are well preserved, and here the connections to the walls can be observed. On this basis it can be observed that the outer part of the mosaic pavement consists of a pattern of framing white and black bands, and that the figurative panels are placed in the centre. The white band of the floor, between the wall and figurative panels, is paved with tesserae of varying sizes (Fig. 5): the outermost part, 25 cm in width, is paved with larger tesserae measuring 1-1.5 cm each (36 tesserae/dm^2); an inner band, 30 cm in width, is executed using smaller tesserae with dimensions ranging from 0.5 to 0.7 cm (113 tesserae/dm^2). In the inner part of the white band, 20 cm away from the figurative panels, is a bold black frame, composed of 5 rows of tesserae and measuring a total of 5 cm in width. The frame can be observed on the north, east and south sides of the central panels, but its presence was not confirmed on the western side due to the presence of the overlying wall. Within the white and black bands is a frame surrounding the figurative panels, 17 cm in width and

Fig. 5. Figurative mosaic M2, Room IV (from Pamir and Sezgin 2016, Fig. 11)

composed of tesserae from 0.5 to 1 cm, consisting of a simple guilloche without any interruption at the corners, using dark maroon, pink and two shades of yellow tesserae, in succession from the inner to the outer areas of the guilloche. Finally, a space of 5 cm between the guilloche frame and the three figurative panels is executed in white tesserae. The three figurative panels are immediately adjacent to one another and depict interrelated subjects concerning the *convivium* (Fig. 5). At the centre is a scene of a standing figure gesturing towards a sundial, representing the moment of deciding to join the *convivium*. The southern panel shows an African figure, but is largely destroyed. The northern panel shows a reclining skeleton holding a drinking cup, flanked by a container of wine and two loaves of bread.

Central panel with 'sundial' mosaic

The centre panel of the three figurative scenes, measuring 75 cm (north-south) by 96 cm (east-west), for a total area of 720 dm^2, used 181 tesserae/dm^2. A pale red frame 2 cm in width and 66 cm in length borders the scene at the top. There are no frame lines on the right and left sides of the scene, instead the white tesserae of the scene background continue in the mode of a frame: tesserae of the same white colour extend in parallel rows beyond the elements of the scene, creating bands of 5 cm to the right and 4 cm to the left of the panel (Fig. 6).

In the left of the scene is a sundial on a column, with Doric capital, executed in cubic orange tesserae. The semi-circular crescent of the sundial stands on the capital, supported by a triangular base shown represented by two single lines of black tesserae. The hours are depicted with sin-

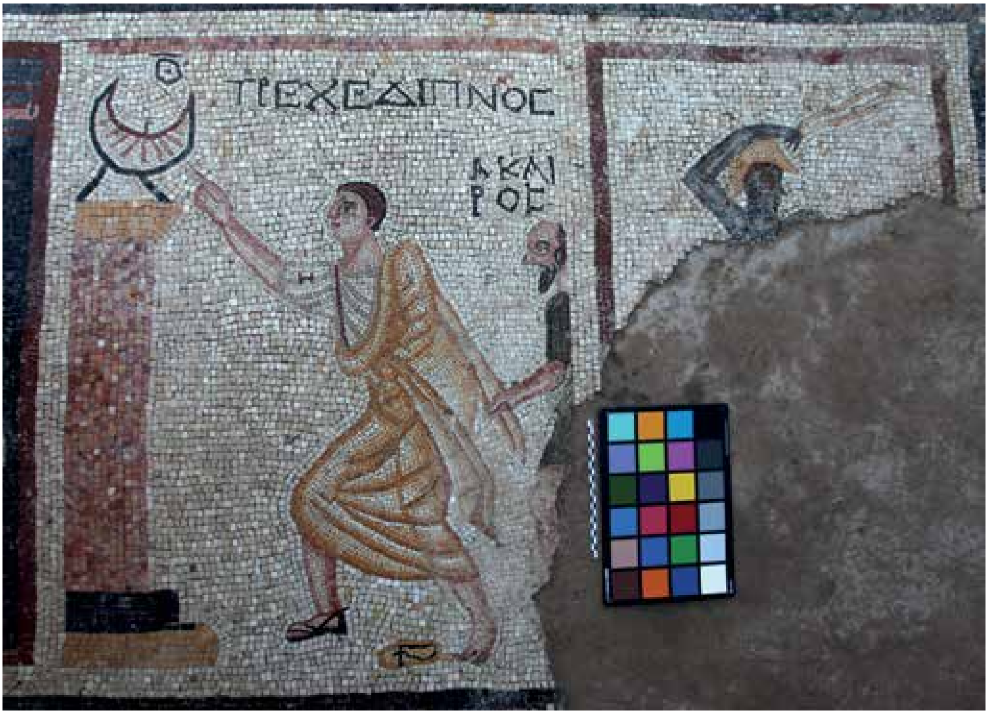

Fig. 6. Mosaic panels with sundial and African figure (from Pamir and Sezgin 2016, Fig. 12)

gle rows of light red tesserae. The Greek letter θ (Theta) with a line above, is depicted linearly with black tesserae above the sundial. In the ancient Greek alphabet the letter θ is the equivalent of number 9. The depiction of the sundial and Theta together symbolises the passing of the ninth hour and the imminent arrival of the tenth hour. In Roman daily life, the ninth hour was the third hour before the sunset, and marked the end of official and business activities (Salman 2009: 85; Kondoleon 2005: 187).

At the centre of panel, next to the sundial, is a short-haired, beardless young man wearing a light tunic with an orange/white/yellow mantle, thrown over his shoulder and draping around his chest and legs. The sandals of this figure are executed with rows of black tesserae and embellished in black and orange: he wears the sandal on his right foot, but that of his left has flown off. The figure stands facing the sundial in profile, raising his right hand and pointing at the ninth hour on the sundial with the forefinger. Above his head is the inscription TREXEDIPNOC (*Trechedipnos*), roughly translated as "run to dinner", however Menander (ca. 342-290 BC), the best known representative of Athenian New Comedy, used this phrase as an epithet, more precisely meaning "parasites who run to dinner" (Dunbabin 2003).

Immediately to the right of the "parasite" figure in the same central panel is a caricaturised male figure with bald head, black beard, large popped eyes and an ugly, oversized nose. This figure wears a green half-sleeved tunic with short skirt and steps forward, following the preceding male figure and holding the fluttering end of his mantle. Above the head of this second figure is the two-line inscription AKAIROC (*Akairos*; ill-timed, untimely). Such grotesque, bald, ugly figures are known from Hellenistic period sculpture, and in the mosaic panels depicting scenes from Menander's works are considered to represent servants or other comic figures (Dunbabin 2003).

The mosaic panel evidently depicts the belated request of a person who intends to join the *convivium* banquet, in a comical manner. The "parasite" figures, alarmed by the time on the sundial, are dressed nicely and rush towards dinner (Pamir and Sezgin 2016: 261).

Panel with African figure

To the south of the central panel is another panel of 58 cm width, preserved only in its eastern part (Fig. 6), depicting an African figure in the centre of a white background and encircled by a simple maroon frame of 2 cm width. The tesserae dimensions vary between 0.5-1 cm, with a density of 195 tesserae/dm^2.

The figure wears a round yellow hat with extensions to the front and back, and raises his right hand towards his head as he holds a yellow forked stick. African figures are often seen in antique mosaics as workers or slaves. An African fisherman figure, found in the Calendar House of Antakya and dating to the 2nd century AD (Levi 1947: 36-39), is seen with a similar yellow cap and double stick. Another African figure, found in the so-called North-South Baths of Timgad, on the threshold between two hot rooms, is shown walking with a shovel as he prepares to throw fuel on the fire (Dunbabin 1989: 42-43). African slaves are known to have been imposed with difficult tasks in the baths, such as tending the fire (Desanges 1976: 265). The hat of the figure in our mosaic certainly suggests the identification as some kind of worker. The time of nine hours indicated in the adjacent sundial mosaic was the moment for the activity of bathing in the Roman day (Salman 2009: 87), suggesting that the panel was probably a depiction referring to a bath context (Pamir and Sezgin 2016: 261).

Panel with skeleton figure

The rectangular figurative panel on the northern side, with an area of 96 cm x 65 cm and bordered by a frame of 2 cm width, is executed with a density of 135 tesserae/ dm^2 (Fig. 7).

The figurative theme is executed in white, black, yellow, red, beige, grey and green tesserae on a black ground. At the centre is a male skeleton with inscription at both sides of the skull. To the rear, at the skeleton's right, are two loaves of bread and a double-handled wine amphora with pointed base, standing on tripod base. The skeleton reclines leaning leftwards, resting his elbow on a pillow and holding a drinking cup in his left hand, the right arm raised above his head with the palm turned towards the ground. He relaxes with the left leg extended and the right leg leisurely crossed at the ankles. The depiction achieves a sense of depth through the placement of the amphora and bread in the background and skeleton in the foreground. At the top of the scene, the inscription EUΦPOCYNOC (*Euphrosynos,* from the root *euphro*) means "enjoy, having fun,

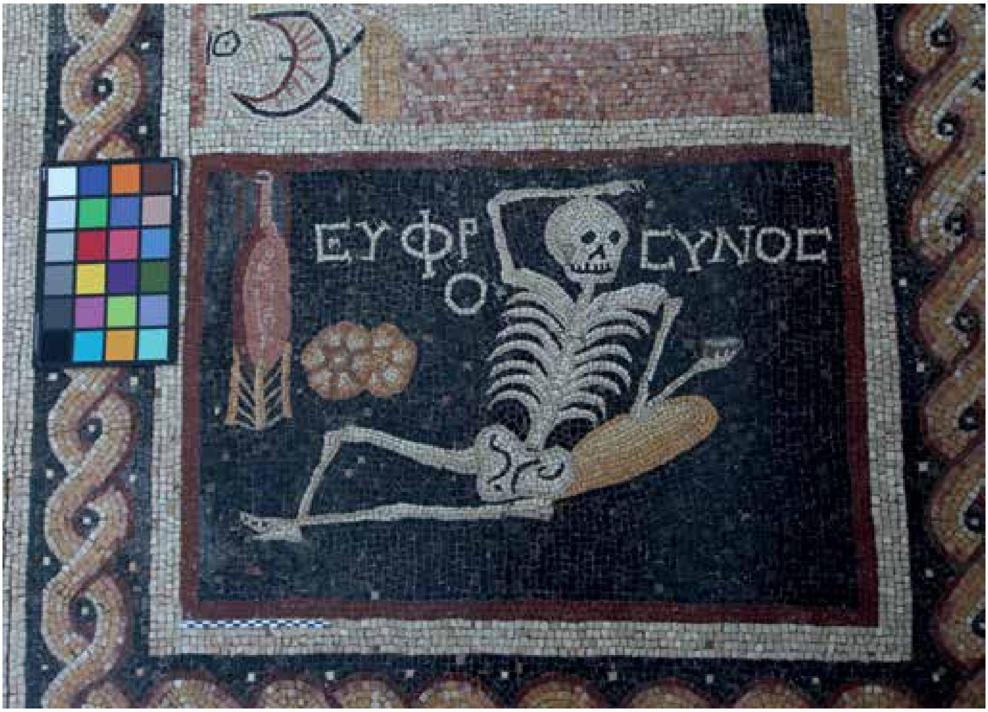

Fig. 7. Mosaic panels with sundial and African figure (from Pamir and Sezgin 2016, Fig. 12)

cheering up". The spelling of *Euphrosynos* identifies a male figure, corresponding with the masculine form of the skeleton, and indicates a command, truth, or expectation of the *convivium* guests and host.

The *convivium* was a custom shared by the elite throughout the Roman empire, in which the host joined with guests for the evening meal and relaxation, taken as they lay on cushions or beds. The depictions of death related to this tradition were intended to convey the joys, pleasures and beauties to be enjoyed in life, just as in the literature of the 1st century BC and 1st century AD, the poets Horace, Martial, Petronius and Pseudo-Virgil also emphasised the pleasures of life in the face of death. The depiction of the skeleton is one of the motifs used to illustrate this philosophical spirit, most often found in contexts related to banquets, feasts and consumption of wine. By the 1st century BC the skeleton motif had become so familiar as to be seen associated with parodies and new interpretations of the basic "eat, drink and be merry" (Pamir and Sezgin 2016).

The set of three panels thus deals with the themes of the *convivium* and bathing, both of which were important socio-cultural activities of the evening hours of Roman life, and seems to be inspired by the Athenian New Comedy (Pamir and Sezgin 2016: 262 ff). Surrounding the decisive moment of "a parasite attending dinner”, we see the bath theme in the figure of the African slave, and the *convivium* with the banqueting skeleton.

The Psyche mosaic

In 2016 the excavations were extended southward to reveal parts of the house covered by later construction. These works brought to light a small room featuring a further figurative mosaic pavement, in this case depicting a young woman in three-quarter view (Fig. 8). The woman

Fig. 8. Aerial view of the figurative mosaics (photo Hatay Arkeoloji Müzesi

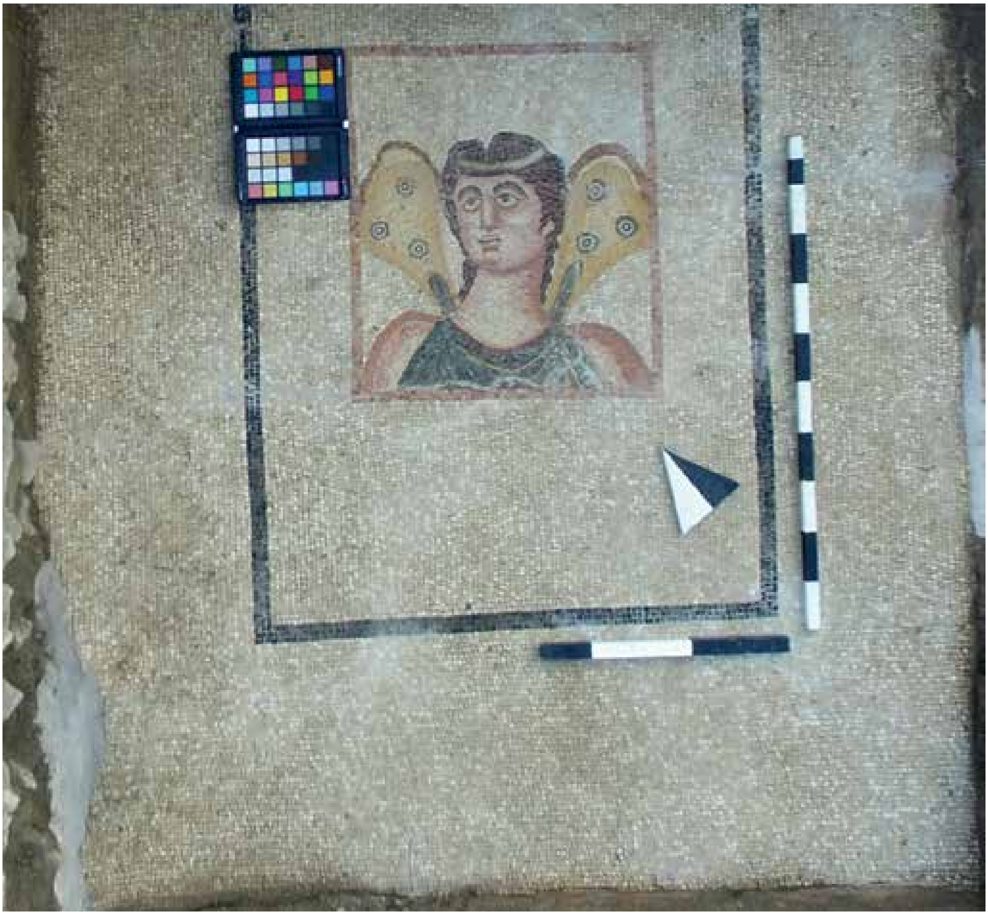

Fig. 9. Mosaic panel M3 with psyche (photo Hatay Arkeoloji Müzesi)

is shown wearing a dark blue tunic with *apoptygma*, with ribbons at the shoulders and wings emerging from each side. The wings are strongly outlined and decorated with circles, in which the dot-like centres create stylised eyes. She turns her head slightly to the right, where she also directs her gaze. Her long dark hair, capped by a corona, is gathered at the back of her head (Fig. 9).

In the mosaics of Antioch, winged female figures are usually considered to be the representation of Psyche (Levi 1947: 159, 176, 208; Cimok 2000:136, 159). In the House of the Drinking Contest in Seleucia, the wings of Psyche are decorated with human eyes. In the House of the Boat of the Psyches, discovered in Daphne, the many psyches are naked and have wings similar to those of a butterfly (Levi 1947: 176; Cimok 2000: 159). Psyche figures were common in Hellenistic art, and although the Roman depictions may show the psyche in different postures, they are still regarded as a reflection of the earlier tradition. The iconography and style of the figurative panel excavated in 2016 are consistent with those popular in the mosaics of Antioch throughout the 3rd and 4th centuries.

Conservation concerns and potential exhibition of the mosaics

The emergence of these mosaic floors was an unplanned outcome of the construction of the funicular station, and raised a series of problems concerning their conservation and potential exhibition. Once the significance of the finds had become clear, and following consultation with the Department of Antiquities, the entire excavated area was placed under temporary protection. During the 2010-2013 campaigns the main part of the mosaic floors and surroundings were excavated, architectural and topographical plans of the area were prepared, the mosaics were cleaned and then the floors were buried using a sequence of layers: first a geotextile, then a 20 cm layer of freshwater sand, a plastic mesh and a layer of 10 cm diameter stones. The second excavation activity was carried out in 2016 as a short rescue campaign to remove the overlying walls and gain more complete understanding of the house structure and mosaic floors. When the reburial layers were removed, there were no traces of deterioration of the fabric or incursions by vegetation. Once the second excavation campaign had revealed the continuation of the *triclinium* floor and the psyche mosaic, the mosaics and excavations were fully documented and published (Pamir and Sezgin 2016). All of the floors were then covered and reburied using the same techniques as previously, awaiting a final administrative decision on the conservation and exhibition of the excavated area and its mosaics, once again in consultation with the Department of Antiquities.

However, since the house floor and the entire excavated area are deep below the present street level, they are effectively situated at the bottom of a deep trench. The soil profiles on the sides risk collapse due to the pressure of heavy traffic, modern construction and rain-driven erosion. The side walls of the area are currently protected by reinforcement using steel mesh and dry stone masonry, without mortar or cement.

The future of the site is being discussed and evaluated prior to the implementation of urgent protective measures for the mosaics. The outstanding issues regarding the protection of the mosaic floor and its *in situ* exhibition can be summarised as follows.

– The request still remains in effect for construction of a funicular station on the area.
– The archaeological remains are 4.4 m below contemporary surface level, meaning that modern construction and heavy traffic put pressure on the soil profiles.
– The remains are within a sloping area, exposing them to further risks including flooding.
– The remains pertain to different phases and are found at different levels, representing a series of construction events.
– The boundaries of the archaeological remains are undefined, since they continue under the stratigraphy descending from the surrounding surfaces.

The initial opinion of the scientific committee was that under these conditions, it would be impossible to preserve the mosaic pavements in their original locations, and that they would have to be removed and exhibited in a museum. However it was also observed that the removal of the mosaics would then imply the abandonment and loss of the architectural context to reburial. This choice would still require modification of the modern construction activities and would above all mean the loss of the architectural and environmental context for the detached mosaics.

The case of these mosaics in Antakya is not unique, and in fact modern construction works in multi-layered cities quite frequently encounter serious problems due to the presence of underground sites. These particular mosaics are important examples which obviously require immediate protective measures. The responsible scientists and authorities have observed that if *in situ* conservation principles can be applied successfully in this case, it would serve as a model for the preservation of mosaics, for potential reapplication in other multi-layered urban contexts. The most recent opinion of the responsible committee and the Antiquities Department has been one of greater vision, providing for the potential preservation of the architectural remains in a museum context, *in situ* within the funicular station, at which point there would also be the hoped-for provision for conservation and exhibition of the mosaic panels in their original context.

References

Cimok F. 2000. *Antioch Mosaics*. Istanbul: Tourism Media Group.

Desanges J. 1976. "L'Iconographie du Noir dans l'Afrique du Nord antique". In *L'image du Noir dans l'art occidental I*, edited by J. Vercoutter, J. Leclant, F.M. Snowden, J. Desanges, 246-268. Fribourg: Gallimard.

Dobbins J.J. 2000. "The Houses at Antioch". In *Antioch the Lost Ancient City*, edited by C. Kondoleon: 50-61. Princeton: Princeton University.

Dunbabin K.M.D. 1989. "Baiarum grata voluptas: Pleasures and Dangers of the Baths", *Paper of the British School at Rome 57*, 1989: 6-46.

Dunbabin K.M.D. 2003. *The Roman Banquet: Images of Conviviality*. Cambridge: Cambridge University.

Kondoleon C. 2005. "Catalogue: Mosaic of Dionysos and Ariadne". In *The Arts of Antioch, Art Historical and Scientific Approaches to Roman Mosaics and a Catalogue of the Worcester*

Art Museum Antioch Collection, edited by L. Becker and C. Kondoleon: 182-189. Worcester: Worcester Art Museum.

Levi D. 1947. *Antioch Mosaic Pavements,* Vols. I-II. Princeton: Princeton University.

Pamir H. and Sezgin N. 2016. "The Sundial and Convivium Scene on the Mosaic from the Rescue Excavation in a Late Antique House of Antioch." *ADALYA,* Vol. XIX: 251-281.

Salman B. 2009. "Mozaikler Üzerinde Güneş Saati Betimli Sahneler - Hatay Müzesi'nde Yer Alan İki Parça ve Diğer Örnekler Üzerine Araştırmalar." *JMR* 3: 83-93.

Stillwell R. 1961. "Houses of Antioch", *Dumbarton Oaks Papers,* Vol. 15: 45-57.

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SESSION VII: CASE STUDIES

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Dora Catalano
Roberto Ciabattoni
Lucia Conti
Daniela Gennati
Valeria Massa
Laura Medeghini
Fabiana Moro
Angelo Rubino
Giancarlo Sidoti
Mauro Torre

Laura Lara
Sílvia Llobet
Josep Maria Llorens
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Agustín Gamarra Campuzano
Eduardo Porta

Francesca Guiducci
Kristian Schneider

Maja Francović
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Ioanna Doganis
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Marina Piranomonte
Anna Borzomati

Bhawna Dandona
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TREATMENT OF THE ANTIQUAILLE MOSAICS IN LYON, CONDUCTED BY THE ATELIER FOR MOSAIC AND WALL PAINTING RESTORATION OF SAINT-ROMAIN-EN GAL

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Abstract

Between 2000 and 2014, the Atelier de restauration de mosaïques et d'enduits peints carried out a series of conservation-restoration interventions concerning the structural complex of the former Hospital of Antiquaille on the slopes of the Fourvière Hill in Lyon. The redevelopment program intented for the historic structures led to conservation operations for a complex of 19th century mosaics covering some 140 square metres of vault and wall surfaces of the crypt below an ancient convent. The area subject to the modern renovation project had been occupied since the Augustan period in the Roman era, and archaeological excavations conducted prior to the renovation program uncovered the remains of floors executed in various techniques, including *opus tessellatum*, *signinum* and *spicatum.* The current report provides an overview of the different types of treatments applied to ensure safeguard and display of all these mosaics: *in situ* conservation, but also removal and re-backing on new supports before remounting *in situ*, and for some of them, to museum exhibition.

Keywords: mosaics, nineteenth century, Antiquaille, removal, re-backing

The site of Antiquaille and the mosaics of the crypt

In the early years of the 16th century, on Fourvière Hill overlooking the Saône River, the humanist Pierre Sala built his country residence. Having discovered the site to be full of Gallo-Roman remains, he named his new house "*Antiquaille*". The area had in fact been the site of the Roman *colonia* of Lugdunum, established on the hill in 43 BC, and the building of 1508 included some Roman vaults, certain of which are now still visible after several transformations. In the 17th century the original residence was converted into a convent occupied by the Visitandine nuns. In 1792, following the French Revolution, the domain became a national property and was converted into a hospital, functioning from 1804 to 2003. The history of the hospital included significant service during wartime, particularly the First World War [1], during which the hospitals of Lyon hosted some 200,000 wounded or sick soldiers (Mornex *et al.* 2003).

In 2003 the hospital was closed and the property was turned over to the Société Anonyme de Construction de la Ville de Lyon (SACVL), which developed a new program for the Antiquaille, including demolitions, renovation and new construction, for development of housing, offices, a hotel and restaurants. Included with this was planned the creation of a space dedicated to the history of Christianity, with a particularly local focus. These functions were to be largely inserted in the former convent chapel and crypt [2].

The floors, walls and vaults of the crypt are covered with mosaics executed in the late

Fig. 1. Detail of crypt before mosaics treatment: photo Atelier de restauration de mosaïques et enduits peints de Saint-Romain-en-Gal (ARM)

19th century, representing the martyrdom of the first Christians of Lyon in 177 AD. Among these was Pothin, the city's first bishop, considered by tradition to have been imprisoned in the so-called "*Cachot de St-Pothin*", at the basement level of the convent and also included in the museum of Christianity.

The martyrs are seen in procession in seven panels covering the walls. The panel of the west wall contains a niche with mosaic of the Virgin and child in *orans* position. The panel surrounding the niche shows Marcellus and Valerianus blessed by the hand of God, as they escape martyrdom taking with them the story of the persecution [3]. The vaults and intrados are decorated with geometrical and vegetal motifs. All of the mosaicists were of Italian origin. The first of these were Ennemond Mora and his son Claudius, of a family originally from Sequals in Friuli [4], working between 1887 and 1891 from drawings by the painter Gaspard Poncet. Following these was Ange Minala, between 1891 and 1893, working from drawings by the painter Claude Barriot. Executed in glass tesserae, the mosaics cover a total of 95 m^2 of vault surfaces and 45 m^2 of walls.

At the time of redevelopment of the Antiquaille properties most of the mosaics showed obvious and numerous deteriorations, stimulating the planning for their conservation (Fig. 1).

Diagnostic survey and proposed intervention, 2004

The diagnostic survey of the mosaics was commissioned by the SACVL in 2004, in the context of the larger renovation project. The agency selected for the survey and subsequently for the conservation-restoration interventions was the Atelier de restauration de mosaïques et d'enduits peints of the Museum of Saint Romain-en-Gal [5].

The first step was to prepare plan, elevation and section views of the crypt and its mosaic installations, then on these to record all the alterations, of which the most visible were the areas of complete loss, in particular on the vaults. The main cause of deterioration has been water infiltration from the open-air cloister, situated immediately above the crypt. The water has saturated the masonry and mortar, leading to oxidation of the nails and wire grids which constitute the mosaic hanging system. This caused the swelling of the iron and the further break-up of the mortar, resulting in considerable losses of tesserae. The action of the moisture had also developed saltpetre over large areas. All of these factors had resulted in significant damages to the mosaic panels (Figs. 2-3).

Given the observations of the damages and causal factors, we prepared a proposal for a conservation program:

– *To lift the mosaics which were almost detached and presented numerous missing tesserae*. This action was to be carried out on the panel with the Virgin and escaping saints, of the west wall: the one most exposed to the infiltrations from the cloister, but also to moisture accumulating behind the wall as it descends from the upper part of the Fourvière Hill. The same action was also proposed for the mosaics of three of the vaults. The fourth vault, as well as the remaining walls, had been repaired during the modern era using extremely hard concrete, which would have been difficult to be remove without damaging the mosaics and were therefore better left without detachment.

Figg. 2-3. Details of mosaic alterations (photo ARM)

– *To temporarily maintain the rest of mosaics in situ, for restoration operations at the closure of the construction works.* The mosaics of the fourth vault, floors, columns and three remaining walls would thus be protected by textile coating and plywood panels, while awaiting future restoration operations.

REMOVAL OF ONE WALL AND THREE VAULT MOSAICS, 2006

The removal operations were conducted in 2006, subsequently to the approval by the SACVL. The first step was to apply the protections to the floor mosaics, columns and marble veneers. The limited size of the crypt entrance (60 cm in width) dictated the maximum dimensions of the pieces to be lifted. Given this constraint, the mosaics of the west wall were removed in 13 sections totalling 6 m^2 and the vaults in 126 sections totalling 70 m^2. The operations were rendered more difficult due to the confined spaces of the crypt, which were very stuffy during the especially hot summer of 2006. The work was conducted by a team of four conservators over two months [6]. All the surfaces to be removed were first cleaned and then faced with cotton textile and vinylic adhesive soluble in ethanol. The facing was then cut along pre-planned lines, established with respect to the decorative composition, and the detachment was carried out using chisels and iron bars. Each of the 139 detached pieces was laid on a lifting table (Fig. 4) and then individually transported to the crypt exterior, where it was prepared for transport to the atelier. There, the 126 curved mosaic pieces were placed on wooden supports, specially built to precisely reproduce the forms of the ceiling (Fig. 5). The mosaics then remained in storage until the atelier received authorisation for their restoration, in 2008 [7].

Fig. 4. Removal of vault mosaics (photo ARM)

Fig. 5. Storage of vault mosaics on curved wooden supports (photo ARM)

RE-BACKING AND SURFACE TREATMENTS, 2008 TO 2011

The first step was to remove the modern concrete, where present, and the original mortar from the rear of the *tessellatum* (Fig. 6). The west wall mosaics were re-backed on six aluminium honeycomb panels, using standard techniques. Particular caution was necessary in the areas of the saints' halos, due to the weakness of the glass cabochons enhancing in re-

Fig. 6. Reverse side of *tessellatum* after assembly of modules composing a vault quarter (photo ARM)

Fig. 7. Beginning of assembly of a vault in the atelier (photo ARM)

Fig. 8. New mosaic support of the vaults seen from above, subsequent to re-backing (photo ARM)

lief. Glass tesserae were otherwise in good condition.

The three-dimensional character of the vault mosaics imposed a different re-backing technique. Following testing, the process selected was to mount the *tessellatum* on a stratified system of fibre glass and epoxy resin reinforced with thin stiffeners carved in extruded polystyrene, in long elements with triangular section. This new backing was in all cases prepared in the same thickness as the previous mortar,

for correct remounting in the original position. The small crypt entrance size again dictated that the re-backed pieces would be of small dimensions: each quarter of a vault was mounted in three modules making a total of 36 elements plus 4 intrados pieces, all to be assembled using a system of screws [8] (Figs. 7-8).
After these re-backing operations, the front surfaces of the modules were treated: removal of the textile coating with alcohol; cleaning; replacement of detached tesserae along joints between *tessellatum* modules. The large lacunae were temporarily left as they were, allowing for treatment following reinstallation in the crypt.

Treatment of Roman era pavements, 2011-2014

Meanwhile, given that the overall Antiquaille renovation program was to include demolitions and new construction, including development of an underground car park, it had also provided during preliminary archaeological investigations, for purposes of salvage, protection and increased knowledge of the Roman occupation on the slope below Fourvière hilltop, which was the heart of *Colonia Copia Felix Munatia Lugdunum*, founded by Plancus in 43 BC. The excavations of this phase, conducted in 2011-2012 by the Service Archéologique de la Ville de Lyon [9] revealed the remains of a *domus* developed between the 1st and 2nd century AD (Hoffmann 2018), including pavements of different types, among which *opus spicatum*, cement with embedded coloured stone, *opus tessellatum*, with *crustae* in limestone and white marble, some of which with ancient repairs in *signinum*. The centuries of occupation and construction in the area had disrupted the ancient levels, and the excavated pavements were therefore incomplete and highly fragmentary.
The floors were documented *in situ* and the fragments were then removed using a system of rigid expanded polyurethane foam, in particular for the pavements in cement. All the fragments were then re-backed on aluminium honeycomb panels, for purposes of long-term preservation in the collections the Lugdunum Museum in Lyon. The curator responsible for these operations viewed these recoveries as particularly useful for correcting the mistaken impression that the houses of antiquity were paved exclusively in mosaic, and for this reason staged two exhibitions in 2012 and 2015 [10] to communicate the full range of systems to visitors who would not usually see them in a museum setting. The exhibitions drew on the excavated fragments from Antiquaille but also from other sites of Lyon.

Re-installation of detached mosaics and final treatments, 2012-2014

Early 2011, the mosaic vault structures were reassembled in the atelier, for verification and final adjustment of the fit between the different modules and preparation of the remounting system. Over the course of several months the entire workshop seemed transformed into the Cachot de St-Pothin. Meanwhile, the crypt was subject to structural renovation, including cleaning of the masonries and installation of barriers against water infiltration under the flooring of the cloister.
The remounting operation was carried out in 2013 (Fig. 9). The modules were fixed to the west wall and vaults in reversible manner, using a system of height ad-

Fig. 9. Reinstallation of re-backed modules in the crypt (photo ARM)

Fig. 10. Re-fitting a lifted fragment on lime mortar (photo ARM)

justable screws inserted in the masonries, which support the modules at a distance from the underlying structures. The final tesserae still missing along the inter-module joints were then replaced. All of this work required very precise adjustment at a monumental scale. The bulk of this demanding installation work was carried out by two restorers over the course of two months, with the final linking operations requiring the presence of the whole team [11].

The final step for the atelier team was to treat the mosaics that had been left *in situ*: removal of the protective facings; lifting of the areas of *tessellatum* swollen by rusting of the underlying nails; removal of the nails; application of lime mortar and remounting of the *tessellatum* (Fig. 10); surface cleaning.

Treatment of missing areas

Our proposal submitted in 2004 had been to fill the large lacunae in a manner similar to that used for ancient mosaics, using mortars of different shades and with application of incised lines in keeping with the original decorative patterns. To our dismay, just as we were about to commence this operation, the site administrators decided that the mosaics should instead by completely "restored", by means of filling the lacunae with new glass tesserae.

Since our own atelier would not carry out this work, it was instead done by a mosaicist of Marseille who is the descendant of a family originally from Friuli [12]. Our feelings of frustration were reduced by this sort of continuity of the tradition of the Italian mosaicists from Sequals, extending not only to Ennemond Mora, but also to 19th-century artisans such as Isidore and Vincent Odorico, and before them Giandomenico Facchina. So, in a certain way, things have finally come full circle.

Conclusion

Following completion of the entire conservation-restoration program, the crypt was re-opened to the public on 7 September 2019 [13].

The fragmentary Roman pavements, transferred to their new supports, are now safely preserved in the Lugdunum Museum stores and are used in temporary displays. However the preservation of the crypt mosaics cannot be considered fully complete. The sections that were removed and re-backed are protected by the modular structure against infiltrations of moisture, and in case of necessity the modules can be readily dismounted for temporary removal. For the sections that were treated *in situ*, the processes causing the oxidation of the iron nails will of course continue, and there must be provision of continuous monitoring and maintenance, with further action when necessary.

Notes

1. Jean Lapouge (1891-1968), grandfather of the corresponding author, was treated in the Antiquaille hospital over a period of several months in 1916, after losing his right arm due to a shrapnel blast in Verdun.
2. The project for the Espace Culturel du Christianisme à Lyon (ECCLY) was assigned to the Lyon architect Pierre Vurpas and conducted under the authority of Didier Repellin, Chief Architect for Historical Monuments. The crypt renovation was planned and conducted by Laurent Volay, director of Archipat, a firm specialised in heritage architecture.
3. The events of the martyrdom were recounted in *The letter of Christians from Lyon and Vienne to their brothers in Asia and Phrygia,* as transcribed by Eusebius of Caesarea in his *Ecclesiastical History*, Book V chapter 1, at the beginning of the 4th century.
4. Antonio Mora, originally from Sequals, founded the Maison de la mosaïque in Nîmes in 1850. The family prospered throughout the south-west of France over more than a century, working in both creation and restoration of mosaics for private and public buildings. Antonio's son Francesco became a specialist in restoration of Roman pavements. Ennemond worked primarily in Lyon, and is known above all for the crypt of the Church Saint-Nizier, the Basilica of Fourvière and the crypt of Antiquaille.
5. The "Atelier for restoration of mosaics and wall paintings" was founded in 1981, with the aim of safeguarding and enhancing the mosaics of ancient Vienne and the area of Lyon, and as a preparatory step to opening the Gallo-Roman museum of Saint-Romain-en-Gal. The Atelier is a unit of the Museum operating under the authority of the Departement of Rhône, with a team of 5 conservators and a vast designated space within the museum. Since 1981 the Atelier has assumed a nationally leading role in this area of conservation-restoration.
6. The team for mosaic removal was composed of Christophe Laporte, Marion Hayes, Andréas Phoungas and Maurice Simon.
7. The conservation-restoration operations were commissioned by the ECCLY, with financial support from private individuals, companies, associations and public authorities (Département du Rhône, Fondation Saint-Irénée and DRAC Rhône-Alpes), under the authority of the Department of Conservation of Historical Monuments.
8. All re-backing systems were developed and implemented by Christophe Laporte, who also conducted the surface treatments with the participation of Hannah Neumann and Astrid Maréchaux.
9. The excavations were conducted by Etienne Hofmann, Archaeologist and Associate researcher.
10. The pavements were lifted by Evelyne Chantriaux, Andréas Phoungas and Alain Wagner; subsequent treatments were carried out by Andréas Phoungas with the participation of Julie Cosson. The two exhibitions were: *Les sous-sols de l'Antiquaille*, 16 May-30 November 2012, and *Ma maison à Lugdunum*, 5 June 2014-5 January 2015, both under the direction of Hugues Savay-Guerraz, Curator and Director of the the Lugdunum Museum in Lyon.
11. The installation was by Christophe Laporte and Alain Wagner; surface treatments by Christophe Laporte, Marion Hayes, Andréas Phoungas, Maurice Simon, with the participation of Léa Rocourt.

12. The mosaic infills were executed by Michel Patrizio, grandson of Ettore Patrizio, originally of Sequals, who in 1903 founded a mosaics atelier in Marseille with his brothers Dante and Camillo. Philippe Mercoiret participated in this work and later joined the Saint-Romain-en-Gal team.
13. Since the inauguration, ECCLY has received the 2018 Citoyens du patrimoine prize from the town of Lyon, for the work carried out on the mosaics of the crypt of Antiquaille.

References

Hoffmann E. 2018. “Les *domus* de l’îlot central de l’Antiquaille (Lyon 5e, 2011-2012)”. In *Lugdunum et ses campagnes: actualité de la recherche, Actes de la commission des antiquités régionales du XVIIe congrès international de l’association Guillaume Budé*, Lyon, 26-29 août 2013, edited by François Bérard and Matthieu Poux. Drémil-Lafage: Editions Monique Mergoil (coll. Archéologie et histoire romaine, 38).

Mornex R., Ducouret B., Faure O. 2003. *L’Antiquaille de Lyon, Histoire d’un hôpital.* Lyon: Lieux Dits.

Authors

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The corresponding author graduated in architecture in Paris, then specialized in conservation-restoration. In 1980 she entered the Conseil Général du Rhône, where she was charged with establishing the Atelier de restauration de mosaïques de Saint-Romain-en-Gal. She has conducted numerous conservation-restoration works in France and abroad and was a member of the board of ICCM from 1986 to 2017.

Christophe Laporte

After studying archaeology and art history at the University of Lyon II, he entered the Atelier de restauration de mosaïques de Saint-Romain-en-Gal in 1983, where he has since been a leading actor in most conservator-restoration works. He has been a member of ICCM since 1987.

Marion Hayes

Holds a master’s degree in Conservation-restoration of cultural properties from the University of Paris I Panthéon-Sorbonne. In 1987 she entered the Atelier de restauration de mosaïques de Saint-Romain-en-Gal, where she is a senior conservator contributing to many projects.

RESTORATION AND CONSERVATION OF THE MOSAICS IN THE CAETANI CHAPEL, CHURCH OF SANTA PUDENZIANA (ROME): FIRST OBSERVATIONS

Dora Catalano, Daniela Gennari, Valeria Massa, Fabiana Moro, Roberto Ciabattoni, Lucia Conti, Laura Medeghini, Angelo Rubino, Giancarlo Sidoti, Mauro Torre

Abstract

The architectural decoration of the Caetani Chapel in the Church of Santa Pudenziana in Rome represents one of the most significant late-16th century artistic expressions of Rome. The wall mosaic, produced by Paolo Rossetti between 1593-1595 based on a sketch by Cesare Roncalli, contribute to the creation of a unified and extremely refined space. The recent conservative intervention concerned the mosaic surfaces of the lunette and the three panels on the vault of the chapel entry. This experience obtained significant data on the general application of mosaic techniques in Rome in the late-16th to early-17th centuries, and in particular about Rossetti's technique of execution, testifying to the skilled use of materials other than tesserae, inserted in a bedding layer of oil-based stucco. The current contribution provides the first observations on the constituent materials, techniques of execution, conservative problems and intervention methodologies.

Keywords: oil-based stucco, Paolo Rossetti, techniques of execution, 16th and 17th centuries, wall mosaic

Introduction

The mosaics of the Caetani Chapel pertain to an overall decorative project applying various artistic techniques with great skill: the mosaics, wall decorations in precious marbles, marble sculptures, bas-reliefs and gilded stuccos are expressed in a unitary language, conferring the chapel with a sense of great quality and elegance. The mosaics take the place of the more usual fresco painting in the rib-vaulting, the lunette of the counter-façade, and to the sides of the windows, serving to unify one of the greatest complexes of architectural decoration of late-16th century Rome.

The large chapel was commissioned by Cardinal Enrico Caetani (1550-1599) towards the close of renovation works on the early Christian church of Santa Pudenziana, in 1586, and adheres to the dictates of the counter-reformation (Fig. 1). The works began in 1588 under the direction of the architect Francesco da Volterra, and were carried out by some of the main artists then present in Rome, including Giovan Battista Della Porta, author of the polychrome marbles of the altar facing, and Pietro Paolo Olivieri, creator of the marble altarpiece itself. Archival sources refer to Stefano Fuccari and Ambrogio Buonvicino for the refined stuccoes in the chapel. Inserted in these are the mosaics, executed between 1593 and 1595 by the artist Paolo Rossetti, based on a design by the painter Cristoforo Roncalli, also known as Pomarancio (Cozzi Beccarini 1975, Parlato 2009, Braconi 2013). The subjects refer to the story of salvation with images of prophets, sibyls and evange-

Fig. 1. General view of the Caetani Chapel (photo A. Rubino, ©ISCR)

lists. The large lunette recalls the theme of martyrdom, depicting sisters Prassede and Pudenziana as they gather the bodies and blood of the suffering Christians.

Paolo Rossetti can be considered one of the main artists responsible for the late-16th century revival of mosaic techniques in Rome, and was a member of the team of masters who eventually set up the Vatican mosaic studio. He was born in the town of Cento, near Ferrara, and arrived in Rome around 1578-1579, during the pontificate of Gregory XIII of the Boncompagni family of Bologna. He immediately joined the papal worksites, including the Gregorian chapel in the Basilica of Saint Peter guided by Girolamo Muziano and Cesare Nebbia. The decoration of this chapel marked the return to Rome of large-scale wall-decoration mosaics, resulting in a strong revival with renewed interest in figurative depictions of early Christianity, in keeping with the recommendations of the Vatican Council. Rossetti's biographer Giovanni Baglione (1662: 169-170) reported that while working at St. Peter's, the artist experimented for the first time with the "*maniera di lavorar musaici con oglio*", gradually becoming a specialist in the new technique of mounting the tesserae with a lime-based stucco containing powdered travertine mixed with raw and cooked linseed oil, which has otherwise generally been attributed to Girolamo Muziano.

In 1584 Rossetti was in Orvieto, for execution of the mosaic image of the resurrection on the cathedral dome, designed by Cesare Nebbia (Cannistrà 2010). Following that he was again in Rome for further projects. At the same time as working on the Caetani chapel he also created the mosaic altarpiece for the Chapel of Santa Catarina in the Church of Santa Maria di Loreto [1], commissioned by the confraternity of bakers, signed and dated 1594. Between 1598 and 1599, under Pope Clement VIII, he was again at St Peter's for creation of the mosaic decorations of Michelangelo's dome, and then in the Clementine Chapel.

Techniques and materials of execution

The mosaics and stuccos laboratory of the Istituto Superiore per la Conservazione ed il Restauro conducted a conservation-restoration project for some of the mosaics of the Caetani Chapel over a period of around three months in 2015-2016, as part of the didactic exercises for students of the institute's advanced degree program. The project concerned the mosaic panels on the wall of the counter-façade and a portion of the white and gilded stucco cornices with detail in high relief, serving towards planning a future restoration project of the vault, as shown in figures 2 and 3.

Fig. 2. Parts of the architectural decoration subject to the current project: in red the mosaics, in blue line the stuccos (photo A. Rubino, © ISCR)

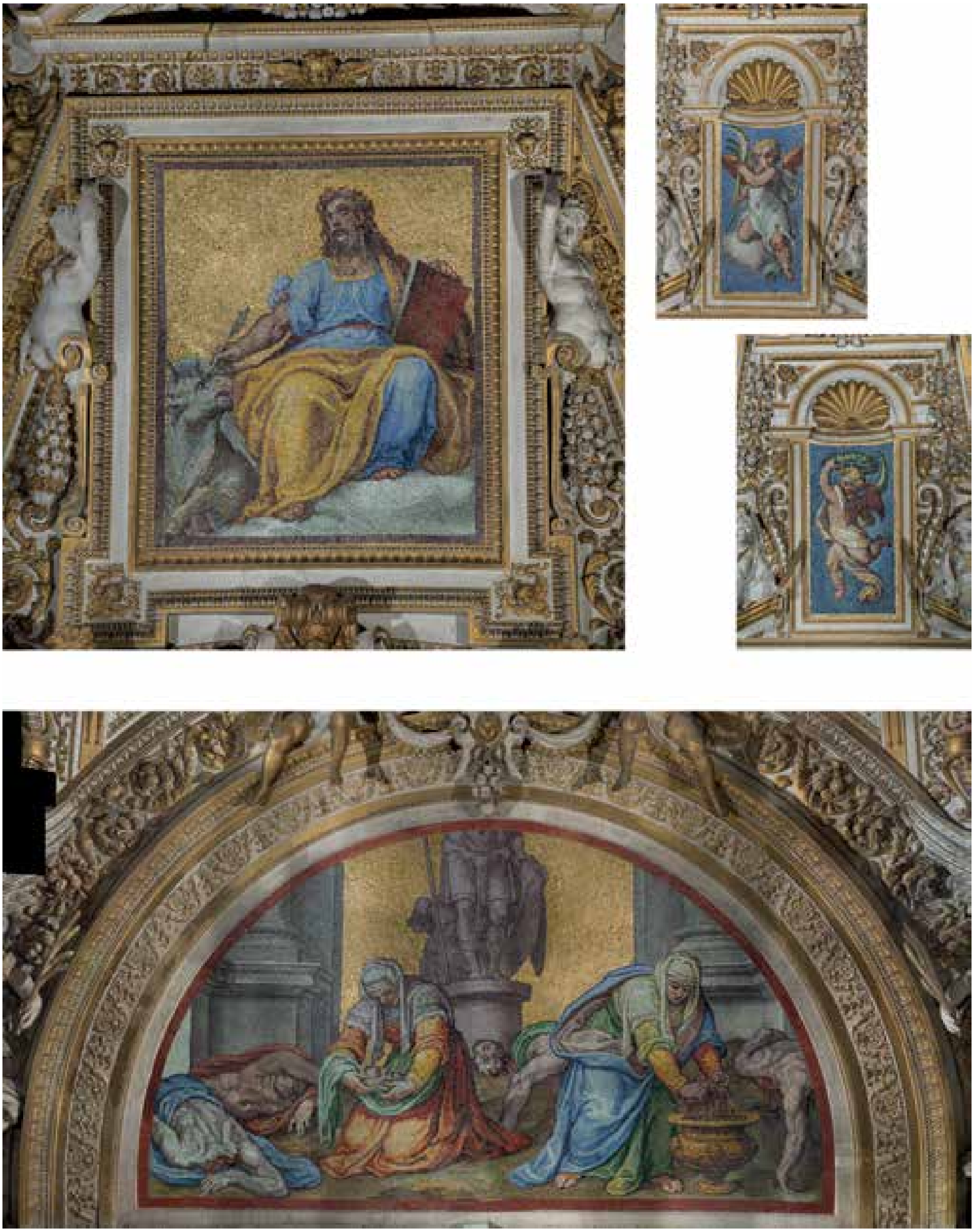

Fig. 3. General view of mosaics after treatment (photo A. Rubino, ©ISCR)

The project provided an opportunity for research and insight into the execution techniques for mosaics on an oil-stucco bedding layer dating to the late 16th century. Careful observation of the surfaces revealed certain technical peculiari-

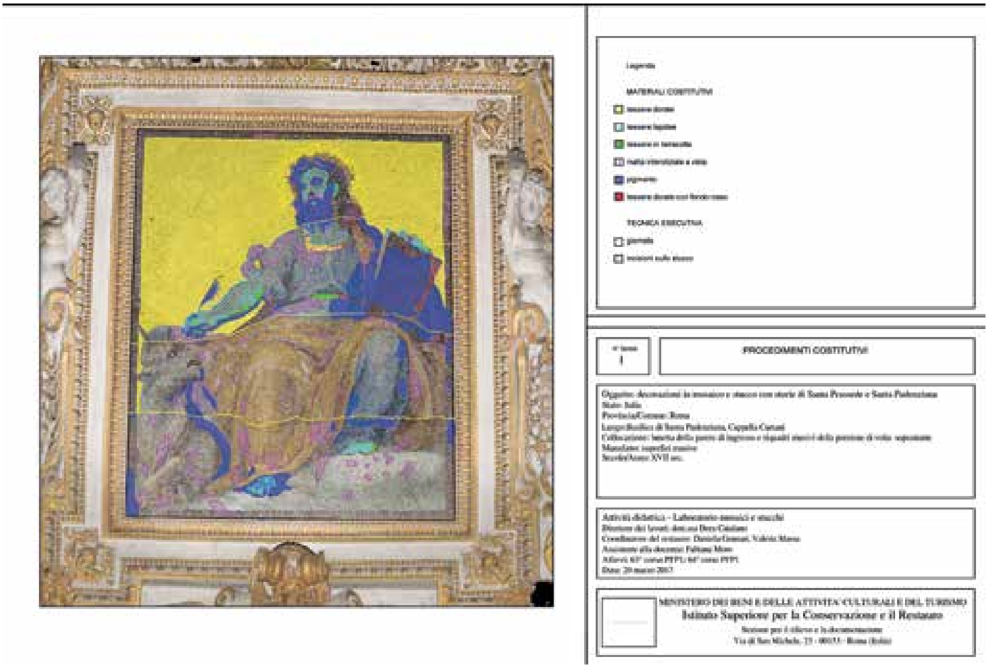

Table 1. Graphic documentation: constituent materials (table prepared by F. Moro, ©ISCR)

ties that could be compared with historical documentation and other sources on mosaic art of the period (Borghini 1584: 469-473, Baglione 1642: 160), in order to advance new ideas about the execution procedures.

The mosaic layer was mounted directly on an oil-stucco layer approximately 3 cm thick. The mosaic layer features a wide variety of materials (see Table 1) with substantial use of coloured glass paste and metallic foil, mostly gold leaf, mainly in the chromatic rendering of the various scenes (Fig. 4). The chemical composition suggests a classification as lead-silicate glass, opacified with tin compounds, containing variable amounts of lead and tin oxides.

The yellow colour of tesserae is due to the presence of lead stannate. The orange colour is related to the presence of cuprite (Fig. 5). As seen in figure 5, some tesserae show one or more black edges due to cuprite oxidation to tenorite during cooling of the melt. The red colour is associated with the presence of copper, iron and manganese, while manganese is also responsible for the violet colour of tesserae. The blue colour is due to a very small percentage of cobalt. Gold and silver lamina tesserae are present in the mosaic.

The gold leaf tesserae are made of a siliceous glass without lead, and the analyses detected the use of pure gold alloys. The different visual effects of gold achieved in the mosaics panel of Saint Luke and in the lunette are related to technical specificities, such as variation in the shape and size of the tesserae and the use of different shades of vitreous substrates. In the panel of Saint Luke, the substrates range from

Fig. 4. Detail of tesserae types: brick, stone, different colours of vitreous paste, metallic foil (gold and silver) (photo A. Rubino, ©ISCR)

dark green to almost transparent black, giving the surface a cool hue, whereas in the lunette the substrate is opaque red with very thin metallic leaf which instead in a general warm tonality.

The head-covering of one of the two saints is very sophisticated, made by interspersing opaque white tesserae with others in silver lamina against a transparent turquoise background. A similar technical device of alternating clear and dark tesserae, known as the 'chequered effect', is also used to achieve chromatic shifts in areas of the lunette.

The study carried out on the vitreous pastes evidences the use of a palette with a wide range of colours, used to achieve shaded tones through selection of con-

Fig. 5. Photomicrographs of representative yellow and orange glass tesserae (photo G. Sidoti, ©ISCR)

trasting hues and complementary colours, and lively tones such as blues, yellows, green, the orange hue known as "*giuggiolino*", and the purple colour "*paonazzi*", with the overall result being that of the mosaic version of the shimmering effect and bold brush-strokes of the Mannerist painter's palette. The use of the vitreous pastes of various hues, the mosaic texture, the choice of closing or leaving open gaps between the tesserae, the more or less accentuated inclination of the tesserae, all produce a vibrant effect over the whole surface of the mosaic, varying with the light's angle of incidence.

The flesh-like hues were created using tesserae of various types of stone and terracotta set within the mosaic fabric in a manner obtaining particular shades of complexion. This execution technique is also documented for Rossetti's mosaics in the Church of Santa Maria di Loreto, and is presumably due to the lack of vitreous materials with such gradations of colour. The brick tesserae instead offer a rich variety of shades ranging from cooler greyish, grey-pink and reddish tones to warmer shades of yellow-orange and brown. Tesserae in stone materials are sometimes alternated with those in vitreous paste to obtain specific colour effects. Rossetti fully exploits the varied nature of limestone within the mosaic fabric, drawing on materials that are more or less compact, with opaque versus shiny and rough versus smooth surfaces, and in stone patterns ranging from uniform to veined and mottled (Fig. 6). The artist's technical abilities reach virtuoso heights in the foreground depiction of the naked bodies of the martyrs, achieving highly pictorial effects through the alternating use of vitreous material for lustrous tones and stone for the warmer hues.

There is a clear difference between the very refined and accurate positioning of the tesserae in the execution in the lunette mosaic, with its chromatic shifts,

Fig. 6. Specific mosaic textures: tesserae in silver lamina and 'chequered' design (photo A. Rubino, ©ISCR)

compared to the mosaic sections inserted in the rib-vaulting above. Examining the panel depicting St. Luke, for example, we can see how this shows a more open texture than the lower-level scenes of saints and martyrs, often leaving the oil stucco on the surface in a thick and uneven layer, sometimes covering the tessellated areas and often extensively retouched with oil paint. This seemingly casual and disordered spread of the stucco, together with the retouching, led to some questions about the techniques of execution. The pictorial film was therefore carefully examined, mapped, and analytically investigated to determine if its presence was attributable to the original execution or to subsequent maintenance work. The examinations distinguished two types of paint application: an accurate one for application of colour precisely only on the gaps, and a different technique for the application over the stucco spreading onto the tesserae. In the more accurate technique the colour generally corresponded to that the tesserae colouration of the surrounding area. In this case, the retouching would have had the effect of reducing the visual disturbance of the exposed oil stucco in the areas where the texture is looser. In the 'less accurate' type of colour application, particularly widespread in the area depicting Saint Luke, the paint film covers the oil stucco, which appears to have perhaps spread out onto the tesserae in the process of 'tapping' or pressing the mosaic

Fig. 7. Area of stucco within the mosaic *tessellatum*, and with paint layer (photo A. Rubino, © ISCR)

tessellatum following its placement by the artist. Close observation of the work also revealed that these areas were particularly present in some physical aspects, as if intended to highlight the shadowy areas or mark the contours of the drawing, particularly in the eyes, beard, hands, arms and feet of Saint Luke (Fig. 7).

All the observed data, including from the analytical investigations of the pigments, seem to confirm that these features pertain to the original execution of the mosaics. Among the pigments we see glaze for the blue paintwork, red lacquer, ochre and minium for the red and brown colours (Fig. 8), green earth for green hues, and the consistent use of oil with a lead-based drying agent as the binder. Pending future investigation of the remaining mosaics of the chapel, these results have convinced us of the integrity of the analysed features.

The stratigraphic study, supported by video-endoscopic investigation, enabled us to advance hypotheses on the mosaic implementation phases and execution techniques. The survey revealed a layer of lime-based mortar, with black and red pozzolanic ash and brick fragments. The dark crust on the surface of this mortar revealed a thin layer of oil, which had not penetrated, which could be traced to a pre-treatment phase similar to the preparatory layer for the oil painting technique of the walls, although it cannot be entirely ruled out that the oil may have been released by the freshly applied mosaic stucco. The analytical investigation of

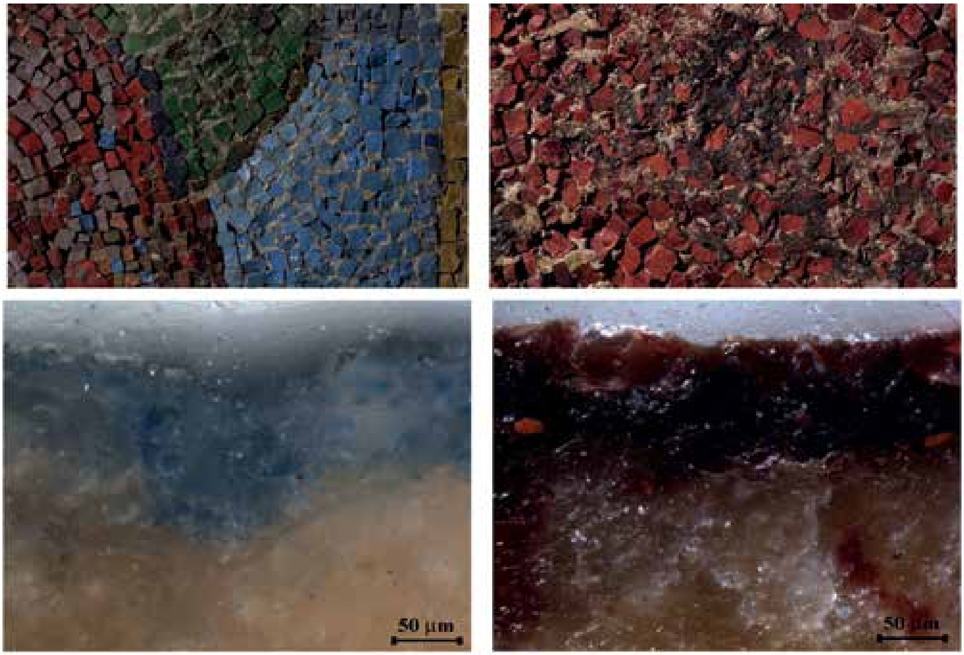

Fig. 8. Photomicrographs of representative stratigraphic sections, including blue and red paint (photo G. Sidoti, ©ISCR)

the tesserae deposition layer, which macroscopically appears yellowish-brown with compact consistency and several white inclusions, confirmed that it is ‘oil stucco’. The composition of this material was similar to the recipe indicated by Gerspach (1881), and described by Borghini (1584) as the invention of Girolamo Muziano for the Gregorian chapel. None of the investigated areas showed the classic pattern of strata found in the traditional wall-mosaic technique using lime-based mortar.

A further consideration regarding the oil stucco is its relation to the drawing technique. Although it is known that there are preparatory drawings for the chapel decorations, the sources do not describe the procedures for transferring these to the mosaics. In any case, the nature of the oil-stucco plaster clearly allows the artist more time to complete the day’s work than is the case with traditional lime-based mortar, thereby allowing larger portions, as shown by the number of days taken to complete the works. These specificities would have ensured the future success of this oil-stucco mosaic technique in the large wall decorations of St Peter’s. In the panels of the upper part of the vaulting (cherubs and St Luke), the distribution of the days follows a predominantly horizontal trend, by bands, defining rather large portions; also in the lunette, the portions of the days are wide but the joints identified follow the contours of the various figures depicted (Fig. 9).

A further observation concerning the worksite execution phases is that the mosaic ar-

Fig. 9. Detail of day's work indications on the mosaics of Saint Luke and the lunette

eas appear to have been specially designed as part of the definition of the architectural scheme, which was in turned designed to accommodate the mosaic decorations. These hypotheses arise from the of observation of some reference marks on the fresh mortar of the stucco frames, showing the layout of the spaces. The finishing layer of the white stucco frames marking the chapel's architectural subdivisions are also in places overlain by the mosaics. Based on these observations, the mosaic seems to be one of the finishing touches of the architectural vaulting surfaces, executed in the final stages of the worksite.

Further examination and study, accompanied by archival research, will expand these first observations allowing us to advance further ideas and continue the testing of the current hypotheses.

Conservation intervention

The main conservation problem was the marked deformation of the entire oil-stucco and tesserae structure, with respect to the underlying layer, over a large area of the left cherub. The absence of fractures in the deformed structure (also subject to video-endoscopic and thermographic investigation) would suggest that the event occurred during mosaic execution, when the oil stucco was sufficiently plastic, perhaps due to poor adhesion with the underlying preparatory layer. The absence of traditional grooves on the preparatory mortar and of any metallic links between the masonry and stucco plaster, together with the positioning of this section on the vaulting, may all have contributed to the detachment.

The detached structure was first consolidated, following which some tesserae were

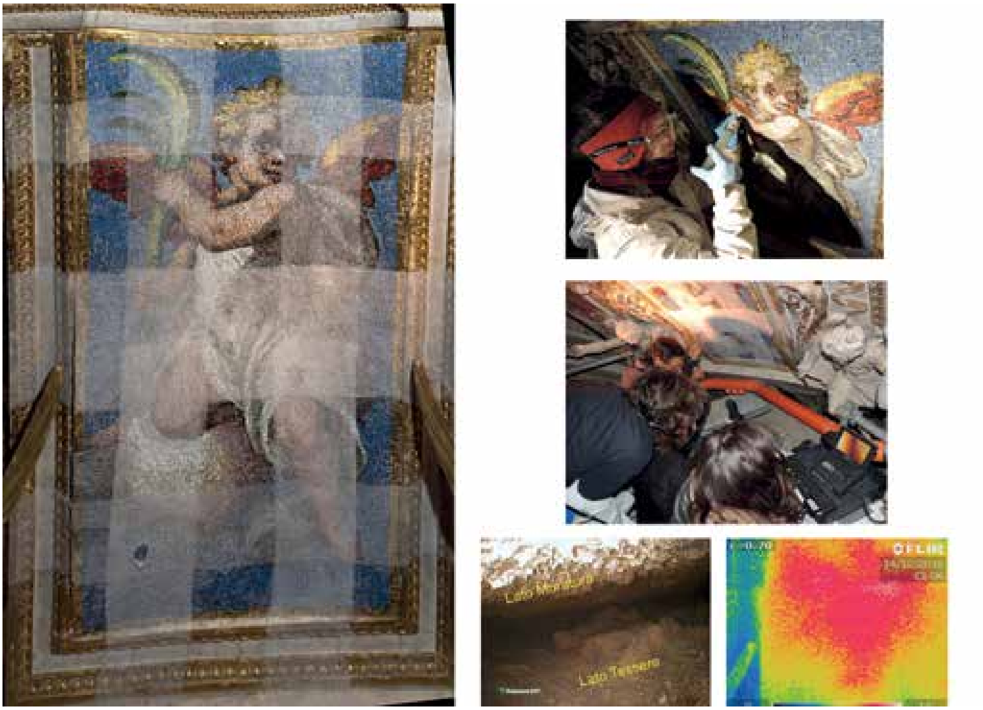

Fig. 10. Video-endoscopic investigation and consolidation during intervention on the left cherub (photo A. Rubino, R. Ciabattoni, © ISCR)

removed, permitting insertion of a fibreglass pin secured to the brick supporting structure. A light hydraulic lime-based premix was then infiltrated using syringes and tubes, thus creating continuity between the detached layers and incorporating the pin along its entire length (Fig. 10).

Before proceeding with the cleaning of the mosaic surfaces, the detached glass layer (*cartellina*) of the metal foil tesserae was consolidated by infiltration with an acrylic resin. The rather delicate presence of oil paint in some areas made it necessary to pre-consolidate with an acrylic micro-emulsion at low concentration, applied by nebulisation. The cleaning procedures involved removal of mineral salts, solid deposits and oily substances, the latter probably applied as surface enhancers during maintenance, all of which contributed to a generalised darkening. This effect was particularly strong in correspondence with the light-coloured vitreous tesserae, where the strongly adhered deposits appeared as a greyish veil. The removal of these layers restored the surface colour. Colorimetric and spectro-photometric detection of polychrome vitreous tesserae was carried out in order for purposes of quantifying the enamel colours, in terms of dominant wave length Ld (nm) and purity P (%), and for comparison of the values before and after surface treatment [2]. The chromatic data also allow evaluation of whether a colour is spectral or not. The results from the preliminary data pro-

Saint Pudenziana - Caetani chapel - Colorimetric measurements
Colorimeter X-Rite model SP-62
Green color tesserae

Tess.		CIE 1931			CIE Lab			Spectral	
n.	Y	x	y	L*	a*	b*	Ld	color	P%
86	28,61	0,312	0,380	60,44	-15,58	11,73	566	y	22,2
87	15,22	0,354	0,385	45,93	-2,76	15,13	572	y	30,2
88	7,81	0,318	0,355	33,58	-3,85	4,20	566	y	13,6
89	10,59	0,315	0,384	38,88	-11,17	9,35	566	y	23,6
90	5,41	0,291	0,322	27,88	-2,88	-2,91	495	y	6,4
91	64,14	0,310	0,338	84,04	-4,79	1,80	-	-	-
92	52,79	0,321	0,358	77,75	-7,64	9,49	566	y	15,1
93	38,35	0,317	0,368	68,28	-11,27	10,50	566	y	18,1
94	26,99	0,321	0,377	58,96	-11,25	11,90	566	y	21,3
95	11,02	0,307	0,390	39,61	-14,57	9,75	549	y	19,1
96	15,11	0,329	0,381	45,78	-8,31	11,58	566	y	23,6
97	6,38	0,301	0,336	30,35	-3,68	-0,24	519	y	3,8
109	57,27	0,320	0,344	80,33	-2,80	5,20	566	y	10,3
110	52,46	0,320	0,357	77,56	-7,81	8,95	566	y	14,7

Ld - Dominant wavelenght
P% - Purity

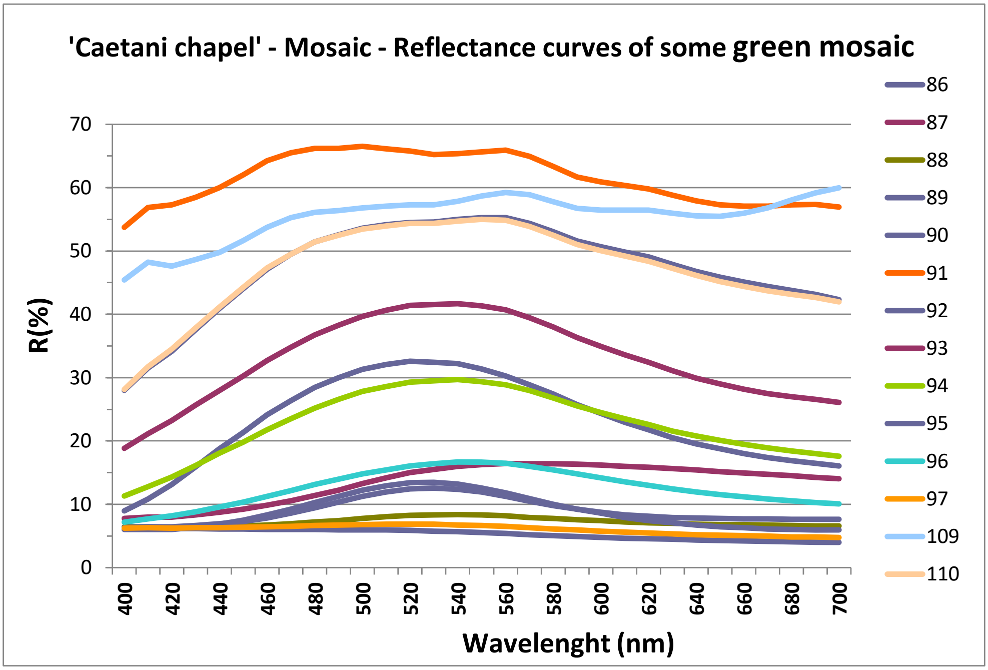

Table 2. Colorimetric and spectro-photometric measurements of the mosaic tesserae (data processing by M. Torre, ©ISCR)

cessing are shown in table 2. This survey, completed in a sample area of the lunette, is aimed at future comparison with the other mosaic surfaces of the chapel, and with other mosaics from the same period. It is hoped that the association of the colorimetric study with the characterisation of the tesserae component materials will provide useful information about enamel production.
As with the observations in the section on techniques and materials of execution, it is expected that these first results will be increased and confirmed by the observations on the remaining mosaics of the chapel.

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Notes

1. The mosaics of Santa Caterina were the subject of a study by L. Olivetti, as part of her Advanced Degree thesis in the 2007-2008 academic year: "Linee guida per la redazione dei capitolati speciali d'appalto per il restauro dei mosaici: studio delle fonti ed evoluzione delle tecniche conservative".
2. The colorimetry and spectro-photometric measurements were obtained using an X-Rite SP-62 colorimeter: standard illumination source D65; standard observer 10°; specular component included.

References

Baglione G. 1642. *Le vite de pittori, scultori et architetti: dal pontificato di Gregorio XIII del 1572 in fino a' tempi di Papa Urbano Ottauo nel 1642*. Roma: nella Stamperia d'Andrea Fei.

Borghini R. 1584. *Il riposo*. Firenze: appresso Giovanni Marescotti.

Braconi M. 2013. "Enrico Caetani e il restauro della basilica di santa Pudenziana a Roma. Fatti e misfatti di un cantiere del tardo Cinquecento". *Rivista dell'Istituto Nazionale di Archeologia e Storia dell'arte*, vol. 68, III serie: 61-99.

Cannistrà A. 2010. "*Li compagni del musaicho*. Cesare Nebbia e la vicenda della realizzazione del mosaico per il timpano superiore del Duomo di Orvieto". In *Il mosaico risorto. Un inedito di Cesare Nebbia tra restauro e valorizzazione* edited by Alessandra Cannistrà, 13-22. Ospedaletto-Pisa: Pacini editore.

Cozzi Beccarini A. 1975. "La Cappella Caetani nella Basilica di Santa Pudenziana in Roma". *Quaderni dell'istituto di storia dell'architettura,* XII, 1975-76: 143-158.

Gerspach E. 1881. *La mosaïque*. Paris: A. Quantin Editeur.

Parlato E. 2009. "Enrico Caetani a S. Pudenziana: antichità cristiane, magnificenza decorativa e prestigio del casato nella Roma di fine Cinquecento". In *Arte e committenza nel Lazio nell'età di Cesare Baronio*, edited by Patrizia Tosini, 143-164. Roma: Gangemi Editore.

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THE MOSAIC *THESEUS AND ARIADNE* OF BELL-LLOC DEL PLA, GIRONA, SPAIN: FROM DARKNESS TO RENEWED MUSEUM, 1876-2016

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Abstract

Between 1876 and 1877, three mosaics were exposed by excavations at the site of Can Pau Birol, on the estate of Bell-lloc del Pla, province of Girona, Spain. These depict: a chariot race, known as the *Circus*; *Bellerophon and the Chimera*; *Theseus and Ariadne*. From the moment of discovery, the Girona Monuments Commission proposed *in situ* conservation, considering this the best form of preservation. However by 1941, through a complex series of events, the three mosaics had arrived at three different museums: Archaeology Museum of Catalonia-Girona; Girona History Museum; Archaeology Museum of Catalonia-Barcelona. The current study reviews the history of the mosaics since the 1870s, including the many decisions concerning their excavation, reburial, extraction, temporary shelter and restoration. Finally, the paper describes the aims, methodology and processes of the most recent project for conservation of the Theseus and Ariadne mosaic, housed in the Archaeology Museum of Catalonia-Girona, and the event of a temporary exhibition in 2016 that "reunited" the three mosaics.

Keywords: Mosaic, conservation, previous interventions, museography

Conservation: an early concept in the history of the mosaics

The adventure of the discovery and safeguard of the mosaics in Bell-lloc del Pla began in March 1872, when the keeper of the Can Pau Birol estate chanced upon one of these works while performing minor repairs. On 25 March the historian Celestí Pujol i Camps, a member of the Girona Monuments Commission, was sent to the site, and confirmed the existence of the mosaic. On 3 April, the majority of the commission members agreed that the best course of action would be for the work to remain where it had been found. As we shall see, future events would prove their wisdom.

In 1876, some four years later, Joaquim de Mercader, the Count of Bell-lloc and owner of the estate, decided to excavate the site in the hope of exposing the mosaics. Fortunately, he alerted the Monuments Commission beforehand, giving the members the opportunity to observe the discovery, on 13 May 1876, of two mosaic works comprising a single pavement: one depicting a chariot race in a circus and the other featuring Bellerophon and the Chimera. The discovery of the mosaics was recorded in the minutes of the commission meeting of 18 May.

The commission members then went forward with a series of manoeuvres, motivated foremost by their concern that the owner might remove the mosaics, resulting in irremediable damage. They asked numerous institutions to back their request for the owner to keep the mosaics *in* *situ*. They engaged the painter Joan Serra i Pausas to create a lithographic copy of the mosaics, in scale 5:100. They included the image in a document prepared by commission members Josep Amatller, Enric Claudi Girbal, Joaquim Botet i Sisó and Josep M. Pellicer, for purposes of communicating knowledge of the mosaics within official and academic circles: *Memoria acerca del mosáico romano descubierto en el presente año en la heredad llamada Torre de Bell-lloch, situada en el llano de esta Ciudad,* printed by Vicente Dorca in December 1876. Serra was also commissioned to create a gouache painting, at 10:100 scale, which is still held by the Archaeology Museum of Catalonia-Girona.

The 1876 report presents a remarkably detailed diagnosis of the condition of the mosaics. The members identified large lacunae, cohesion problems, cavities, depressions and cracks and gave a detailed analysis of the damages already observed due to exposure to the elements and the inevitable effects of plant growth. The text also proposes measures aimed at providing a minimal level of protection, including the construction of a shelter and a perimeter fence. They also considered the possibility of more direct interventions for cleaning and conservation of the assemblage (Comisión de Monumentos 1876: 81-82):

> "As can be seen in the engraving, the mosaic presents large lacunae, which affect its cohesion, as well as numerous other gaps exposed to the action of the elements; in addition to the lacunae, there are also considerable depressions, cracks in certain places, a loss of cement in others, and as the stones become easily disaggregated, the rain and wind have pushed them in opposite directions. Lastly, the gusts of wind, one of nature's main means of dispersal, have deposited in the earth inside the lacunae weed seeds, which have germinated and covered the mosaics with undergrowth.
> (...) A shed to safeguard it from the rain and a fence to protect it from intrusive visitors, a thorough cleaning and, if we were inclined to ask for so much, a restoration to conserve what remains, without disfiguring it with pristine additions, is the advice we would dare to put to the owner for his enlightened consideration."

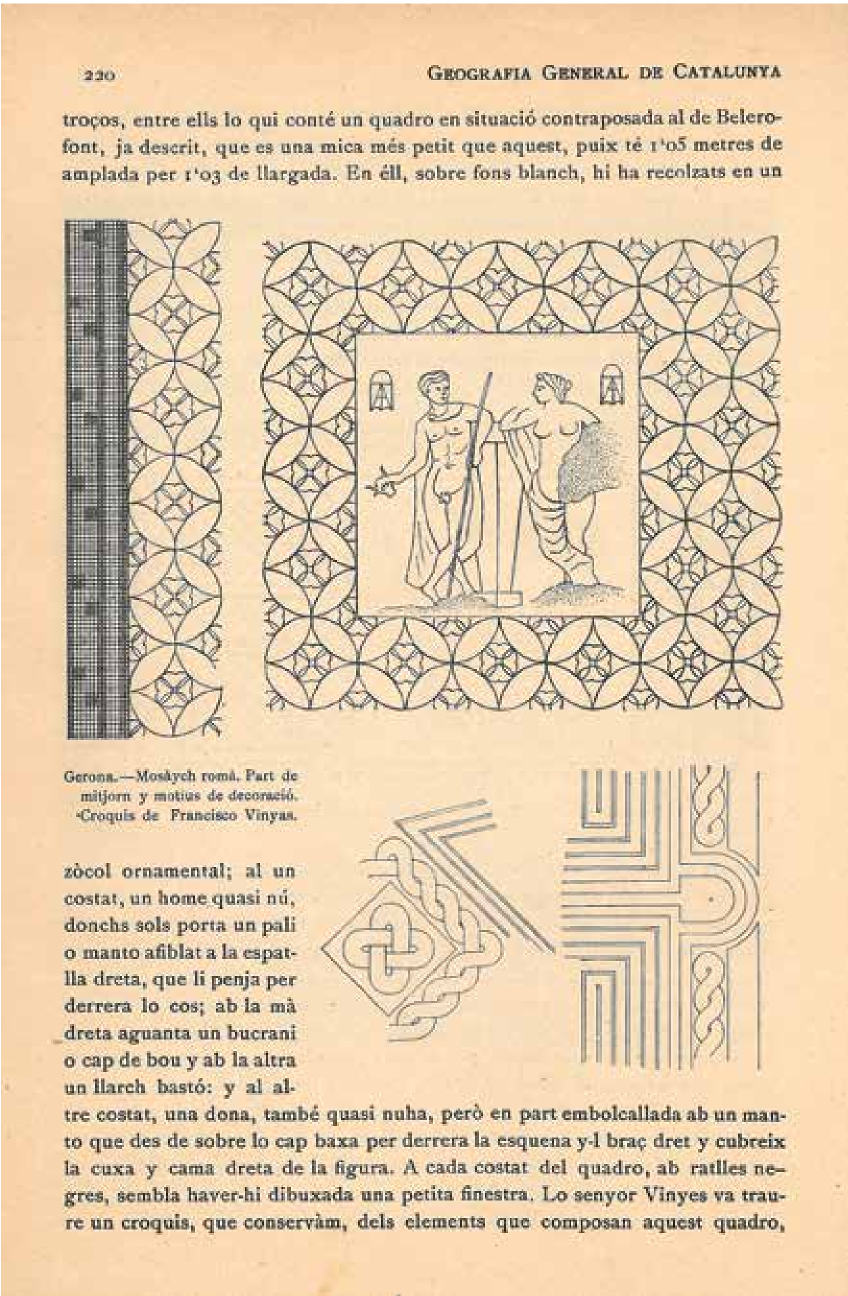
As we can see, the members of the Girona Monuments Commission were sincerely concerned, and from the outset contributed substantially to the assessment and analysis of the mosaics, while promoting their *in situ* preservation. In taking this approach the commission was faithful to its mandate, having been created in 1844 (the first minutes date to 22 November 1847), with the purpose of serving as a consultative body for advice, oversight and safeguard of the local heritage, and for direction of archaeological excavations in the province.

As the years progressed, the Count of Bell-lloc continued his interests in archaeological discoveries, occasionally pushing ahead with excavations and also undertaking attempts to extract the mosaics, on more than one occasion. The members of the commission were apprehensive about these interventions and regarded them as inadequate, due to the lack of technical skill and potential for damage, but especially due to the harm of dismembering an assemblage that would be more historically powerful if conserved *in situ*. The situation sparked the interest of the scientific community near and far, and various personages raised their voices concerning the perilous condition of the mosaics. National and international scholars lamented the fact the mosaics had been "reprehensibly abandoned and virtually destroyed" (Girbal 1883) and reported that they had "completely disappeared as a result of delicate defects" (Laurière 1887).

Indeed the commission received frequent news of Roman-era archaeological findings at Can Pau Birol. In May 1877, some five years after the initial discovery, the commission noted the finding of "new pieces of mosaic with various decorations and a square containing two figures". These reports concern the emergence of the so-called "Theseus and Ariadne mosaic". From our research it results that there are extensive records concerning the finding of the main assemblage (chariot race, Bellerophon and Chimera), however relatively little regarding the discovery of this latter mosaic. It was not until 1911 that the Theseus and Ariadne mosaic appeared in publication, when Joaquim Botet i Sisó provided a description and sketch of the work in the volume on the Province of Girona within the series *Geografia General de Catalunya*, edited by Francesc Carreras i Candi (Fig. 1). In fact, following the 1877 discovery, the work had been recovered with earth, consigning it to near oblivion, but also providing protection.

The next available news regarding the group of mosaics dates to 1930, when the archaeologist Josep de Calassanç Serra i Ràfols, of the Institute for Catalan Studies, and architect Rafel Masó, member of the Monuments Commission, contacted the new owners, M. Dolors González Muñoz i de Mercader and Jeroni Fabrés, with the intention of ensuring the conservation of the mosaics. In 1933, the parties reached an agreement to remove the Circus and Bellerophon mosaics and conserve them in a purpose-built shelter, until the site could be excavated and they works re-laid in their original locations. The correspondence between Josep de Calassanç Serra i Ràfols and Joan Subies i Galter, of the Delegate Commissioner's Office of the Government of Catalonia, as well as Carles Rahola and commission member Puig Pujades, reveals the sense of importance they placed on conservation of what remained of the mosaics. The correspondence describes the actions planned: they two mosaics were to be photographed, removed, consolidated, and eventually relaid in their original locations. The removal and placement of the mosaics within the shelter was completed in early 1934 (Fig. 2). The Theseus and Ariadne mosaic was also exposed during these interventions, however it was again covered with earth, still in its original location.

Particularly interesting is a note sent on 6 September 1933, listing the materials needed by the workers of the Archaeology Museum of Barcelona for lifting the mosaics, including sackcloth, metal mesh, iron rods, strong glue, hydrochloric acid, Portland cement, fine sand and ethyl alcohol, and quoting a total price of 1,553 pesetas. The significance of this list can be understood from a publication of 1950, in which J. de C. Serra i Ràfols explains the techniques used to extract and consolidate mosaics. The first step was to clean the surface of the *tessellatum*; next came the process of gluing the cloth to the tesserae and excavating underneath with chisels or metal tools, detaching the tesserae from the preparatory layers while keeping them adhered to the cloth. He also explained how to divide a large-scale mosaic into sections and re-lay them on a new concrete support reinforced with metal



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troços, entre ells lo qui conté un quadro en situació contraposada al de Belerofont, ja descrit, que es una mica més petit que aquest, puix té 1'05 metres de amplada per 1'03 de llargada. En éll, sobre fons blanch, hi ha recolzats en un

Gerona.—Mosàych romà. Part de mitjorn y motius de decoració. Croquis de Francisco Vinyas.

zòcol ornamental; al un costat, un home quasi nú, donchs sols porta un pali o manto afiblat a la espatlla dreta, que li penja per derrera lo cos; ab la mà dreta aguanta un bucrani o cap de bou y ab la altra un llarch bastó: y al altre costat, una dona, també quasi nuha, però en part embolcallada ab un manto que des de sobre lo cap baxa per derrera la esquena y-l braç dret y cubreix la cuxa y cama dreta de la figura. A cada costat del quadro, ab ratlles negres, sembla haver-hi dibuxada una petita finestra. Lo senyor Vinyes va traure un croquis, que conservàm, dels elements que composan aquest quadro,

Fig. 1. *Geografia General de Catalunya*, in which Botet i Sisó includes the 1877 drawing of the Theseus and Ariadne mosaic, by Francesc Viñas i Serra. Source: Geografia General de Catalunya. Directed by Francesc Carreras i Candi. *Província de Girona*, Volum II, by Botet i Sisó, J. Barcelona, 1908-18. Edited by Albert Martín, p. 252

Fig. 2. The Circus mosaic following removal, 1934-1936 (photo *Arxiu del Museu Arqueològic de Catalunya-Girona*)


MUSEU D'ARQUEOLOGIA
PARC DE MONTJUIC
BARCELONA

Barcelona 6 de setembre de 1933

Fig. 3. Quote for the removal work, 1933 (photo *Arxiu General de la Diputació de Girona*)

mesh or iron rods. The description of this methodology corresponds perfectly to the materials appearing in the quote of 6 September 1933 (Fig. 3).

The quote was accepted days later, in a decision of the Government of Catalonia, Office of the Delegate Commissioner for Girona, allocating funding for the work. This led to the drafting of the contract, which noted the poor condition of the mosaic and the forthcoming intervention by the Archaeological Research Service of the Institute for Catalan Studies. On 20 December 1933, a breakdown of the cost of the intervention was sent, detailing the materials used and the subsistence allowances for restorers Joan Roure and Llorenç Alomar, members of the Reconstruction Workshop at the Archaeology Museum of Barcelona (Gracia 2002-2003: 305): yet another interesting document offering insight into the management practices and techniques of the times.

Following extraction, the Circus and Bellerophon mosaics were kept under the shelter. The inevitable processes of degradation soon became visible and the conditions of the mosaics continued to deteriorate. On 15 July 1936, they were purchased by the Archaeology Museum of Barcelona, with the intention of moving them to indoor protection. However the move to the museum was halted by a militia committee, which forced the deposit of the mosaics in the Archaeological Museum of Girona, where they would remain until the end of the Spanish Civil War. They finally arrived in Barcelona on 9 May 1939. Subsequent attempts by the reconstituted Girona Monuments Commission to recover them failed (Llorens 2016).

The excavations resumed in August 1941, once again directed by J. de C. Serra i Ràfols, during which the Theseus and Ariadne mosaic was unearthed for the final time. The mosaic was lifted in October. The Monuments Committee succeeded in keeping it in Girona, subsequently displaying in the Sant Pere de Galligants Monastery, home to the Archaeological Museum of Girona as of November of that year (Fig. 4). The preparation of the mosaic for relocation and display was guided by Francisco Font Contel, head of the Reconstruction and Restoration Workshop at the Archaeological Museum

Fig. 4. Theseus and Ariadne mosaic: presentation within the monastery church of Sant Pere de Galligants, 1942 (photo *Arxiu MAC-Girona* and J. Casanova)

Fig. 5. Theseus and Ariadne mosaic: presentation within the Church of Sant Pere de Galligants, 2016 (photo *Arxiu MAC-Girona* and J. Milian)

of Barcelona, with financing from the civil governor of Girona, in cooperation with the Municipal Council of Girona, which provided labourers, and the Provincial Council, which covered subsistence costs and other expenses.

The Theseus and Ariadne mosaic

The Bellerophon and Circus mosaics constitute one pavement, while the Theseus and Ariadne mosaic was part of another assemblage, perhaps including other scenes of the legend. The intact portion of the mosaic, recovered in 1941, consists of four fragments composing the form of a T, measuring 3.12 m x 2.39 m at the widest point (Fig. 5).

Little can be discerned about the original techniques of execution, since the preparatory layers were lost during removal. Some preserved fragments of lime bedding mortar contain a small amount of sand aggregate, of 0.2 to 1 mm grain size. The tesserae are limestone, in 12 colours.

The design (Vivó and Palahí 2016: 31-32; Patiño 2002: 168-173) shows a geometric field beginning with a border of 38cm width formed of a white band and, towards the centre, a meander with imbricated fractions of contrasting colours (Decor I, 32e). This is followed by a triple fillet of black, ochre and black, enclosing an orthogonal pattern of intersecting circles (Decor I, 238f), with a single tessera at the points of tangency and a flower inside the concave squares.

The emblemata, presumably set at the centre of the top half of the original room, measures 1.22m x 1.33m. Against a neutral background we see two young figures, standing and leaning against a pilaster. The male figure is naked apart from a *chlamys* draped over his back and tied with a fibula above his left shoulder. In his right hand he holds an object, the interpretation of which is debated, while a staff rests in the nook of his left arm. The female figure does not show any identifying attributes. She holds her right hand to her face, resting her elbow on the pilaster as she gazes towards the young man. Her hair is held in place by a headband and she wears an over-garment with elaborate pleats, cascading down her back and draped around her right leg.

Two marks are seen on either side of the figures, towards the top of the ground area: these can be understood as windows, or more likely as monograms representing the name of the workshop master or mosaic owner (Patiño 2002: 172-173).

A number of different interpretations regarding the mosaic iconography have been put forward. The lack of identifying attributes for the female figure and the uncertain interpretation of the object in the right hand of the male figure have prompted numerous theories (Patiño 2002: 170-172). The most substantiated seems to be that the depiction is either Paris and Aphrodite (Guardia 1992: 56) or Theseus and Ariadne, with the latter conception being the most plausible, as a fragment of mosaic representing a labyrinth has also been identified (Vivó and Palahí 2016: 32-33).

73 years later: condition and intervention

Our intervention began in 2014, in the context of a renewal program for the exhibition halls of the MAC-Girona. The intent was to showcase the mosaic with a place of prominence within the new exhibition discourse. At this time the mosaic was situated within the transept of the decommissioned monastery church of Sant Pere de Galligants, on a pedestal consisting of a simple brick structure filled with sand and ceramic shards, the sides of which were coated with painted cement. A first step was to dismount the mosaic from this location and transport it to the Centre for the Restoration of Movable Property of Catalonia (CRBMC), where the conservation work would be performed (Lara *et al.* 2016: 81-86).

As noted above, the mosaic had been extracted in four fragments during the excavations of 1941, which were then restored atop a cement bed. Unlike the case of the Circus and Bellerophon mosaics, we have no direct documentation of the materials or procedures used, however in both cases the works were directed by the Reconstruction and Restoration Workshop of the Archaeology Museum of Barcelona and in fact the same methods can be observed: all the original layers of mortar were removed and the mosaic *tessellatum* was re-laid on a new support of Portland cement reinforced with metal mesh.

Structurally, the most severe pathologies were the weakening of the cement support, caused by corrosion of the mesh and isolated fracturing in the perimeter. The lacunae were filled with heavily deteriorated cement, and the surface was characterised by depressions, possibly from incorrect handling during the extraction or in the stage of creating the cement support.

The *tessellatum* presented a series of surface accumulations that obscured the colours and design. The first of these consisted of carbonate incrustations, resulting from the centuries the mosaic spent underground. Atop this layer were substantial residues of glue with embedded marks of sackcloth, from the stage of facing the mosaic during extraction. Finally there were several layers of wax and resin, applied with the intention of brightening the colours. The later materials had yellowed heavily over time, altering and disfiguring the aesthetics of the work. The FTIR analysis[1] of two tesserae determined the presence of calcium oxalates, possibly due to the decomposition of these organic substances.

Several methods had been used in the reintegration of losses during the 1940s. The mosaic fragments, each on their cement backing, had been set on the brick structure described above. The cut lines separating the four fragments were then reintegrated using plaster. In some instances, the plaster fills were covered with what appear to be original tesserae, while in others, the forms were engraved, in a manner perfectly matching the shape and colours of the tesserae. The larger areas of loss in the *tessellatum*, which affected the two figurative representations and the edges, had been filled with cement.

Before dismounting the mosaic from its location in monastery church, we first cleaned the surfaces mechanically. The four fragments were then separated along the original cut lines, followed by surface application of polyester gauze soaked in K60 polyvinyl acetate dissolved in 20% acetone (Llobet and Mailan 2012: 153-158). Each of the fragments was then placed reverse side up in a custom-made wooden case for transport to the CRBMC.

We then proceeded with the elimination of the Portland cement, using an angle grinder with diamond disc to make a grid of deep cuts from the reverse, for removal of the metal mesh. More precise mechanical tools, such as a vibrating cutter, were then used to remove remaining cement from the lacunae, joints, and the areas surrounding the tesserae.

The next step was to apply new preparatory mortars to the reverse side of the mosaic, for structural consolidation and as an intervention layer between the tesserae and the new support. The decision was made to apply a first layer of mortar consisting of equal parts hydraulic lime and aggregates (7 parts NHL 3.5; 5 parts marble powder (MK 000) and 2 parts ceramic powder 0/1), followed by a fibreglass mesh covered with a second layer of mortar in proportion 2:1 (7 parts NHL 3.5; 2

Fig. 6. Tests for chemical-mechanical elimination of facing materials (photo *Centre de Restauració de Béns Mobles de Catalunya*)

parts ceramic powder 0/1; 5 parts marble powder (MK 000) and 7 parts river sand 0/2) (Llobet *et al.* 2017: 143).

Work commenced on the front side of the mosaic a month later. First, the facing materials were removed with water vapour, after which the cleaning process was continued with ethanol and acetone (1:1), applied using cellulose gauze and left for 15 minutes, for removal of the residues from past applications of glue, wax and resin (Fig. 6).

Most of the surface presented a layer of concretion, largely formed of carbonate minerals. To determine the most suitable cleaning method, a protocol was established for testing different products, application times and mediums. This led to a decision in favour of a mixture of 10% sodium polyphosphate, 2% neutral detergent and distilled water, gelled with a natural water-based polymer (Vanzan NF-C, 2 gr per 100 ml), subsequently removed using distilled water dressings. The cleaning process was completed using a scalpel and ultrasonic scrubber, and finally by micro-blasting using glass microspheres (Figs. 7-8).

Once cleaned, the four fragments were re-set on a new honeycomb support of

Fig. 7. Chemical-mechanical elimination of surface deposits, including carbonate minerals (photo Centre de Restauració de Béns Mobles de Catalunya)

Fig. 10. Final work for reintegration of losses (photo Centre de Restauració de Béns Mobles de Catalunya)

Fig. 8. Final cleaning: micro-blasting using glass microspheres (photo Centre de Restauració de Béns Mobles de Catalunya)

Fig. 9. The new support with a fragment of mosaic in place (photo Centre de Restauració de Béns Mobles de Catalunya)

30mm PGA panel, adhered by application of EPO 121 epoxy resin to the intervention mortars (Fig. 9). Once mounted, the mosaic perimeter and the lacunae were filled with expanded clay, adhered with EPO 150 epoxy resin. This mixture provided lightness and a coarse character achieving secure attachment to the reintegration mortar.

The cut lines between the four fragments were reintegrated with tesserae recovered during the lifting process. To fill the losses in the *tessellatum,* we looked for a type of mortar that could achieve unity and harmony in the museum viewing context, avoiding excessive contrast with the original material, and meeting criteria of reversibility and material compatibility (Fig. 10). We also recognised that the interstices between the tesserae would require refilling, as the original mortar was either completely absent or severely eroded. In each of these instances we used a mortar consisting of hydraulic lime and aggregates, with a proportion of 1:3 -1 part NHL 3.5; ½ part river sand 0/2; 3

parts marble powder (MK 000): *giallo oro, bianco Verona, rosa corallo*.

Lastly, it was necessary to display the mosaic in the museum in a way that would not inhibit the space's new uses and could dignify its presence within the monument. For this purpose, we mounted the four fragments on a custom-made steel structure that holds each piece independently, but is equipped with a system of rails that enabled us to slide the fragments together and achieve a seamless linkage. The frame holds the four sections vertically, as a unified whole, but in full keeping with the criteria of reversibility.

The unusual T shape of the assemblage could have led to some misunderstandings among the general public. Part of the missing mosaic was therefore reintegrated with photographic panels that reproduce the geometric field around the central emblem, in a subdued effect (Fig. 5).

Subsequently, in 2016, the museum prepared the temporary exhibition *3 Mosaics, 3 Museums: 140 Years of the Roman Mosaics from Bell-lloc (Girona)*. The exhibit sought to reunite the three works, discovered during the era of great discoveries in Girona, but separated into three museums by the vicissitudes of history.

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References

Balmelle C., Blanchard-Lemée M., Christophe J., Darmon J-P., Guimier-Sorbets A-M., Lavagne H., Prudhomme R., Stern H. 1985. *La décor géométrique de la mosaïque romaine (I). Repertoire graphique et descriptif des compositions linéares et isotropes*. Paris: Picard.

Comisión de Monumentos Históricos y Artísticos de la Provincia de Gerona. 1876. Memoria acerca del mosáico romano descubierto en el presente año en la heredad llamada Torre de Bell-lloch, situada en el llano de esta ciudad. Gerona: Vicente Dorca.

Girbal E.C. 1883. "Sepulcre romà dels encontorns de Girona". *Anuari de l'Associació d'Excursions Catalana*, 2: 527-530.

Gracia F. 2002-2003. "La depuración del personal del Museo Arqueológico de Barcelona y del Servicio de Investigaciones Arqueológicas después de la Guerra Civil (1939-1941)". *Pyrenae*, 33-34: 302-343.

Guardia M. 1992. *Los mosaicos de la antigüedad tardía en Hispania. Estudios de iconografia*. Barcelona: PPU.

Lara L., Llobet S., Jorba M. A. 2016. "El procés de conservació i restauració del mosaic de Teseu i Ariadna". In *Els mosaics de Bell-lloc del Pla (Girona): una aventura de 140 anys*, directed by Josep Manuel Rueda, 79-86. Barcelona: Generalitat de Catalunya, Departament de Cultura; Museu d'Arqueologia de Catalunya.

Laurière J. de 1887. "La mosaïque romaine de Gérone (Espagne)". *Bulletin Monumental*, 53: 235-251.

Llobet S. and Mailan A. 2012. "Treballs de conservació i restauració a la vil·la romana del Pont del Treball". *Anuari d'Arqueologia i Patrimoni de Barcelona* 2011: 153-158.

Llobet S., Pugès M., Bertral A. 2017. "Discovering and safeguarding the mosaics at the

Pont del Treball Roman villa in Barcelona". In *The Conservation and Presentation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference. Sardinia, October 27-31, 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed et Roberto Nardi, 136-144. Los Angeles: The Getty Conservation Institute.

Llorens J. M. 2016. "Les aventures i desventures dels mosaics de can Pau Birol". In *Els mosaics de Bell-lloc del Pla (Girona): una aventura de 140 anys,* directed by Josep Manuel Rueda, 9-20. Barcelona: Generalitat de Catalunya, Departament de Cultura; Museu d'Arqueologia de Catalunya.

Patiño C. 2002. *Les produccions musives de les vil·les suburbanes de Gerunda*. Girona (unpublished).

Serra Ràfols J. de C. 1950. "Modificaciones en la técnica del arranque de mosaicos". Memorias de los Museos Arqueológicos Provinciales 1948-1949: 48-54.

Vivó D. and Palahí Ll. 2016. "Els mosaics de Bell-loc del Pla. Descripció i interpretació". In *Els mosaics de Bell-lloc del Pla (Girona): una aventura de 140 anys*, directed by Josep Manuel Rueda, 21-33. Barcelona: Generalitat de Catalunya, Departament de Cultura; Museu d'Arqueologia de Catalunya.

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THE MOSAICS OF THE 14TH-CENTURY MAMELUKE FOUNTAIN OF THE MUSEUM OF ISLAMIC ART, CAIRO: A CULTURAL HERITAGE OF TECHNIQUES AND MATERIALS

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Abstract

Within the context of the renovation of the Museum of Islamic Art in Cairo (2003-2010), the Aga Khan Foundation provided resources and technical assistance for the conservation-restoration of a large Mameluke-era fountain, finished with pieces and mosaics in marble, mother of pearl and glass. The project provided an opportunity for better understanding of the techniques and patterns in the construction of this type of mosaic, based on the tracings that were also used to guide the process of reassembling the dismantled fountain. The conservation-restoration work was carried out with the help of ten trainee Egyptian restorers. These professionals contributed to many of the processes involved, and the experience led to the establishment of temporary restoration laboratory within the Citadel of Egypt. The laboratory operated for a total of four years, particularly on Egyptian heritage in stone and plaster.
Keywords: Islamic Art, Cairo, mother of pearl, Mameluke fountain, 14th century

Project context

The project for the overall renovation of the Museum of Islamic Art in Cairo (MIA) presented a complex of challenging problems concerning the conservation-restoration, mounting and relocation of some of most emblematic works held by the museum. For this reason the Supreme Council of Antiquities (SCA) and the Aga Khan Trust for Culture entered into a partnership, capable of ensuring the necessary expertise, materials and personnel necessary for the works.

The starting point for this partnership was the work for the Mameluke fountain. From there the partnership evolved to include almost all of the panels of in stone and plaster materials exhibited within in the museum, including pavements, ornamental plinths, plaster mihrabs, marble reliefs, tombstones and wall paintings. The increasing volumes of work led to the creation of the Citadel Restoration Laboratory, as a structure capable of dealing with the range and volume of challenges. Over the period 2007 to 2010, the laboratory developed as a full conservation-restoration centre, staffed primarily by Egyptian restorers, working with all sorts of materials and artefacts from different periods in history, largely from the MIA but also other pieces recovered from important collections held in the SCA store rooms situated in different buildings with the Citadel of Cairo.

Previous restoration of the Mameluke fountain

The so-called Marmeluke fountain is an example of the water dispersion systems

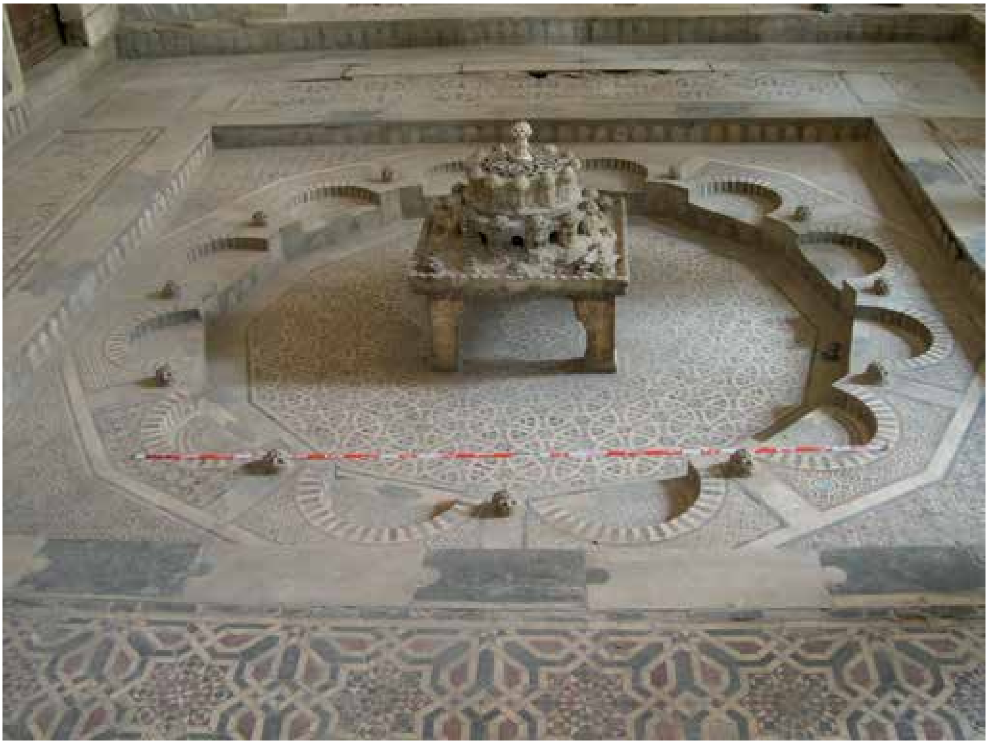

Fig. 1. Initial state of the fountain inside the MIA (photo A. Gamarra)

used in the great palaces of the 14th century for purposes of cooling the air. It consists of a central spout which provided several jets of water; the water collected in a low twelve-sided pool, made of stone covered with marble facing and decorated with geometric mosaics (Fig. 1). The fountain has two steps providing access to the spout, also decorated with black and white marble facing and geometric polychrome mosaics.

In the 1930s the fountain was extracted from its original building and the mosaics were transferred to blocks of steel-reinforced Portland cement. The fountain was then reassembled inside the original exhibition halls of MIA building, in operating order (Fig. 2).

Fig. 2. Central spout of the fountain, made of translucent green calcite (photo A. Gamarra)

Over the course of many years, the presence of the water led to deterioration of the construction materials, including erosion and generalised chalky concretions, but most importantly a loss of adhesion, caused by the oxidation of the steel reinforcing within the cement blocks supporting the mosaics.

PROJECT WORK FLOW

Work began with the documentation of the 30m² of mosaics and marble surfacing covering the structure, all of which required detachment prior to restoration (Fig. 3). The mosaics and marble facing were traced onto transparent PVC sheeting, for documentation and in preparation for the reinstallation of the fountain in its new location. This measure had the added advantage of providing a clear view of how the dimensions of the fountain would fit within the new hall.

The mosaics had accumulated surface dust as a result of the construction work already under way. After removing this we covered the surfaces with vinyl glue and two layers of cotton gauze. (Fig. 4). On these surfaces we marked the different parts of the fountain that we proposed for separation. Once the adhesive of the facing fabric was completely dry we proceeded with the work of separating the sections. During this stage we were able to observe the very extensive deterioration of the mortar backing the surfaces and the underlying steel frameworks, caused by the years of moisture (Fig. 5). Parts of the marble facing came away from the mortar beds very easily, and the mosaics mounted on large blocks of cement were cracked all along the lengths of the steel reinforcing.

The blocks that had been used to mount the mosaics were very heavy, however the immediate separation of the mosaics themselves was not possible as the percussion on the rigid cement would have endangered the marble pieces. As the dismantling progressed it became apparent how the fountain had been assembled on the concrete blocks and mounted within

Fig. 3. Documentation stage, prior to collaboration with museum staff (photo A. Gamarra)

Fig. 4. Mosaics with facing, prior to extraction (photo A. Gamarra)

Fig. 5. Removal of the blocks supporting the mosaic, showing effects from iron oxidation (photo E. Porta)

Fig. 6. Museum staff moving a block on a wooden platform (photo E. Porta)

Fig. 7. Removal of the cement, brick and iron supports (photo A. Gamarra)

the museum, as we traced the process in reverse. Since the museum was closed to the public during the renovation phase, the team were able to quickly adapt the tools necessary for the dismantling, and areas were found for storage of even the heaviest pieces (Fig. 6). Some of the better lit areas were modified to provide conditions suitable for the removal of the supporting blocks of cement, and the transfer of the mosaics to a new light support structure made of honeycomb aluminium and fibreglass (Fig. 7).
During this phase of the restoration work we could see the care and consideration applied in the preparation of the supporting blocks in the 1930s. The reinforcing steel had been riveted and welded into frameworks, and the mortar made lighter by using of pieces of ceramic brick, rather than being made entirely of gravel and cement. The deterioration of these carefully built blocks had unfortunately been hastened by the moisture caused by the functioning of the fountain within the museum.
Once we had removed the layers of material composing the blocks then the last of the back mortar on the back of the coloured pieces of marble came away very easily, leaving a completely clean surface. The interstices between the smallest tesserae even preserved small amounts of lime mortar, probably from the installation of the fountain in its original location within a palace or other important building of medieval Cairo.
The ease with which the pieces were ultimately detached revealed that the pieces of marble had for some time no longer been securely attached to the cement blocks, but were instead simply held in place by the rigidity of the modern interstitial mortar. With this observation we were able to understand the risks the pieces had been exposed to, from movements caused by accidental bumps and knocks during everyday museum visitation and maintenance.
The remaining stages of the restoration work were the usual ones involved in the process of changing an existing support for one made of lighter materials: an intervention layer of marble dust and Paraloid® B-72 reversible acrylic resin in 10% acetone solution, a layer of Perlite® mortar adhesion layer and Araldite® M epoxy resin, finally followed by adhesion to honeycomb aluminium panel (Gamarra and Garcia 1996).

Fig. 8. Installation of the pieces of the fountain in their new location at the MIA (photo A. Gamarra)

Once the mosaics had been attached to the new synthetic supports, we proceeded to eliminate the two layers of facing gauze, by means of applying hot water to soften the impregnated vinyl glue. During the meticulous cleaning process we observed the hardened remains of old hide glue on the edges between the smallest pieces of mother of pearl and vitreous paste: this was the heated glue applied to the fountain surfaces for purposes of detaching the mosaics in the 1930s.

The restoration process also led to important discoveries concerning the operation of the central spouts of the fountain. The centre part was composed of two monolithic pieces of green calcite, also known as green onyx, originating from the country's quarries. These two carved pieces composed a four-legged marble table at the centre of the fountain. One of the legs of the table was drilled with a hole, which led upwards into an internal system of further holes drilled through the pieces of calcite, which were then used to channel the water to the 42 jets of the fountain. The drilling of this complex system of interlinked holes (Fig. 8) was made possible because the stone is translucent, making the path of the drilling visible as the artisans advanced their work. Once the linkages between the channels had been achieved and the water circuit was complete, the superfluous holes used in the drilling process

Fig. 9. Detail of the quality of the geometric polychrome mosaics of one of the pieces (photo A. Gamarra)

– where water was not intended to flow – were sealed using an impermeable mix of plaster, glue and wax, in this way achieving the final magical effect of the fountain. Once the mosaics had been remounted on the honeycomb panels and the marble facing cleaned and restored, a pre-assembly was carried out at the Citadel Laboratory. This pre-assembly permitted the necessary final adjustments to the supports, and the preparation of the anchorages to the new paving structure in the museum (Fig. 8). Finally, the mosaic panels were fixed to the floor using screws, and the surrounding marble facing was settled in a dry layer of sifted sand. This system is intended to facilitate maintenance and any need to transport the artwork for future temporary exhibitions (Figs. 9-10).

Conclusions

The lightness of the materials used in the restoration of the large mosaic panels permitted ease of transport and handling as the pieces were reassembled within the museum. The reassembly was completed without the use of mortar, meaning that it could be delayed until the other furnishing of the newly renovated museum were already complete. The structure can now also be dismantled for exhibition elsewhere.

However the most important factor in the development and extension of the

Fig. 10. Final view of the exhibition hall at the MIA, with some of the mosaic panels and plaster mihrabs also restored by the project team (photo A. Gamarra).

work over the four year period has been the specialised training permitted for the group of 10-15 Egyptian restorers, exposed to the materials, methodologies, criteria and systems for conservation of these kinds of cultural heritage, so abundant in this country and at the same time so little known in comparison with other forms of Egyptian cultural heritage. Many of these professionals continue to work in the conservation and restoration of cultural heritage, within in the Aga Khan Conservation Trust of Egypt, the Supreme Council of Antiquities and the new Great Egyptian Museum soon open in Giza.

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References

Gamarra A., Garcia M. J. 1996. "Resinas Sintéticas y Cargas Ligeras en el Cambio de Soporte y Reintegración de Mosaico: Mosaico Romano. Thermalia. Caldes de Montbui, Barcelona". In *Acts of XI Congreso de Conservación y Restauración de Bienes Culturales: Castellón, 3, 4, 5 y 6 de octubre de 1996*. Diputació Provincial de Castellón: Servei de Publicacions.

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THE PRETTY, THE UGLY AND THE UNCOMMON: CONSERVATION OF THREE ROMAN MOSAICS FROM OSTIA ANTICA, ITALY

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Abstract

The paper reports on a conservation intervention carried out over the course of a five-year archaeological excavation at Ostia Antica, Italy, on three floors: an *opus sectile*, an *opus tessellatum* with inserted marble *crustae* and an 'irregular *terrazzo*' containing polychrome tesserae. Although the site is of lesser importance compared to some of the best-known Italian sites, the experience presents several aspects of best practice in conserving archaeological mosaics in commonly encountered situations. It also allows reflection on the manner in which conservation interventions provide a privileged moment for gathering information about an artefact. The material textbook of the floors recounts of the changing perceptions of the value of the mosaic floors and their materials in the Antique and Medieval periods: this layered history is a strong tool to engage the public.

Keywords: Ostia Antica, mosaic, *opus sectile*, best practice, communication

Introduction

Site history and current context

The area at object of the current report lies just outside the main archaeological excavation area of Ostia Antica, the ancient port city about 25 km from Rome proper. In Imperial times this particular area was part of the city periphery, and featured important infrastructure, villas and funerary monuments arranged along the main road, the *Via Ostiensis* (Pellegrino and Raddi 2014). The location is now known as Parco dei Ravennati.

Excavations were undertaken in the 1960s by the Rome Superintendency for Archaeological Properties (Ostia Antica Excavations) but were soon interrupted, and then resumed on a systematic basis in 2013 by the American Institute of Roman Culture (AIRC) directed by Dr Darius Arya. The AIRC project was conducted in collaboration with the superintendency, under a permit from the Ministry for Cultural Properties and Activities and for Tourism (AIAC 2018). Between 2013 to 2017 the AIRC excavated two main areas dating to different periods: Area A consists of an imperial Roman structure in *opus mixtum*, identified as a residence, part of which was redecorated in Late Antiquity with frescoes and an elaborate *opus sectile* floor. Area B consists of a well-preserved stretch of Roman road, likely the last major phase of the *Via Ostiensis*, flanked by a small circular Late Republican mausoleum in cement and travertine. In Late Antiquity the core of the mausoleum was converted as an octagonal structure, and in the Middle Age it was again used as a place of burial (Pellegrino and Raddi 2014).

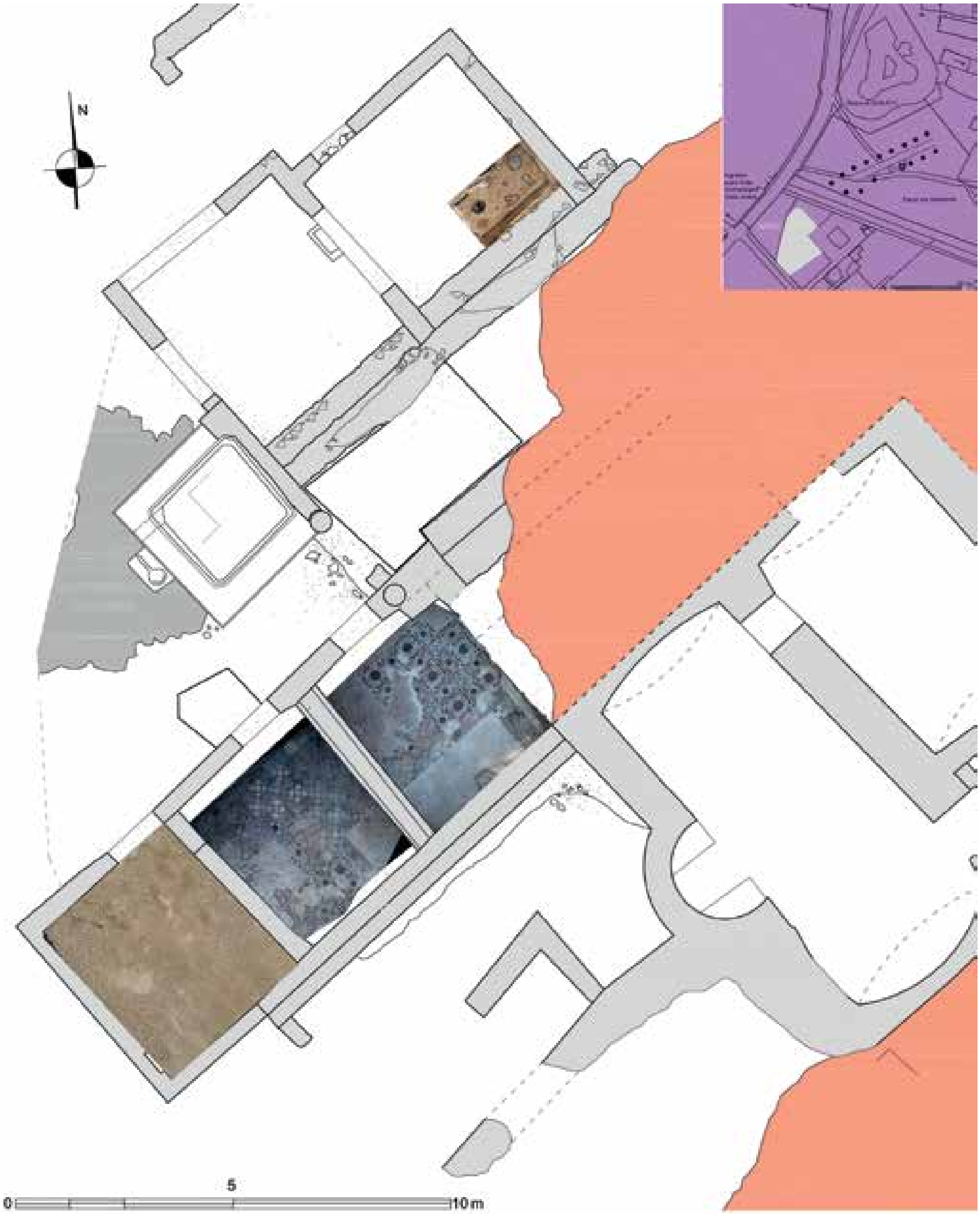

Fig. 1. Plan of Area A with the three mosaic floors (K. Schneider and F. Guiducci)

The current paper focuses on three floors excavated in Area A, which were probably part of the same residential context (Fig. 1). The dating of the area is not clearly established but ranges from an early estimate of around the 1st-2nd century AD to a later estimate of around the 3rd-4th century AD (Pellegrino and Raddi 2014).

The conservation intervention

Conservation *in situ* was carried out in conjunction with the 2013 to 2016 excavation seasons. The conservation project was designed and implemented by Kristian Schneider of Consorzio Kavaklik Restauro, in collaboration with Darius Arya of the AIRC.

The intervention concerning Area A aimed to stabilise all the archaeological remains exposed in each successive season, as well as the structures excavated in the 1960s campaigns. The areas of 1960s excavations were first treated with biocide to remove damaging vegetal growth. Pre-consolidation with lime water was also conducted where necessary. The exposed walls were then consolidated by pointing and capping with lime mortar. The remains of plain and painted wall plasters were consolidated by injections of grouting lime mortar. Finally, the whole area was covered by a temporary reburial system.

The Pretty, the Ugly and the Uncommon

The Area A excavations revealed three mosaic floors: an *opus sectile*, an *opus tessellatum* with inserted marble slabs (*opus scutulatum*), and an 'irregular' mosaic of scattered tesserae mixed with mortar.

The opus sectile, *description and history*

The *opus sectile* covers an area of about 35 m^2 in the south-western side of Area A. Originally serving as the floor of a single room, in Late Antiquity a tuff wall was built directly overtop, dividing the surface into two floors of roughly equal dimensions, serving two rooms.

The decorative pattern is organised in two main areas: a band of squares in a relatively simple structure composed of triangles of different coloured marble *crustae*, forming squares of exactly one Roman foot per side (about 30 cm), with these square units arranged around a central squared slab (Fig. 2). The central area is composed of more complex squares of different shapes and sizes, the biggest being exactly two Roman feet per side. The design of this area is composed of circular slabs enclosed in squared and rectangular shapes, surrounded by curved frames and decorative leaves.

The chromatic effects of the floor are extremely rich, presenting a full catalogue of all the main marbles and coloured stones used in the Imperial Roman period: porphyry, serpentine, *giallo antico*, *cipollino, breccia verde, greco scritto, marmo africano, lunensis,* and alabaster. However the marbles used for the *crustae* are clearly reused, as evidenced by the wide variation in thicknesses, from 2 to 40 mm, and by signs of previous use on some of the reverse sides.

The floor presents the typical sequence of preparatory layers, with a *nucleus* of lime mortar and *pozzolana* mixed with marble and pottery fragments. The final bedding layer is composed of a mix of marble dust and lime mortar, very poor in lime content, and is extremely thin (about 2-3 mm). Given the difference in thickness of the *crustae*, this means that to achieve a smooth surface, the latter must have been laid while both the bedding layer and underlying preparatory layer were both fresh, a supposition confirmed by the ob-

Fig. 2. A section of squared tiles of the *opus sectile* floor (photo K. Schneider and F. Guiducci)

servation of imprints in the bedding layer where the slabs are missing.

The form and uses of the room were changed through time. Given the rich decoration, including frescos, the space must originally have served a public function, possibly in the context of an important dwelling (Pellegrino and Raddi 2014), however at some point it was no longer in use and was then converted as a lime-slaking pit. In fact the floor was overlain by a series of multiple lime layers, indicating prolonged use for this purpose, and the deposits are also found in some lacunae of the original floor, indicating that it must first have fallen out of use (Fig. 3). The deposits are clearly visible on the frescos of all four exterior walls, up to a height about 30 cm above floor level.

In the early Medieval a tuff wall was built across the centre of the original space and

Fig. 3. *Opus sectile* before cleaning, showing the layer of lime encrustation (photo K. Schneider and F. Guiducci)

the entrance was modified, creating two rooms of roughly equal dimensions. The tuff wall sits directly on the *opus sectile* with no other foundation, and has no traces of lime, proving that it was built subsequent to the usage as a slaking pit. At the same time the floor level was raised by about 50 cm and finished in *opus caementicium*, in both of the newly created rooms.

Conservation status and intervention

The *opus sectile* floor was generally in very good condition, having been hidden and protected by the thick layer of lime putty. The *crustae* were still firmly in place, although those next to the lacunae were prone to detachment under mechanical stress. The lacunae were concentrated in the central area, where about 30% of the marble pieces were missing. In general there was only modest carbonated encrustation due to burial.

The final stage of excavation of the two rooms was completed in 2015, with the constant presence of conservators to ensure proper operations and protection of the marble *crustae* from detachment, particularly given the very thin and lime-poor bedding layer.

Fig. 4. Mechanical cleaning of the *opus sectile* (photo K. Schneider and F. Guiducci)

Fig. 5. *Opus sectile* after conservation intervention (photo K. Schneider and F. Guiducci)

The accumulations of lime putty varied in thickness from 1 to 15 mm. These were removed using spatulas and scalpels (Fig. 4). A few areas of carbonated encrustations were partially cleaned with abrasive stone. An initial application of 10% citric acid v/v in water, intended to soften the carbonated lime, proved ineffective, and was discontinued. The edges of lacunae in the *opus sectile* were finished with lime mortar and all the interstices of the surfaces were also filled with mortar, for purposes of consolidation and long-term stability. Finally a layer of Paraloid B72 2% w/v in acetone was applied, for protective and aesthetic reasons.

At the request of the superintendency, the lime layers were left intact over an area of about 2.4 m by 1.2 m, as a testament to the different phases in the history of the site (Fig. 5).

The *opus scutulatum*, description and history

The excavations also revealed a portion of a floor in *opus scutulatum* at the centre of Area A. This flooring pertains to a space apparently used as a passageway between residential areas, immediately adjacent to the room floored in *opus sectile*, and may date to the same period.

The portion of floor uncovered shows a *tessellatum* composed of a frame of two strips of black tesserae around a central white tesserae carpet. The central white carpet presents scattered black tesserae and carefully embedded fragments of marble *crustae* of different qualities, colours and shapes, framed by two courses of tesserae (Fig. 6). There were no lacunae in the excavated area of the *tessellatum*, and for this reason it was not yet possible to examine the preparatory layers.

As with the room in *opus sectile*, the space and its uses changed over time. After originating in what was probably the same housing context, the space once again went into disuse and was later adapted as a lime-slaking pit. Once again, the multiple deposition layers show prolonged usage

Fig. 6. Excavated area of *opus scutulatum* (photo K. Schneider and F. Guiducci)

for this purpose. Finally the floor level was raised by about 50 cm and finished in *opus caementicium*.

Conservation condition and intervention

Thanks to the protective action of the thick layer of lime putty, the exposed area of *opus scutulatum* was found in near perfect condition. Only a single circular marble slab was missing: there were no further lacunae, no vegetation growth, and no signs of detachment between preparatory layers or between these and the *tessellatum*. The conservation intervention, undertaken in 2015, consisted simply of mechanical removal of the lime layer using spatulas and wet cleaning with water.

The "*irregular terrazzo*" floor, description and history

The "irregular *terrazzo*" floor covers an area of about 14 m^2 in the north-western side of Area A. This floor does not belong to any of the traditional categories of mosaic floors of the Roman period (Fiori and Vandini 2002: 16-35; Ling 1998: 6-10). We apply the term *terrazzo* in reference to the techniques of very long tradition in the Venetian area, but also used in some earlier Greek and Roman sites. The Venetian *terrazzo* floor was executed using two main techniques: in the *battuto* technique a final layer of lime mortar mixed with small stone and terracotta fragments was spread on the usual preparatory stratigraphy and packed by striking with tools until it became highly compact, and it was then polished. The *seminato*, or literally

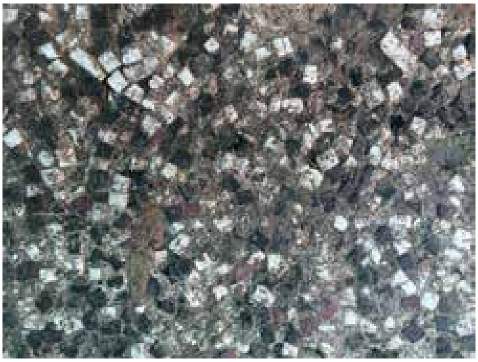

Fig. 7. Detail of the "irregular *terrazzo*" (photo K. Schneider and F. Guiducci)

"seeding" technique, instead involved application of a final layer of bedding mortar on the preparatory stratigraphy and then sprinkling more or less regular tesserae or irregular pebbles on the surface, achieving a rougher effect (Cacciatori 2008: 14).

The irregular *terrazzo* floor achieves a visual result similar to that of the *seminato*, using an application of mosaic tesserae (Fig. 7). However the technique of execution is different in that the tesserae were not seeded on the surface but instead mixed with the mortar and then compacted, as in *battuto*. The layer of mixed tesserae and lime mortar was laid over the usual mosaic preparatory layers, to a thickness of about 10 cm (Fig. 8). The surface was then levelled and pounded until smooth.

The tesserae are of various colours and materials: white, black and green stone, red terracotta, and a small share in blue or green glass paste. The variability and large amount of the tesserae material leads to the supposition that these were derived from one or more polychrome *opus tessellatum* floors dating to earlier occupations, probably representing a much greater area than the one covered by the irregular *terrazzo* floor.

It has not been ascertained if the room was originally part of the same housing context that contained the two other floors, or if it belonged to a different one, perhaps separated from the first by an as yet unexcavated road. Unlike the other two

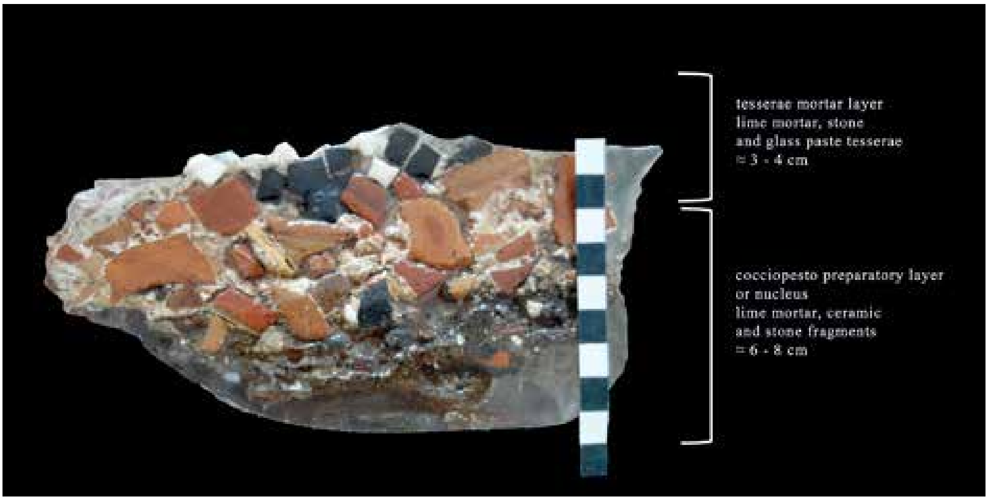

Fig. 8. Stratigraphic section of irregular *terrazzo* (photo K. Schneider and F. Guiducci)

cases there are no signs of this area having been used as a lime-slaking pit. The time correlation between the two areas is unclear, in part because the irregular *terrazzo* is at a slightly higher elevation than the other two floors. However, as with the other cases, the floor level was raised by about 50 cm in the early Medieval, and finished in *opus caementicium*.

Conservation condition and intervention

The floor was found in quite good condition, presenting only few minor lacunae and no carbonated encrustations, while the surface of the final 10-cm layer of tesserae and mortar was stable and well attached to the preparatory layers. The conservation intervention, undertaken in 2016, consisted of wet cleaning the surface using water and stuccoing of minor lacunae with lime mortar (Fig. 9).

An area of about 0.6m^2 of the floor was detached and removed to allow archaeologists to explore the underlying stratigraphy. The detachment was undertaken by facing the area with gauze and a vinyl-based adhesive. The surface layer was then lifted in two pieces by means of inserting metal bars. The expectation was that this would lift the complete *tessellatum* layer, however due to the unusual thickness and technique of the floor only the surface layer remained attached to gauze, while the lowest 2-3 cm of the mortar-tesserae material remained attached to the preparatory layers. It was only in this moment that the construction technique of the floor became fully apparent (Fig. 10).

At this point the archaeologists were able to dig an exploratory trench below the floor level. The expectation had been that since the irregular *terrazzo* was at a

Fig. 9. Wet cleaning of irregular *terrazzo* surface (photo K. Schneider and F. Guiducci)

Fig. 10. Detachment of an area of irregular *terrazzo* (photo K. Schneider and F. Guiducci)

height above the other two floors there would be another floor of Imperial era below. However, the test excavations did not show any sign of lower levels of habitation. Following this observation, the detached portions of the floor were reapplied in their original position. The trench was first backfilled with soil and a preparatory layer of lime mortar was laid. The two lifted blocks were then reinserted in original position. After having given time to the mortar to partially set, the facing was removed using a solution of water, alcohol and acetone in equal parts (3A). Finally, the edges of the lifted blocks were reintegrated using loose tesserae, thus restoring complete visual and structural unity.

Best practice: inter-professional cooperation, in-situ conservation, reburial

The project reported demonstrates several aspects of best practice on a site of lesser importance and within very limited costs. In particular these were:
the fruitful cooperation with archaeologists throughout the planning and implementation phases;
the development of a reburial system while waiting for the final uses to be agreed with the site administrators;
the application of best technical practices over entire site and through all the project years, for the 'pretty' *opus sectile* but also the 'uncommon' irregular *terrazzo* mosaic and even the 'ugly' *opus scutulatum.*

Collaboration with archaeologists

The need for greater integration between the disciplines of archaeology and conservation has been discussed and advocated for many years now. In theory the two sciences must be considered as "natural partners (…) on an intellectual par" (Agnew 2003: 25), both sharing the same aim of facilitating access to the past. While this is agreed in principle, many examples can still be found in the literature and are heard in conversation concerning disagreements or even conflict between the two disciplines. In order to bridge the gap it is crucial that conservators seek and be permitted inclusion in the initial stages, beginning with the design of the archaeological project. Then, in advance and once on site, conservators will be prepared to immediately tackle issues as the structures are excavated, by establishing procedures that can prevent damages caused by inappropriate techniques and materials. Conservation thus becomes proactive rather than reactive, minimising damages, facilitating the archaeological objectives, and ensuring long-term sustainable preservation.
The archaeological project at Parco dei Ravennati is not at all the largest of the Italian context, but it provides an example of fruitful inter-professional collaboration. The intervention was discussed, planned and carried out in full agreement: conservation and excavation were carried out simultaneously and operations were planned in a manner that would avoided cross-interference. Conservators were constantly engaged in discussion with the archaeologists, in evaluating possible options and so achieving results that were satisfying in terms of both preservation and scientific inquiry. These discussions took place in the planning phase prior to the initiation of both the overall project and each individual season, and then every time a new challenge arose during excavation. In this way even the most unexpected situations could be successfully managed.
In Area A conservators worked alongside archaeologists from the initial phase of discovery of the floors to the final seasonal reburial of the rooms. When the first signs of the *opus sectile* started to appear under the shovels, conservators stepped in and completed the uncovering of the floor, ensuring that the operation was executed carefully and avoiding damage to the loosely attached *crustae*. The same division of labours was applied for the other two floors. When it was necessary to dig an exploratory trench in the room with the irregular *terrazzo* mosaic, the conservators

detached a portion of the floor and then carefully reinstalled it once the tests were completed. This coordinated operation allowed the archaeologists to explore the stratigraphic layers beneath the *terrazzo* floor while at the same time achieving its integral preservation.

Conservation in situ and reburial

Every newly excavated structure was consolidated within the same season, avoiding the exposure of fragile remains to atmospheric agents for months or years. The practice of immediate intervention is always sure to be more effective, durable and sustainable than emergency remedial treatments, including in terms of long-term economic sustainability. At the close of the season the consolidated pavements were also reburied, avoiding any risks due to discontinuity in the project operations and while waiting for the site administrators to determine whether portions of the site will eventually be provided with a shelter and public visitation services.

Conclusions

Best practice is not a question of budget but of attitude: every project has a budget limitation and we all have to make the best out of the resources at hand. In the case reported, excavation, conservation, study and dissemination were delivered by a small, multidisciplinary team of well trained, dedicated professionals. The conservation team, following an initial risk assessment, designed a priorities-responsive and precisely scheduled conservation program, including the documentation and dissemination of the retrieved information. The AIRC communicated the entire project on social media throughout all the excavation seasons, including the conservation aspects.

The relevance of cultural heritage is based on its value for its current and future users. In other words, it depends on our capacity to read/recognise the informational and emotional content embedded in its material fabric and connect it to our contemporary values. The so called minor sites, making up the great majority of our archaeological heritage, and minor interventions, constituting the great majority of our day to day professional work, will very rarely generate the dramatic effects of sites such as the Italian cases of Pompeii or Piazza Armerina, and their associated huge conservation projects. However they can still generate added value in understanding and comprehension of history, and this potential is too often underexploited.

The common denominator of the all the Area A floors thus far excavated is the notion of change. All the materials used have been retrieved elsewhere and reused. The materials have lost their value as artefacts in the original context, but still preserved their value as precious building materials. In the case of the *opus scutulatum,* and especially of the irregular *terrazzo* mosaic, it seems that the character of these materials was more important than the execution of a specific design: even the simplest reuse of the materials from a context of a previous importance was enough to convey a certain social prestige and achieve aesthetic pleasure. Later the physical qualities of these same floors were deemed their most important quality, completely bypassing their aesthetic perception: the compact, smooth and durable surfaces made them ideal for use as the base of lime-slaking pits. All of this builds up idea of the layered nature of history and its complex web of meanings, challenging the widespread conception of aesthetics in antiquity as being monolithic and univocal. All three floors differ from the common types of Roman mosaics of the period and yet still lived happily in a single context and in harmony with the contemporary perceptions and sensitivities. The quantity and quality of information retrieved during the treatment of the floors was directly correlated to the qualification of the professionals carrying out the conservation. The knowledge retrieved by their particular competences was used to engage the wider public and to communicate richer perceptions of the site, to promote the understanding of cultural heritage as a material textbook of layered history. The real importance of these floors is therefore not their aesthetical aspect, but their capacity to help us to better understand history in a context of change.

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References

Agnew N. 2003. “Of the past, for the future: a coalition for change at the Fifth World Archaeological Congress”. *Conservation: the GCI newsletter* 18/1: 22-25.

Cacciatori V. 2008. “I pavimenti alla veneziana. Storia ed evoluzione artistica.” In *Pavimenti alla veneziana*, edited by Lorenzo Lazzarini, 11-49. Rome: Cierre Edizioni and Istituto Veneto di Scienze, Lettere ed Arti.

Fiori C. and Vandini M. 2002. *Teoria e tecniche per la conservazione del mosaico*. Saonara, Padua: Il Prato.

International Association for Classical Archaeology (AIAC). 2018. “Fasti Online. Parco dei Ravennati.” http://www.fastionline.org/excavation/micro_view.php?fst_cd=AIAC_3357&curcol=sea_cd-AIAC_5422, last accessed February 25, 2018.

Ling R. 1998. *Ancient mosaics*. London: British Museum.

Pellegrino A. and Raddi M. 2014. “La periferia orientale dell’antica Ostia”, *Mélanges de l’École française de Rome-Antiquité* (Online) 126/1. https://mefra.revues.org/2169?lang=en, last accessed February 25, 2018.

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A EUROPEAN REGIONAL COLLABORATION PROJECT: CONSERVATION AND RESTORATION OF ANCIENT MOSAIC FROM VILLA URBANA IN BUDVA, MONTENEGRO

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Abstract

The paper presents the results of the regional collaboration between institutions in Montenegro and Serbia for the conservation-restoration of approximately 40 m^2 of mosaics from the thermae of Villa Urbana in Budva, Montenegro, dating to the 2nd century AD, depicting marine creatures in dark and white tesserae with red accents. The mosaic was lifted in 1986, following a devastating earthquake. The aims were to conserve the mosaic fragments on movable support for purposes of presentation in different display contexts, and to promote administrative and professional exchange between the Centre for Conservation and Archaeology Montenegro, the Public Institution Museums and Galleries of Budva, the Central Institute for Conservation in Belgrade and the Serbian Institute for Protection of Cultural Heritage, in Belgrade.

Keywords: *opus tessellatum*, 2nd century, conservation-restoration, museum presentation, Budva Montenegro

Archaeological context

The mosaic at object of the current paper was recovered from the site of the so-called Villa Urbana, a Roman habitation discovered on the site of the current Avala Hotel in Budva, Montenegro, near the shore of the Adriatic Sea. The villa was part of a settlement founded in the late 1st or early 2nd century AD and destroyed by the end of the 3rd century. The room containing the mosaic measured 9.10 x 7.80 m. On the southeast side it was demarcated by a large wall fragment. The excavations revealed four cisterns found below the mosaic level (Gazivoda 2010). The mosaic had been heavily damaged by subsequent construction on the site. Given the history of disturbances, a total of around 37 m^2 of the original 70 m^2 of mosaics still survived.

The mosaic was first discovered in 1937 but was reburied prior to construction of the Avala Hotel (Kovačević 1996). After an earthquake causing severe damage, in 1979, the original hotel was renovated and construction of a new hotel was begun on the same site. In 1986 the mosaic was lifted from the site in 26 fragments. The facing of the mosaic and its detachment were carried out under the direction of Mr. Vladimir Rasic, conservator of the Republic of Yugoslavia Institute for the Protection of Cultural Monuments. The mosaic was then relocated several times over the course of the following years (Karović 2014) before finally arriving in the basement storage area of the Public Institution Museums and Galleries of Budva, where it was last located prior to the current conservation-restoration project.

Mosaic description

The mosaic is executed in *opus tessellatum* technique, using calcareous white, grey and red tesserae of 2.0 to 2.5 cm in height. The mosaic is figurative, with representations of marine, mostly fantastic creatures, executed as dark silhouettes on a white background, with accents in red tesserae. The tesserae are placed precisely, with narrow joints, achieving a highly artistic quality. The figures preserved include a dolphin and seahorse, leading to the supposition that the complete mosaic presented a scene of the triumph of the sea god Neptune, however this assumption cannot be proven because the only figure preserved from the centre of the mosaic is a portion (the back of the body) of a fantastic dragon-like animal (Karović 2014). The central field is framed by a monochrome band composed of three rows of tesserae, surrounded by a wide border in which other sea creatures proceed in clockwise direction. This border is in turn enclosed in a monochrome band of five rows of tesserae. Finally, the spaces intervening between the patterned mosaic and the walls were filled with a white *tessellatum* (Fig. 1).

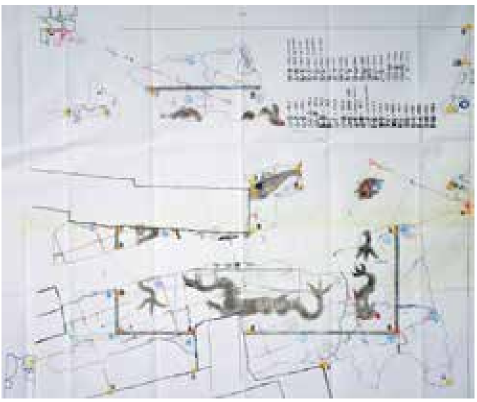

Fig. 1. Technical drawing of the mosaic prior to lifting (Serbian Institute for Protection of Cultural Heritage, Belgrade)

Conservation-restoration project

The main aim of the current project was to restore the mosaic on a movable support, for purposes of long-term conservation and public enjoyment. A secondary aim was to promote administrative and professional collaboration involving four regional institutions: the Montenegro Centre for Conservation and Archaeology, the Public Institution Museums and Galleries of Budva, the Central Institute for Conservation in Belgrade, and the Institute for Protection of Cultural Heritage of Serbia, in Belgrade [1]. The project was carried out from March to August 2014 and concluded with the exhibition of the newly restored mosaic in the framework of the celebrations of Budva Municipal Day, on 21 November 2014.

Conservation treatment

The objective was to restore the mosaic in a manner enabling several kinds of presentation:

1. temporary exhibition of the figurative part of the mosaic floor at the Church of Santa Maria in Punta, Budva;
2. longer-term exhibition of the figurative part in the very limited space of City Museum of Budva archaeological exhibition;
3. potential presentation of the entire mosaic, in recreated archaeological context, in the lapidarium situated in the courtyard of the City Museum.

The presentation of the entire mosaic was considered as the most desirable option, however the reality of this occurring in the short term is unlikely given the current intensive use of the courtyard for mixed purposes. Given this, the project was designed to provide for the restoration of the

Fig. 2. Assembling mosaic fragments prior to conservation

Fig. 4. Preparation of the mosaic support: a) application of NHL mortar; b) application of epoxy resin mortar

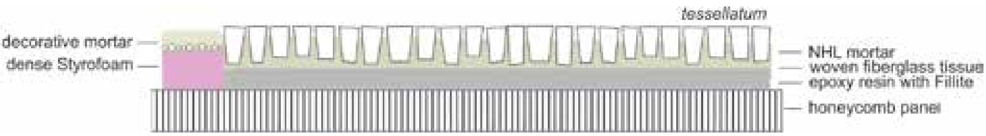

Fig. 3. Cross-section of the mosaic support

mosaic on movable, lightweight supports, in panel sections, so that these could be easily handled and joined to form montages of different sizes, suited to temporary display and to mounting on the very limited wall-spaces of the current archaeological exhibition. At the same time, the support was designed to withstand exposure in outdoor sheltered area, in the case that presentation in the *lapidarium* eventually becomes possible.

Given the height of the tesserae and size of the floor fragments (e.g. 2.3 x 1.29 metres for the fragment with the dolphin), it was important to reduce the weight of the support layers. The narrow spaces and low ceilings of the archaeological exhibition space also meant that it would only be possible to mount the panels by sliding them in a horizontal movement. Because of this, two wide fragments representing sea horses had to be cut in half. This decision permitted the restoration of the best preserved parts of the mosaic on five honeycomb panels of similar size. These could be mounted with the long axis in a vertical position and handled with relative ease (Fig. 2). The remaining fragments were also mounted on honeycomb panels, with the edges prepared in a manner permitting close interconnection. However not all the fragments were directly connected, so it was also necessary to determine the exact positions and distances between them. The positions of these fragments were determined from the original drawing prepared when the mosaics were lifted (Fig. 1).

The honeycomb panels were custom made by Composite Technologies Team, an industrial design and production company based in Belgrade. The decision was made to apply the mosaic fragments to the honeycomb by the indirect, face-up method, for purposes of achieving the best fit between fragments. The support for the mosaic was prepared in three layers: a thin intermediate layer of hydraulic lime mortar (NHL 5 mixed with sand in 1:3 ratio by volume), underlain by woven glass fabric and a synthetic layer of Fillite® and epoxy resin (Figs. 3-4). This support allowed the removal of the facing from the fragments prior to their placement on the honeycomb panels.

The honeycomb edges were prepared in two ways: the inner edges of adjoining pieces were filled with epoxy resin thickened with fumed silica; the outer edges were filled with epoxy resin mixed with limestone aggregate to resemble mortar. Once the tesserae were mounted on the honeycomb backing the edges of the adjoining pieces were trimmed for a perfect fit using a motorised grinder. The tesserae along these edges were first provided with temporary protection, using paper adhesive tape (Fig. 5).

The *tessellatum* was then cleaned, in several steps: by steam-cleaner, using compresses of 10% ammonium carbonate solution in water, and using soft brushes with a mild disinfectant solution to remove the traces of animal glue used for the facing.

Fig. 5. Assembling mosaic fragments on the honeycomb support

Fig. 6. Altered surface of gray tesserae

The condition of the *tessellatum* was assessed during cleaning. The damages were mainly due to mechanical stresses, such as many thin cracks in the joints, and dents from the impact of rubble during the building destruction. Scaling of some tesserae was also noted. In addition to the physical damage the surface of the grey tesserae presented a surface disfiguration, giving the dark silhouettes of the sea creatures a whitish appearance and making it difficult to recognise the figures (Fig. 6).

The SEM-EDS analysis of the surface of grey tesserae was carried out at the Faculty of Mining and Geology of the University of Belgrade, using a JEOL JSM-6610LV scanning electron microscope connected to an X-Max energy dispersive spectrometer, for identification of the morphology and chemical composition of the mineral

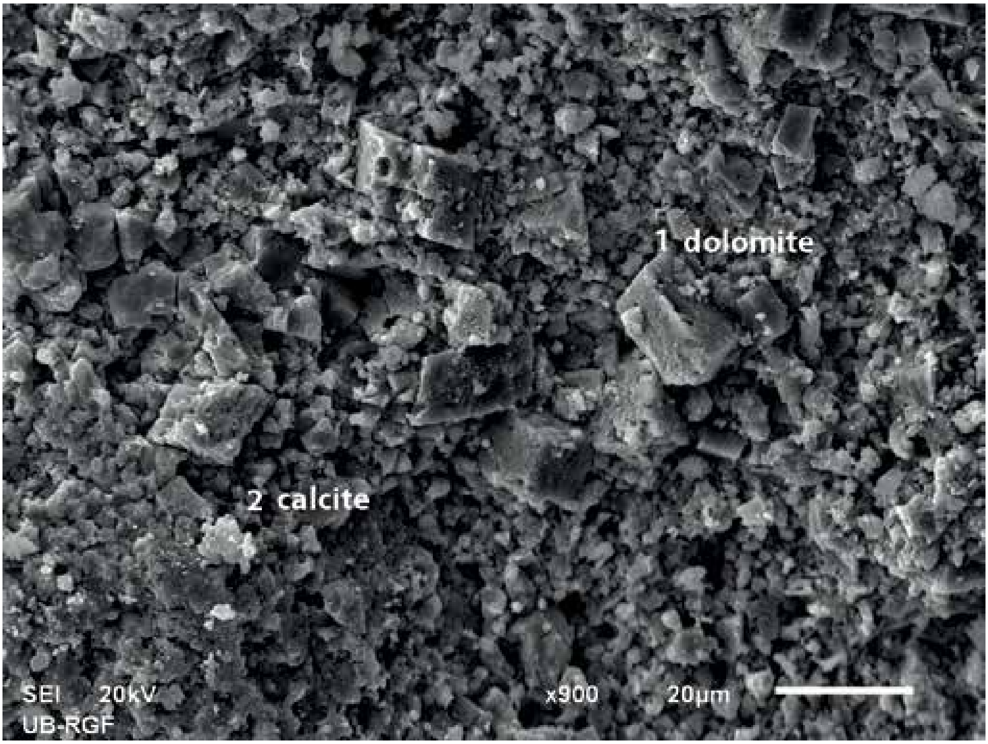

Fig. 7. SEM image of the analysed sample showing 1) dolomite and 2) calcite

phases present in the sample. The sample was covered with gold using a BALTEC-SCD-005 sputter coating device and the results were recorded under high vacuum conditions.

The analysis showed the presence of dolomite and calcite minerals, indicating that the dark tesserae had been prepared from a dolomitic limestone (Fig. 7). The EDS analysis did not show the presence of chlorine or sulphur, leading to the conclusion that no chloride or sulphate salts were present, and that the discolouration was due to a process of dissolving the calcite mineral, highly soluble in water (Steiger *et al.* 2011), followed by its migration and precipitation at the surface (Bilbia and Matović 2009). Given that the alteration made the mosaic decoration illegible, it was decided to mechanically remove this micron-thin layer. This was accomplished by micro-blasting using an aluminium-oxide abrasive at 2 Bar (43 psi), thus recovering legibility of the mosaic colours.

The reintegration of the lacunae was accomplished using two techniques. The smaller lacunae were reintegrated with original tesserae and the damaged joints were filled with dry mortar mixture, subsequently hardened by spraying with water. The larger lacunae were filled with hydraulic lime mortar (NHL 5 and limestone aggregate), matching the colour and texture of the original *supranucleus* mortar (Fig. 8).

Fig. 8. Application of the decorative mortar to mosaic panels

The fragments mounted on honeycomb were then integrated into larger panels prepared of dense Styrofoam of 2 cm thickness, attached to the honeycomb using epoxy resin. The Styrofoam surface was coated with a thin layer of epoxy resin embedded with coarse limestone aggregate, providing a rough surface for attachment of a thin layer of mortar (Fig. 3). The entire composition of the Styrofoam panels was temporary assembled as a single unit, separated only by strips of epoxy-impregnated fibreglass, so that the mortar could be applied over the entire composition in a uniform level. On this mortar backing, the dark border between the central mosaic 'carpet' and the surrounding elements was reintegrated with a colour matched lime wash drawing, for purposes of clarity of aesthetic presentation and enjoyment (Fig. 9).

Fig. 9. Representative part of the mosaic on exhibition in the Church of Santa Maria, Budva

Conclusions

The methodology of restoring and mounting the detached mosaics on a movable support was chosen for purposes of effective conservation and reconstruction in display, also considering the extent of damage to the mosaics. The size and composition of the movable panels, as well as the design of the layers of support, was governed by considerations of how to re-establish the decorative scheme, the demands of the future environment, and the objectives for display and storage. In particular, the limits of the available exhibition spaces imposed restrictions on the size of the panels, for purposes of safe handling and mounting (Fig. 10). The materials used to build the support had to be suited to display both indoors and outdoors, in a sheltered context. Care had

Fig. 10. Representative part of the mosaic in the City Museum of Budva archaeological exhibition (photo by J. Đurović)

to be taken to fit the mounting panels as closely as possible, to avoid disruption in viewing the mosaic. The fragments featuring figurative mosaic, in particular, offered little possibility for linear junctions between the panels. The task was time consuming and labour intensive but in the end achieved very good results.
The figurative part of the mosaic was exhibited at the Church of Santa Maria in Punto for two years, after which it was remounted on the walls of the Budva Museum archaeological exhibition (Fig. 10). Presentation of the entire mosaic in the museum *lapidarium* is still pending.
The conservation project also provided the intended opportunity for the conservators of Montenegro and Serbia to meet, collaborate and share experiences, thus promoting further institutional and professional cooperation in the field of conservation-restoration and cultural heritage in general.

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Note

1. Members of the conservation team were: Željko Čelebić, project leader, Labud Jakšić, Miljana Martinović, Nevenka Popović, Dragan Kekić and Željko Kalezić, all of the Montenegro Centre for Conservation and Archaeology; Biljana Brajović, Director, Public Institution Museums and Galleries of Budva; Lidija Ljesar, Director of Cultural Heritage, Ministry of Culture of the Republic of Montenegro; Nemanja Smičiklas, of the Institute for Protection of Cultural Heritage of Serbia, Belgrade; Maja Franković, Dunja Davidović Gnjatović and Dušan Maksimović, all of the Central Institute for Conservation in Belgrade.

References

Bilbija N., Matović V. 2009. *Primenjena petrografija, svojstva i primene kamena, drugo dopunjeno izdanje*. Belgrad: Građevinska knjiga.

Gazivoda D. 2010. "Zaštitna arheološka istraživanja na "Lokalitetu Stara Avala", *Glasnik Narodnog muzeja Crne Gore*, new series 6: 175-184. Cetinje.

Karović M. 2014. Ancient mosaic – Villa Urbana – Budva, PI Museums and Galleries of Budva, Podgorica (In the original: Karović, M., 2014, Antički mozaik – Villa Urbana – Budva: crkva Santa Maria in Punta, Stari grad Budva – prvo javno prikazivanje 21.11.2014, kat. izložbe. JU Muzeji i galerije Budve, Podgorica).

Kovačević, M. 1996. Budva stari grad, o graditeljskoj baštini, monografija Budva, Budva.

Steiger M., Charola A.E., Sterflinger K. 2011. "Weathering and Deterioration". In *Stone in Architecture, Properties, Durability*, edited by Siegfried Siegesmund and Rolf Snethlage, 4th ed, 227-316. Berlin-Heidelberg: Springer.

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RESTORING THE LEGIBILITY OF A BYZANTINE OPUS SECTILE PAVEMENT, MONASTERY OF THE TRANSFIGURATION, MESSENE, GREECE

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Abstract

In 2015, an impressive 13th-century *opus sectile* pavement was uncovered in the narthex of the *katholikon* of a fortified monastic complex, known as Andromonastiro. The pavement consists of a tripartite composition with a central quintuple *omphalion*, executed in polychrome stone. The conservation project for the pavement was developed in parallel with the overall restoration and site management goals, which involved reopening the location, including the church, to public visitation and use. The specific aims were to restore the legibility of the pavement, preserving the surviving fragments and strata in situ, and schematically rendering the outlines of the design using new marble infills and mortars, without compromising authenticity. The detached marble fragments and tesserae recovered during excavation were replaced in their original locations. The selection of new material infills was based on the physical evidence of the original pavement. The conservation program provides for long term monitoring and preservation, with specific measures proposed for moments of high visitation.

Keywords: *opus sectile*, Byzantine, Messenia, conservation, infill

Administrative and historical context

The Andromonastiro, or Monastery of the Transfiguration, is situated in a lush valley southeast of the village of Petralona, close to the ancient city of Messene (370 BC-395 AD) in the southwest Peloponnese. The monastic complex had not been in use since the 1970s, but retained many of its original features, including the refectory, bakery and a multifunction building to the north, a wing comprised of storerooms, stables, monastic cells and a reception hall to the west, as well as a three-story tower containing the abbot's quarters. Between 2011 and 2015 the Ephorate of Antiquities of Messenia conducted a restoration program for the complex, including two projects funded by the National Strategic Reference Framework (NSRF) at a total cost of almost 2 million euro ((Militsi-Kehagia *et al.* 2015). This program has contributed to the study of monastic architecture in the area and transformed the monastery as a living heritage site and source of pride for the local community.

The *katholikon* of the complex is a large four column cross-in-square domed church of the semi-complex variant, with narthex to the west. It was built shortly after the Franks arrived in what was then known as "the Morea", establishing the Principality of Achaia (1205-1428). The church is a rare example of this ecclesiastical type and is the second earliest in Messenia after the 12th-century Church of Saints Theodoroi at Achladochori (Kappas 2010: 202). The structure was erected

Fig. 1. View of the monastic complex (photo M. Kappas)

over the most important natural spring in the area, which was incorporated into a system of vaulted cisterns.

The Turkish conquest of the Peloponnese in the mid-15th century led to the dissolution, sacking and razing of the monastery. The church probably acquired its present form shortly before 1612, during a building program sponsored by the monk Anthimos, of Voulkano Monastery. This extensive refurbishment involved the construction of the spaces flanking the *katholikon* on the north, west, and south sides. These featured higher ceilings and required the almost complete reconstruction of the narthex, whose original ceiling was much lower, as in most churches of this type. There was also the addition of a large exonarthex, necessary for monastic services. Chronological evidence for this phase is provided by a *sigillion* of 1612, issued by Patriarch Neophytos II of Constantinople, which mentions the re-establishment of the dissolved Byzantine stauropegic monastery, at the initiative of and with the sponsorship of the monk Anthimos from Kythera, "at Ilios": a location quite securely identified as Andromonastiro. The re-founded complex, dedicated to the feast of the Transfiguration and again a stauropegic monastery, was annexed to the Voulkano monastery.

The monastic complex acquired its present form in the mid-18th century (Fig. 1). In 1770, during the Orlov Revolt, a precursor of the Greek war of Independence, the monastery appears to have suffered extensive damage, a conclusion substantiated by the type of damage suffered by the *opus sectile* pavement. In 1785, in the face of decline, the monastery was annexed to the Monastery of Saint Catherine on Mount

Sinai. This situation continued until 1929, when the complex was sold to a private individual, who then ceded it back to the Voulkano Monastery in 1962. The last large-scale refurbishment of the complex appears to date to the end of the 19th century, at which time the floor of the main church, narthex, and exonarthex were covered with rectangular stone slabs by craftsmen from the village of Langadia, Arcadia, thus concealing the original *opus sectile*.

DESCRIPTION OF THE PAVEMENT

The elaborate *opus sectile* was originally a tripartite composition, with an impressive central quintuple *omphalion* flanked by two side panels of framed lozenges (Fig. 2). The tripartite composition of the pavement echoed the original spatial arrangement of the narthex, before its 18th-century reconstruction. It is centred symmetrically along the north-south axis, with respect to the openings of the side spaces. The central and south panel are in turn symmetrically placed along the east-west axis, yet the north panel was displaced by 40cm towards the centre, indicating the original symmetry of the composition.

The central panel presents a quintuple *omphalion* measuring 1.91×1.92m, consisting of five pairs of interlacing concentric circles of white marble (8cm wide and 5.5cm thick), with a central red marble disc (Ø15cm). The ground is laid in black, white and red tesserae, which are either lozenge-shaped (1×1cm or 1.8×1.8cm) and laid in a checkerboard pattern, or triangular (sides of 1.0 or 1.8cm) and set in radial arrangement. These patterns of installation are consistent with Byzantine craft, which favoured slight differentiation in keeping with the geometry of the tesserae.

Two smaller panels, each 1.55 ×1.55m, flanked the central composition only one of which remained partially in situ. The imprint of the frame from the missing north panel, surviving in the setting bed, suggests that its design was similar to that of the south panel (Fig. 3). The surviving half of this southern panel features a red marble rhombus inscribed in a white marble frame with a central circular disc

Fig. 2. Material and condition mapping (drawing I. Doganis)

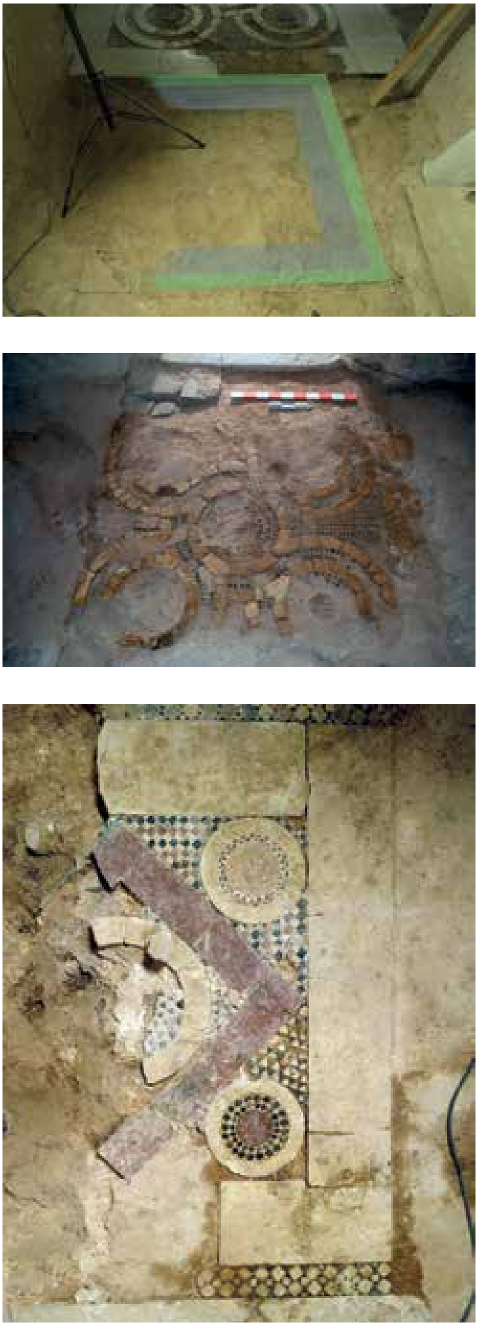

Fig. 3. Opus sectile panels, in condition as discovered: a) north, b) central, c) south (photo I. Doganis)

(Ø 11cm). Four smaller discs of concentric white marble and tesserae bands with central red disc (Ø 9-13cm), are inscribed in the four corners. The ground was also laid with black, white and red tesserae, set in patterns similar to those of the central panel. The white marble slabs are framed by *opus sectile* bands (9cm wide) laid in rhomboidally placed square tesserae (4×4 or 1.8×1.8cm) and triangular tesserae. The areas surrounding the three panel pavement were laid with slabs of local cream coloured limestone.

Materials and techniques of execution

Systematic documentation is arguably the single most important tool in proposing conservation objectives and methodology, as well establishing a baseline for monitoring the treatments over time and assessing their efficacy. In this case the team carried out macroscopic observation, photographic and graphic documentation, and analysis of the strata of bedding mortars, for the development of viable conservation and presentation solutions. The *opus sectile* was traced to 1:1 scale on PVC sheets, and the individual architectural elements were measured. This information was transferred onto the measured drawings serving as base maps for material and condition mapping. The information recorded included the characterisation of materials and technologies of execution, the condition assessment and the identification of previous repairs.

Macroscopic examination permitted the identification of several types of marble, apparently originating from the Mani peninsula. Indeed, since antiquity the area had served as a source of polychrome and white marbles, used locally export.

The marbles identified in the *opus sectile* are red marble (*rosso antico)* from Profitis Elias near Laghia, or Panaghea; black marble (*nero antico Tenario*) from Kisternes Tainaron; white marble from Marmari or Mezapos and light green schist (*cipollino Tenario*) from Kourello or Mianes (Lazzarini 2007). All of these stones could either have been sourced directly from the quarries in Mani or obtained as recycled material from pavements and revetments from the nearby ancient Roman city of Messene. The white marble bands are fashioned from fine-grained white Pentelic marble. The tesserae were catalogued in terms of material, colour, dimensions and shape: they are trapezoidal in section of 1-2.5cm height and were laid by the direct method, as seen from the imprints on the bedding mortar.

The stratigraphy of the *opus sectile* is quite simple, being comprised of two layers, the setting bed and the bedding mortar. The setting bed was a 2-4cm layer of compacted earth containing haphazardly mixed ceramic fragments, and stones used to support the curved white marble slabs. The off-white bedding mortar layer was 1-1.5cm thick (Fig. 4). The mortar was rich in lime, with a binder to aggregate ratio [1] of 3:2. The aggregates consisted of ceramic dust and fine grained sand (Ø75m-2mm), with a median grain of Ø 0.35μm. The mortar had an apparent specific gravity [2] of 0.84gr/cm^3 and water absorption at saturation [3] of 26.2%. A pinkish repair mortar was also identified, possibly dating to the 19th century, used to smooth out the surface and fill depressions and lacunae before laying the stone slabs over the opus sectile. This mortar was quite compact and contained ceramic dust, charcoal and medium-grained aggregates (Ø75m-6.3mm) with a median grain size of Ø 0.6μm in a 1:1 binder to aggregate ratio. This mortar had an apparent specific weight of 1.03gr/cm^3 and water absorption at saturation of 14.5% (Table 1).

Fig. 4. Central panel, tesserae imprints on the bedding layer (photo I. Doganis)

Material	Granulometry		B/A ratio	Porosity & med.pore r (Øμm)	Sp.ap.wt (gr/cm^3)	Water absorption (%)	Mechanical strength 28days (MPa)	
	Grain size (Øμm-mm)	Med. gr.size (Øμm)					compression	tension
Bedding mortar	75μm-2mm	0,35	3:2	-	0,84	26,2	-	-
19th century repair mortar	75μm-6,3mm	0,6	1:1	-	1,03	14,5	-	-
infill mortar	75μm-4,75mm	0,9	1:2	34,51 0,4	1,96	18,55	5,85	1,55
grout	< 75μm	-	2:1	44,59 0,05	1,42	18,68	7	2,14

Table 1. Characteristics and properties of authentic and repair mortars

Condition

The condition of the *opus sectile* was mediocre. There were extensive losses of both the *opus sectile* marble elements and ground and pronounced overall deformation and fragmentation. The fragmented, somewhat illegible state of the pavement, as well the types of damage, suggest that these were brought about by a catastrophic event, involving the burning and collapse of the timber roof. This hypothesis was corroborated by findings of charred timber and ash in the lacunae, and the charred surfaces of many tesserae.

What remained of the *opus sectile* provided only a fragmentary reading. The central panel preserved most of the white marble bands delineating the *omphalia*, the north-west red marble disk, sections of opus sectile ground and extensive areas of bedding mortar bearing tesserae imprints, as well as the fragmented white marble slab to the north. None of the original materials of the north panel were preserved, however the bedding layer showed the imprints of the framing marble slabs and outer tessellated band, of the same dimensions as those in the south panel. These indications, together with a handful of loose tesserae, suggest a similar design to that of the south panel, the surface of which was about one half preserved.

There were varying degrees of cracking in the remaining marble slabs, with those to the north of the central panel among the most severely affected. The stone of both the marbles bands and tesserae was subject to delamination and thermal deterioration of the upper surfaces. Loose and missing tesserae were found in the ground as well and along the edges of lacunae. Apart from the extensive surface deterioration of exfoliation and erosion, there were also staining phenomena attributed to the effects of fire. Acoustic sounding detected extensive internal voids, with detachment of the setting bed from the bedding layer. Infills with the shoddily applied pinkish mortar were quite extensive. Several fragments of marble bands and small sections of the ground were found within the lacunae.

Conservation program

The conservation program was designed to enhance the values embodied by the *opus sectile*, considering it as an integral part of the 13th-century church, in the broader context of the restored monastery as a heritage site, and taking into account that the structure is periodically used as a house of worship. In fact the Feast of the Transfiguration, celebrated in the church every summer, attracts as many as 2,000 participants. The *katholikon* of this monastic complex is the only church in the region featuring an early 13th-century *opus sectile* pavement. The spiritual values of the pavement pertain to the symbolism of the *omphalion*, the miracle of feeding the multitudes with the five loaves of bread. Terms of artistic values, the opus sectile features precious polychrome materials and highly quality of craftsmanship, attested in particular by the rendition of the ground. The fact that it was executed soon after the Frankish occupation indicates that the local monastic communities still maintained the freedom to construct churches of their dogma and of Byzantine typology, with the accompanying decorative schemes, and that they could access the necessary financial means, material resources, and skilled craftsmen.

The conservation plan was developed based on the survey and analysis of the artefact, the assessment of context and the prioritisation of its value, and the principles and guidelines established by both the Greek Ministry of Culture and international organisations. It addressed issues of authenticity and integrity, reversibility, differentiation of interventions, the use of compatible materials and documentation. The primary aim of the project was to conserve the authentic fabric *in situ* and to restore the legibility of the overall decorative program by a schematic restitution of the missing elements, in a manner that would prevent false readings and regain overall continuity and harmony. The conservation of the original fabric encompassed stabilisation with minimal intervention, retaining a clear reading of the overall damages by keeping the *in situ* slabs in their fragmented condition. Given that only some 30% of the total original surface area was preserved, the most challenging decision then became how to best portray and reinstate the ground, considering factors of authenticity in design, legibility and durability of the materials. In keeping with the decision to broadly delineate the decorative program and ensure reversibility, it was decided to fill the ground with a neutral coloured mortar, capable of reducing the visual contrast of the lacunae and regaining harmony in the composition.

Conservation materials

The pointing, infill, and grouting mortars were custom designed on the grounds of compatibility with the original materials, using a natural hydraulic lime NHL 5 binder and well graded aggregates. In order of importance, the desired characteristics were reversibility, adequate mechanical strength and durability. The infill mortar was thus designed in keeping with the composition of the original bedding mortar, using natural hydraulic NHL 5 lime in a 1:2 ratio with aggregates silica sand and crushed ceramic. The mortar has total porosity [4] of 34.5%, compressive strength of 5.85MPa, and tensile strength of 1.55MPa at 28 days [5]. The grout used was based on natural hydraulic lime NHL5 binder and pozzolana. An acrylic dispersion (trade name

Hydroground) was used to consolidate the earth based setting layer and ensure adhesion of the infill mortar. The surviving original bedding mortars were consolidated using a dispersion of nanolime in isopropyl alcohol (trade name Nanorestore).
Polychrome marbles sourced directly from the nearby Mani peninsula were used for the new marble elements and a very few tesserae infills. White Pentelic marble was used for the infills of bands.

Fig. 5. Central panel, consolidation of setting and bedding layers by grouting (photo I. Doganis)

Implementation

Work began with the removal of the accumulated debris and loose soil, using an air suction system and soft bristle brushes. All detached tesserae and fragments of marble band were catalogued, along with a section of detached sectile ground that had been historically repositioned within a lacuna. The original positions of most of these detached materials could be identified by the imprints left in the bedding layer. The 19th century mortar was removed using stone-working tools and scalpels.
The voids between the setting and bedding layers were grouted using hand-operated syringes and a dense network of pliable tubes, inserted via the lacunae and cracks (Fig. 5). Loose tesserae were repositioned using the same grout. The new marble pieces and detached original fragments were positioned using the infill mortar (Figs. 6-7). Salt encrustations, soot deposits and wax stains were removed using an ultrasonic pick and further cleaned using a non-ionic detergent and soft bristle brushes.
Prior to application of the infill mortar, the bedding mortars were consolidated using the nanolime dispersion, applied by

Fig. 6. South panel, during positioning of new marble elements (photo I. Doganis)

Fig. 7. Central panel during positioning of new marble elements (photo I. Doganis)

Fig. 8. Central panel, infill with new marble tesserae (photo I. Doganis)

brush, taking care to retain all imprints of tesserae. New tesserae were used for selected infill of the smaller lacunae (<3-4 tesserae), and in lieu of edging mortar, for the retention of the borders of the surviving areas, before application of the infill mortar (Fig. 8). The shape and material of these tesserae was chosen according to the existing layout. These materials were cut to a lesser thickness than the original so that no remnants of the underlying bedding mortar would be disturbed, while still achieving the same surface plane as the original. The new materials remain discernible thanks to their evident machine cutting, regularity and sharp edges.
The conservation program includes regular monitoring, maintenance and protective measures, considering that the site and the church are open to the public. In particular, a thick PVC sheet is lain over

Fig. 9. *Opus sectile* after conservation (photo I. Doganis)

the *opus sectile* for protection against foot traffic, prior to occasions of heavy visitation such as the annual festival of the Transfiguration.

Conclusion

The fragmented *opus sectile* pavement of the 13th century *katholikon* serves as a vivid testimonial to Byzantine craftsmanship, and embodies important artistic and religious values. The choices involved in presenting and interpreting is always case-specific, given the values, context, condition and function of the artefact, and often requires balancing conflicting demands. The main aim of the current project, was to restore and present a correct reading of the *opus sectile*, without compromising the preservation or authenticity of any of the remaining fragments or stratigraphic layers. The *opus sectile* encompasses almost the entirety of the narthex area, serving as the access to the church interior (Fig. 9). In this case, the challenging task of restoring legibility to the pavements involved a number of trade-offs in the decision process, also considering the durability and resistance of the conservation-restoration over time. The church is now restored its original splendour, replete with wall paintings and sculptural elements. The conservation-restoration of the entire monastic complex is presented to the public and to scholars using both panels and pamphlets, which illustrate the evolution of the site throughout its history.

Notes

1. Teutonico J.M. (1988) A Laboratory Manual for Architectural Conservators – Mortar analysis: Simple Analysis 73. ICCROM: Rome
2. EN1015-10 (1999). Test methods for masonry mortar: determination of dry bulk density of hardened mortar
3. ELOT 747 (1993) Water absorption at saturation
4. Micromeritics Auto Pore IV 9500 Mercury porosimeter
5. EN1015-11 (1999) Test methods for masonry mortar-Part 11: Determination of flexural and compressive strength of hardened mortar

Technical Notes

©Nanorestore (C.T.S. srl) https://www.ctseurope.com/en/scheda-prodotto.php?id=232 (accessed January 22, 2015)

©Hydroground (Lascaux) https://www.kremer-pigmente.com/media/pdf/81027e.pdf (accessed October 23, 2015)

References

Kappas M. 2010. "Churches of the Holy Diocese of Messene 1204-1500" In *Christian Messenia Monuments and History of the Holy Diocese of Messene* edited by P.Sarantakis, 189-273. Athens: Militos Editions (in Greek).

Lazzarini L. 2007. *Poikiloi Lithoi, Versiculores Maculae: I Marmi Colorati della Grecia Antica,* Marmora 2/2006 Supplemento 1, 71-115. Pisa-Rome: Fabrizio Serra Editore.

Militsi-Kehagia E., Barmparitsa E., Bouza L., Kappas M. 2015. "Andromonastiro of Messenia - Restoration and Display of the monastic Complex"edited by E.Militsi-Kehagia. Kalamata: Ministry of Culture and Sports Ephorate of Antiquities of Messenia.

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THE COLOURFUL MOSAICS OF THE GYMNASIUMS OF THE BATHS OF CARACALLA IN ROME: RESTORATION AND CONSERVATION FOR A FAMOUS ROMAN MONUMENT

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Abstract

The colourful mosaics of the Baths of Caracalla in Rome are an example of great craftsmanship within the colossal works of Roman imperial authority. For the sculptural decoration, painting and mosaics of these baths, the emperor Caracalla employed the finest materials and greatest artists of the time. The mosaics floors in particular are a masterpiece of design and technology. Beginning in 2011, the floors were the subject of a project for conservation-restoration, reconstruction and reopening to public enjoyment, under a cooperation agreement between the Italian Ministry for Cultural Heritage and Tourism and Bulgari S.p.a. The restoration work consisted of freeing the floor from its thick overburden of soil and grass, cleaning, cataloguing and mapping the tesserae colour and size, repositioning of the detached pieces, and consolidation of the entire surface. The conservation-restoration aspects of the project began in 2016 and are currently in their final stages.

Keywords: Baths, Caracalla, mosaics, repositioning, art bonus

Introduction

The mosaics and marble floors of the Baths of Caracalla represent a unique decorative complex, both for artistic quality and for preservation, given that most of the Imperial decorative complexes were subsequently destroyed or dispersed while those of the Baths were still largely preserved and sufficiently intact for reconstruction. The mosaic floors include examples of decorative vegetal, marine and geometric motifs, as well as figurative works, in coloured and black and white tesserae.

The floors were first excavated by Conte Egidio di Velo in 1824-1825, and accurately documented by Henry Blouet, who is believed to have drawn the mosaics as the excavations progressed. From these drawings, published in 1828, we can conclude that many floors are no longer preserved, but also that the excavators did not discover and reveal all of the mosaics, as we shall see later (Fig. 1). The excavation of the two gymnasiums continued under Giuseppe Fiorelli in 1878-1879, as seen in a contemporary photo (Fig. 2). The masterpiece mosaics of athletes and judges, found in the exedras of the gymnasiums, were lifted from their locations and are now preserved in the Vatican Museums (Secchi 1843). The literature on the Baths of Caracalla [1] has often analysed these famous floors, ignoring the other mosaics of the same rooms.

A possible hypothesis concerning the outstanding quality of the mosaics of the Baths of Caracalla, relative to those of other public buildings, could be that the beauty of these very works created a fashion, then widely imitated in other structures but

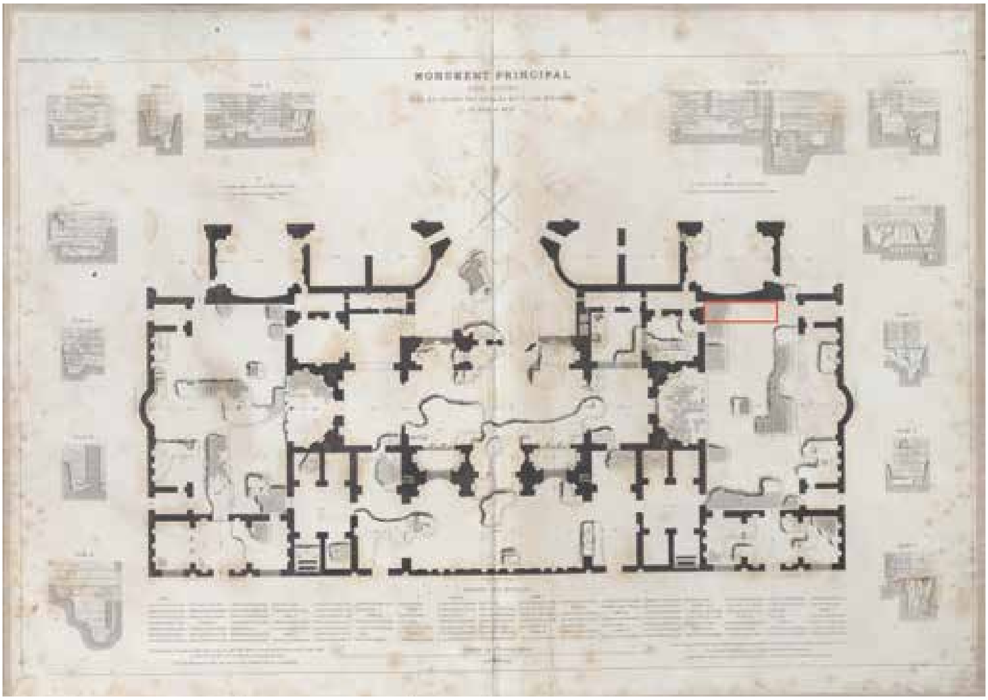

Fig. 1. The Baths of Caracalla, Blouet H., 1827, *Restauration des Thermes D'Antonin Caracalla*, Rome

without achieving the same excellence of design and skill [2]. A further hypothesis is that the source of the mosaic materials derived from the massive use of marble in the wall and floor coverings, which then created a large amount of waste of material suited for reuse in the production of tesserae [3]. According to this reasoning, unlike that of some other hypotheses, the production of the floors would have been contemporary with the original construction.

The colourful mosaics of the gymnasiums are a masterpiece, inspired by the tradition of "Neronian quadrichromy" [4] in which the "scale" pattern is executed in red porphyry, green serpentine, yellow *marmor numidicum* and whitish *proconnesium* (Guidobaldi 1985: 224).

Conservation intervention

In recent years the superintendency decided to uncover some of the gymnasium mosaics that had not been seen for decades, in order to expand the cultural offer of the monument, which although it has retained its beautiful decorative elements in the floors, presents only limited remains of architectural decoration [5]. Thanks to an important cooperation agreement between the Rome Superintendency and Bulgari S.p.a. it was possible to bring back 82 square metres of this wonderful polychrome mosaic. The geometric design of the gymnasium floors is perfect, of exceptional modernity, and provides a strong contrast with the motif of the central floor, executed in a pattern

Fig. 2. The excavation (Fiorelli G. 1878-1879) in the Western Gymnasium brought to light the mosaic floors (photo D. Anderson)

of green acanthus with alternating discs of the four colours.

The mosaic which is the subject of the current report was covered by soil and grass, making it impossible to ascertain the precise location or conditions of the original floor. Excavations for this purpose were begun in 2011. An aerial photograph was made after the excavation was completed. By overlapping this image with the part mapped by Blouet it can be seen that at that time the right portion was not historically documented. The conservation intervention was then conducted in three stages over a total of approximately 12 months.

The first cleaning tests revealed the wonderful colour tones of the mosaic. The frame is composed of the marbles cited as part of quadrichromy scheme (serpentines, porphyries, *numidicum*, *proconnesium*), as well as reddish-purple toned *luculleum* and reddish-orange *chium*. The scales pattern is executed with great skill. The tesserae alternate in a sequential pattern of porphyry, *proconnesium*, serpentines and *marmor numidicum*. The border of each scale is formed by double rows of tesserae, and triangular cut tesserae are placed in the curved parts. Each 'scale' is typically composed of about 600 tesserae (Fig. 3).

The same decorative motif can be observed in the Baths of Diocletian (Guidobaldi 1984), executed later in the same century (3rd century AD), however the quality of execution is remarkably different: the same marbles have been used, but

Fig. 3. The mosaic decorative motif: an example of Neronian quadrichromy (photo A. Borzomati for Rome Special Superintendency for Archaeology, Art Heritage and Landscapes)

Fig. 5. Baths of Caracalla, aerial view subsequent to excavation (photo A. Borzomati for Rome Special Superintendency)

Fig. 4. Baths of Caracalla, northwest part of Western Gymnasium: the site covered by grass prior to excavation and restoration (photo A. Borzomati for Rome Special Superintendency)

Fig. 6. The working team during treatment (photo A. Borzomati for Rome Special Superintendency)

the tesserae for the mosaic of Diocletian Baths are larger and are positioned in a more approximate manner.

The 2011 excavations revealed the critical condition of the floor, buried under a thick layer of soil and grass (Fig. 4). The conservation of the mosaics was particularly compromised. The soil had penetrated the preparatory layers, causing the complete detachment of the tesserae. In the left area there was an important fracture caused by the collapse of the floor and the presence of underground tunnels. The fracture runs through the decoration and extends to the outer perimeter. The mosaic areas near the wall structures also suffered from a layer of carbonates overlaying the original colours. The fracture and many lacunae of medium and large dimensions had been partly reintegrated with various types of infill. The history of previous, unpublished restorations could be detected by observing the different materials used. The hydraulic mortars dated to the earliest works, those of cement probably to the first quarter of the 20th century, and those of grit cement to the 1960s.

Figg. 7-8. Reintegration phase: an old cement filling removed and reintegrated with original tesserae (photo A. Borzomati for Rome Special Superintendency)

Figures 9-10: Baths of Caracalla: the mosaic before and after the restoration (photo A. Borzomati for Rome Special Superintendency)

The first cleaning steps, preceded by a preliminary biocide treatment [6], were a dry cleaning with soft brushes and then with the addition of water, using brushes, scalpels and dental probes (Fig. 5). During these stages, the loose tesserae were recovered from the lacunae, as well as a significant number from inside the fracture. Other polychrome tesserae were retrieved from the storage areas of the Caracalla monument. The tesserae were then cleaned and sorted by colour (Fig. 6). These detached tesserae were placed on new mortar in keeping with the decoration design, using a cardboard template as a guide (Figs. 7-8).

After the reintegration phase the consolidation was carried out, using a low-salt hydraulic lime [7] infiltrated by injection between the tesserae and subjected to a vibration sequence. During the consolidation phases it was possible to recover the correct lines of the decoration where these had become deformed. The exposed preparatory layers showed the impression of tesserae and were particularly fragile and detached from the *rudus*. Over these we applied a thin layer of nano-acrylic resin [8]. After the reintegration and consolidation phases, we performed a second mechanical cleaning step using an Ibix 25® micro-air abrasion device [9].

After the cleaning operations, tests were carried out to identify the appropriate colours and compositions of the plasters to be used between the tesserae and for the large lacunae. The fills were made with hydraulic lime, sand and *pozzolana* of varying grain sizes [10]. Finally, the restoration was completed by application of a protective film [11] over the mosaic, as well as a final biocide treatment.

For the future preservation of this important mosaic, a half-yearly scheduled maintenance campaign has been recommended. A simple disinfection, removal of organic materials and surface cleaning will ensure an indefinite guarantee of the integrity and brilliant appearance of this floor, witness to the great glamour of the decorations of the majestic Roman Baths of Caracalla (Figs. 9-10).

Notes

1. Among the most notable publications is Iwanoff S.A and Hülsen Ch. 1898, *Architektonische Studien, III, aus den Caracallathermen*, Berlin: G. Reimer.
2. The Baths of Caracalla were considered one of the seven wonders of Rome for their magnificent luxury and decoration.
3. The immense production of bricks for the construction of the Baths during the Severan dynasty has been another factor responsible for the surviving evidence of this period.
4. Federico Guidobaldi defined "*quadricromia neroniana*" as a stylistic innovation that came into vogue during the reign of Nero and continued for centuries, in which marble floors were executed using two light coloured marbles (antique yellow and *pavonazzetto*) and two dark ones (red porphyry and Greek green porphyry).
5. Some exceptional marble pieces of the architectural decoration have been displayed in the small antiquarium, on site at the monument, since 2012 (Piranomonte 2012).
6. 3% Preventol RI80 in deionised water
7. Hydraulic lime Ledan TA1
8. MicroAcril CV40 1:10 in deionised water
9. Garnet Mesh 80
10. Fill between tesserae: 6 parts thin red *pozzolana*, 1part thin black *pozzolana*, 2 parts grey river sand, ½ part Moretta hydraulic lime, 2.5 parts Rabot hydraulic lime, ½ part Ledan Adranal; Fill for large lacunae: 2 parts black *pozzolana*, 3 parts red *pozzolana*, 4 parts grey river sand, ½ part Moretta hydraulic lime, 2.5 parts Rabot hydraulic lime, ½ part Ledan Adranal
11. 12% Rhodorsil RC80 in white spirits

Technical Notes

Preventol RI 80 (Benzalkonium chloride)
LANXESS Distribution GmbH
https://lanxess.com
Ledan TA1
injection mortar for structural consolidation
Tecno Edile Toscana S.r.l.
https://www.tecnoediletoscana.com/
MicroAcril CV40
acrylic polymer
CHEM SPEC S.R.L.
https://www.chemspec.it/
Garnet Mesh 80
abrasive silicate mineral
http://www.imaronline.com
Rhodorsil RC80
polyethysiloxane
Rhodia Silicones, Italy
https://www.siliconiitalia.it

References

Blouet G.A. 1828. *Restauration des Thermes d'Antonin Caracalla a Rome*. Tables IV, V, XIV. Paris: Imprimerie et Libraire de Firmin Didot.

Guidobaldi F. 1984. "Mosaici con tessere porfiretiche a Roma tra III e IV secolo*"*. In *Atti del III* Colloquio Internazionale sul *Mosaico Antico*, *Ravenna, 6-10 dicembre 1980*, edited by R. Farioli Campanati, Vol. 2, 491-503. Ravenna: Edizione del Girasole.

Guidobaldi F. 1985. "Pavimenti in *opus sectile* di Roma e dell'area romana: proposte per una classificazione e criteri di datazione". In *Marmi Antichi. Problemi d'impiego, di restauro e d'identificazione,* edited by P. Pensabene, 171-233. Roma: "L'Erma" di Bretschneider (Studi Miscellanei, 26).

Iwanoff S.A. and Hülsen Ch. 1898. *Architektonische Studien, III, aus den Caracallathermen.* Berlin: G. Reimer.

Piranomonte M. 2012. *Le Terme di Caracalla.* Milano: Electa.

Secchi G. P. 1843. *Il Mosaico antoniniano rappresentante la scuola degli atleti*. Roma: Tipografia della Rev. Cam. Apost. Salviucci.

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CHALLENGES OF *TERRAZZO* CONSERVATION IN BRITISH PERIOD BUILDINGS OF DELHI, INDIA

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Abstract

Terrazzo has been widely used in India since the early years of the 20th century. Particularly interesting installations were produced during the British period. The qualities of the *terrazzo* demonstrate innovation and skilled craftsmanship. Many of the relevant buildings are still in use, and the floors now require repair and conservation. Unfortunately the knowledge system and the craft skills involved in the original production are now difficult to recover and obtain especially in India. The paper provides a brief history of *terrazzo* during the British period in Delhi, India, a report on the results of literature and archival research, and from the study of five buildings. The degradation observed is classified, gaining greater understanding of the deterioration processes, maintenance and conservation problems. Materials analysis is used to characterise the technology of the original production. The study closes with observations on the challenges in conserving Indian *terrazzo*, and the possible ways forward in developing adequate approaches the maintenance, repair and restoration of *terrazzo* in this and other contexts.

Keywords: *Terrazzo*, conservation, India, British period, degradation, glossary

Introduction

Terrazzo flooring has been used widely in construction in India, in particular in the later British period, meaning beginning in the early 20th century, in Art Deco construction, and extending to the present day. *Terrazzo* offers advantages of versatility in design and properties as a floor finishing, but requires specialised skills in preparation and execution. The first *terrazzo* floors executed in India were prepared in a manner similar to the *pavimento alla Veneziana* and *seminato* techniques (Johnson, 1995), in which marble fragments are embedded in a mortar base. Over time, the technique of application has changed, with such meticulous craftsmanship now becoming obsolete.

Terrazzo has found its application extensively as flooring and as a finishing material for various architectural elements in British period buildings in Delhi. The *terrazzo* floors of the British period in Delhi are now showing signs of ageing and deterioration. The limited understanding of methods for restoring, conserving and maintaining *terrazzo*, as well as the loss of traditional skills, pose challenges to the resolution of these issues.

Research methodology

We began our study by searching secondary and archival sources for information on architectural development in the British period. From these sources we were able to understand the distinct architectural vocabulary of British colonial architecture in India, the prominent architects, major contractors, and the prevalent building materials. This survey included reference to archival documents, and to Indian, UK and USA architectural and building journals of the period, for a better understanding of the Indian development within the international context. In this stage of the research we found many advertisements for coloured cement, *terrazzo* tiles, and *in situ terrazzo* installation.

Next reference was the lists of buildings protected under provisions of the Archaeological Survey of India (ASI), the Government of Delhi, and the built heritage listed by the Indian National Trust for Art and Cultural Heritage (INTACH), for purposes of identifying the buildings of the British period with terrazzo floors. Since these lists are not exhaustive, we continued with secondary research and site visits to identify further buildings with *terrazzo* floors. All of this information was compiled in a database (see Table 1).
Reviewing the whole of the collected information we were able to observe that the *terrazzo* technique was used primarily for flooring, in many buildings pertaining to public administration, educational institutions, and in large residences, including princely palaces. The preferred choice of flooring for the most important administrative and institutional buildings was stone, with *terrazzo* entering into use in the public buildings of the next level of prestige, in particular those with high foot traffic.
At this stage we determined to narrow the scope of our study to the private and institutional buildings of central Delhi, also known as Lutyens' Delhi. In 1911, King George V proclaimed the transfer of the capital of British India to Delhi from Calcutta: the central area takes its name from Sir Edwin Lutyens, the architect responsible for much of the building.
Cases of particular interest included:

- those with photographic documentation
  - Gandhi Smriti Sadan, formerly known as Birla House or Birla Bhawan, built as a private residence in 1928;
  - Indira Gandhi Memorial, originally built as a colonial-era bungalow, later becoming the residence of the prime minister;
- those permitting detailed visual study -
  - Teen Murti Bhawan, built in 1930 as the residence of the commander-in-chief of the British Indian Army, to a design by the British architect Robert Tor Russell;
  - Hungarian Cultural Centre, housed in a "deco" style residence;
- those permitting both detailed visual study and material investigation -
  - Akashvani Bhawan, built in 1936 as the headquarters of All India Radio.

A commonality of all five buildings listed is the use of *in situ terrazzo*, without joints or gaps. The visual assessment of the Gandhi Smriti Sadan memorial revealed that only a small fragment of *terrazzo* flooring has survived, following changes in the function of the building spaces. In the case of the Indira Gandhi Memorial, the remaining flooring was enclosed in displays that prevented access. We therefore concentrated our studies on the last three buildings of the list. In the case of All India Radio (Broadcasting House) we were able to conduct testing of material samples, as part of the condition assessment done by

Information of the Buildings during British period in Delhi with use of Terrazzo

S. No.	Building Name (Present)	Earlier Function	Period	Terrazzo in	Architect
1	University of Delhi-Office	Circuit House, Viceregal lodge	1902	Floor	
2	Indraprastha College for Women	Alipore House	1917	Floor	
3	Bengali Club		1925	Floor	
4	Kashmere Gate Market (Bara Bazaar)		1890's	Floor	
5	Town Hall, Chandni Chowk	Lawrence Institute	1864-1898 expansion	Floor	Mandreth And Cooper
6	PNB Building, Katra Mohan Chandni Chowk		1920's	Floor	
7	St. Columba's School, Ashoka Place		late 1930s	Floor	
8	Central Telegraph Office, Janpath	Hostel for Legislators	1920's	Floor	Russel
9	Western Court, Janpath	Hostel for Parliamentarians	1920's	Floor	Russel
10	Modern School, Barakhamba Road		1930's	Floor	C.G. and F.B. Blomfield
11	Patiala House		1938	Floor	Edwin Lutyens
12	Indira Gandhi Memorial, Safdarjung Road		1930's	Floor	
13	Gandhi Sadan Smriti, Tees January Marg	Birla House	1930's	Floor	
14	Hungarian Cultural centre, Near Janpath	Residence of Sir Sobha Singh	1933	Floor	Walter George. Approved by Lutyens
15	Kashmir House, Prithvi Raj Road		1930's	Floor	Walter George. Inputs by Lutyens

16	All India Radio (Broadcasting House)		1936-1940	Floor	
17	Teen Murti House	Flagstaff House	1930's	Floor	Robert Tor Russell

Table 1. Information on British period buildings in Delhi with use of *terrazzo*

the second author this article, in her role as team member of Sanrakshan Heritage Consultants Pvt. Ltd., contracted as conservation consultant for the building.

What is "terrazzo"?

Terrazzo is most commonly used as flooring, and is made by embedding small pieces of marble or coloured stone in mortar and then polishing the surface (Del Turco & Bros. Inc., 1924). The constitution of the material is similar to mosaic, since both consist of smaller aggregates placed in a bedding mortar. In the case of mosaics, patterns can be created by manually embedding the individual *tesserae*, of characteristic sizes and colours, in particular ways (Tapini, 2009). Patterns can also be created in *terrazzo*, however the individual granules are positioned randomly within defined areas, often using mixes of different coloured granules, thereby achieving patterns and shapes.
The *terrazzo* flooring of the 20th century typically consists of a mixture of Portland cement and aggregates of crushed marble or stone. The colours are provided by adding pigments to the mixture and choosing aggregates of the desired hues. The aggregates are crushed and graded into sizes. The selected aggregate is mixed thoroughly with dry cement and water to form concrete, which is then laid on the subfloor and left for a few hours. It is then rolled and repeatedly troweled to release air bubbles and remove surplus cement from the surface. The floor is then left to set for a period of days, determined according to conditions of temperature and humidity. The surface is ground to expose the aggregates, and finally polished (Sahu & Jena, 2015).
The use of dividing strips between sections of *terrazzo* flooring was begun around the 1920s in the USA and UK. Prior to this *terrazzo* was typically laid in alternate blocks, temporarily bordered with wood or other materials (Del Turco, 1921). Once the first series of blocks was laid the edges were removed and the voids were filled with further blocks. The use of dividing strips meant that the entire floor could be laid at once, reducing the time and labour required. Indian Standard 2114-1984 specifies that the area of *in situ terrazzo* flooring panels should not exceed 2 m^2, to reduce the risk of cracking. In case of butt joints, the panels must be laid alternately with a time gap of 24 hours.

History of *terrazzo* in India

In India, *terrazzo* came into popular use in the early 20th century, most prominently in Bombay (now Mumbai), as part of the vocabulary of the Art Deco movement (Lang, 2002).
The Bharat Floorings company operated as a prominent contractor for *terrazzo* in Bombay, beginning in 1922, laying floors

for public administration and other institutional buildings, as well as private residences. The testimonials for *terrazzo* on the current website of Bharat Floorings cite the value of the material for its resistance to heavy foot traffic, and the fact that it becomes stronger as it ages. The current range of company products includes *in situ terrazzo* installation as well as *terrazzo* tiles, as a part of their Art Deco range.

The history of *terrazzo* use has been similar in other cities where the Art Deco movement was prominent, including Madras (now Chennai), Hyderabad, Jaipur and Kolkata. The case of Delhi was somewhat different, where after the transfer of the capital in 1911, the British architectural vocabulary became particularly prominent, often hybridised with the local architectural language. In Delhi, the use of *terrazzo* began in the early 1900s, in British administrative buildings, barracks, institutions and technical infrastructure, but also in private bungalows and important residences. Eminent architects such as Edwin Lutyens, Robert Tor Russell, John Begg, Walter George and C.G. Bloomfield used *terrazzo* flooring in their buildings. Many of the institutional buildings featuring *terrazzo* flooring were built by Sir Sobha Singh, a prominent contractor during the development of New Delhi.

Why *terrazzo*?

Terrazzo offered advantages over stone, cement and lime-mortar floors, particularly for its durability in areas of high foot traffic. With time it becomes more compact and stronger, particularly if prepared using lime mortar. Its low porosity makes it relatively impermeable to water, meaning that maintenance is easier and hygiene is improved. It is also absorptive of noise. A further important feature is its flexibility in creating designs, allowing the designer to create patterns that compliment spatial organisation and visual movement. *Terrazzo* is also lower cost, compared to stone flooring.

Case studies

Teen Murti Bhawan

Teen Murti Bhawan was built in 1930s by British architect Robert Tor Russell, then Chief Architect of the Public Works Department, Government of India, as the residence for the commander in chief of the British Indian Army. Originally known as Flagstaff House, it later became the residence of the first Prime Minister of India, Jawahar Lal Nehru. Currently it houses the Nehru Memorial Museum and library. Most of the rooms are used as exhibition spaces. Tor Russell specified terrazzo and plain cement floorings throughout the rooms of the house, often with the *terrazzo* as the frame or border for a central area of cement flooring. Three major pigments, black, white and green, are used with white marble aggregate, to form the linear borders. The corridors and transition spaces are instead executed in continuous *terrazzo* flooring with simple geometric patterns and borders (Fig. 1).

Hungarian Cultural Centre

The Hungarian Cultural Centre was constructed in 1933 designed by the architect Walter George, as the residence of Sir Sobha Singh, a prominent builder of the British Period. Singh was involved as the contractor

Fig. 1. *Terrazzo* flooring pattern, external corridor, Teen Murti Bhawan, Delhi (photo by Dandona and Shah)

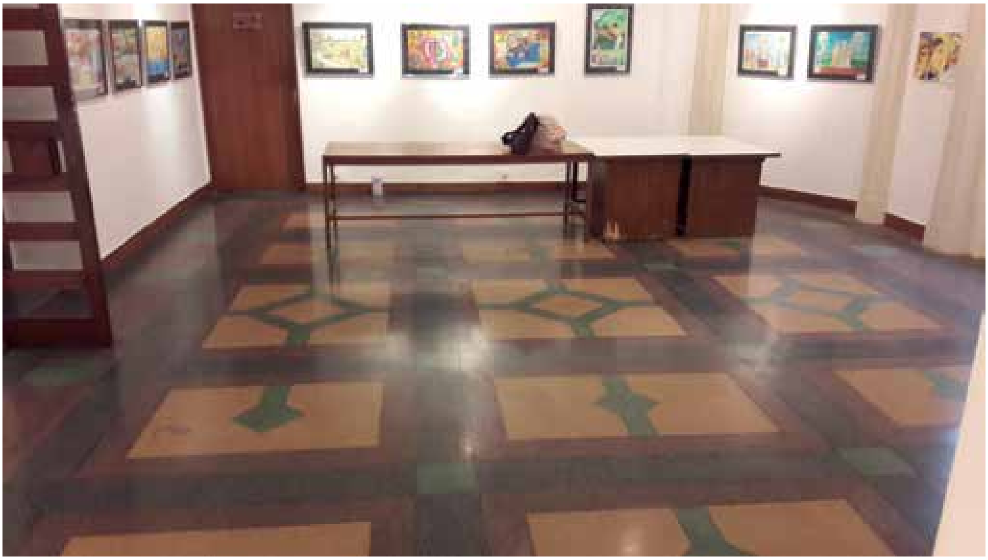

Fig. 2. *Terrazzo* flooring pattern, exhibition room of Hungarian Cultural Centre, Delhi (photo by Dandona and Shah)

for many projects, including Viceroy House and other important buildings of Lutyen's Delhi. For his residence, *terrazzo* was laid in the prominent main hall, now used for exhibitions. The exquisite design consists of geometrical patterns in mortar colours of dark red, black, yellow and green, with white marble aggregate (Fig. 2).

All India Radio (Broadcasting House)

All India Radio (Broadcasting House) was constructed in 1936 by Public Works Department. The building is characterised by its art deco style and is considered one of the iconic British buildings of Delhi. The structural volumes, inspired by radio equipment, take the form of a central spool with spokes radiating out to three further spools. The facades of the spools and spokes feature external corridors, with design features complementing those of the nearby Parliament House. *Terrazzo* was used floor the flooring and skirting of the various spaces throughout the building. The *terrazzo* was laid in-situ, without gaps at the joints, and without glass or brass strips.

Different geometrical patterns were used for different spaces. The entrance lobby, the focal point of the three radiating wings, features an elaborate geometric pattern of hexagons, using cement pigmented in dark grey, light grey and white, with white aggregates. The corridors instead show geometric patterns with star shapes repeated at regular intervals. The colour combinations include dark red, yellow, light grey and white cements, along with aggregates. *Terrazzo* was used for the stairs and skirting, as well as the flooring. The material facilitated the creation of rounded skirting, often seen in buildings of the Deco period. The corner detail of the skirting is unique (Fig. 3, Table 2).

Attributes	Building Name					
	Teen Murti Bhawan			Hungarian Cultural Centre	All India Radio (Broadcasting House)	
	Exhibition space	Entrance to ball room	External Corridor on FF	Exhibition Hall	Corridor, GF	Corridor, FF
Colours (pigmented cement with marble aggregate)	Black with white White with white	Black with white	Black with white White with white Jade Green with white	Dark Red with white Black with white Yellow with white Green with white	Dark Red with white Yellow with white	Grey with white White with white
Marble aggregate size	3-7 mm (approx.)	3-5 mm (approx.)	3-7 mm (approx.)	3-5 mm approx.	3-7 mm (approx.)	3-7 mm (approx.)
Marble aggregate shape	Angular	Angular	Angular	Angular	Angular	Angular
Average distance between the marble aggregate	4-8 mm (approx.)	3-6 mm (approx.)	4-8 mm (approx.)	2-5 mm (approx..)	2-5 mm (approx..)	2-5 mm (approx..)

Table 2. Pigments and aggregate sizes observed in case studies

Typology of degradation

The defects listed below are conditions observed in the *terrazzo* floors of Delhi as part of the current surveys. The aim of the listing is to better specify and understand the conditions, as well as their causes. The terminology used in the development of the typology is based on the "Illustrated Glossary, Mosaics in Situ Project" (2013), published by Getty Conservation Institute.

Structural cracks

Terrazzo tends to crack with time, for different reasons. The cracks consist of separations in the material, with a linear break visible at the surface of the *terrazzo*. In the current survey we have considered cracks wider than 4mm, also penetrating into the lower layers, as structural cracks. Such structural cracks were observed in the All India Radio building in locations at the edges of the ground floor corridors, in all the three wings. The main reason for the cracking could be differential settlement of the soil and foundation, however we have not yet been able to ascertain whether the cracking is still active. The cracks are considered problematic because of their tendency to

Fig. 3. Sampling an area of *terrazzo* flooring in a corridor, showing settlement, in All India Radio (Broadcasting House), Delhi (photo by Dandona and Shah)

Fig. 4. Structural crack in a corridor of All India Radio (Broadcasting House), Delhi (photo by Dandona and Shah)

collect water, thereby leading to more deterioration. The circular corridors of first and second floor of the central "spool" also showed radial cracks. These could be shear cracks, but such a hypothesis requires proper investigation (Fig. 4).

Settling

In the circular ground-floor corridor of one of the wings of All India Radio, a part of the *terrazzo* flooring is settling and appears out-of-plumb, due to differential settlement of the subflooring or movement in the ground below. The floor is settling to one side, leading to cracking and separation from the main area. The cracking and loss of level lead to water ingression, which then accelerates damages.

Previous interventions

As the *terrazzo* of all three buildings surveyed has aged, the building owners and users have provided maintenance. However, due the lack of previous understanding, or guidelines and repair manuals, and in the absence of expertise, the repairs have been done arbitrarily. Most often these are small repairs in the form of patches of new material. However, the pigments and aggregate size of the patches are incongruous, usually without reference to the original design, reducing the aesthetic value of the floors (Fig. 5).

Another common practice, given the difficulty in finding expertise for repairs and maintenance, is to cover the damaged or deteriorated *terrazzo* with new material such as tiles, linoleum or carpets. In Teen Murti Bhawan, linoleum sheeting has been used to cover the *terrazzo*: an intervention that changes the character of the space and causes further damage to the *terrazzo* surface. The linoleum itself is now also deteriorating. Similarly, In All India Radio BH, parts of the circular corridors have been converted to office space, with ceramic tiles laid over the *terrazzo* flooring (Fig. 6).

Fig. 5. Patching of *terrazzo* in All India Radio (Broadcasting House), Delhi (photo by Dandona and Shah)

Fig. 6. *Terrazzo* covered with linoleum sheeting in Teen Murti Bhawan, Delhi (photo by Dandona and Shah)

Deteriorated material

The constituent materials of *terrazzo* deteriorate with age and exposure, just as for other building materials. In the areas of the surveyed buildings subject to constant foot traffic, the deterioration of material is readily observable. These areas are in particular subject to consumption, erosion and loss of material.

Deteriorated joints

In All India Radio and Teen Murti Bhawan, even though the joints in the *terrazzo* were originally very fine, they have begun to open up and the adjoining areas are now also subject to erosion (Fig. 7).

Testing and analysis

Four samples of the *terrazzo* of All India Radio (Broadcast House) were taken for laboratory analysis (Fig. 8).

X-ray diffraction (XRD) was used to identify single-phase (minerals, ceramic) and multi-phase materials (microcrystalline mixtures like stone). The XRD patterns of all four samples are presented in figure 9, showing the principal peaks (Figs. 9-10).

The findings show the presence of the following main materials:

Sample 1: Dolomite, quartz and calcite;
Sample 2: Calcite, dolomite and portlandite;
Sample 3: Calcite, dolomite and portlandite;
Sample 4: Calcite, dolomite, portlandite and quartz.

Fig. 7. Deteriorating joints and weathering of *terrazzo* surface in Teen Murti Bhawan, Delhi (photo by Dandona and Shah)

The minerals calcite (calcium carbonate or $CaCO_3$) and dolomite (calcium carbonate and magnesium carbonate or $MgCO_3$) are constituents of limestone (Diekamp *et al.*, 2008). The firing of dolomitic limestone results in formation of CaO and MgO, both highly reactive during slaking, leading to the formation of portlandite $Ca(OH)_2$, which is also found in the samples. Thus, the presence of calcite and portlandite confirms the use of lime mortar. Quartz is present as the main component of silica sand, the aggregate in the mortar. The observations of dolomite and some of the calcite could also related to the stone chips used in the *terrazzo*.
Secondary electron micrography (SEM) was also used in characterisation of the *terrazzo* samples from All India Radio in terms of microstructural features, including surface morphology. Examination of the SEM scanning images at various mag-

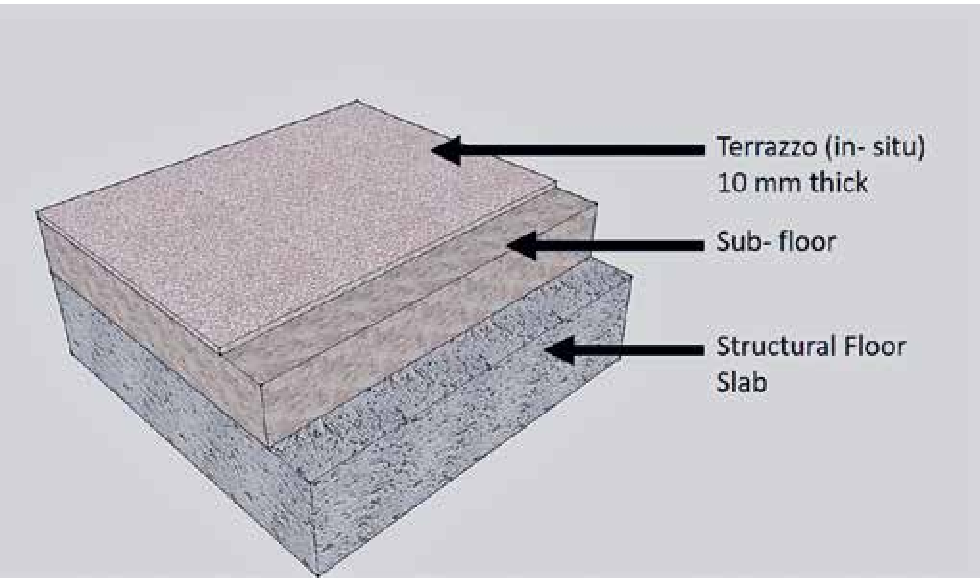

Fig. 8. Typical section of terrazzo, All India Radio (Broadcasting House), Delhi (photo by Dandona and Shah)

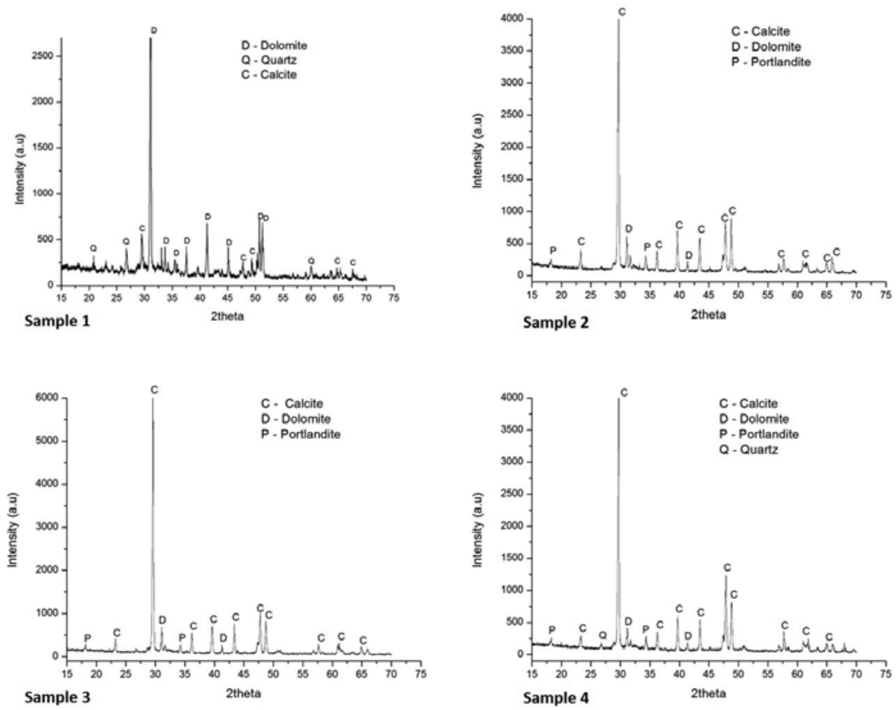

Fig. 9. XRD result for sample 1 of *terrazzo* from All India Radio (Broadcasting House), Delhi. Source: Material Testing by IIT, Chennai

nifications revealed that the composition of the samples in two phases, with the aggregate embedded in the cementitious binder. The morphology of aggregates was similar across the samples, suggesting that the same type of aggregate may have been used in all four cases. The aggregates appear to be stone chips and the cementitious binder consists of lime, as also indicated by XRD. The adhesion of the binder-aggregate interfaces appears intact, remaining solid even when preparing smaller samples for observation. This implies that the sampled areas were still sound, and had not severed severe deterioration. The strength of the interfaces also suggests the probable use of a bonding agent in preparing the *terrazzo* mix. The scans revealed a uniform morphology consisting of a dense matrix devoid of pores, representing a highly durable material.

Energy-dispersive x-ray analysis (EDS) would be required to identify any further compositional difference between the samples.

Challenges in the conservation of Indian *terrazzo*

The professionals working in the field of Indian architecture are struggling with the problems of *terrazzo* conservation, which require specialised skills backed by thorough understanding of the material. In the following we note some of the issues.

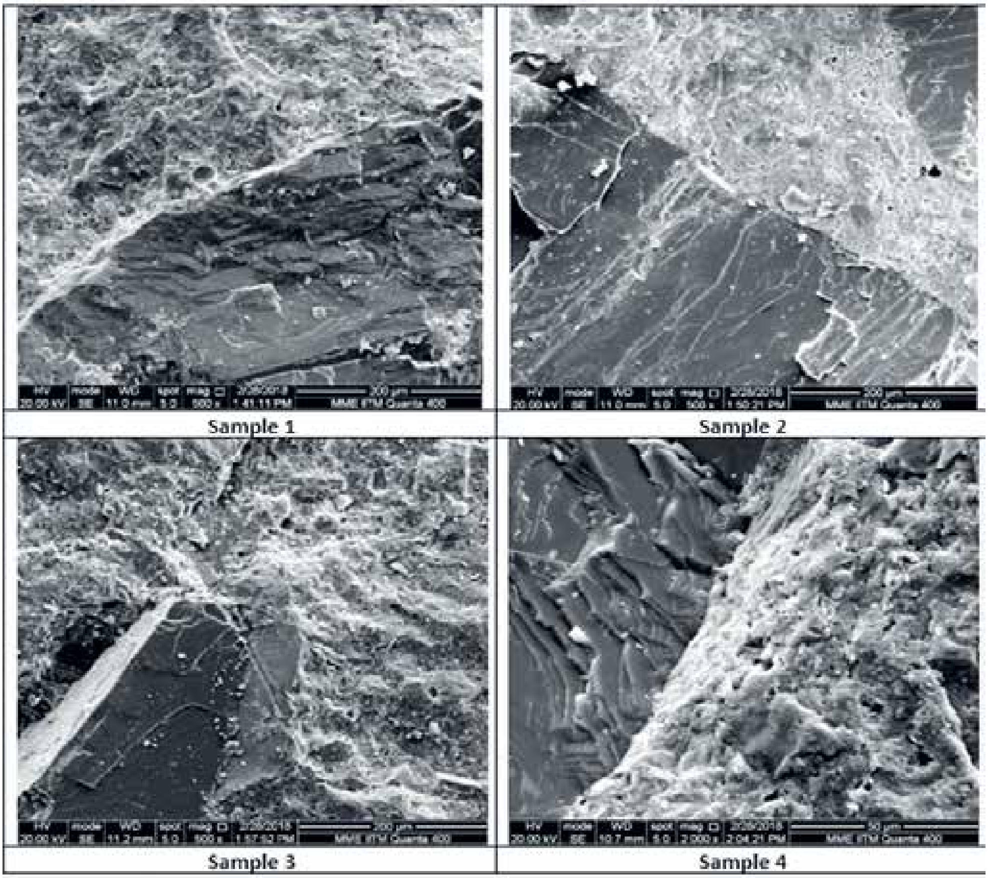

Fig. 10. SE micrograph of terrazzo samples from All India Radio (Broadcasting House), Delhi, at lower magnification (500X). Source: Material Testing by IIT, Chennai

Lack of historical information

In spite of quite extensive research into historical and archival sources, little data was found on the *terrazzo* floors of British period buildings. We have thus far been unable to find precise information on the materials, compositions, specifications of installations, and techniques. We believe that the archival information for this time period would be more readily available in archives in England. The earliest data we were able to trace in India is from the 1960s, long after the British period, by which time *terrazzo* tiles were also widely used, in addition to in-situ installations. Understanding of the original process would be important in the development of maintenance routines and the formulation of appropriate conservation techniques.

Discontinuity of craftsmanship for in-situ *terrazzo*

Though *terrazzo* has survived in the form of various new types of in-situ and tile installations, the craftsmanship seen in the historic examples is no longer practiced. The lack of knowledge transfer to contemporary artisans makes it challenging to come up with proper repair techniques.

Lack of technical understanding and expertise

There has recently been substantial attention to the significance of the 20th century built heritage in India, much of which made extensive use of *terrazzo*. Most of the buildings are still in use for their original purposes, while some have been adapted for new functions. The floors have often been the object of repairs, in the form of patches. While well-meaning, these have been done without full understanding of the material or concern for the root causes of degradation. There is need for more research, aimed at developing the technical knowledge and expertise necessary for terrazzo conservation. As per the ICOMOS Charter- Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage (2003), proper understanding of the behaviour of the original material and the architectural context is required for the development of repair solutions.

Lack of appreciation of significance

In India, *terrazzo* is still widely used for flooring, skirting, and production of work counters, but is no longer considered a particularly prized craft. There is a lack of awareness of its historic significance, its role as a building craft, and its properties. Because of this, the users of the buildings resort to repairs and interventions that are not appropriate.

Lack of information on repair and maintenance

Internationally, the conservation of *terrazzo* does not seem widely studied. We were unable to discover any publications of techniques intended for owners and users of the material, in the form of maintenance manuals or guidelines, for repair or treatment of defective *terrazzo*. The lack of these resources contributes to neglect and inappropriate interventions.

Lack of adequate facilities for scientific investigation

During the course of research, it was found difficult accessing facilities with testing equipment. Campaigns of analysis using the techniques of petrography, microscopy, and energy dispersive x-ray spectroscopy (EDS), for example, would help gain more details about *terrazzo* materials and techniques, useful for conservation-restoration purposes.

Conclusions and way forward

Terrazzo has been widely used in India from the 20th century British period until present. Historical and scientific studies must be conducted to gain more comprehensive knowledge of this material, for effective conduct of conservation works. A national campaign for documentation of buildings with *terrazzo* would be a first step. A glossary specific to the Indian context and this particular technology would be useful in listing and documenting defects, for both the development and proper application of knowledge. The glossary could then be shared internationally, becoming more inclusive and broader. It would serve as an important tool in surveying and evaluating the conditions of individual installations, and ultimately in planning their treatment. This would help achieve consistency in dealing with *terrazzo*, both among professionals and the users of the historic buildings. The professionals and trades active in this field should also be brought together to present and discuss the techniques they have employed, and to share knowledge concerning problems and solutions, including through publications. This would lead to the further development of appropriate methods and best practices, with preparation of guidelines and manuals. It is also important to train and conduct capacity-building programs for artisans and professionals.

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References

Alberti L., Bourguignon E., Carbonara E., Roby T., and Escobar J. S. 2013. *Illustrated Glossary: Technician Training for the Maintenance of In Situ Mosaics*. Los Angeles; Tunis: Getty Conservation Institute; Institut National du Patrimoine de Tunisie.

Bharat Floorings and Tiles. 2016. "Testimonials". Accessed 28 February 2017. https://www.bharatfloorings.com/testimonials.html

Del Turco L. 1921. *Patent for Dividing Strip for Cementitious Floors*. US Patents Office

Del Turco L. & Bros. Inc. 1924. *Modern Mosaic and Terrazzo Floors*. Harrison, N.J.: L. Del Turco & Bros. Inc.

Diekamp A., Konzett J., Wertl W., Tessadri R., and Mirwald P.W. 2009. "Dolomitic Lime Mortar: A Commonly Used Building Material for Medieval Buildings in Western Austria and Northern Italy". In *Proceedings of the 11th International Congress on Deterioration and Conservation of Stone*, edited by J. W. Lukaszewicz and P. Niemcewicz, 15–20. Torun: Uniwersytetu Mikołaja Kopernika.

Johnson W. 1995. "Terrazzo". In *Twentieth Century Materials: History and Conservation*, edited by Thomas Jester, 234-239. New York: McGraw Hill.

Lang J. 2002. *A Concise History of Modern Architecture in India*. New Delhi: Orient Blackswan.

Sahu G.C. and Jena J. 2015. *Building Materials and Construction*. New Delhi: McGraw Hill Education.

Tapini L. 2009. "Terrazzo and Mosaic Floors in Inter-war buildings in Athens- Conservation Issues" MA diss., University of York.

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ENHANCING THE BEAUTY OF ANCIENT REMAINS: TECHNOLOGY AND PROMOTION IN THE ARCHAEOLOGICAL SITE OF PALAZZO VALENTINI (ROME, ITALY)

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Abstract

The purpose of this paper is to show the archaeological remains found during the excavations in the cellars of Palazzo Valentini (Rome) and how they have been restored, displayed, enhanced and promoted. This articulated project has involved a team of various experts, who have contributed to the creation of a multimedia itinerary for the public. The main idea for enhancement and promotion of the site was to use technology to reconstruct the reality helping visitors to understand and appreciate the value of an archaeological context without giving up the scientific truth.
Keywords: Palazzo Valentini, Temple of Trajan and Plotina *divi*, late-antique *domus*, site-museum, multimedia itinerary

The archaeological remains uncovered beneath Palazzo Valentini, the historical site of Provincia di Roma, now Città Metropolitana di Roma Capitale, but also one of the most important Renaissance palaces of Rome, are now on permanent display. The archaeological investigations (Fig. 1) have been promoted and funded by the Administration of the Città Metropolitana and also by the Italian Ministry of Cultural Heritage, in the project Fondi Roma Capitale, and by the private Fondazione Roma. The archaeological research is part of a large-scale project, which includes the study of the Renaissance building and has led to the restoration of the cellars and to the creation of a "site-museum", opened to the public since 2007 and progressively enlarged. This project has foreseen from the beginning various steps; it involves a team of archaeologists, art historians and architects, most of all working for the provincial Administration, and is directed by Roberto Del Signore, Director of "Servizio Manutenzione e Ristrutturazione dei Beni Patrimoniali".

Palazzo Valentini lays in one of the most interesting areas of the city, the heart of ancient and modern Rome, rising on a trapezoidal block which was never excavated systematically before our intervention, except for a limited investigation of the Soprintendenza Archeologica di Roma in 1980-81 (Gatti, De Spagnolis 1981). It is defined by two streets -via di S. Eufemia on the East, via de' Fornari-vicolo di S. Bernardo on the West- that seem to follow the itinerary of ancient Roman roads, at least on the western side (Cucinotta 2012, Rispoli 2016). The block adjoins to the south the Trajan's Forum with the courtyard of the Trajan's Column and the two Libraries (for the extensive bibliography see Bianchi, Meneghini 2002; Meneghini, Santangeli Valenzani 2007: 83-114; Meneghini 2009: 117-163; Bianchi, Meneghini 2011; Delfino 2015; Meneghini, Ungaro 2015). On the west side it is very near to a public building of early Hadrian's age, which has

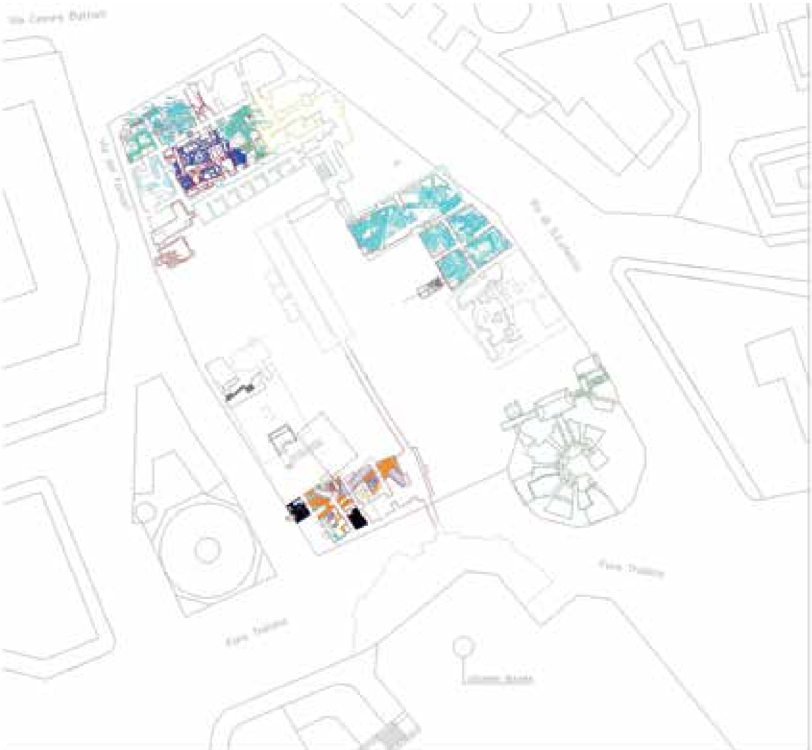

Fig. 1. Rome, Palazzo Valentini: planimetry of the cellars with the archaeological finds 2005-2015 (scale 1:1000, des. A. Capponi, R. Sandri, Cooperativa Parsifal, R. Stocco, Società Archeometra, F. Turchetta, Società Archeologia e Tecnologie)

been discovered in recent times and identified with the Hadrian's *Athenaeum*, but this interpretation is still much discussed (Egidi 2010: 117-118; Egidi 2013). For other identifications: Claridge 2007: 76-84; La Rocca 2008-2009: 395-398). After the fall of the Roman Empire, a long period of decay and a new occupation with medium size houses in the late medieval age (Meneghini 1993; Meneghini 2001; Meneghini 2004; Santangeli Valenzani 2007, 115-162), this area, facing onto Piazza dei SS. Apostoli, has become a sought-after location for the residences of aristocratic and high prelature representatives since the early sixteenth century.

Palazzo Valentini, commissioned by Cardinal Michele Bonelli (1541-1598), a nephew of Pope Pius V Ghislieri (1566-1572), is one of them (Farina 1985; Amendolea, Indrio 2005; Del Signore 2008, particularly Cicconi 2008; Cola 2012). However its name is connected to Vincenzo Valentini, a banker who purchased it during the nineteenth century. In 1873 it was sold to the Provincial Administration.

The archaeological excavations of the cellars, directed by Eugenio La Rocca and me, have been carried out since 2005 in four different areas. In the first two areas (W and S) the excavation has revealed re-

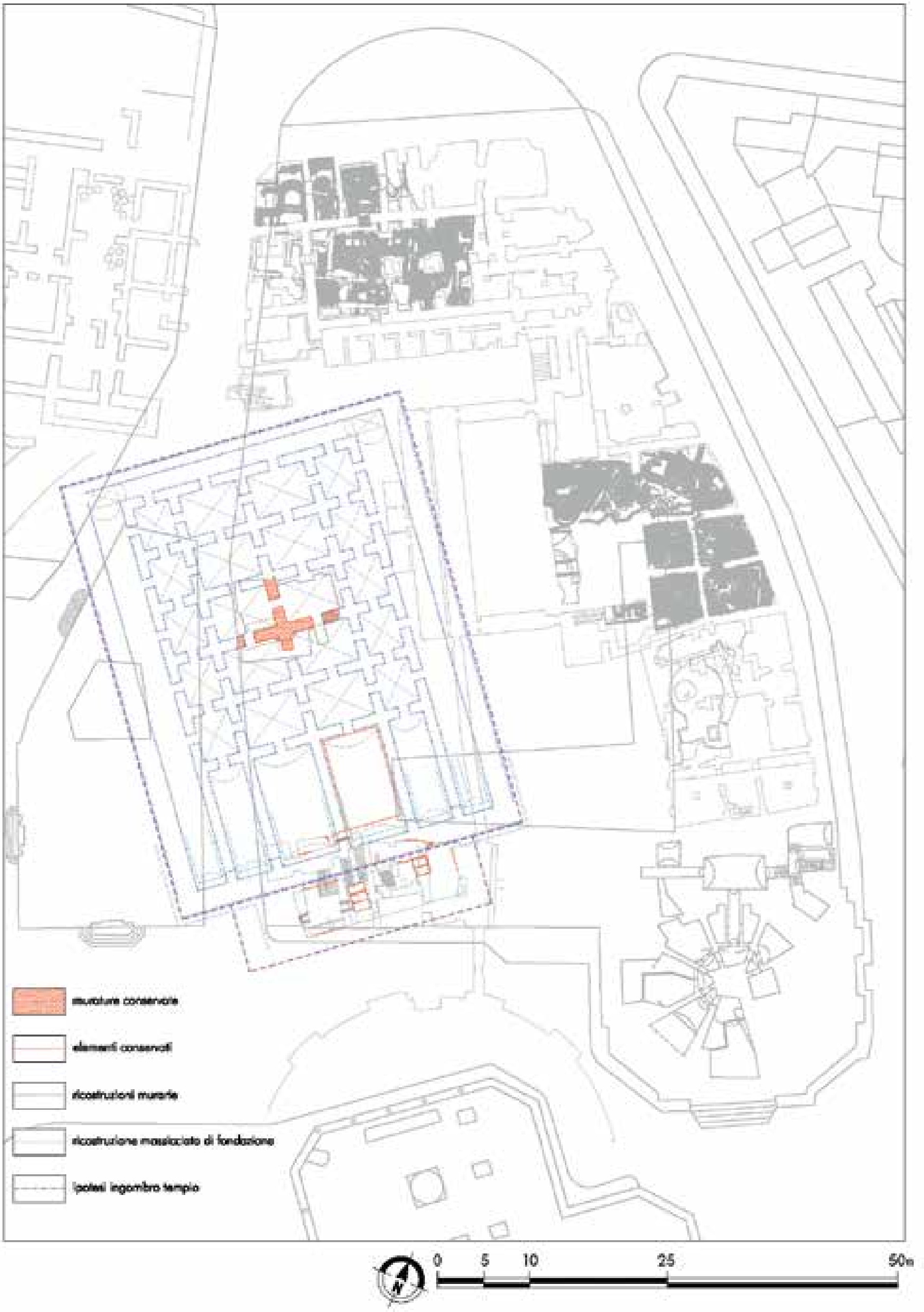

Fig. 2. Palazzo Valentini: planimetry of the archaeological finds with the reconstruction of the podium of *Divi* Trajan and Plotina's Temple (scale 1:500, des. R. Sandri, Cooperativa Parsifal)

Fig. 3. Palazzo Valentini, southern side, room 44: fragment of an Egyptian grey granite column shaft (ACC Photo)

mains of the beginning of the Hadrian's age, related to a public building, that can be identified with the Temple of *Traianus and Plotina Divi* (Fig. 2), the monument erected by Hadrian around 123-128 AD to his adoptive parents *divi* (for the few literary and epigraphical sources about this *templum* see recently Meneghini 2009: 115-116; Baldassarri 2013: 466-469; Palombi 2014: 136-137). What survives is most probably the "interior" architectural reality, inside the podium of a large building or inside the large podium of a building: walls in *opus latericium* belonging to vaulted cellars built in the basement and under the staircase of this temple, enormous foundations in *opus caementicium* and stone blocks, which supported the weight of the walls and of huge Egyptian grey granite columns (Fig. 3), suggest a peripteral *sine postico* temple with eight columns on the front (Fig. 4), whose original height was 15 m and the maximum diameter was more than 1,90 m (Baldassarri 2005; Tommasi 2005; Baldassarri 2012b; Baldassarri 2013, Baldassarri 2015; Baldassarri 2016; Baldassarri 2017; Baldassarri 2018).

In the other two areas (E and NW corner) the excavations have disclosed part of a high residential headquarter of the late imperial age, which was built "in the shade" of the Trajan's Forum (Baldassarri 2008; Baldassarri 2008-2009; Baldassarri 2009; Baldassarri 2011; Baldassarri 2012a). Important remains of two build-

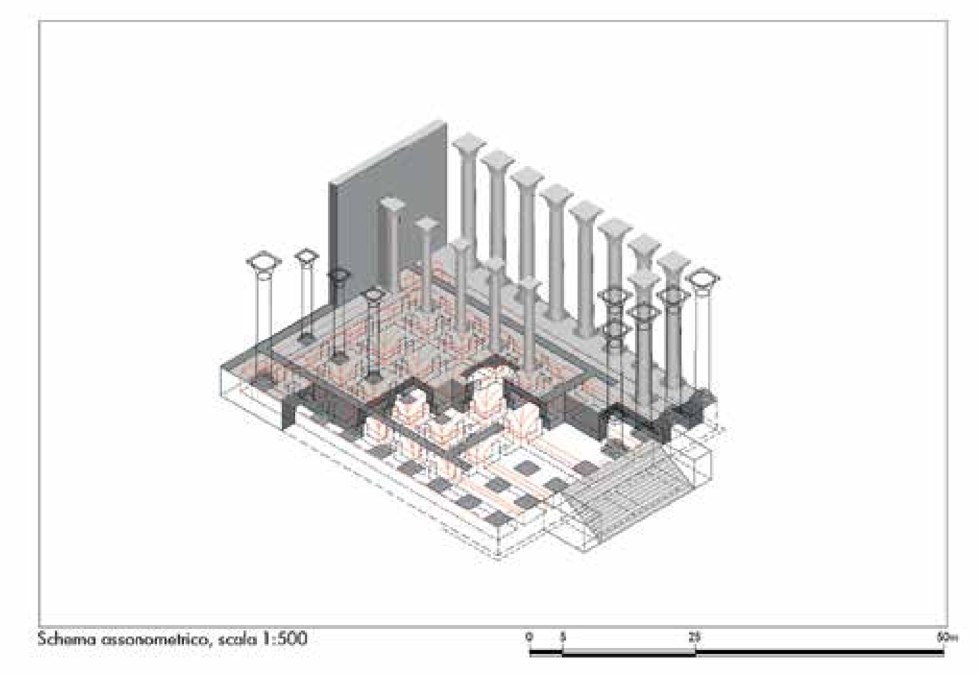

Fig. 4. Hypothetical axonometry of *Divi* Trajan and Plotina's Temple (des. R. Sandri, Cooperativa Parsifal)

ings, A and B, have come to light. Their first phase dates to 2nd century. Nothing sure can be proposed about the function of B, which belongs to the Severan age (Baldassarri 2008: 50-52; Quattrocchi 2008a: 160-161, ns. 9.6, 9.7), but a public function can be suggested for the building A, which dates to the early Hadrian's age (Baldassarri 2008: 42-46; Quattrocchi 2008a: 161-163, ns. 9.8, 9.9). It occupies an area, which at the same time or shortly before was completely transformed according to the construction of the Trajan's Forum: it was brought to the same level of the large square of the Forum (about 16 m above the sea) and was attainable through a short stairway and later covered with *basoli*. Probably the building A was a service building of the Forum, the headquarters of a *collegium* connected with the imperial cult of the deified emperors or the seat of an official responsible for the Trajan's Column, as the comparison with *Marcus Aurelius*'s Column in *Campus Martius* and the adjacent *domus* of *procurator columnae Adrastus* seems to suggest (Maffei 1993; Coarelli 2008: 112-115; Daguet-Gagey 1998: 893-915; Colugnati 2012).

However the internal arrangement and decoration of the two buildings A and B belong to the first half of the 4th century, when they have surely a residential function: their position in the centre of the *Urbs*, adjoining the Imperial Fora, their dimensions (over 1000 m²), articulated plan and decorations suggest that they

Fig. 5. Palazzo Valentini, *domus* A: general view of the *triclinium* with polychrome mosaic (ACC Photo)

were senators or dignitaries of the imperial court (La Rocca 2008-2009: 392-393). In the domus A a small *triclinium* has a precious mosaic of coloured marble tesserae with geometric and figured motifs (Fig. 5) and the peristyle has a black and white mosaic (Baldassarri 2008: 57-59, figs. 43-50; Quattrocchi 2008b; Baldassarri 2011; 48-49, 58-63 and 2012a: 1635-36, 1645-50); in the domus B floor and walls of an apsed *aula* (see Fig. 9) and of a big staircase were covered by a luxurious marble geometric decoration (Baldassarri 2008: 60-67, figs. 55-64; Lumacone, Quattrocchi 2008; Baldassarri 2011: 50-54, 2012a: 1637-1639, 2017b, 316, figs. 4-5).

Another peristyle probably connected the living part of the domus B with a big thermal complex to the NW, which was also renewed during the first half of the 4th century A.D. (Baldassarri 2008-2009: 356-380; Baldassarri 2011:54-58; Baldassarri 2012a: 1639-1644; Baldassarri 2017a: 245-251). In the heated sector of it the *praefurnium*, the *calidarium* with two basins, a *laconicum* and perhaps two *tepidaria* have been identified. The *frigidarium* is a very large room, probably covered by a barrel vault decorated with a glass mosaic, with a big tub on the southern and three horseshoe-shaped basins on the northern part. Floors and walls of the *thermae* were covered with marble *opus sectile*, whose traces remain *in situ*.

Eastwards of the *frigidarium* another room has come to light (Fig. 6): it was probably an *apodyterium* or a *palaestra* and preserves the pavement in *opus sec-*

Fig. 6. Palazzo Valentini, thermal complex: *apodyterium* or *palaestra* communicating with the frigidarium; at the top suspended pavement of the second floor (ACC Photo)

tile and fragments of its flat ceiling, which was supported by wooden beams and painted *lacunari* (Baldassarri 2011: 56-58; Baldassarri 2012a: 1641; Baldassarri 2017: 251-255): a mass of collapsed plaster fragments and parts of the burned beams have been discovered over the pavement. The existence of a second floor is sure: fragments and panels of its pavement had been collapsed over the plaster fragments and the burned beams. This pavement (see Fig. 6) is a very precious example of *opus sectile* (Baldassarri 2012a: 1641-43; Baldassarri 2017: 257-281). Wide signs of fire, large faults and evident traces of collapse of the pavement of the lower floor let us suppose that the building, which was already abandoned and plundered, collapsed for an earthquake around the end of the 5th–beginning of the 6th century and was no more inhabited. The *domus* A was abandoned at the beginning of the 7th century.

After the excavation of each area a campaign of restoration of structures, decorations and objects has been conducted by restorers of accredited societies. Since the beginning restoration has been conducted together with the scientific research in the field of Diagnostics applied to the Cultural Heritage with the aid of students of the Università La Sapienza-Roma, directed by Prof. Maria Pia Sammartino. Microclimate, right lighting in order to reduce or even to prevent the growth of vegetable microorganisms, groundwater analysis, researches on marbles, mortars, colored plasters and metals have been the main application fields and the results have been mostly published (Baldassarri 2012c; Silvestri *et al.* 2014; Montenero *et al.* 2015).

The restorers of the company Capitolium Conservazione Restauro have been responsible for the reconstruction of the *opus sectile* pavement of the second floor and for the solutions proposed for its exposition: in order to place the pavement at the height of the Roman construction and to show it in the moment in which it collapsed (see figure 6), the Roman marble slabs have been "sawn up" on panels made of light materials such as glass fiber and polyurethane foam. Moreover between January and December 2015 the same company has realised a pilot project of monitoring the site in order to program the interventions and to prevent the arising of conservative problems slowing down the degradation and avoiding radical, more expensive restorations.

Fig. 7. Palazzo Valentini, *domus* A, *triclinium*: virtual reconstruction of the mosaic and of the furnishing (ACC Photo)

It has been very complex to plan and carry out the visitor's itinerary, because we had to respect the archaeological and historical structures, their visibility and, at the same time, the security and the possibility of a disabled access (Napoli 2008; Stecchiotti 2008; Napoli, Baldassarri 2015: 97-99). We chose an itinerary made of glass and iron floors and runways linked to the foundations of the palace or to walls without decorations.

The archaeological site of the" Domus Romane di Palazzo Valentini" is open to the public every day except Tuesday: the visit is organised in groups of 15 persons and lasts about 1 hour and half. There is a booking service organised by the company Civita Opera Laboratori. The visit is realised in seven languages: Italian, English, French, German, Spanish, Japanese and Russian.

The visit system is innovative (Baldassarri, Angela, Lanciano 2012: 224; Napoli, Baldassarri 2015: 99): it was really a bet when we chose between a traditional system with a human guide or with audio-guides and eventually some reconstructive videos projected in separated rooms far from the archaeological remains and a new revolutionary system, that had never been developed before, at least in Italy. The site with its mosaics (Fig. 7), decorated walls, floors, staircases, peristyles, *thermae* with their furnishing (Fig. 8), streets, columns and foundations and the same renaissance palace have been made into a fascinating virtual journey through time by Piero Angela,

Fig. 8. Palazzo Valentini, thermal complex, room 5: thermal complex, under the glass floor remains of *laconicum* and *tepidarium*; on the back wall virtual reconstruction of the heating system (ACC Photo)

journalist and scientific divulgator, and a team of technicians and experts including Paco Lanciano and Gaetano Capasso of the Mizar and Capware companies. They have given new life to the past through virtual reconstruction, light and sound effects (Fig. 9), projections and 3D models (Fig. 10) and have made the site easily comprehensible even to non-experts.
As they have affirmed, multimedia technologies are an highly effective instrument to the service of museum communication, but their utilisation has often been cause for conflict between experts. In the early nineties there was a widespread belief that technologies would invade the museum world. This initial enthusiasm has, over time, given way to more considered analysis which revealed how sensitive the issue of the use of multimedia tools and virtual tours within the museum is.
In Palazzo Valentini the technology, together with the cooperation of all the experts involved in the project-archaeologists, art historians, architects, restorers, chemists, anthropologists and palaeontologists- has set up a very special multimedia museum.
After the excavation and restoration of the site, the experts in "virtuality" -about 40 people, including computer technicians, engineers, film directors, musicians, light technicians, all of them coordinated by Mizar company- have been asked to design a project to promote that space, to revive the findings and the hypothetical original appearance of them, based on the scientific research. This has allowed them to experiment some ideas, combining the use of the technology of virtuality and more traditional methods.
The particular idea of the project was to put technology at the service of reality to enhance and not to replace it by a new technique. This technique consists in "telling" the archaeological matters, the scientific results of the excavations with the help of particular light effects projected not in a separate room, where people sit and look at a video like at the cinema, but directly onto the objects themselves and without any tool which could intrude between the remains and the visitor. This helps to appreciate the details and rebuild the gaps and to better understand and appreciate the existing value, stressing the uniqueness of authentic.
The multimedia experts have tried to protect the remains from their technological

Fig. 9. Palazzo Valentini, *domus* B: apsed *aula* with virtual reconstruction of the marble decoration of the eastern wall (ACC Photo)

Fig. 10. Palazzo Valentini, thermal complex, rooms 9 and 14: *frigidarium* and *apodyterium* during the virtual tour, on the back wall reconstruction of the desctructive fire at the end of the fifth century AD (ACC Photo)

invasion as much as possible. They could do it: indeed when the lights are on, you cannot see any technological gadgets. Servers, computers, projectors, lights are hidden and don't encumber on the archaeological structures.
We have a big number of signals indicating that the result is satisfying for the visitors. Moreover our experience has served as example for other archaeological sites in Rome and outside Rome, especially indoor sites or outdoor sites during the night, due to the necessity to be in the dark, even if the long and extensive journey through the ruins under Palazzo Valentini remains a unique experience.
To conclude, we can say that the museum experience of Palazzo Valentini has taught that we need a careful study to the specificity of the place, to identify the best narrative strategy not to distort the context. It comes to making "soft" the utilisation of multimedia technologies that, only in this way, may contribute to the enrichment of the visitor experience, providing the means to understand and contextualise that makes the visit more efficient and, perhaps, more fun and enjoyable.

References

Amendolea B., Indrio L., eds. 2005. *Palazzo Valentini: Storia di un palazzo e di una istituzione*. Roma: Bardi Editore.

Baldassarri P. 2005. "Il contesto archeologico." In *"La Provincia capitale". Storia di una Istituzione e dei suoi Presidenti*, edited by Roberto Del Signore: 158-160. Roma: Ediart.

Baldassarri P. 2008. "Indagini archeologiche a Palazzo Valentini. La campagna 2005-2007." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione* edited by Roberto Del Signore: 29-78. Roma: Ediart.

Baldassarri P. 2008-2009. "Indagini archeologiche a Palazzo Valentini: *domus* di età imperiale ai margini del Foro Traiano", *Rendiconti della Pontificia Accademia Romana di Archeologia*, LXXXI: 343-384. Città del Vaticano: Tipografia Vaticana.

Baldassarri P. 2009. "Ultime acquisizioni nel campo delle indagini." In *"La Provincia capitale". Storia di una Istituzione e dei suoi Presidenti*, edited by Roberto Del Signore: 201-209. Roma: EdiArt.

Baldassarri P. 2011. "Archaeological excavations at Palazzo Valentini: a residential area in the shade of the Trajan's Forum." In *XIth International Colloquium on Ancient Mosaics*, Bursa, October 16th-20th 2009, edited by Mustafa Şahin: 43-67. Istanbul: Zero Prodüksiyon Kitap-Yayın-Dağıtım Ltd. Şti.

Baldassarri P. 2012a. "Materiali, motivi e ispirazione africana nell'arredo decorativo delle *domus* di Palazzo Valentini". In *L'Africa Romana*, XIX Convegno di Studi, edited by Maria Bastiana Cocco, Alberto Gavini, Antonio Ibba, Sassari 16-19 dicembre 2010, 1631-1650. Roma: Carocci Editore.

Baldassarri P. 2012b, with Lumacone A. and Salvatori L. "Nuove indagini archeologiche a Palazzo Valentini. Il Tempio dei *divi* Traiano e Plotina", *Forma Urbis*, XVII, 5, Maggio: 45-52. Roma: E.S.S. Editorial Service System.

Baldassarri P. 2012c. "Palazzo Valentini - archaeological investigations and preservation", paper presented at the 4th International Meeting on Use of Multivariate Analysis and Chemometrics in Cultural Heritage and Environment, Roma, 27-30 Maggio 2012, Abstract book: 42-43. Roma: Marcovalerio edizioni.

Baldassarri P. 2013. "Alla ricerca del tempio perduto: indagini archeologiche a Palazzo Valentini e il *Templum divi Traiani et divae Plotinae*", *Archeologia Classica*, LXIV: 371-481. Roma: L'Erma di Bretschneider.

Baldassarri P. 2015. "Le indagini archeologiche a Palazzo Valentini (Roma) e il tempio dei *divi* Traiano e Plotina". In *L'Africa Romana*, XX, Alghero 26-29 settembre 2013, edited by Paola Ruggeri: 1689-1716. Roma: Carocci Editore.

Baldassarri P. 2016. "Indagini archeologiche a Palazzo Valentini. Nuovi dati per la ricostruzione del tempio di Traiano e Plotina *divi*", *Mitteilungen des Deutschen Archäologischen Instituts, Römische Abteilung*, 122: 171-202. Regensburg: Schnell und Steiner.

Baldassarri P. 2017a. "Lusso privato nella tarda antichità: le Piccole Terme di Palazzo Valentini e un pavimento in *opus sectile* a motivi complessi", *Archeologia Classica*, LXVIII: 245-287. Roma: L'Erma di Bretschneider.

Baldassarri P. 2017b. "Mosaici e *sectilia in situ* e multimedialità: il caso di Palazzo Valentini (Roma, Italia)." In *The Conservation and Presentation of Mosaics: At What Cost?,* Proceedings of the12th ICCM Conference Sardinia, October 27-31, 2014, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, Roberto Nardi: 314-321. Los Angeles: The Getty Conservation Institute.

Baldassarri P., 2018 "*Templum divi Traiani et Divae Plotinae*: nuovi dati dalle indagini archeologiche a Palazzo Valentini", *Rendiconti della Pontificia Accademia Romana di Archeologia*, LXXXIX. Città del Vaticano: Tipografia Vaticana.

Baldassarri P., Angela P., Lanciano P. 2012. "Le *domus* romane di Palazzo Valentini: un esempio di scavo urbano e di valorizzazione attraverso un percorso multimediale." In *Archeologia e città: riflessione sulla valorizzazione dei siti archeologici in aree urbane*, Atti del convegno internazionale, Roma, 11-12 febbraio 2010, edited by Alice Ancona, Alessia Contino, Renato Sebastiani: 215-227. Roma: Palombi Editori.

Bianchi E. and Meneghini R. 2002. "Il cantiere costruttivo del foro di Traiano", *Mitteilungen des Deutschen Archäologischen Instituts. Römische Abteilung*, 109: 395-417. Regensburg: Schnell und Steiner.

Bianchi E. and Meneghini R. 2011. "Gli impianti scalari del Foro di Traiano", *Bullettino della Commissione Archeologica Comunale di Roma*, CXII: 77-118. Roma: Arbor Sapientiae.

Cicconi M. 2008. "La fabbrica di Palazzo Bonelli-Valentini, residenza cardinalizia del Cinquecento: il punto di partenza." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione*, edited by Roberto Del Signore: 1-27. Roma: Ediart.

Claridge A. 2007. "Hadrian's lost Temple of Trajan", *Journal of Roman Archaeology*, 20: 54-94. Portsmouth, Rhode Island: J.H. Humphrey.

Coarelli F. 2008. *La Colonna di Marco Aurelio*. Roma: Quasar.

Colugnati G. 2012. "La colonna di Marco Aurelio e il suo contesto originario." In *La Galleria di Piazza Colonna*, edited by Annalisa Lo Monaco and V. Nicolucci: 166-176. Torino/Londra/Venezia/New York: Allemandi.

Cucinotta L. 2012. "L'insula sotto il Palazzo delle Assicurazioni Generali di Venezia in Piazza Venezia a Roma", *Bullettino della Commissione Archeologica Comunale di Roma*, 113, 2012: 157-187. Roma: Arbor Sapientiae.

Cola M. C. 2012. *Palazzo Valentini a Roma. La committenza Zambeccari, Boncompagni, Bonelli tra Cinquecento e Settecento*. Roma: Gangemi.

Daguet-Gagey A. 1998. "*Adrastus* et la colonne Antonine. L'administration des travaux publics à Rome en 193 ap. J.-C.", *Mélanges de l' l*École *Française de Rome-Antiquité*, 110: 893-915. Rome: École Française de Rome.

Delfino A. 2015. "Foro di Traiano: lo scavo dell'area a nord-ovest della Colonna." In *Il Foro di Nerva. Nuovi dati dagli scavi recenti*, *Scienze dell'Antichità*, 21.3, edited by Eugenio La Rocca, Roberto Meneghini, Claudio Parisi Presicce: 219-252. Roma: Arbor Sapientiae.

Gatti E. and De Spagnolis M. 1981. "Un intervento nel centro storico di Roma: impianto termale all'estremità della Regio VII." In *Archeologia Laziale IV: quarto incontro di studio del Comitato per l'archeologia laziale*, edited by Stefania Quilici Gigli: 132-141. Roma: Consiglio Nazionale delle Ricerche.

Lumacone A., Quattrocchi M. 2008. "I rivestimenti in *opus sectile* della *domus* B." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione*, edited by Roberto Del Signore: 95-107. Roma: Ediart.

Maffei S. 1993. "Columna Marci Aurelii Antonini." In *Lexicon Topographicum Urbis Romae*, edited by M. Steinby, I: 302-305. Roma: Quasar.

Meneghini R. 1993. "Il Foro ed i Mercati di Traiano nel medioevo attraverso le fonti storiche e d'archivio", *Archeologia Medievale*, XX: 79-120. Firenze: All'Insegna del Giglio.

Meneghini R. 2001. "Il Foro di Traiano nel medioevo", *Mélanges de l*'École *Française de Rome, Moyen* Âge, 113, 1: 149-172. Rome: École Française de Rome.

Meneghini R. 2004. "I fori imperiali nel quattrocento attraverso la documentazione archeologica." In *Roma. Le trasformazioni urbane nel Quattrocento II. Funzioni urbane e tipologie edilizie*, edited by Giorgio Simoncini. Firenze: Leo S. Olschki Editore

Meneghini R. 2009. *I Fori Imperiali e i Mercati di Traiano. Storia e descrizione dei monumenti alla luce degli studi e degli scavi recenti*. Roma: Libreria dello Stato.

Meneghini R. and Ungaro L. 2015. "Il punto sul *Mons Egestus*. Considerazioni sulla paternità del Foro di Traiano". In *Il Foro di Nerva. Nuovi dati dagli scavi recenti*, *Scienze dell'Antichità*, 21.3, edited by Eugenio La Rocca, Roberto Meneghini, Claudio Parisi Presicce: 253-263. Roma: Arbor Sapientiae.

Montenero A., Visco G., Baldassarri P., Capretti S., Petrini C. 2015. "Caratterizzazione di vetri archeologici provenienti dal sito delle Piccole Terme di Palazzo Valentini a Roma." In *Il vetro nell'Italia centrale dall'antichità al contemporaneo*, edited by Luciana Mandruzzato, Teresa Medici, Marina Uboldi, Atti delle XVII Giornate Nazionali di Studi sul Vetro, Massa Martana e Perugia 11 e 12 maggio 2013: 71-76. Cremona: Comitato Naz. Italiano AIHV.

Napoli L., Russo R. 2008. "Gli interventi di restauro e musealizzazione delle aree archeologiche." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione*, edited by Roberto Del Signore: 181-196. Roma: Ediart.

Napoli L., Baldassarri P. 2015, "Palazzo Valentini. Archaeological investigations and Redevelopment Projects", *Frontiers of Architectural research,* 4, 2, June: 91-99. Amsterdam: Elsevier, http://dx.doi.org/10.1016/j.foar.2015.01.003

Palombi D. 2014. "Roma: culto imperiale e paesaggio urbano." In *Sacrum facere. Atti del primo seminario di archeologia del sacro*, Trieste, 17-18 febbraio 2012, edited by Federica Fontana: 119-164. Trieste: EUT Edizioni Università di Trieste.

Quattrocchi M. 2008a. "Schedatura dei materiali rinvenuti. 9. I bolli laterizi." In *Pa-*

lazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione, edited by Roberto Del Signore: 156-165. Roma: Ediart.

Quattrocchi M. 2008b. "I mosaici della domus A." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione*, edited by Roberto Del Signore: 81-93. Roma: Ediart.

Rispoli M. 2016. "Gli scavi di Giuseppe Gatti per la costruzione del Palazzo delle Assicurazioni Generali in piazza Venezia a Roma", *Mitteilungen des Deutschen Archäologischen Instituts. Römische Abteilung*, 122, 2016: 123-170. Regensburg: Schnell und Steiner.

Santangeli Valenzani R. 2007. "I Fori Imperiali nel medioevo e nell'età moderna." In Meneghini R. and Santangeli Valenzani R., *I Fori Imperiali. Gli scavi del Comune di Roma (1991-2007)*: 115-165. Roma: Viviani editore.

Silvestri C., Di Luca L., Visco G., Sammartino M. P., Baldassarri P. 2014. "First Tentative of Characterization of Underground Spring Water in the Roman Bath of Palazzo Valentini in Rome." In *Proceedings of the 5th Meeting on Employ of Multivariate Analysis and Chemometrics in Cultural Heritage and Environment Fields, 14-17 December 2014*, edited by Giovanni Visco, Rome: 90-91. Roma: Marcovalerio edizioni.

Stecchiotti R. 2008. "Il restauro delle Piccole Terme." In *Palazzo Valentini. L'area tra antichità ed età moderna: scoperte archeologiche e progetti di valorizzazione*, edited by Roberto Del Signore. 197-199. Roma: Ediart.

Tommasi F.M. 2005. "Le nuove indagini archeologiche". In *"La Provincia capitale". Storia di una Istituzione e dei suoi Presidenti*, edited by Roberto Del Signore: 196-198. Roma: EdiArt.

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CLOSING SESSION

Jeanne Marie Teutonico
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ICCM 13TH CONFERENCE, BARCELONA 2017: SUMMARY CONCLUSIONS

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The following conclusions were presented at the closing session of the conference. They represent a distillation and synthesis of the main issues and recommendations that emerged during the various thematic sessions. Clearly, it is not possible to be comprehensive in capturing the diverse ideas and experiences that were shared over the course of several days. However, it is hoped that this summary will serve as an overview of the more important points raised during the conference and provide some indication regarding significant trends in thinking and practice.

MANAGEMENT & PLANNING

- Regular conservation and maintenance is preferable and more effective than the *magnum opus* (i.e. large-scale interventions).
- Lack of funds or economic capacity is not an excuse for inaction, but rather a motivation for action.
- It is critical to think strategically and to develop clear priorities at the national and international level.
- Techniques like seasonal reburial can be cost effective and still allow for periodic viewing of mosaics by the public.
- Policies are needed that make provision for conservation a mandatory requirement for permission to excavate.
- Conservation and maintenance strategies must be developed for mosaics in urban contexts, which often demand continued use.

Survey and Documentation

- New digital technologies can be utilised to inform and interest a wider public about mosaics and mosaic conservation.
- Geo-spatial inventory systems, especially those that are open source, can be powerful management tools.
- Documentation systems should be chosen based on the aims and desired outcomes of a project.
- To be widely used, documentation systems should be designed with the non-specialist in mind, at least at the front end.
- New imaging techniques provide opportunities for more nuanced and detailed examination of mosaics and other works of art.
- Documentation can be a tool not just for conservation and management but for interpretation and understanding.

Mosaics as a Continuing Tradition

- Mosaics represent a living tradition, constantly changing and evolving, but taking inspiration from the past.
- Our definition of mosaics has broadened to include works from ancient to modern, and that vary by time and geography.
- Contemporary mosaics face conservation problems similar to those of ancient mosaics, while also posing unique challenges including an incredible variety of materials of unknown durability, and continued use.
- Traditional techniques like *terrazzo* deserve careful conservation and maintenance as important components of historic buildings; such techniques were often designed to perform well in their environmental context (e.g. in seismic zones) and offer lessons for contemporary design.

Lifted Mosaics

- We are still facing the consequences of decades of lifting mosaics, including overflowing storage facilities and the problems caused by reinforced cement backings.

- As a first step, lifted mosaics in storage should be inventoried and housed in proper conditions that include provision for security and fire suppression.
- We are still in need of more cost-effective approaches to backing lifted mosaics that make use of locally available and inexpensive materials as alternatives to honeycomb aluminium panels.
- More research is needed on the behaviour and durability of mosaics that have been lifted and backed with various materials/systems and then re-laid on site.

Conservation, Presentation and Display

- Conservation and presentation must safeguard the object while also addressing its physical context and history of interpretation/s.
- Past treatments may have historic importance or continue to provide adequate protection for an object, and should be considered in making decisions about current conservation approaches.
- Presentation and display must also engage the public and communicate the meaning of a site or object.
- Treatment decisions depend not just on an understanding of deterioration issues but of social/cultural context.
- Sheltering mosaics for protection and display remains a challenging and complicated area of practice; there is a need for clear guidelines on the decision-making process for the design, construction, and maintenance of shelters.

Education and Training

- Effective training requires significant investments of time and resources.
- Regional training builds professional networks and communities of practice that help to ensure sustainability.
- Engagement of decision-makers is key to the long-term success of training efforts.
- It is important that specialised conservation competencies and skills are recognised in job profiles at the national level.

- Field schools may provide valuable training opportunities while contributing to the conservation of a site.

Best Practices for Mosaic Conservation

- Mosaics are part of a larger context, be that an archaeological site or an urban centre; treatment decisions must be based on an understanding of broader social and cultural dimensions, in addition to concern for the physical fabric and its condition.
- *In situ* conservation remains the preferred approach for the conservation of archaeological mosaics.
- Preventive conservation and regular maintenance are more effective than occasional large-scale interventions.
- Good practice is not dependent on a large budget.
- A concern for authenticity and the reversibility of treatments remain important conservation principles.
- Conservation of mosaics should involve multi-disciplinary teams, including archaeologists, conservators and architects.
- Strong national, regional and international professional networks allow the sharing of experiences and promote standards of best practice.

Ongoing challenges

- Much has been accomplished in recent decades to preserve our mosaic heritage. However, many challenges remain including:
  - Insufficient funding at national and international levels;
  - Lack of trained personnel and recognition of specialist conservation knowledge and skills;
  - Conflict, war, looting, and vandalism;
  - Addressing the consequences of previous conservation interventions;
  - Lack of understanding and appreciation of mosaics by the public.

Mosaics as a Shared Heritage

- Mosaic heritage is a global heritage, representing human innovation and creativity through time and across boundaries; mosaics are evidence of our common humanity and can be tools for mutual understanding and inter-faith dialogue.

- Cultural heritage can be understood as a textbook of layered history, which reveals changes in use and value over time.
- In our work to conserve mosaics and archaeological sites, we must focus on the message not just the preservation of physical fabric.

POSTERS

THE MOSAIC OF *CENATIO* C6, *DOMUS* OF CANTABER, CONIMBRIGA, PORTUGAL: PAST, PRESENT AND PROSPECTS

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Abstract

The mosaic floor of *cenatio* C6 of the *domus* of Cantaber was discovered and removed during excavations of the site of *Conimbriga*, Portugal, in 1899. A small percentage of the original surfaces were left *in situ,* where they still remain. A fragment prepared for presentation to the Queen of Portugal, on a gypsum plaster backing, eventually arrived in the reserves of a national museum. Over the latter half of the 20th century, the largest part of the work was transferred to concrete backing and placed in outdoor exhibition. The current situation requires research to identify the situation of the different fragments, and the potential conditions for preparation of a project to regroup the materials and return them to their place of origin.

Keywords: Consolidation, conservation, Roman mosaic, *domus* of Cantaber, *Conimbriga*, Portugal.

Introduction

The first excavations of the Roman city of *Conimbriga* were begun in 1899, thanks to the sponsorship of the Queen of Portugal, Amélia de Orleães e Bragança. These resulted in the discovery and removal of four mosaics, which were placed on gypsum supports and exhibited in the Museum of Archaeology of the Coimbra Institute. In 1912, the Institute (founded in 1874) ceded its collections to the National Museum Machado de Castro, Coimbra, and in 1961, they were transferred to the newly organised Monographic Museum of *Conimbriga*. At this time the four mosaics were consolidated using reinforced concrete backings, before again returning to public view. The largest of the four mosaics in question (4.60 x 3.85m) had been lifted from *cenatio* C6 of the so-called "*domus* of Cantaber". In 1975, during the most recent restructuring of the Monographic Museum, this work was placed outdoors, at the entrance to the *Conimbriga* national monument (Fig. 2).

Fig. 1. The mosaic panel offered to Queen Amelia of Portugal in 1899, as it appeared in 2004 (MPNA) (photo F. Abraços 2004)

Fig. 2. Mosaic in open-air display at the entrance to the archaeological site (photo F. Abraços, 2017)

When the C6 mosaic was lifted in 1899, the Archaeology Section of the Institute of Coimbra had removed a fragment (0.77 x 0.77m) and presented it to Queen Amélia (Fig. 1), as a gesture of thanks for her support of the scientific explorations. This fragment is now in the reserves of the Museum of Palácio Nacional da Ajuda, Lisbon (MPNA). An examination conducted in 2004 showed that it was in very good condition, at that time.

It should also be noted that the 19th-century excavations did not provide for complete removal of the C6 mosaic, and that some small portions still remain *in situ.*

The outdoor display of the C6 mosaic

The largest part of the C6 mosaic has been exposed to harsh climatic conditions in outdoor display, for more than 40 years. Apart from the typical thermal gradients, the mosaic has been planted with shrubs along the south side. These create shade for the large part of the day and contribute to a humid environment, favouring the growth of flowering plants wherever roots can take hold, as well as the development of colonies of fungi, lichens and algae on the mosaic surface. The shady conditions also obscure the *tessellatum,* making it more difficult to read the compositions and patterns.

The stone tesserae composing the work now show symptoms of deterioration. In addition, the plates constituting the concrete support are subject to volumetric deformation, resulting in varying movements in the mosaic fabric and consequently the development of cracking. These latter pathologies are mostly confined to the joints between the concrete sections composing the overall assembly, however the entire system underlying the *tessellatum* is in general becoming increasingly less stable, thereby jeopardising the overall conservation of the historic pavement. It is well known that the oxidation of the iron rods embedded in such systems result in strong mechanical stresses, in turn giving rise to cracks, ruptures and bursting of the *tessellatum* from below. The use of Portland cement mortars in the historic conservation treatment also leads to the release of alkaline substances, which effloresce and form concretions on the mosaic surface. These in turn constitute a substrate for biological colonisation.

Given these developments, the concrete backings applied to the mosaics in the 1960s are considered to be approaching the end of their useful life. Our conservation team is currently recommending that a specific research project be conducted for evaluation of the degradation of the concrete systems and their interactions with the *tessellatum*, so that advance preparations can be made for the good conservation of this particular mosaic, as well as for others of the *Conimbriga* site (Sales 2007).

The C6 mosaic fragment in the Museum of Palácio Nacional da Ajuda

In 2017, we were able to return to the MPNA for further examination of the detached piece of the C6 mosaic. At this time we found it on a table, within its broken wooden frame (Fig. 3): unfortunately the piece had been subject to a fall within the museum stores, resulting in substantial damage.

Fig. 3. The mosaic panel offered to the Queen as it appeared in 2017 (MPNA) (photo F. Abraços, 2017)

The breakage of the supporting frame allowed observation of the conservation systems used for this piece in the late 19th century. The *tessellatum* had been embedded on a layer of gypsum plaster and framed in wood. This structure was then reinforced with criss-crossed wooden slats at the front. Through the remains of this structure we could observe severe breakage of the *tessellatum* over about a quarter of the composition, and a crack crossing the almost the entire fragment, diagonally. Hundreds of white and black tesserae have been lost and many others are becoming detached from the plaster support.

It is readily apparent that this section of the mosaic is in danger of total loss of physical and formal integrity, unless urgent conservation-restoration measures are conducted.

Conclusions

Since it was discovered in the late 1800s, the mosaic of room C6 of the *domus* of Can-

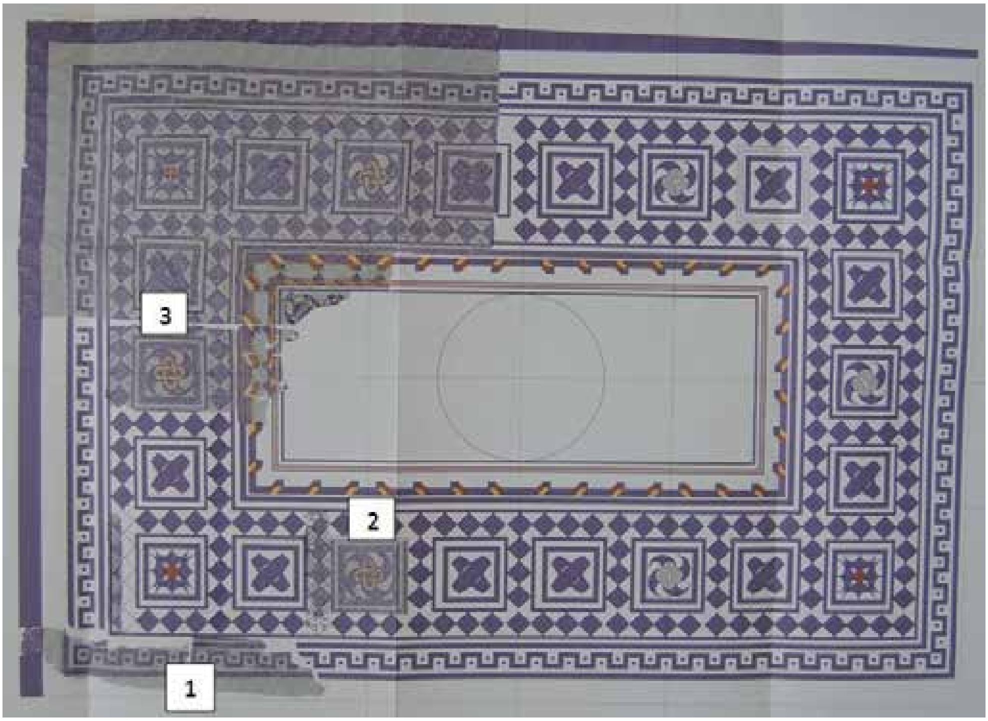

Fig. 4. Design for reconstitution of the C6 mosaic, by architect Ana Patrícia Claro (see Ribeiro n.d.: 12) 1: fragment remaining *in situ*; 2: Fragment offered to the Queen (1899); 3: portions displayed in the Museum of *Conimbriga* (1961) then moved to open-air display (1975) (photo F. Abraços, 2017)

taber has been subject to various interventions and accidents, including the removal of a part to a completely separate location. Our current proposal is that this piece, the fragments still present in room C6, and those at the entrance to the *Conimbriga* site, should all be reunited. In the case of a total excavation or at least a full archaeological assessment of the *domus* of Cantaber, it would be conceivable to return all the fragments as nearly as possible to their original locations, executing a "pavement" of room C6 in the manner presented here, in Figure 4. The undertaking of such a project would be timely, given that the exposed mosaics are in the process of advanced deterioration. The project would represent an opportunity to carry out a profound conservation and restoration intervention, at a time when such measures are becoming urgent. The current proposal envisions the replacement of all the *tessellatum* supports, both those in concrete and that underlying the section offered to the Queen. The mosaic fragments would be placed in a light synthetic support, enhancing the preservation and presentation of the overall work. The supports of the individual pieces would be designed to enable reassembly, either in indoor or outdoor environments, allowing the presentation of the mosaic in temporary exhibitions.

References

Ribeiro A. s/d.: Mosaico da Casa de Cantaber, in Geometrias. Faculdade de Arquitetura, rel. EA/ATM, 12. Coimbra.

Sales, P. 2007. *A Casa dos Repuxos de Conimbriga – Evolução das soluções de Reabilitação, Conservação e Restauro*, Faculdade de Engenharia da Universidade do Porto.

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TOWARDS A COLOUR CHART OF THE BYZANTINE MOSAIC TESSERAE OF THE DAPHNI MONASTERY

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Abstract

The authors have undertaken an initiative for systematic documentation of the materials and colours of the tesserae of the Daphni Monastery wall mosaics. Systematic investigation of the mosaics of the *Katholikon* cupola were possible during the major conservation-restoration project of 1999-2015. The research combines macroscopic examination, high resolution photography, colorimetry and microscopic examination using a digital portable microscope. Further data recording of the wall mosaics will be conducted as opportunities arise. The study aims to correlate the chart of tesserae colours and materials with the art-historic execution of specific depictions and patterns.

Keywords: Byzantine, tesserae, colour chart

Introduction

The Monastery of Daphni (Athens, Greece) dating from the 11th century is an important monument of the Byzantine period, included in the UNESCO World Heritage List, primarily in consideration of its architectural forms and superb mosaic works. Following extensive damage from the earthquake of 1999, the Hellenic Ministry of Culture conducted a large scale conservation project for the stabilisation and restoration of the building and the conservation of its mosaics. The project was co-funded by the European Union and was completed in 2015. The conservation-restoration project involved the mounting of an extensive system of scaffolding in the *Katholikon* (conventual church), which enabled access to the existing mosaics for observation, assessment, and recording of the tessellated areas.

Scope and methodology

A large number of Byzantine monuments with wall mosaics survive, however the art historical study of these works tends to take a “pictorial” approach, focusing mainly on iconographic and stylistic issues (Mouriki 1985). Some recent research programs have aimed at a more holistic understanding of the production and distribution of Byzantine mosaics (James 2006; Sussex Centre for Byzantine Cultural History 2017). The present study, initiated in 2015, contributes to this direction, inserting a technological path. In particular, the project consists of pilot research aimed at determining the choices of materials and their corresponding colours for the production of the depictions and patterns (i.e. the “styles”). The project combines traditional macroscopic observation with digital documentation, recording and measuring techniques, and utilises both pre-existing data on the mosaics along with additional information

Fig. 1. Digital imaging of a selected area of mosaic (photo M. Krini, Directorate of Conservation of Ancient and Modern Monuments (DCAMM), Hellenic Ministry of Culture and Sports)

obtained via systematic examination and non- destructive optical techniques.

Conservation documentation

The 1999-2015 Daphni Monastery mosaics conservation project produced multiple series of records, including analogue and digital photography, photogrammetric ortho-photography, conservation mapping, CAD-assisted graphic documentation, and non-graphic documentation of the condition of the works, the previous interventions, and the interventions of the project itself. Through reference to archival sources, including conservation records, studies and publications, information can also be gained about the interventions and observations conducted at earlier dates (Anamaterou 2011).

High resolution photography

High resolution photography and video-recording were used to record the colour of the tesserae in the details of the depictions (Fig. 1). Several series of pictures were taken with natural light, artificial light at selected colour temperatures, and using specific filters.

Macroscopic examination

A systematic macroscopic examination was conducted using data recording sheets for identification of the tesserae materials and colours, under both natural and artificial light sources of different kinds. The colours were described using both conventional characterisations and terms used in the mosaics literature. The technical details, irregularities and exceptional uses of colours observed during the overall examination were noted for further investigation and interpretation at a later date.

Colour measurements

The visual and written documentation are being integrated with an assessment of the colours and hues of the tesserae of the church cupola, conducted using a portable colorimeter (NCS Colour Scan 2.0). The results and the colour charts will be assessed in parallel with macroscopic examination charts.

Microscopic examination

Microscopic examination was carried out *in situ* using a digital portable microscope (Dino-Lite AM211, with adjustable focus and magnification from 10x to 200x) connected to a portable computer (Sony Vaio), on selected colours of glass and stone tesserae on different depictions of the same iconographic cycle (the Prophets, at the base of the cupola) (Fig. 3). The purpose of this was to record details of the tesserae surface in terms of the different hues, and to verify the material types. The procedure involved selecting the appropriate areas, temporary marking using masking tape, and microscopic imaging. The microscopic images were later correlated with the images resulting from the macro-digital examination (Fig. 2).

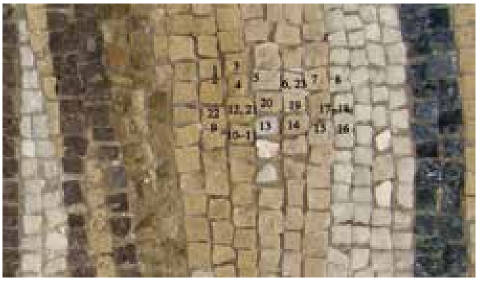

Fig. 2. Recording of different colours and hues (photo M. Krini, DCAMM, Hellenic Ministry of Culture and Sports)

Fig. 3. Microscopic imaging of a tessera (photo P. Loukopoulou, DCAMM, Hellenic Ministry of Culture and Sports)

Gold and silver tesserae

The study of the nature and decay of the glass tesserae with gold and silver leaf was conducted as part a PhD thesis on this theme (Loukopoulou and Moropoulou 2013). The study revealed that the makers of the Daphni mosaics had used the metal-leaf tesserae with several colours of glass support. The gold tesserae could be classified in three main colour categories (yellow, aqua, and purplish), with the distinctions deriving from the colour of the glass used in the production. According to the colour of the support glass the gold tesserae were classified in three

Fig. 4. Microscopic imaging of a detached gold-leaf tessera , side view (photo P. Loukopoulou, DCAMM, Hellenic Ministry of Culture and Sports)

main categories: yellowish, aqua and roughly purple, while the silver ones in two: yellowish and aqua. Within each of the three categories of gold tesserae there were a broad range of shades. In particular, the purple tesserae varied from almost colourless, with a light pinkish-red hue, to dark purple colour and a brownish-amber hue (Fig. 4).

Future work

At present, the collected data is being processed and analysed for development of the colour chart of the Daphni mosaics. In 2015 the main conservation project was concluded and the scaffolding was removed, therefore in the foreseeable future, access to the mosaics will be possible only, when temporary scaffolding or scissor lifts are installed for mosaic and building maintenance. We also expect to carry out a detailed examination of the loose tesserae, obtained as a result of past damage to the monument. These future studies will continue to contribute to the development of the colour chart.

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References

Anamaterou E. 2011. "Συντήρηση των εντοίχιων ψηφιδωτών της Μονής Δαφνίου (Conservation of Daphni Monastery wall mosaics)". In Έργα συντήρησης συγχρηματοδοτούμενα από το Γ' ΚΠΣ *(Conservation projects co-funded by Greece and European Union)*, edited by Maria Krini. Athens: Ministry of Culture-and Tourism, Directorate of Conservation of Ancient and Modern Monuments.

James L. 2006. "Byzantine glass mosaic tesserae: some material considerations". In *Byzantine and Modern Greek Studies*, 30(1), 29-47. DOI: 10.1017/S0307013100015032.

Loukopoulou P., Moropoulou A. 2013. "Notes on the Morphology of the Gold Glass Tesserae from Daphni Monastery". In *New Light on Old Glass: Byzantine Glass and Mosaics*, edited by Liz James and Chris Entwistle, 76-81. London: British Museum.

Mouriki Nt. 1985. Τα ψηφιδωτά της Νέας Μονής Χίου (*The mosaics of Nea Moni of Chios)*, Athens: Εμπορική Τράπεζα της Ελλάδος (Commercial Bank of Greece).

Sussex Centre for Byzantine Cultural History 2017. "The Composition of Byzantine Glass Mosaic Tesserae". October 6. http://www.sussex.ac.uk/byzantine/research/mosaictesserae

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THE TESS WEB PORTAL ON ANTIQUE PAVEMENTS OF ITALY: KNOWLEDGE, CONSERVATION, AND "VIRTUAL RESTORATION" IN ORIGINAL CONTEXTS

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Abstract

The TESS web portal ("System for Computerised Cataloguing of Antique Pavements") contains about 16,000 records on the antique pavements of the Italian peninsula. Each record draws on a multiplicity of data sources and types for the completion of a set of specific fields. The database is useful not only for historical and archaeological research, but also in the field of conservation and restoration. One of the unique features is the capacity to "reconstruct" the pavements in their original contexts, long after they have been detached.

Keywords: Mosaics, ancient floors, Roman, virtual conservation

Introduction

The TESS web portal (*Sistema per la catalogazione informatizzata dei pavimenti antichi*; System for Computerised Cataloguing of Antique Pavements) is a tool for both heritage professionals (institutions, scholars) and the general public, aimed at providing knowledge, protection and enhancement of the ancient floors (4th century BC-6th century AD) of the Italian peninsula. The portal is created and directed by the Department of Cultural Heritage, University of Padua (Ghedini *et al.* 2007; Ghedini 2016; Ghedini *et al.* 2016a-b), and has been available online since June 2016 (tess.beniculturali.unipd.it) (Fig. 1).

TESS integrates a multiplicity of data sources and types, ranging from information on archaeological context, to technical and decorative features, conservation status and bibliographic sources. The database permits both simple and complex searches (Fig. 2). The results, georeferenced on Google Maps, are extracted from a computerised archive that collects the records of about 16,000 floors, each linked with its geographical and archaeological context (room, building). Each database record includes descriptive information on the geometric and figurative motifs, as well as the conservation and restoration of the work, meaning that the different experts can access a powerful tool for a "virtual restoration of the contexts", in terms of both the structures and the larger human settlement. This function results as particularly useful for floors excavated long ago, and now detached, which can now be "re-contextualised" in the database.

Reading the mosaics: conservation-restoration information

The Conservation section of the records contains all available information concerning the protection of the pavements, such as whether the work is whole or frag-

Fig. 1. The TESS home page (tess.beniculturali.unipd.it)

Fig. 2. The TESS interactive map for geographical searches (tess.beniculturali.unipd.it)

Fig. 3. Example of the record for a mosaic in Piazzetta Pescheria, Verona, containing information on ancient restorations (tess.beniculturali.unipd.it)

mentary, observations on damages, the storage location, conditions on availability, the ownership status, etc. The University has taken particular care in entering information on any modern and ancient restorations. The insertion of the information on the original archaeological investigation and past conservation-restoration offers significant new research opportunities in the study of the ancient floors. (Rinaldi 2011, with bibliography) (Fig. 3) discusses an emblematic case in this re-

Fig. 4. "Bringing home" the mosaics of Villa Gordiani, Rome (tess.beniculturali.unipd.it)

gard, of a pavement from Verona showing numerous ancient restoration interventions, now recorded in TESS.

"Bringing the mosaics home": virtual restoration within the original contexts

The insertion of records in the TESS archive requires highly demanding operations of critical analysis and homogenisation of the data, so as to reduce problems in the interpretation and identification of the ancient pavements and to ensure the correct classifications. The relational structure of the database allows the linkage of each floor with its true archaeological context. This aspect is particularly important for detached pavements, such as those preserved in museums and collections, or known only from archival sources. In this way we were also able to reconstruct large and articulated "sets" of mosaics (Fig. 4), for comprehension of their diachronic development. Angelelli (2016: 16) provides some particularly interesting case studies drawing on these possibilities.

References

Angelelli C. 2016. "Le ville del suburbio di Roma tra età repubblicana e tarda antichità. Integrazioni e Aggiornamenti attraverso l'analisi dei contesti pavimentali." *Amoenitas*, V: 9-151.

Ghedini F., Rinaldi F., Tognon M., Kirschner P. 2007. "Il progetto TESS: sistemi informativi applicati ai rivestimenti pavimentali musivi. Un modello di catalogazione." *Archeologia e Calcolatori*, 18: 13-43.

Ghedini F. 2016., "Il Progetto TESS: uno sguardo d'insieme. Storia, stato attuale dei lavori e obiettivi futuri". In *Per un corpus dei pavimenti di Roma e del Lazio. Atti della Giornata di Studi*, edited by C. Angelelli and S. Tortorella, 1-12. Roma: Sapienza Università Editrice.

Ghedini F., Angelelli C., Bueno M., Kirschner P., Rinaldi F. and Tognon M. 2016a. "Tess:

dal sistema di catalogazione informatizzata al portale web." In *Atti del XXI Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico*, edited by C. Angelelli, D. Massara and F. Sposito, 577-586. Milano: Scripta Manent Edizioni.

Ghedini F., Bueno M., Kirschner P., Rinaldi F. and Tognon M. 2016b. "Il Progetto TESS. La schedatura informatizzata e la creazione del portale web." In *Per un corpus dei pavimenti di Roma e del Lazio. Atti della Giornata di Studi*, edited by C. Angelelli and S. Tortorella, 13-26. Roma: Sapienza Università Editrice.

Rinaldi F. 2011. "Il problema dei restauri antichi in un pavimento inedito da Verona." In *Atti del XVI Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico*, edited by C. Angelelli, 633-645. Tivoli: Scripta Manent.

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CONSERVATION AND RESTORATION OF A MODERNIST MOSAIC: VISUAL RECOMPOSITION OF MISSING TESSERAE USING A NON-3D CHROMATIC REINTEGRATION METHODOLOGY

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Abstract

In 2015, the Oficina de Patrimoni Cultural (OPC) of the Diputació de Barcelona performed an on-site minimal intervention of an early-20th century modernist mosaic held at the Casa-Museu Lluís Domènech i Montaner. Adhering to an ever-expanding minimal intervention philosophy, the conservation team applied a treatment that favoured integrity, effectiveness and immediacy. A particularly innovative aspect was the use of a non-3D recomposition methodology, by which the voids left by the missing tesserae were only subject to chromatic reintegration, thus giving an optical illusion of a positive space from afar. In this way, the intervention is both respectful of the original material and provides the public with an opportunity to understand the manufacturing technique of this particular mosaic.

Keywords: Chromatic reintegration, Lluís Brú, Mario Maragliano, Modernism, Mosaic.

Project context and history of the mosaic

The Oficina de Patrimoni Cultural (OPC) is the office responsible for the conservation of cultural heritage belonging to the Diputació de Barcelona, a Catalan public institution. On an annual basis, the OPC selects eligible pieces to be included in the Local Museums Network Conservation Program.

In 2015, the OPC included an early-20th century modernist mosaic in its aforementioned annual conservation service program. The intervention was undertaken on-site in its current location at the Casa-Museu Lluís Domènech i Montaner, a historic house museum in the seaside town of Canet de Mar (Barcelona province), which was once the home of one of the fathers of Catalan modernist architecture. The project was conducted by the OPC's inorganic materials conservator in collaboration with two undergraduate interns from the Escola Superior de Conservació i Restauració de Béns Culturals de Catalunya (ESCRBCC).

Probably executed by Gaspar Homar at Mario Maragliano's or Lluís Brú's workshop, the piece was an early-1900s original design by Pere Domènech Roura, son of Lluís Domènech Montaner. The mosaic was made for his own home in Barcelona, where it decorated a mirrored entryway-furniture piece (Fig. 1). However, circa 1940, when the work was moved to the Casa-Museu in Canet de Mar, it was transferred to a new support made of painted chipboard and the furniture-piece got lost (Salvador Munrabà Valls, e-mail message to author, 2017).

Description: morphology, composition and execution techiniques

The mosaic measures 160 by 215 cm and takes and inverted-U shape, hav-

Fig. 1. Entryway mirrored furniture piece, early 1900s (source: Casa Museu Lluís Domènech i Montaner)

ing a curved upper and lower frame and straight sides; the mosaic and its support total 3 cm in thickness.

The figurative composition evokes a coastal, Mediterranean landscape, showing elements of the natural world, such as the sky, the sea, cliffs, cypress trees and rose bushes. On the upper band, the layout displays a white country house and a sailboat, whilst the lower plane highlights a rooster, a white path and a brick wall.

The object's supporting structure is made of iron rods and crossbars joined with rivets and wires. The arched lower frames show a hole near the interior angle of each piece, which provides insight into the mounting system that may have been used to fix the mosaic to the long-lost piece of furniture. The iron structure is covered by two layers of bedding mortar, the first of which presents a coarser aggregate than the one at the top, where the tesserae are set.

The mosaic tiles are less than 5 mm thick and are made of *pâte da verre –glass paste–*, glazed red-paste ceramic and glazed white-paste ceramic, which were placed into a design that combines three Roman-styled techniques: *opus tessellatum*, *opus vermiculatum* and *opus sectile*. A close-up visual examination of the detached tesserae revealed that the blue pieces were made of a white-paste ceramic glazed on both sides, which is the same technique that was used by Lluís Brú and Mario Maragliano for the modernist mosaics of the Santa Creu i Sant Pau Hospital (Barcelona city), which provides clues to the mosaic's authorship.

Diagnosis

The mosaic was subject to visual analysis in order to discover deterioration patterns and their causes. The resulting condition assessment primarily documented damage of the mosaic's internal iron structure, which had expanded along the upper corners due to corrosion mechanisms triggered both by internal and external causes, mainly high relative humidity and the salty environment typical of a coastal location. Consequently, this force fractured the overlying mortar of the tesserae, which in turn blistered, got detached from the expansion area and eventually got lost. As a whole, the deterioration patterns that were identified consisted of:

- Corrosion and soiling of the iron structure;
- Cracking, losses and soiling of the mortars (Fig. 2);

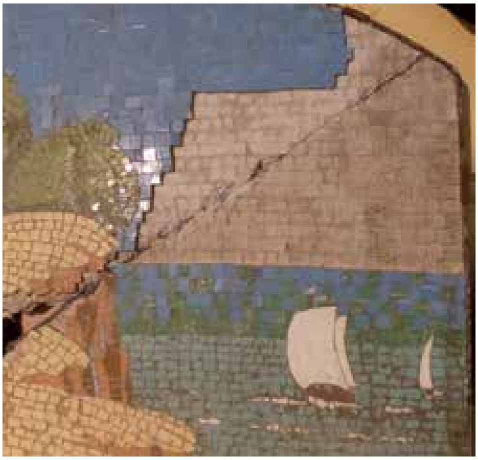

Fig. 2. Upper right corner before treatment, 2015 (photo Núria Avecilla Palau)

– Glazing abrasion, blistering, losses and detachment of the tesserae, as well as soiling, glue residues, and brown and amberish residues (probably shellac and varnish) (Fig. 2).

Interestingly enough, glue residues are probably related to the use of an indirect method of making the mosaic, as described by Llobet Font *et al.* (2015).

Treatment

Complying with the OPC's intervention guidelines, it was determined that the most immediate and effective solution should consist of a minimally-invasive approach with an eye to treating the corrosion and to simulating the missing tesserae with no-3D reintegration. The work process took place as follows:

1. General cleaning of the mosaic with synthetic and metallic brushes, stainless steel scourer, rotary power tool, water, acetone, ethanol an pH-neutral soap;

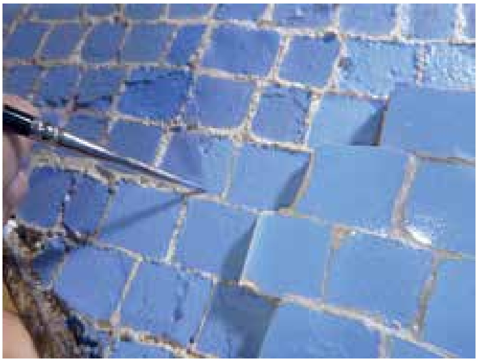

Fig. 3. Chromatic reintegration in process, 2016 (photo Núria Avecilla Palau)

Fig. 4. Mosaic after treatment, 2017 (photo Núria Avecilla Palau)

2. Cleaning and inhibition of the exposed iron structure corrosion with tannic acid and acrylic resin;
3. Consolidation and repair of blistering tesserae with acrylic resin and nitrocellulose adhesive;
4. Filling of the setting-bed lacunae with closed-cell polyethylene foam, epoxy resin and gypsum plaster blended with perlite and acrylic resin;
5. Protective coating of the exposed

original bedding mortar with acrylic resin;
6. Chromatic reintegration of the tesserae over the original imprints (Figs. 3-4).

Conclusions

Following the diagnosis, consideration was given to the replacement of the internal iron structure. However, this option was ruled out given the constraints of such effort-and-time-consuming process, which would indeed put the mosaic at risk.
Fortunately, the procedures that were actually implemented proved effective in achieving the proposed objectives. Abiding by the overall criteria of reversibility and retreatability, the protection coating applied to the mortar acts as a buffer and favors both the eventual removal of the pictorial layer and further treatments. Even more so, the intervention is both respectful of the original material and provides the public with an opportunity to understand the manufacturing technique of this particular mosaic.

As regards the process in itself, there were physical limitations during the chromatic reintegration phase that relate to the fact that work had to be performed with the mosaic in horizontal position and under different lighting conditions than the final exhibition's, which required subsequent retouching of the colors.

In view of the optical reintegration solution applied, the exhibition light beams were to be pointed in a frontal manner so as to prevent shadow casting over the lower-relief reintegrated areas. Other measures to take into account include lamps with Ultraviolet/Infrared blocking filters and controlling relative humidity and temperature values to prevent corrosion and pigment-and-binder degradation.

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References

Llobet Font S., Andino Pol L., Colonna-Preti K. 2015. "La Conservació-Restauració dels Elements de Mosaic del Pavelló de l'Administració de L'Hospital de La Santa Creu i Sant Pau (Barcelona)." *Unicum*, 14: 5-26. https://www.raco.cat/index.php/UNICUM/article/view/305541/395363

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ULTRASONIC INVESTIGATION OF AN *IN SITU* ROMAN MOSAIC FLOOR IN VOLUBILIS, MOROCCO

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Abstract

The non-destructive technique of ultrasonic testing was used to identify and map the voids, cracks and other anomalies beneath the *tessellatum* layer of the "Ephebe" mosaic floor in the Roman archaeological site of Volubilis. Prior to using the technique, a small model (0.9 x 1.10 x 0.15 m) was first prepared using traditional Roman techniques, also inserting voids and a grid of metal reinforcing bars to replicate the potential characteristics of the original floor, as restored in the 1950s. In this way the efficacy and operation of the technique could be learned on the model, for application to the real floor. The ultrasonic technique proved useful in mapping the heterogeneities, including hollow spaces, corroded rebar and fractures zones, and can therefore be used to support the planning of future interventions.

Keywords: Volubilis, Roman mosaics, House of Ephebe, non-destructive testing, ultrasonic velocity

Conservation status of the mosaic, objectives of the investigation

The archaeological site of Volubilis, situated at 30 km northeast of Meknes, contains the remains of houses, public baths, religious and official buildings decorated with fascinating mosaic floors (Panetier and Limane 2002; Limane *et al.* 1998). Since they were first restored in 1950, the mosaics have suffered multiple forms of deterioration, due mainly to weathering and lack of preventive maintenance. The 1950s restoration consisted of lifting the mosaics, removing the *statumen* and replacing it with reinforced concrete as the new support. The mosaics were originally constructed over marl clay soils, and it has been observed that the concrete slabs were subject to cracking caused by the shrinkage expansion and contraction of the clay, particularly where the concrete slab is thin (Chen and Ma 1988). Other damage has been caused by the corrosion of the reinforcing bars and the surrounding development of oxidation products, which leads to an increase pressure and cracking in the concrete. Both of these actions cause cracking which could then also contribute to the creation of void spaces and the collapse of the mosaic floor (Balafas and Burgoyne 2011).

The objective of the ultrasonic survey reported here was to document and better understand the condition of a 7.30 x 7.30 m mosaic floor depicting Ephebe, in the roman villa known by the same name. More specifically, the objectives were to identify heterogeneities in the mechanical properties across the surveyed area and assist in the location of deteriorated areas and exploration of the best possible intervention approach.

Fig. 1. Ephebe floor mosaic (photo by F. Bakadi)

Analytical methods

The P-wave velocity values were measured, and a velocity contours map was generated. Details on the use of ultrasonic P wave velocity to detect heterogeneities of mechanical properties of tested materials can be found in the work of Christaras (2009).
Prior to the survey of Ephebe, an *in situ* model (0.9 x 1.10 x 0.15 m^3) of a mosaic floor (Fig. 1), was constructed according to standard Roman practices (Fig. 2). Parts of the model were also inserted with a grid of steel bars and void spaces. These features were included in the for testing of the analytical methods.
The apparatus used was the Portable Ultrasonic Non-destructive Digital Indicating Tester (PUNDIT) Lab 54 KHz. The transmitter and the receiver were placed on the surface at 20 cm spacing and measurements were taken every 10 cm for the model and every 20 cm for the House of Ephebe floor. To obtain good coupling between transducers and the mosaic surface, a traditional non-destructive soap was used. A real-time signal was visualised directly on the PC screen via “Pundit-Link”, a commercial software provider by the manufacturer. The contour maps were developed using Surfer by Golden Software Company.

Results and discussion

The mosaic model

For the mosaic model, the contour map

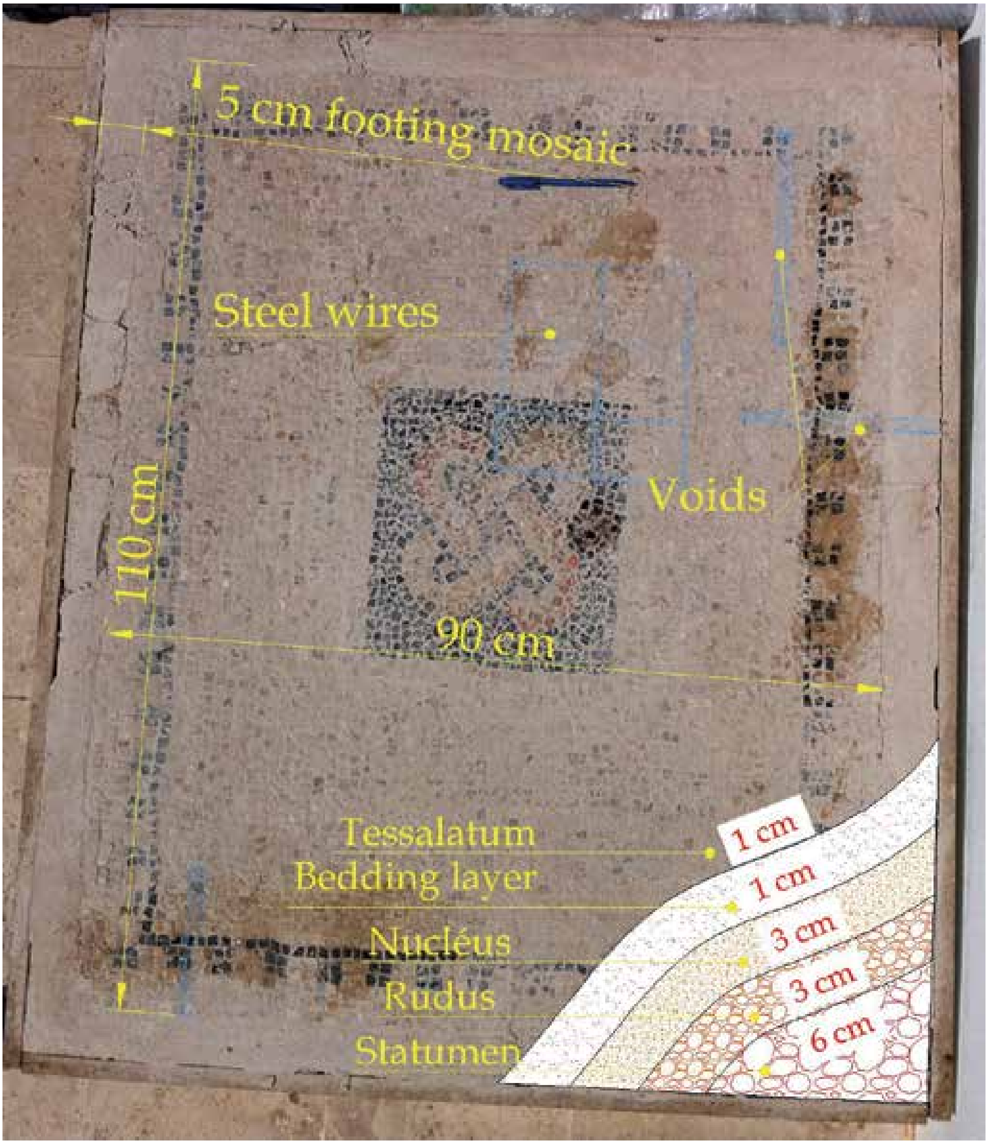

Fig. 2. Mosaic model (photo by F. Bakadi)

generated based on the velocity data is seen in Figure 3. The variations in heterogeneity are caused by the metal reinforcement bars, and the varying presence of micro cracks and the level of compaction. An area of low velocity (<400 m/s) covers the entire upper half of Figure 3. Within this zone, three small areas characterised by a P-velocity values ranging from 800 to 1200 m/s were observed to match the location of the inserted grid of metal bars. The lower half of Figure

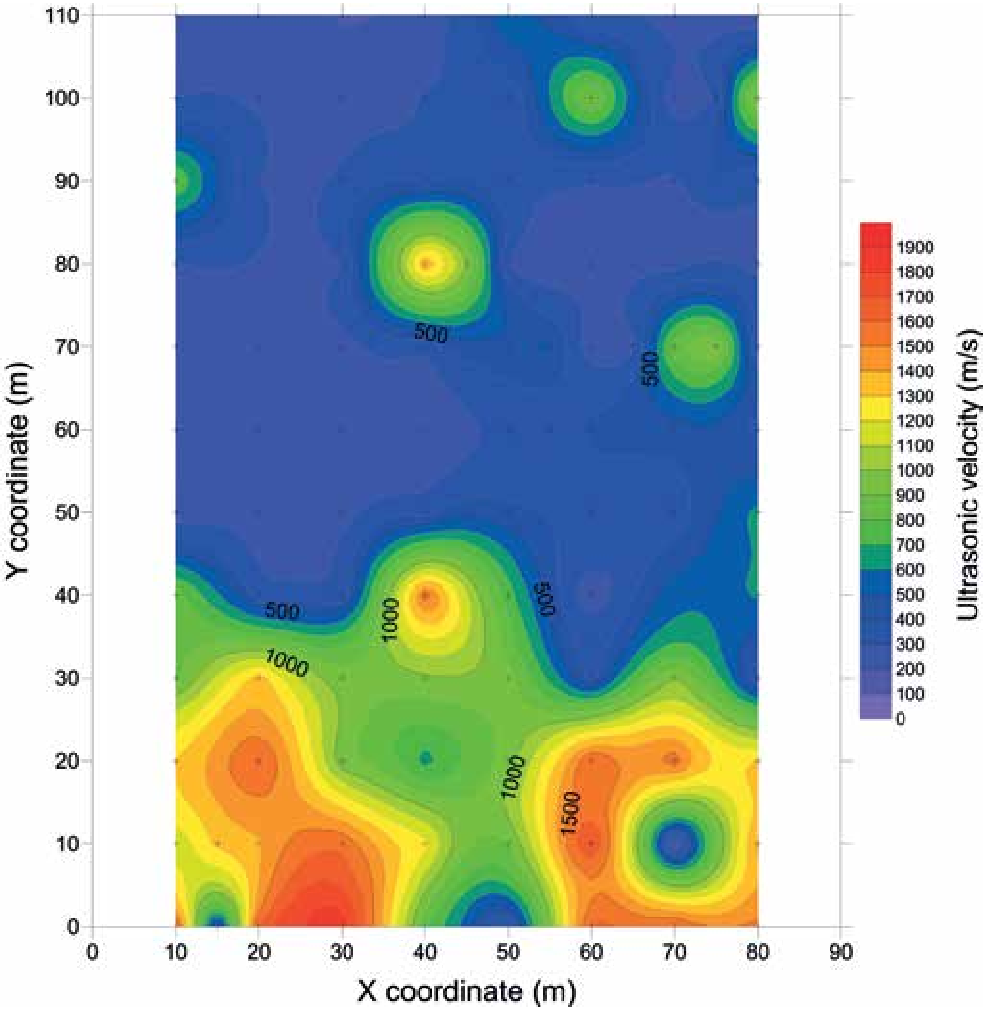

Fig. 3. Spatial map of ultrasonic velocity for the modern mosaic model (by F. Bakadi)

3 shows high velocity values (reaching 1900 m/s) which appear to correspond to a more highly compacted section of the model.

House of Ephebe in situ floor mosaic

The ultrasound velocity map of the Ephebe mosaic shows great heterogeneity (Fig. 4) within the mechanical properties of the surveyed area and assist in locating deteriorated areas. The small islands characterised by high velocity values match the highly compacted areas, where repairs have been conducted using concrete. Conversely, the areas with low P wave velocity constitute more weathered areas characterised by the deterioration of mosaic pavement (fracturing and the oxidation of steel bars) due probably to water infiltration from mosa-

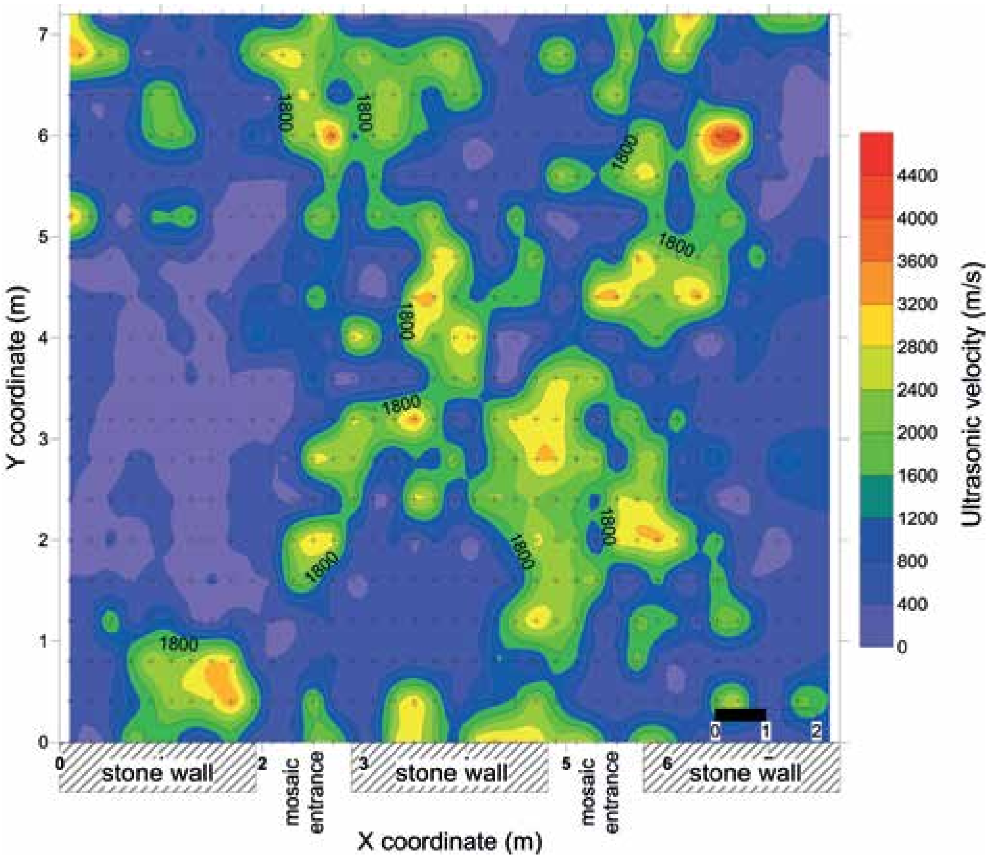

Fig. 4. Spatial map of ultrasonic velocity for the in-situ Ephebe mosaic floor (by F. Bakadi)

ic surface. This mapping shows the spatial distribution of the healthy and deteriorated areas, which could be useful for monitoring the restoration.

Conclusion

The variation of the P wave velocity values in the mosaic model provided good information on the application of the technique for detecting heterogeneities and the state of consolidation of the materials, which could then be applied in understanding the tomograph of the *in situ* original mosaics. When applied to House of Ephebe mosaic, the technique provided information about pavement heterogeneities, useful for mapping and assessing the mosaic condition and for quantifying the damages deriving from weathering and the related degradation process.

References

Balafas I. and Burgoyne C. 2011. "Modeling the Structural Effects of Rust in Concrete Cover." *Journal of Engineering Mechanics,*Vol. 137, Issue 3 (March 2011)

Chen F.H. and Ma G.S. 1988. "Swelling and shrinkage behaviour of expansive clays". In *Proceedings of the 6th International Conference on Expansive soils, 1-4 December 1987 New Delhi,* India,127-129. United States: CRC Press.

Christaras B. 2009. "P-Wave velocity and quality of building materials". In *Recent Advances in Geology and Seismology, Proceedings of the 3rd IASME/WSEAS International Conference on Geology and Seismology (GES 2009), Cambridge, UK February 24-26, 2009* edited by Leon Trilling, D. Perkins, Dionysios Dionysiou, Leonid Perlovsky, Kent Davey, David Landgrebe, Miguel A. Marino, D. L. Russell, Steven H. Collicott, Marco Ceccarelli, John W. Lund, 41–46. WSEAS Press.

Limane H., Rebuffat R., Drocourt D. 1998. *Volubilis de mosaïque à mosaïque*. Aix-en-Provence: Edisud.

Panetier J. L., Limane H. 2002. *Volubilis une cité du Maroc antique*, 108-109. Casablanca: Edition Malika.

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RELOCATION OF A MOSAIC PAVEMENT ON A LIME MORTAR BASE PREPARED IN ANCIENT ROMAN TECHNIQUE

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Abstract

In the 1960s, a Roman mosaic pavement was lifted from its original location and reconstructed on concrete bedding, as a feature of the '*grande allée*' of the archaeological site of Tyre, Lebanon. The climatic exposure of the mosaic, in close vicinity to the sea, had resulted in extreme deterioration. In 2014-2015 a conservation intervention was conducted for an area including 69 m² of the mosaic, within the framework of the Ba'albek and Tyre Archaeological Project (BTAP I), aimed at developing sustainable methods of conservation for extension to other areas of the sites, and training of local building technicians and youth. The methodology was informed by the historical and archaeological literature on ancient bedding stratifications and by material analyses of mortar samples from original pavement substrates within the site of Tyre. The mosaic was lifted, cleaned of its concrete backing and re-laid on a new lime mortar foundation, constructed in a manner to provide improved drainage. A demonstration piece By the late 1960s the mosaic was entirely lifted and relocated onto sections of reinforced concrete along the centre of shows the construction technique and commemorates the involvement of the 41 skilled artisans.

Keywords: Tyre, Roman mosaic, reinforced concrete bedding, *in situ* relocation, new lime mortar substrate

History of the mosaic

In the 1940s, a Roman mosaic of simple geometric design, with large white circles separated by dark lozenges, was excavated at the archaeological site of Tyre. The mosaic, executed in cubic tesserae of standard size 1.2 to 1.8 cm², has been dated between the 2nd century AD (Chéhab 1962) and the early fourth century AD (Chéhab 1967; Gatier 2012). The so-called *grande allée*, the reconstructed colonnaded monumental complex within the archaeological city.

In this position the mosaic was subject to progressive decay, due to the exposure to local climatic conditions and resulting biological growth, occurring in four distinct seasons (Fig. 1). Besides higher plant and microbiological colonisation, the pavement also demonstrated deterioration phenomena typical of mosaics mounted on concrete: corrosion of metal reinforcement, differential settling, bowing and disintegration of the underlying concrete sections, and as a result, innumerable cracks in the *tessellatum*, with many lacunae and loose and scattered tesserae. It was also possible to read a history of intervention in response to this decay, in the form of varied repairs in cement, as well as some lime mortar patching and localised reconstructions. A particular detail of the deterioration was the disproportionate loss of the black and brown tesserae, in basalt and sometimes

Fig. 1. View to the southwest along the *grande allée*, with a large section of geometric black and white mosaic pavement (photo by Badde/MacKinnon 2014-2016)

ceramic, relative to that of the creamy white tesserae in limestone, due to the higher porosity of the darker tesserae and to their much more pronounced fragmentation.

Aims of the intervention

Our intervention, conducted between May 2014 and May 2015, was limited to the largest reconstructed section, measuring 87.54 m^2. Of this total area, some 20 m^2 constituted internal voids, while the mosaic surfaces themselves totalled 69 m^2, bedded in approximately 35 reinforced concrete slabs of various sizes (Fig. 2).

The intervention was designed as a pilot project within phase I of the Ba'albek and Tyre Archaeological Project (BTAP I) [1], aimed at developing appropriate and sustainable methods of conservation that can be extended to other areas of the sites, including to the remainder of this specific pavement. Apart from dealing with the challenges of the specific pavement, the aim was also to provide on-site training of local building technicians and youth in the principles and techniques of mosaic conservation-restoration, beginning with condition reporting, topographic survey, photo documentation and digital mapping, foil mapping of gridlines and lacunae, mapping of past repairs and mortar sampling. The training activities continued throughout the phases of lifting the mosaic in sections, with the top half of the cement substrates, removing the cement and cleaning the tesserae, and then relocating the mosaic *in situ* on a new, hydraulic lime mortar substrate.

Fig. 2. View onto area of intervention, May 2014 (photo Badde/MacKinnon 2014-2016)

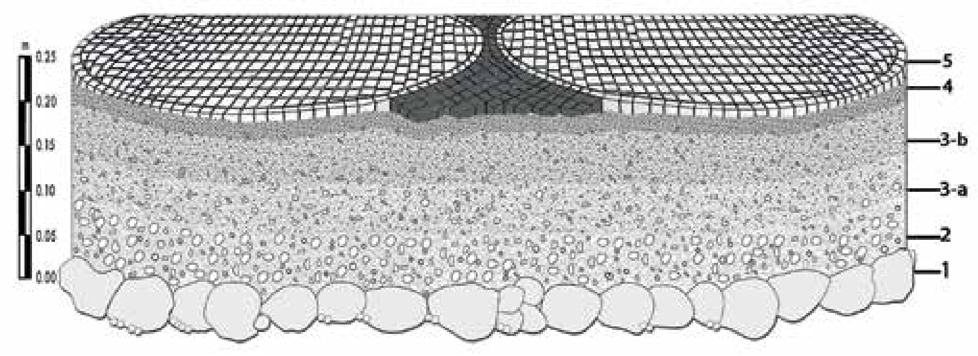
Fig. 3. Demonstration piece showing the substrate reconstruction, with inscription ARTE FABRVM XLI REFECTVM, signifying the restoration by the skill of forty-one artisans (photo Badde/MacKinnon 2014-2016)

Replication of ancient Roman techniques

As a mitigating measure against the effects of climatic exposure and biological growth, we installed the reconnected sections of pavement at a slightly higher level, about 4cm above the surrounding ground. The sections were installed on a substrate of about 25 cm depth, on a uniform plane, with a drainage gradient of about 1%.

Our methodology and choice of materials in preparing the substrate (Fig. 4 and Table 1) were informed by the historical and archaeological documentation of ancient bedding stratifications and by the substantial literature on their conservation-restoration (Vitruvius: 7.1.1–7; Pliny: 36.60–64; Alberti 1755: Book 3; Selvig *et al.* 1981; Cassio and Nardi 1985; Melucco Vaccaro 2003; Starinieri 2009; Roby and Demas 2012; Wootton 2014), as well as by our own investigation of the paving substrates preserved in local sites. Mortar analyses were conducted for the identification of a characteristic mortar of the late 4th to early 5th centuries AD, among others on the substrate of *opus sectile* pavements in the nearby Roman baths. The analysis were conducted by means of microscopic and thin-section analyses with 3D X-ray micro-computed tomography (3D-μCT), Fourier transform infrared spectroscopy (FTIR), micro X-ray fluoroscopy (μ-XRF), X-ray powder diffraction (XRD) and radiocarbon dating (C^{14}). These analyses identified a lime mortar with hydraulic properties, including traces of dolomite, clay minerals and gypsum. Calcium had the highest proportion and a homogeneous distribution, both as a component of the main phase and binder and also in aggregate grains. Quartz was present in the aggregates, not in the binders. The aggregate granules were primarily angular to subangular in form (Badde *et al.* 2020).

Based on our investigations, we chose imported St. Astier NHL 5 and locally produced slaked lime as the binder for the mortar foundation. Local limestone and basalt from Syria were ground to meet the desired grain sizes of the aggregate fractions. Quartz sand was available on site. Ceramic tiles were imported from France and pebbles in a variety of mineralogi-



No.	Layer	Thickness	Lime : aggregate ratio	Lime composition	Aggregate composition
5	Tessellatum	0.5 cm	ca. 1 : 2.25	1= 2 vol. NHL 5	2.25 = 2.0 vol. limestone sands (0.1 - 2 mm), 0.5 vol. quartz sand (0.2 - 0.8 mm), 0.5 vol. crushed brick powder (≤ 1 mm), 1 vol. basalt sand (≤ 1 mm)
4	Bedding layer	2 cm	ca. 1 : 2.5	1 = 3 vol. NHL 5 (dry), 1 vol. slaked lime	2.5 = 5 vol. limestone sands (0.1-2 mm), 2 vol. quartz sand (0.2-0.8 mm), 2.5 vol. crushed brick (1-2 mm), 1 vol. basalt sand (≤1.5 mm)
3-a	Nucleus 2	0-7 cm	ca. 1 : 2.5	1 = 4 vol. NHL 5 (dry), 1 vol. slaked lime	2.5 = 2 vol. quartz sand (0.2-0.8 mm), 5 vol. limestone sands (0.1-4 mm), 2.5 vol. crushed brick (2-4 mm), 1 vol. basalt sand (≤1.5 mm)
3-b	Nucleus 1	5 cm	ca. 1 : 2.5	1 = 4 vol. NHL 5 (dry), 2 vol. slaked lime	2.5 = 4 vol. quartz sand (0.2-0.8 mm), 5 vol. fine limestone gravel (≤6 mm), 1.5 vol. limestone sands (0.1 - 4 mm), 2.5 vol. crushed brick (2-4 mm), 0.5 vol. basalt sand (≤ 1.5 mm)
2	Rudus	10 cm	ca. 1 : 3	1 = 3 vol. NHL 5 (dry), 1 vol. slaked lime	3 = 5.5 vol. round-grained quartz sand (0.2-0.8 mm), 8.5 vol. angular limestone gravel (5 mm-≥2 cm), 1.25 vol. pebbles (0.5 mm-≥2 cm), 0.25 vol. ceramic fragments (0.4 mm-≥2 cm)
1	Statumen	7 cm	Na		Limestone fragments (5 mm≥-7cm), quartz sand (0.2-0.8 mm)

Fig. 4. with Table 1. Schematic cross-section of the mosaic pavement and stratified substrate (Linda Hakim 2017)

cal compositions from Iraq (Badde and MacKinnon 2016). We prepared samples of each type of aggregate in their respective curves of grain-sizes and archived these for future reference, together with a demonstration piece showing the construction technique of the new mosaic substrate (Fig. 3).

Note

1. The BTAP-I conservation intervention was conducted under the direction of Jean Yasmine of the CHUD Project Management Unit, Council for Development and Reconstruction, Ministry of Culture, Republic of Lebanon. The overall design of the BTAP-I development project is by ARS Progetti S.P.A. of Rome. The intervention was contracted to JESCO Contracting Trading & Enterprising of Beirut, with operations led by contract conservators Aurelia Badde and Kai Rötger, and guided by consultant Yasmine Bou Makaroun of Rafik el Khoury & Partners of Beirut.

References

Alberti L. B. 1755. *The Architecture of Leon Battista Alberti in Ten Books. Of Painting in Three Books, and of Statuary in One Book.* Translated into Italian by Cosimo Bartoli and into English by Leoni J. in one volume. London: Printed by Owen E. for Alfray R.; digitized Kansas City (2010): Linda Hall Library, LHL Digital Collections.

Badde A., MacKinnon A. 2016. "A pavement laid to rule and level: restoring a Roman mosaic in Tyre." *Berytus Archaeological Studies,* LVI: 47-86.

Badde A., Badawi A. Kh., Gardei A., Illerhaus B., MacKinnon A., Mucha F. 2020. "Investigating mortars in the Roman baths in Tyre: a preliminary report." Ed. Gatier P.-L. *BAAL Hors Série*, XII (in press).

Cassio A., Nardi R. 1985. "Esempi di conservazione *in situ* di mosaici pavimentali." In *Conservation in Situ. Proceedings of the 2nd Conference of the International Committee for the Conservation of Mosaics. Aquileia, 3-7 October 1983,* 129-148. Rome: ICCROM.

Chéhab M. 1962. "Tyr à l'époque romaine: aspects de la cite, à la lumière des textes et des fouilles." *MUSJ* 38: 11-40.

Chéhab M. 1967. "Fouilles de Tyr." Ed. Saidah R. *Chronique. Fouilles de Tyre. BMB,* XX: 159-161.

Gatier P. L. 2012. "La grande salle basilicale des bains de Tyr." In *L'histoire de Tyr au témoignage de l'archéologie.* Actes du Séminaire international, Tyr 2011. *BAAL hors-série*, VIII: 55-70.

Melucco Vaccaro A. 2003. "Philosophies favouring *in situ* conservation." In *Mosaics make a Site: The conservation in situ of mosaics on archaeological sites. Proceedings of the 6th conference of the International Committee for the Conservation of Mosaics, Nicosia, Cyprus, 1996,* 17-29. Rome: ICCROM.

Pliny the Elder, *The Natural History*. 1855, trans. Bostock J. and Riley H. T. London: Taylor and Francis.

Roby T., Demas M., eds. 2012. *Mosaics in Situ: An Overview of Literature on Conservation of Mosaics in Situ.* Los Angeles: The Getty Conservation Institute.

Selvig F., Rockwell C., Inman S., Novis W. and de Guichen G. 1981. Mosaics No. 2 *Safeguard.* Carthage 1978 Perigeaux 1980 ICCM. Rome: ICCROM.

Starinieri V. 2009. *Study of materials and technology of ancient floor mosaics' substrate.* PhD diss., University of Bologna.

Vitruvius. *The Ten Books on Architecture.* 1914, ed. Morgan M H. Cambridge, MA: Harvard University Press.

Wootton W. 2014. "Ancient mosaic techniques and modern conservation: an archaeologist's perspective." In *Conservation of Mosaics: An Act of Discovery. Proceedings of the 10th ICCM Conference, Palermo, 20-26 October 2008* edited by Michaelides D., Guimier-Sorbets A. M., Nardi R., 99-110. Palermo: Regione Siciliana.

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IN SITU CONSERVATION FOR MOSAICS OF THE PUPPUT ARCHAEOLOGICAL SITE, TUNISIA

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Ferhani Chihaoui

The Pupput Archaeological Site is situated 60 km northeast of the capital city of Tunis, on the Mediterranean coast, within the modern city Hammamet (Fig. 1). In the late prehistoric period the area was the site of a modest village. Following the Roman conquest of the Africa Province in the 2nd century AD, the settlement assumed the status of a city and important cultural centre. *Pulpite* underwent considerable development during the age of the Emperor Commodus (161-192 AD). The Roman-era site contains numerous villas, public squares and thermal baths, as well as a cemetery.

The mosaic floor reported here, of black and white tesserae, is situated in the so-called Triclinium House, dating to 3rd century AD. The mosaic had been excavated in the past and was now suffering from detachments and infestation by the root structures of vegetation (Fig. 2). An *in situ* conservation intervention was carried out by the technicians Taieb Bel-

Fig. 1. View of the Pupput Archaeological Site (photo T. Belgacem)

Fig. 2. State of conservation of the mosaic of the Triclinium House (photo T. Belgacem)

Fig. 3. The mosaic during cleaning intervention (photo F. Chihaoui)

gacem and Ferhani Chihaoui, under the supervision of Mounir Fantar, Inspector with the Institut National du Patrimoine.
The phases of preliminary documentation, analysis of the state of conservation and planning focused in particular on the problems of vegetation infestations and the presence of loss of cohesion of the *tessellatum* from the bedding layer.
Following this, the intervention proceeded in stages:

1. Consolidation of areas of the mosaic not requiring detachment, by injection of liquid mortar, and filling of gaps;
2. Removal of vegetation from the surface and cleaning with water and sponge;
3. Delimitation of a mosaic section to be detached;
4. Application of textile on the surface of the mosaic, removal of the mosaic section, removal of roots and application of dense lime based mortar to reconstruct the bedding layer;
5. Application of a thinner traditional lime based mortar as a bedding layer for the tesserae; re-laying of the detached section;
6. Final cleaning of the mosaic surface (see Fig. 3).

Conclusion

The problems encountered in this exposed mosaic illustrate the importance of planning and execution of ordinary periodic maintenance, in the frame of *in situ* conservation of mosaics.

Authors

Taieb Belgacem is a conservation technician with the Institut National du Patrimoine of Tunisia, at the Pupput Archaeological Site. Following participation in the MOSAIKON Mosaic Conservation Course he assumed responsibilities for mosaic conservation-restoration throughout the Province of Nabeul.

Ferhani Chihaoui is a mosaic conservation-restoration technician with the Institut National du Patrimoine of Tunisia at the site of Thuburbu Majus. He has pursued his education in conservation techniques and methodologies through the Getty Conservation Institute and the MOSAIKON Mosaic Conservation Course.

THE MORTAR PAVEMENTS OF THE ROMAN SITE OF COSTA DE LA SERRA (LA SECUITA, TARRAGONA, CATALONIA). A MULTIDISCIPLINARY STUDY

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Abstract

In this paper, we present the first results of an interdisciplinary investigation in progress, developed by specialists in archaeometry, archaeology and conservation-restoration, on a set of samples, commonly called *opus signinum* pavements, recovered from the Roman site of the Costa de la Serra (la Secuita, Tarragona).

The samples have been analysed by scanning electron microscopy (SEM-EDX), X-ray diffraction (XRD) and petrographic microscope. The goal was to collect all possible information about these mortars (composition, method of preparation, etc.), before undertaking the conservation and restoration work. Besides, we intend to highlight the importance of this type of pavement, often underestimated, as well as to emphasize on the relevance of working in multidisciplinary teams, which contribute to the preservation of our heritage.

Keywords: Pavement, roman, multidisciplinary work, conservation, archaeometry

The site of Costa de la Serra

The site of Costa de la Serra is located in the municipality of La Secuita, some 13 km north from the city of Tarragona. It is a late-republic small fort, dating back between the end of the 2nd century BC and the beginning of the 1st century BC (Fig. 1). Since 2014, the ICAC has been conducting archaeological fieldwork, in the framework of the project "*Formes d'ocupació del territori i evolució del poblament a la Cessetània occidental durant la protohistòria (Ier mil·lenni aC)*". These works revealed the existence of a military settlement, which was intentionally devastated at the moment of its abandon. The fort would have been presumably in use for a short time, most likely during the Sertorius war (80-72 BC). Moreover, two towers located at the southern and eastern façades were documented. They have also identified several walls belonging to barracks, as well as three cisterns to collect rainwater, together with a channelling system partially covered by slabs, probably also linked to the water management.

What do we study?

The samples studied represent a set of mortar pavements traditionally called *opus signinum*. However, there is still no agreement about which denomination should be used. In any case, this is an old technique consisting of a mortar made from a mixture of lime, sand, water and powder of tiles or *pozzolana*, giving a reddish aspect to the surface. These pavements are either non-decorated or with simple geometric decorations made with coloured tiles or marble fragments. In some cases, a layer of red paint is applied to enhance the

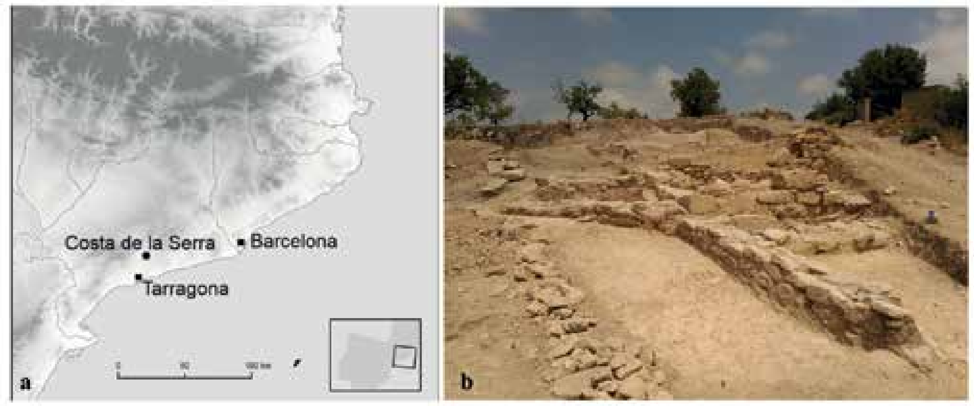

Fig. 1. a) Location of the site of Costa de la Serra in relation to the present-day cities of Barcelona and Tarragona. Map background: H. Bohbot (UMR 5140 CNRS). b) Detail of the tower at the SW of the fortification and related structures (Photo by Equip d'Arqueologia Protohistòrica, ICAC)

colour of the surface. The main characteristics of those pavements are impermeability, solidity and an insulating nature (Vassal 2006).

To present, the concept of *opus signinum*, highly controversial in the last years, is falling into disuse. It is now frequent the use of "*mortier de tuileau*" (Vassal 2015) (tile mortar), which includes the wide variety of mortar types existing in Roman times with the previously explained characteristics.

Fig. 2. Mortars recovered at Costa de la Serra, with the indication of the number of samples selected for our study (Photo by A. Bertral)

Samples

Archaeological context: Most of the samples were recovered from stratigraphic layers that backfill the area of the Southern façade tower once the settlement is abandoned. Those materials are supposed to be the remains of the domestic area of the garrison officers. Similar remains, from other stratigraphic layers offering the same chronology, were also found backfilling other areas of the site. Those results enable us to infer that the whole settlement was abandoned in the same period.

Analysis

All samples were prepared for their petrographic inspection through thin-section analyses. A Leitz Laborlux 12 Pol (2.5x, 4x, 10x and 40x) microscope was used for the identification and description, on the one hand, of the preparation layers of the mortar pavements; and, on the other hand, for the identification and description of the inclusions included in

Sample	PAV001	PAV002	PAV003	PAV004	PAV005	PAV006	PAV007
Mortar composition							
Includes ceramic fragments	X	X	X	X	X	X	X
Single layer		X	X	X		X	
Two layers	X				X		X
Surface character (visual)							
Incrustation layer		X	X	X	X	X	
Uniform		> PAV001					
Fine-grained			< PAV002	≥PAV002	X	X	X
Smooth		> PAV001			X	X	X
With visible ceramic fragments	X		X	X		X	X
Surface colour							
Pinkish		X					
Reddish						X	
Greyish				X			X
Pale salmon					X		

Table 1. Macroscopic characterisation of the samples

those layers. Besides, mineralogical characterisation was performed by means of XRD with a PANalytical X'Pert PRO MPD powder diffractometer (radius = 240 millimeters), in order to identify the main mineralogical phases of the mortars (binder, inclusions and possible secondary phases). In situ surfaces of PAV004, 6 and 7 were also examined by SEM. This study allowed the observation of the microstructure, identification of secondary and/or altered phases, surface layers and incrustation layers.

First results

Mineralogical and petrographic analyses point out that all samples are lime binder mortars, showing differences in grain size, without mixing of gypsum or clays. The textural and compositional study allowed to distinguish differences among the preparation of mortars. While most of them are single layer, PAV001, 5 and 7 exhibit two different layers. Finally, it must be highlighted that samples PAV005, 6 and 7 exhibit a covering layer in the surface.

Samples PAV005 and 7 exhibit ichnotaxa (Fig. 3) probably produced by phototro-

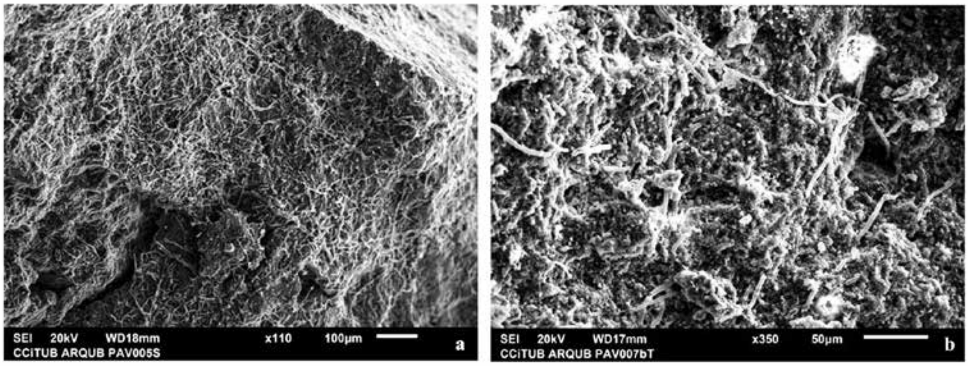

Fig. 3. Trace fossils of ichnotaxa, possibly calcifying cyanobacteria of the PAV005 (a) and PAV00'7 (b) (Photo by J. Buxeda)

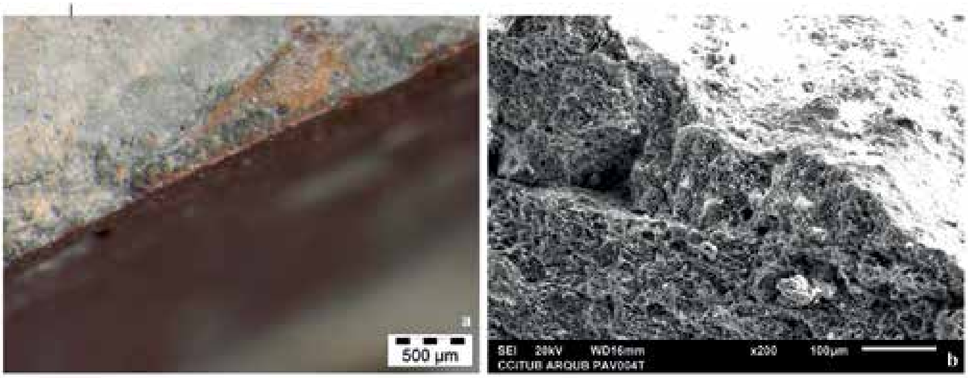

Fig. 4. a) Surface-layer of hematite of the mortar PAV006 (a). Incrustations layer in the surface of PAV004 (b) (Photo by J. Buxeda)

phic microborers, possibly calcifying cyanobacteria. These communities easily develop in mortars, the most bioreceptive construction material, with low light intensities and high relative humidity or with the presence of water. Their activity is one active agent of biodeterioration of mortars producing coloured patches mainly of biofilms, but also favouring the rise of hard crusts and patinas. Moreover, they also contribute to mechanical degradation (Ariño and Saiz-Jiménez 1996; Heindel, Wisshak and Westphal, 2009).

In PAV006 the surface layer is hematite, which provides the red colour, mixed with calcium carbonate (Fig. 4a). Some samples exhibit incrustation layers in the surface (Fig. 4b). In all cases, the examination reveals that these layers are the result of calcium carbonate precipitation.

Conclusions

Before proposing conservation and restoration treatments, it is compulsory to perform a multidisciplinary study to assess the nature and the state of conservation of artefacts of interest, such as the *opus signinum* presented in this article. Working in that direction, we will be able to shed light on the techniques employed to made mortars, the main component of those pavements, and to observe whether a similar receipt for their preparation exists in different places of the Roman world. The preliminary results here exposed are part of a study like that. Regarding the composition of the mortars, we could identify a single layer or double layer preparation of lime binder mortars, mixed with a diversity of different size fragments of ceramics, together with other stone aggregates. About the state of conservation and the future restoration purposes, we have identified the composition of a concretion layer (PAV002, 3, 4, 5 and 6), the trace fossils of ichnotaxa, possibly related to cyanobacteria (PAV005 and 7), and the identification of calcium carbonate (PAV005 and 6) and hematite (PAV006) superficial layers.

The continuation of analytical studies like the presented in this article will help to deepen our knowledge on the manufacture and deterioration processes of those pavements. A database of mortars concerning both aspects can be useful as a comparative basis in new studies. Finally, it must be highlighted that the success of such an investigation is only possible through the collaboration of different specialists allowing to design interdisciplinary research.

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X-ray diffraction analysis and SEM-EDX observations have been made at the Centres Científics i Tecnològics de la Universitat de Barcelona (CCiTUB)

References

Ariño X., Saiz-Jiménez C. 1996. "Factors affecting the colonization and distribution of cyanobacteria, algae and lichens in ancient mortars". In *Proceedings of the 8th International Congress on Deterioration and Conservation of Stone, Berlin 30 Sept. – 4 Oct. 1996* edited by Josef Riederer, Vol. 2, 725-731. Berlin: Rathgen-Forschungslabor.

Heindel K., Wisshak M., Westphal H. 2009. "Microbioerosion in Tahitian reefs: a record of environmental change during the last deglacial sea-level rise (IODP 310)". *Lethaia* 42: 322-340.

Vassal V. 2006. *Les pavements d'opus signinum: technique, décor, fonction architecturale*. Oxford: BAR International Series 1472.

Vassal V. 2015. "Techniques et décors des bassins en mortier de tuileau". In *Atti del XII Colloquio AIEMA, Venezia 11-15 Settembre 2012,* edited by Giordana Trovabene e Alessandro Bertoni, 451-457. Verona: Scripta edizioni.

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MOSAIKON-ARLES TRAINING: A NEW EXPERIENCE IN CONSERVATION AND RESTORATION OF MOSAICS IN MUSEUMS

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Abstract

MOSAIKON-Arles was a course within the larger MOSAIKON program, a collaborative initiative supported by the Getty Foundation, ICCROM, and the International Committee for the Conservation of Mosaics. Twelve professionals from museums and sites in Algeria, Egypt, and Lebanon attended several sessions in 2016-2017 at the Conservation and Restoration Workshop of the Arles Departmental Museum, France. The course aim was to develop the autonomy of the trainees in implementing the different phases of conservation and restoration treatments. The report describes the case of treating three mosaic panels belonging to the collections of the Louvre Museum. For each trainee, the interventions represented an experience of true professional interchange.

Keywords: MOSAIKON, training restorers, mosaics collection, historic restoration

Introduction

MOSAIKON is a collaborative, regional initiative dedicated to improving the conservation, restoration and management of mosaics in the Mediterranean basin. The aim of the MOSAIKON-Arles course was to respond to the growing demand for training in these matters. It was supported by two institutions: the Conservation and Restoration Workshop of the Arles Departmental Museum (MDAA), of the Bouches-du-Rhône Departmental Council, and the Interregional Centre for the Conservation and Restoration of the Heritage of Marseille (CICRP). The theoretical-practical education was provided in Arles, between October 2016 and April 2017, in three sessions of six to seven weeks each. Further practical training was completed on archaeological sites: at Byblos, Lebanon, in November 2016, and at Tipaza, Algeria, in April 2017.

The inclusion of multiple training sessions over this considerable period signified a substantial commitment on the part of each trainee, however the acquisition of the necessary practical knowledge can only be accomplished over the long term. The major contributors to MOSAIKON, as well as the home institutions, recognise the need for the trainee restorers to develop a knowledge basis for autonomous operation. The course was therefore designed to place the participants in practical situations, where they would gain experience in identifying, elaborating and solving real problems. The training supported them in developing confidence in their practical interventions, the assurance that they can present and explain the needs and urgencies for a particular intervention, and provided the practical knowledge of how these can be implemented.

Fig. 1. Awareness of scientific issues (photo MOSAIKON-MDAA)

The courses dealing with certain scientific aspects were provided by the CICRP team (Fig. 1). The trainees were otherwise led and supported by the team of conservator-restorers from the Arles Departmental Museum, who also supervised all other tutorials. Complementary viewpoints were provided through participation from external archaeologists, historians, scientists, restorers and other specialists, on topics such as the history of mosaics, history of conservation, and ancient and modern materials. In particular, the course covered the properties and alteration of the original materials, and the properties of those used in restoration, both historically and today. The theoretical-practical training covered conservation diagnosis, preventive conservation, and implementation of restoration practices on ancient pavements.

For the 17th ICCM Conference held in Barcelona, the MOSAIKON-Arles participants chose to design and prepare a poster on the various interventions they had conducted for the conservation-restoration of mosaic panels held by the Louvre Museum, with a history of previous restorations dating to the early 19th century. The current article reprises the content of the poster. The restoration interventions were carried out in close cooperation with the Department of Greek, Etruscan, and Roman Antiquities of the Louvre. Mrs Cécile Giroire, the curator of the Department, supported and assisted the entire training event. We all wish to thank her warmly for the trust and confidence she has given us, and for the time devoted to shared exchanges with the team and trainees, contributing to a truly professional context in the practice of mosaics conservation, for all the participants.

We also wish to again thank the Getty Foundation, which, through this fine example of working together, continues to promote the "sharing" in the conservation of the Mediterranean heritage.

Restoration of three mosaic panels from the Louvre Museum

The three panels subject to intervention are part of the *Mosaic of Bacchus and the Seasons*: a pavement of exceptional interest in terms of the evidence it offers on the history of conservation practices. The pavement was discovered in December 1825 near the remains of Roman baths known as the *Palais du Miroir*, in the city of St Romain-en-Gal and Ste Colombe, on the west bank of the Rhone River, opposite what is now the city of Viennes. It was bought by the Comte de Saint-Priest soon after discovery, but remained *in situ*, covered by "3 feet of earth", until 1838. Probably in 1825, the year of its discovery, the archaeologist François Artaud prepared a coloured drawing of the full pavement (Artaud 1935, pp. 118-119, pl. LVII). Between 16 June and 25 July of 1838, it was lifted from its original location under the supervision of the

Fig. 3. Final state with line drawn on the mortar, suggesting the pattern (photo MOSAIKON-MDAA)

architect L. Hippolyte Le Bas, assisted by the Italian artist Clemente Ciuli (*Journal de Vienne*, 7/7/1838; Lancha 1981, p. 207; Lemaître 2008, pp. 102-104). Ciuli subsequently restored the panels, following their transfer to Paris by boat. In 1903, E.J. Savigné provided a first description of the pavement in *Histoire de Sainte-Colombe* (Savigné 1903, p. 187). More recently, the mosaic was studied by François Baratte (Baratte 1978, n. 3, pp. 21-24), and by Janine Lancha (Lancha 1981, n. 367, pp. 204-208).

The mosaic is now held in the Louvre Museum reserves, in the form of 11 fragments (Ma 4128, date of entry unknown [1838-1839?]). The aim of the intervention was to ensure the conservation of three of these fragments, but also to understand and document the 19th century practice of lifting and restoring mosaics, using stone, wax, plaster, and a wooden box (Fig. 2).

The work began with a complete diagnosis of the state of each fragment: identification and description, condition assessment, materials analysis, research of archival and archaeological data, laboratory analysis and microscope observations, including accurate documentation of the panels in 1:1 drawings and photography (Fig. 3). Photographic documentation continued throughout the steps of the intervention.

During the intervention, the fragments were removed from their historic packaging and restored on a new honeycomb support. The surfaces of the mosaics were first subject to a cleaning, for purposes of achieving good adhesion of cotton fabrics

Fig. 2. 1:1 scale drawing before any intervention (photo MOSAIKON-MDAA)

Fig. 4. Discussion on proposals of restitution (photo by MOSAIKON-MDAA)

during the facing stage. The beeswax on the surface of the limestone and marble tesserae was removed using a hot air gun and absorbent paper. The residual wax was removed using solvent compresses (paper pulp with cyclohexane).

Two cotton gauzes were adhered to the face of the mosaic using a vinyl acetate adhesive. After checking the facing, and preparing the space and material needed for disassembly, the next operation was to pass metal blades and planks of wood under each *opus tessellatum* fragment, adjust a plywood panel on the surface, and then flip the piece. At this stage, from the reverse of the fragments, we could observe and document how the 19th century procedures had involved the use of small slabs of slate placed on the hot wax, to reinforce the fragments during the lifting from the site. Indeed, the wax had passed between the tesserae in many zones, marking the reverse of the panels. Residues of old newspapers were also found, which were kept for archiving. At this stage, the reverses of the panels (tesserae and preserved ancient mortar) were consolidated with acrylic resin (Primal® 33).

After discussion and decision on the dimensions of the new support, the fragments were adhered with an epoxy resin on the honeycomb panels. In keeping with guidance from the Louvre Museum curator regarding the eventual presentation of the pieces, two adjoining fragments were assembled on one support and the third one on a second support, each with aluminium components for wall mounting. The honeycomb panels were prepared using two layers of synthetic mortar (based on polyvinyl acetate, Mowilith®) and a rigid layer of two-component resin filled with micro-glass beads (Fillite®).

At this stage the mounted fragments could again be turned right side up and the facings removed with a mixture of solvents (acetone and ethanol 1:1). A final detailed cleaning was made using Mora gel, to visually unify all the fragments and obtain better readability of the geometric pattern. Some detached tesserae were fixed in their places using a synthetic mortar. The areas surrounding the fragments were filled with lime mortar applied on a bed of expanded clay pellets, with consideration of the predominant colour harmony.

Finally, in agreement with the curator, a single line of decoration was drawn on the panel joining the two fragments, suggesting a better reading of the mosaic pattern (Fig. 4).

All the interventions were recorded and are detailed in a final report.

Conclusion

During the six months of training, MOSAIKON-Arles contributed greatly to strengthening the exchanges between the trainees and their management teams. The participants established links and contacts, becoming part of a professional network.

The sessions in Arles were complemented by the workshops at archaeological sites in Lebanon and Algeria, during which trainees and professionals from Arles continued their cooperation.

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References

Anonymous, "Note sur un pavé antique de mosaïque découvert à Sainte-Colombe et sur les opérations employées à son extraction et à son transport à Paris, où il est destiné à orner l'une des salles du Musée des antiques du Louvre". *Journal de Vienne et de l'Isère, Organe des intérêts manufacturiers, commerciaux et agricoles du Département*, N°27, Samedi soir 7 Juillet 1838 (abbreviated version in: S. Henry Berthoud, *Le Musée des familles*, lecture du soir, 1939, p. 30).

Artaud Fr. 1835. *Histoire abrégée de la peinture en mosaïque, suivie de la description des mosaïques de Lyon et du midi de la France,* Lyon.

Baratte Fr. 1978. *Catalogue des mosaïques romaines et paléochrétiennes du Musée du Louvre*. Paris: Editions de la Réunion des Musées nationaux.

Lancha J., 1981. *Recueil général des mosaïques de la Gaule. III. Narbonnaise 2*. Paris: Editions du CNRS (X[e] Suppl. à Gallia).

Lemaître C. 2008. *La conservation des mosaïques, Découverte et sauvegarde d'un patrimoine (France 1800-1914)*. Rennes: Presses universitaires de Rennes.

Savigné E.-J. 1903. *Histoire de Sainte-Colombe-lès-Vienne*. Vienne.

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THE ROLE OF THE MOSAICIST IN THE CREATION OF THE WORKS, AND THE CONSEQUENCES FOR THEIR CONSERVATION

Antonio Cassio

Abstract

Experience shows that the identities of the individual mosaicists of the historic era can be associated with certain choices of materials and techniques. Knowing the author of a mosaic can thus provide direct and precious information about its manufacture, and guidance in planning restoration and conservation. The paper associates some mosaicists of the last century with the contexts, materials and techniques of their works, and reports cases of restorations where this kind of information has been useful in planning and implementation.

Keywords: Vatican mosaicists, restoration, mosaics of the Basilica of Saint Peter, history of mosaics, Antonio Cassio.

The mosaic tradition in renaissance Rome

Modern Roman mosaic tradition begins with the thousands of square metres of mosaics created in the Basilica of Saint Peter (Fig. 1), roughly between the years 1500 and 1800. This work nurtured entire generations of *mosaicisti*, who pursued the evolution of techniques and materials in mosaics and eventually created an entirely new and exclusive artistic style.

One of the innovative new techniques was the use of *stucco ad olio* (oil-based stucco) as the base and filler for the mosaic tiles, initially applied by Girolamo Munziano, one of the first mosaicists who worked on the Cappella Gregoriana, in 1580.

Another innovator was Alessio Mattioli, who in 1730 introduced the production of an incredible variety of new enamel colours. Instead of the former availability of only 150 colours imported directly from Venice, there were now 15,000, including warmer hues making it possible to replicate those used in paintings. These enamels were produced in glass-blowing furnaces at the Vatican itself and in the areas surrounding Rome.

In the early 19th century, when the Vatican mosaicists reached the utmost level of artistic creation, canvas paintings from the Basilica altar were removed to be substituted by incredibly realistic copies, now in mosaic. The desired levels of realism could be reached precisely because of the materials used in enamel production, as well as the use of coloured waxes.

Over the course of the three centuries outlined, other new artists entered the limelight, adding further innovation to the ancient Roman mosaic tradition. Among the outstanding innovators were Marcello Provenzali, who advanced artistic techniques in the early 1600s, and Giacomo Raffaelli, active in the late 1700s-early 1800s. Some of Provenzali's masterpieces can still be admired in the Borghese Gallery in Rome. Raffaelli was the first mosaicist to use the so-called "spun-glass mosaic" (*mosaico filato*), producing extremely

Fig. 1. "Studio del Mosaico" in the Vatican, the History (source: Archive of the Fabrica di San Pietro, edited by A. Cassio)

small enamel tiles for use in "micro-mosaics". Raffaelli was exceptionally prolific, and is still considered the greatest artist in this type of production.

The role of the "*mosaicista*" in the creation of the modern masterpiece

The mastery of these great artists was continued by craftsmen at the highest level throughout the 20th century, some of whom I have met, and from whom I have had the honour of receiving important instruction. In some cases these craftsmen executed the mosaics on behalf of contemporary painters, but in these cases they were no longer allowed to continue the practice of showing their signatures – their "*FECIT*", on the products of their work.

As one artist remarked "You mosaicists are only the midwives of this birth". However, just as in the previous two millennia, these craftsmen have continued to create true masterpieces and to constantly evolve the techniques and materials of the art. Indeed the task of the mosaicist has never been to simply copy an image in "pixel-like" miniscule pieces. They have always been active in the artwork through the choice of materials and colours, sometimes even creating new ones. The mosaicist decides where to locate highlights, depth, and all the small details, even in the case of transposing paintings of a very large scale.

Fig. 2. Mosaic in the crypt of the church of Saint Emidio, in Ascoli Piceno, Italy (photo A. Cassio)

Therefore, the mosaicist is not merely an "executor" of the art of another. This active part in the creation of the masterpiece was for a long time rightly acknowledged, and it is only now that it is the opposite.
A case in point is the mosaic in the crypt of the Saint Emidio Church, in Ascoli Piceno, Italy. This artwork was made in 1954 by the Studio del Mosaico Vaticano, based on an original drawing by Professor Pietro Gaudenzi (Fig. 2).
I remember clearly all the mosaicists who participated in the execution of this extraordinarily beautiful masterpiece: the directing mosaicist, Virgilio Cassio, who personally created the more complex figures on the right side of the *absis*, as well as Fabrizio Parsi and Silvio Secchi, engaged in the rest of the work. The techniques and the materials used descended from a centuries-old tradition, and as such they should be documented and passed on to the following generations of artists who both create and restore mosaics.
The anonymity of mosaic artists has prevailed even for famous masterpieces, sometimes resulting in incorrect attributions. This is the case for the Strawberry Fields mosaic in the John Lennon Memorial of New York's Central Park (Fig. 3). This mosaic, made in 1985 by Antonio and Fabrizio Cassio, of the third generation of a mosaicists family, was for a time wrongly attributed to Neapolitan craftsmen.

Fig. 3. Strawberry Fields, John Lennon Memorial, New York City (photo F. Guiducci)

The importance of known the "*mosaicista*" in restoration

Recording the mosaicist's name is not only appropriate in terms of recognition, but also as a crucial indication at the time when restoration must be undertaken. The creation of every mosaic is unique, dependant on the techniques and styles of the individual artist and the entire artisanal workshop. Knowing who made the mosaic can help the restoration team to carry out their work effectively and correctly job.

During the night of 10 August 1992, a large piece of mosaic fell from the ceiling of the Chapel of the Blessed Sacrament of St. Peter's Basilica, due to water infiltrations. The restoration was undertaken by a team from Studio del Mosaico Vaticano, who based their work largely on personal experience and the use of traditional materials. The same miniature enamel tiles and oil-based stucco as in the original work, but especially the same skilful craftsmanship, were used to re-create a faithful copy of what had been lost (Fig. 4). The perfect imitation in both

Fig. 4. Re-creating the missing piece of mosaic on a temporary clay base (photo: Archive of the Fabrica di San Pietro)

the use of materials and style was carried out following traditional ways.

Conclusions

The choice from the exceptionally wide variety of mosaic techniques and of materials depends on the person who physically created the artwork. Every mosaicist has had their personal set of preferences in technique and use of materials, and the innovations and practices of the individual mosaicists have shaped the entire tradition. Knowing the name of the executor of a mosaic is therefore much more than a simply a piece of art-historical information. Instead it can be a useful source of indications for the identification and understanding of the original techniques and materials. This knowledge can then creatively and correctly inspire the choices of the mosaicists in their restoration work.

AUTHOR

Antonio Cassio
Born in Rome into a family of mosaicists, for 65 years he has dedicated his life to realising mosaic masterpieces worldwide, and to restoring thousands of square metres of works. In 1967 he was appointed Technician of Mosaic Restoration following a national competition by Opificio delle Pietre Dure of Florence. He was head of the technical laboratory for Ostia Antica excavations from 1968 to 1977, and at the Istituto Centrale del Restauro from 1977 to 1996. At the Ravenna Conference (1982) he communicated a new technique for restoration and conservation of mosaic based on detachment in small pieces and re-assemblage on composite Aerolam panels. At the 11th Conference of the ICCM in Meknes, in October 2011, he was awarded an Honourary Medal in recognition of his professional career.

TABLE-TOPS MADE OF ANCIENT MOSAICS: AN ALTERNATIVE FORM OF CONSERVATION IN THE 18TH-20TH CENTURIES

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Abstract

Italian restorers developed many techniques of conserving ancient mosaics during the 18th century, as numerous mosaics were recovered from excavations. One of the most interesting case is the use of mosaics as table-tops: a fashionable idea that has survived the centuries.

Keywords: Mosaics, conservation, Italy, 18th century, table-tops.

Historical introduction

The 18th century can be considered the golden age of discovery and conservation of ancient mosaics, due in large part to the great number of archaeological excavations in archaeological sites and ancient Roman urban centres. The discovery of many complete, richly polychromatic mosaics promoted knowledge among scholars, and interest in such works of art among collectors. Such pavements were rarely reburied and more often completely detached, for fashionable use on walls in a manner similar to paintings, or as pavements of modern rooms, or sometimes as table-tops.

One of the crucial moments for the conservation of ancient mosaic in the 18th century was the great rediscovery of Villa Adriana in Tivoli. Private explorations of the site had begun in the 17th century (De Franceschini 1991). In 1736, Cardinal Alessandro Furietti from Bergamo purchased permission for excavations from the Bulgarini family, owners of the area (Bulgarini 1848: 115). He concentrated on the area of the so-called Accademia, where among a vast number of polychrome mosaics he discovered the stunning *Emblema of the Doves* in 1737. Given the abundant results of his excavations, Furietti then had to deal with the conservation issues of many pavements. On 21 November 1739 he writes, translated from the original (Slavazzi 2004):

> From antique mosaics, which served as pavements, I discovered the manner of making Small Tables … This invention of mine, which none of our Antiquarians had thought of, has stimulated the appetite of all to search for coloured Mosaics, after they had sent many to ruin. At least I will have done this for the benefit of the public, who , after finding new mosaics, will bring them out with diligence.

Furietti explained this new use in his masterpiece *De Musivis*, published in Rome in 1752, considered the most important work on ancient mosaics of the entire 18th century (Furietti 1752: 53-54). In this volume he inserted a complete illustrative plate (Furietti 1752: table IV) of table-tops

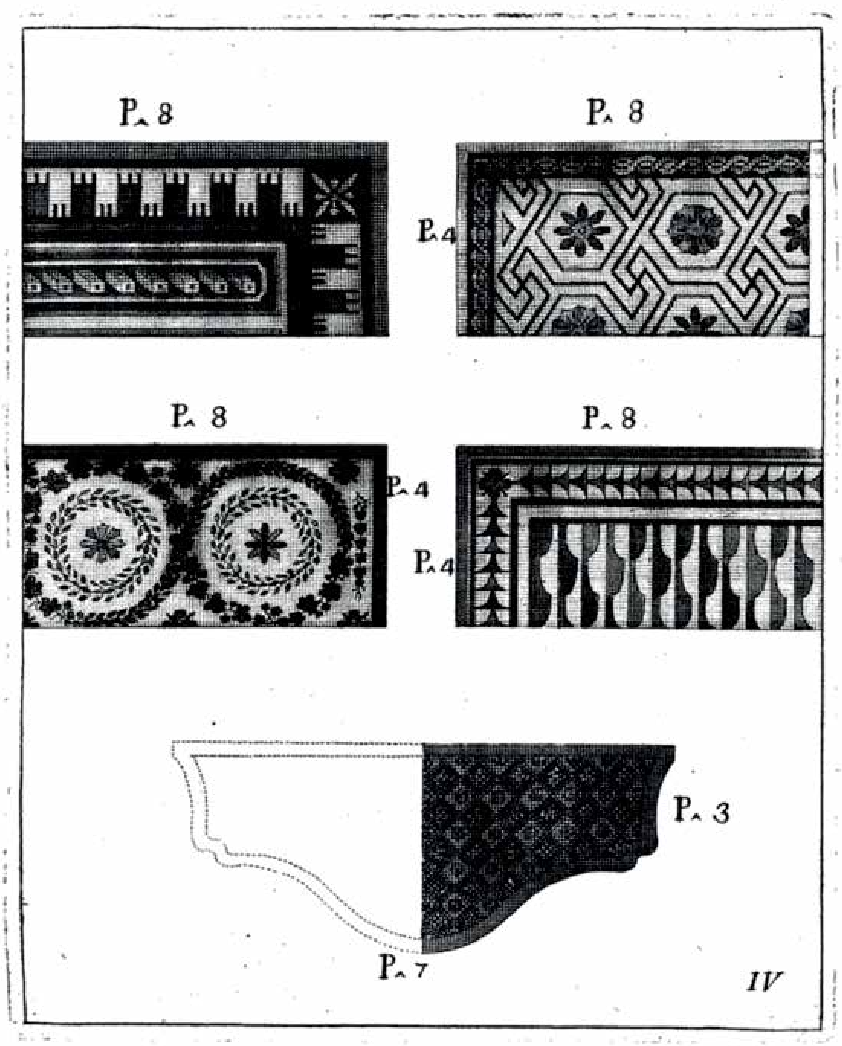

Fig. 1. Table from Furietti's book *De Musivis*, depicting tabletops made of ancient mosaics (Furietti 1752)

made with the mosaics excavated at Villa Adriana, and then donated to many different people (Fig. 1). Two of the best known examples of these works are the large tables gifted by Furietti to Pope Benedict XIV, in which the tops are composed of a central, geometric polychrome mosaic with a frame of black and white tesserae, taken from the pavements of the so-called Accademia (Fig. 2). Also well known are the table-tops composed of a mosaic segments inserted in a pink alabaster slabs, now in the Staatliche Kunstsammlungen in Dresden. For this last one, intended as a gift to Cardinal Ales-

Fig. 2. One of the two big tables made with ancient mosaics from Villa Adriana for Pope Benedict XIV, now held in the Capitoline Museum of Rome (photo by C. Cecalupo)

sandro Albani, Furietti chose part of the mosaic frame of the *Emblema of the Doves*, creating a magnificent table. This was part of a group of rich tables (De Franceschini 1991: 342-344; Slavazzi 2004: 227-234), which Cardinal Albani then gifted to the Elector of Saxony.

Techniques of execution

In this manner Furietti created a new taste. Antique dealers and antiquarians became interested in polychrome frames and repetitive patterns to be used as table-tops. The diffusion of this fashion was also enabled by the simplicity and adaptability of the execution techniques. The table-tops could be composed of different pieces from one or more ancient mosaics, but also by selecting a single fragment to insert into larger slab of thicker marble or other stone, prepared in on purpose. Once all the decorative parts were composed, the top was cleaned and polished with lead and wax. Although these fragments of ancient mosaics lost virtually all connection with the original architecture, they did at least enter in the collections of wealthy individuals, rather than disappear completely.

The popularity of Furietti's invention continued through the 19th century, when the practice was also extended to the use of larger pieces of ancient marble in preparing table-tops, and the dimensions of the tables tended to become smaller. In this way, even less wealthy collectors could have tables made of ancient materials, or use these fashionable objects as gifts and furnishings.

Examples and diffusion

A prominent example, not limited to mosaic, is the small round table gifted to Pope Gregory XVI by the Bishop of Algeri, now held in the Vatican Museums. This table-top is made of marble *crustae* from the early Christian basilica in the city of *Hippo Regius*, in Algeria. The polychrome, geometric decoration is surrounded by a circular porphyritic frame and dedication in bronze letters on white marble:

> Frammenti di marmi dell'antica basilica d'Ippona mandate in dono dal Vescovo di Algeri alla Santità di Nostro Signore Gregorio XVI P.M. l'anno M DCCCXLIII.

Indeed, many mosaics from North African archaeological sites were used for table tops during the second half of the 19th century. This occurrence likely arose both from the great number of European explorations in this region and, in the Italian case, due to the strong protective laws for the archaeological heritage of the peninsula enacted between 1820 and 1939 (Emiliani 1978; Cecalupo 2016), which forced antique dealers and antiquarians to focus on materials from non-Italian areas and sites. Small tables with their surfaces

Fig. 3. Table-top made of a mosaic from Carthage, owned by Captain d'Albertis in the early 20th century (photo by C. Cecalupo)

made from ancient North African mosaics would have been seen as "exotic" objects, in connection with the tastes of the 19th and also the 20th centuries. An example in this sense is the small round table held in the Castello d'Albertis Museum of World Cultures in Genoa (Fig. 3). In this case the table-top, made from an ancient mosaic of a polychrome flower from ancient Carthage, was brought to Italy by Captain Enrico d'Albertis at the beginning of the 20th century. The mosaic has lost its architectural relevance, but gained new meanings of historic association and style, which are different from those of the magnificent and massive tables for wealth patrons in the 18th century.

The conservation technique of remounting ancient mosaics as table-tops has indeed had a long history, through changes in fashion and social context, due to its versatility and adaptability to different tastes and situations.

REFERENCES

Bulgarini F. 1848. *Notizie storiche, antiquarie, statistiche ed agronomiche intorno all'antichissima città di Tivoli e suo territorio*. Roma: Arnaldo Forni Editore.

Cecalupo C. 2016. "Il mosaico antico negli editti papali di tutela tra XVIII e XIX secolo". In *Atti del XXI Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico*, a cura di Claudia Angelelli, Daniela Massara, Francesca Sposito, 651-655. Tivoli: ScriptaManent.

De Franceschini M. 1991. *Villa Adriana: mosaici, pavimenti, edifici*. Roma: "L'Erma" di Bretschneider.

Emiliani A. 1978. *Leggi, bandi e provvedimenti per la tutela dei beni artistici e culturali negli antichi stati italiani, 1571-1860*. Bologna: Alfa.

Furietti A. 1752. *De musivis.* Roma: Salvioni.

Slavazzi F. 2004. "I mosaici di Monsignor Furietti. Nuove notizie sul Mosaico delle Colombe di Villa Adriana". In *Atti del X Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico*, a cura di Claudia Angelelli, 227-234. Tivoli: ScriptaManent.

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CONSERVATION OF THE 'PROCESSION OF DIONYSOS' MOSAIC FROM STARA ZAGORA, BULGARIA

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Abstract
In 2009, rescue excavation in the modern city of Stara Zagora brought to light a mosaic, subsequently identified as the flooring of the reception room of a wealthy private dwelling of the 4th century AD. Excavations continued for a total of three field seasons. In 2011 the mosaic was detached by an initial team and the sections were placed in the collections stores of the Stara Zagora Regional Museum. In 2014 the museum obtained funding from the American Research Center in Sofia and commissioned the Rest Art Association to "continue" the conservation process, preparing it for display within the museum. The conservation-restoration was made more difficult by a lack of full records of the original detachment, and by damages occurring at that time. This is the first time that a mosaic of such dimensions and importance has been successfully prepared for exhibition in a Bulgarian museum.
Keywords: Roman floor mosaic, Augusta Traiana, transfer on honeycomb, museum display, Rest Art Association

Discovery and detachment of the mosaic
The modern city of Stara Zagora, Bulgaria, was the site of the Roman city of Ulpia Augusta Traiana. In 2009, a mosaic dating to the first half of the 4th century AD was discovered during rescue excavation in an area corresponding to the northern part of the ancient city. Entitled the 'Procession of Dionysos' after the theme of the *emblemata*, the mosaic was excavated over the course of three field seasons, under the direction of the archaeologists Maria Kamisheva and Dimiter Yankov. The mosaic once served as the flooring of the reception room of a wealthy private dwelling; it encloses an octagonal in plan pool of running water (*piscina*), lined with white marble (Fig. 1). The northern part of the room and more than half of the mosaic were uncovered (Kamisheva 2010; Илиев 2011; Янков 2012; Kamisheva *et al.* 2015). In October 2011, an initial conservation team had detached the mosaic in sections, and these had been placed in the museum collections storage.

Continuing the conservation process, three years later
In 2014, the Stara Zagira Regional Museum of History commissioned the Rest Art Association to "continue" the conservation of the mosaic, preparing it for horizontal display on the floor of an area within the museum. The project received important financial support from the American Research Center in Sofia (ARCS).

All 38 sections, representing a total area of some 30 m^2, were transported to the association's studio in Sofia. At that point the team was confronted with complex con-

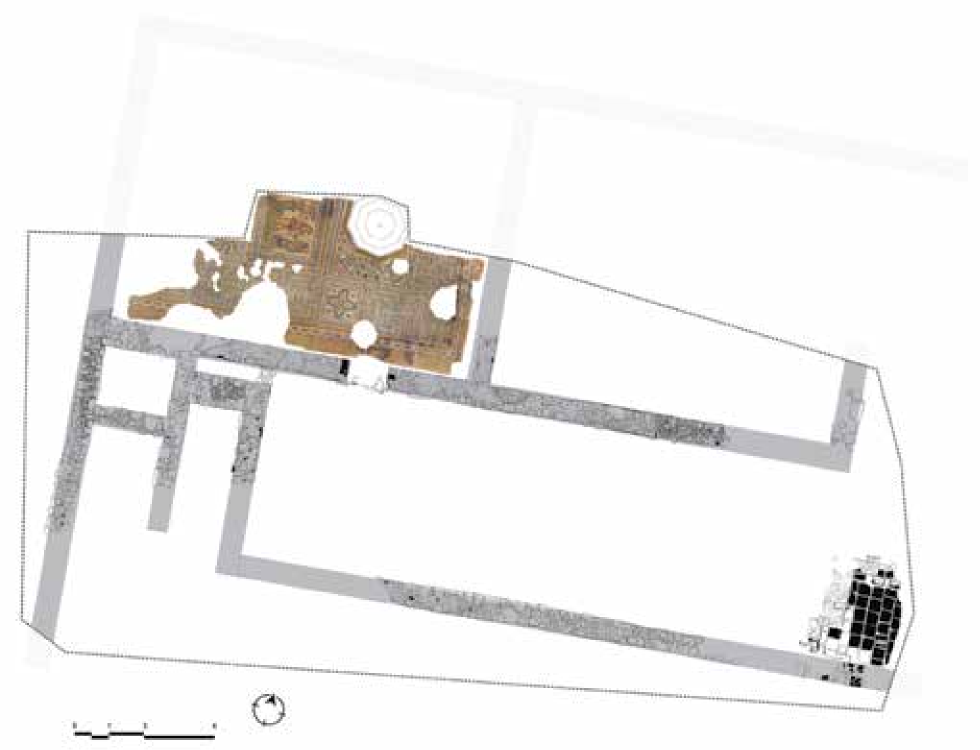

Fig. 1. Plan of the wealthy private dwelling (early 4th century AD) with the mosaic (source: Kamisheva *et al.* 2015: fig. 3)

servation problems, owing to highly deteriorated condition of the mosaic sections and the lack of comprehensive records concerning the detachment.

The detachment process had led to serious damage, due in part to the exceptionally solid structure and binding of the mosaic layers. The problems observed included detachment of the facing from the mosaic surface, detachment of tesserae, and fragmentation of tesserae along the borders of the lifted sections. Another serious problem was the loss of surface cohesion of those tesserae made of weaker types of stone.

Given the hardness and weight of the 8 to 10 cm original mortar, it was decided to thin by mechanical means. This would obtain more manageable sections while still achieving maximum preservation of the original *nucleus* and tesserae bedding layer.

After the original mortar was thinned, it was observed that there were considerable deformations in the plane of the mosaic surface. The deformations were mainly in areas where the facing had detached during the lifting process. These cavities were partially filled with fragments of crushed mortar and could not easily be returned to the plane of the surrounding surfaces. This problem was overcome to a considerable degree by carefully cleaning out the cavities, after which the adhesion could be established between the protective layer and the detached tesserae.

Fig. 2. Stage of removing the facing (photo I. Vanev)

The mosaic fragments were transferred on aluminium honeycomb sandwich panels, using a foaming epoxy system for adhesion. To avoid direct contact between the resin and the back of the tesserae in the sections lacking *nucleus*, new mortar was laid, consisting of lime, sand, ground pottery and hydraulic lime.

The transfer of the sections onto new supports allowed complete reconstruction of their placement, including those for which the museum archives no longer had any traces of numbering. At this stage it was possible to gradually removal the facing by activation of the adhesive (Fig. 2), and so assess the condition of the mosaic surface. Heavy incrustations were found across most of the sections. There had also been severe alterations in the colour and structure of the tesserae

Fig. 3. Fragment no. 23 after treatment (photo I. Vanev)

Fig. 4. Scheme of the mosaic (photo I. Vanev)

in areas subject to fire. After full removal of the adhesive residues, the team began consolidation of the tesserae with loss of surface cohesion. Particular attention was paid to the glass tesserae used in the *emblemata* of the mosaic. Sadly, these had not been consolidated prior to detachment, and most of them were in deplorable condition.

To restore the original colours of the mosaic, the surface was cleaned in several stages. Initially, the surfaces were treated for removal of extraneous substances by the application of distilled water poultices, followed by mechanical thinning and removal (Fig. 3).
It was decided that the conservation-restoration would not include reconstructions of the areas of loss, so as to maintain an authentic view of the mosaic in the manner of its discovery during the archaeological excavations. Small areas of reconstruction were executed along the edges of the segments where many tesserae had been destroyed during the detachment process.

Conclusion

The 'Procession of Dionysos' is now on display at the Stara Zagora Regional Museum of History (Fig. 4), marking the first time a mosaic of this dimension has been hosted in such a public institution. The project has been achieved thanks to the efforts of the museum, the Rest Art cooperative association, and the financial support of the American Research Center in Sofia.

References

Kamisheva M., Vanev I., Stanev S. 2015. *Procession of Dionysos, A Masterpiece of the Ancient Mosaic Art.* Stara Zagora: Regional Museum of History.

Kamisheva M. 2010. "Археологически проучвания в археологически резерват „Августа Траяна – Верея – Стара Загора" УПИ VI-3419, кв. 656 (ул. „Иречек" No. 38)". In Археологически открития и разкопки през 2009 г. София: НАИМ, 400-402.

Илиев Г. 2011. "Археологически проучвания в резервата „Августа Траяна – Верея – Стара Загора", УПИ VI-3419, кв. 65б (ул. „Иречек" No. 38)." In Археологически открития и разкопки през 2010 г. София: НАИМ, 354-356.

Янков Д. 2012. "Антична подова мозайка на ул. „Иречек" No. 38, УПИ VI 3419, кв. 65Б, гр. Стара Загора. In Археологически открития и разкопки през 2011 г. София: НАИМ, 343-345.

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THE CASES OF THREE SHELTERS FOR PROTECTION AND PRESENTATION OF MOSAICS AT CONSTANTINE'S VILLA IN MEDIANA, SERBIA

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Abstract

The emperor Constantine the Great built a villa near the Roman city of Naissus in the 4th century AD, at what is now the archaeological site of Mediana, Serbia. The concept of the emperor's dynastic power is conveyed through the architectural detailing, frescos and mosaics. The mosaics of the peristyle, reception room, two smaller banquets rooms, a corridor leading to the baths and some surfaces within the baths total about 1,000 m². Most of these mosaics were conserved *in situ* in the periods 1972-1977 and 2014-2016, and are now sheltered under two permanent and one temporary shelter. Experience demonstrates the need to involve all stakeholders in planning such shelters, in a multidisciplinary manner.

Keywords: Mediana, Constantine the Great, villa with peristyle, mosaics, shelters

The archaeological site with imperial villa and mosaics

The archaeological site Mediana is situated near the modern city of Niš (ancient Naissus) in southern Serbia. The territory of the site includes the residential complex built by the emperor Constantine at the beginning of 4th century and occupied until at least the mid-5th century. The central part the site comprises the large villa with peristyle and bath, separated from the rest of the settlement by an enclosing wall with gate. The villa with peristyle is a spacious building with elongated, axial layout, oriented north-west and totalling around 6,000 m² in area (Vasić *et al.* 2016: 11, 13).

The concept of the emperor's dynastic power is conveyed through the architectural detailing, frescos and mosaics. The mosaics of the peristyle, reception room, two smaller banquets rooms, a corridor leading to the baths and some surfaces within the baths total about 1,000 m². These are executed mostly in *opus tessellatum* using tesserae of stone, ceramic and glass. The most costly execution and complex motifs were reserved for decorating the reception hall and banquet rooms. The mosaics are preserved and presented to the public *in situ,* and were the subject of conservation interventions over the periods 1972-1977 and 2014-2016 (Crnoglavac 2017: 129-135).

The shelters over the villa

1. The 1930s museum building sheltering a small banquet room A

Shelter surface: 190 m²

Mosaics surface: 45 m²

During archaeological excavations carried out by the National Museum of Niš in 1935, a small banquet room A with

Fig. 1. View of the 1930s museum building sheltering mosaics of a small banquet room A, after excavations in 2013 (photo Z. Cajic, 2018)

preserved mosaic floor was discovered. Being aware of importance of this discovery, the Museum made great efforts to find funds for the building of protective structure, which could at the same time be used for displaying artefacts from the site. The project was supported by numerous donations from the citizens of Niš, and thus the first permanent shelter, the "Museum at Mediana", was opened to visitors in 1936. The designer was Vladimir Hodanovic a respected engineer of the period. The one-storey structure presents load-bearing exterior walls fronted on the southern side by a portico with four columns and *tympanon*, suggesting the façade of an ancient temple and emphasising the entrance. The interior was divided in three rooms by non-bearing walls.

In 2013 the Institute for Cultural Heritage Preservation of Niš carried out works on the museum building, with the intention of executing repairs and renovating the structure. The original cement floor, a railing that had surrounded the mosaic pavement, and the partition walls were removed, thereby enabling archaeological excavations within the structure. However these excavations have resulted in a situation in which the extensive changes to the building interior prevent visitor access for presentation, and in addition left an unprotected opening to the ancient sub-floor heating system. The continuing works for reinforcement of the foundation prevented all access to the building (Fig. 1). As of 2017, the National Museum of Niš had selected the winner of a design competi-

Fig. 2. Winner of the design competition for renovation of small banquet room A shelter (image by M. Komlenic, I. Raskovic, B. Petrovic, N. Jelic)

tion for further renovation of this historic structure sheltering the mosaics of a small banquet room A, and the implementation of works was expected for 2018 (Fig. 2).

2. Shelter over villa with peristyle

Shelter surface: 10,000 m^2
Mosaics surface: 952 m^2
In approximately 2004 the Institute for Cultural Heritage Preservation of Niš designed a new shelter with the intention of covering the entire villa with peristyle. The project was budgeted at 1.1 million euros, with funding to be provided by the Serbian Ministry of Culture. The design proposed was that of a laminated wood arch-shaped frame topped by PVC membrane, with the frame is secured to the ground by means of 60 enormous blocks. Construction began in 2013, however the intended site had not been completely excavated, and as digging for the foundations proceeded this revealed the presence of further remains of the villa walls. For this reason the decision was made to abandon the plans for the part of the shelter to cover the thermal baths in the north-western part of the site. In addition, the design was found to include two wooden arches that would have passed directly through the roof of the 1930s museum building (Fig. 3). The project was suspended in 2015 without having provided shelter for the entrance zone and baths of the villa. In addition, the membrane over a newer residential hall in the northern part of the villa not installed.

3. Shelter over small banquet room B

Shelter surface: 120 m^2
Mosaics surface: 45 m^2
Immediately after positioning of elements of the large new shelter described above,

Fig. 3. Dismantling the roof of the 1930s banquet room A shelter due to errors in positioning the arch-shaped frame of new shelter (photo N. Gavrilovic, 2015)

it became clear that this did not provide proper protection for the small banquet room B. A temporary structure was built using a steel frame with plastic sheets on the sides and corrugated roofing.

Conclusion

The archaeological site Mediana is legally protected and considered as having the highest cultural value for the Republic of Serbia. It would have been expected that the shelter project over the most important building at the site should be the result of multidisciplinary effort, however this was not the case. The resulting structure is therefore afflicted by design faults, and has remained unfinished, with impossibility of visitor access since 2013. As of the date of this presentation, two years had passed since the biggest part of the shelter was installed, and several issues have been observed concerning protection and presentation. In particular, it is evident that the mosaic pavements in the northwest corner of the villa are partially outside the shelter. The shelter is also open

Fig. 4. General view of Mediana shelters (photo Z. Cajic, 2018)

on the north side, allowing entry of wind, rain and snow (Fig. 4). Observation has also shown that water vapour condenses on the metal components and drips directly onto the mosaics. Furthermore, the designer of the shelter did not provide for site drainage system, electrical systems or visitor pathways.

Much remains to be done for the completion of the shelter. It is hoped that all stakeholders will be involved in the upcoming decision-making processes, for correction of the observed errors and avoidance of new ones when the project is scheduled for resumption in 2018.

References

Crnoglavac V. 2017. “History of the Conservation of the Mosaics at the Archaeological Site of Mediana”. In *The Conservation and Preservation of Mosaics: At What Cost? Proceedings of the 12th ICCM Conference, Sardinia, October 27-31, 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed and Roberto Nardi, 129-135. Los Angeles CA: Getty Conservation Institute.

Vasić M., Milošević G., Gavrilović Vitas N. and Crnoglavac V. ed. 2016. *Constantine's villa at Mediana*. Niš: The National Museum Niš.

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RESTORING THE *TRENCADÍS* MOSAICS OF THE INNER SIDE OF THE PARK GÜELL BENCH, BARCELONA

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Abstract

The great bench designed by Josep Maria Jujol is one of the key features of the Plaça de la Natura, within Park Güell, developed between 1907 and 1913. Both sides are largely decorated with *trencadís,* the inner side in ceramic, the back side in glass. In 2011 the bench was subject to the first major intervention for conservation-restoration of the ceramic elements. The second of a continuing program of checks and interventions took place in 2016. The initial phases of the program included analyses of the causes of the degradation, the evolution of the materials used in previous maintenance, and the aging of the materials proposed for new conservation-restoration works.

Keywords: Park Güell, Barcelona heritage, Modernist mosaics, *trencadís*

Origins of the Park Güell bench

In 1899 Eusebi Güell bought the lands composing the current Park Güell, and entrusted the architect Antoni Gaudí with developing them as a residential complex. The inspiration was that of the English "garden city", as an alternative to mass industrial-urban development. As well as a planned 60 building lots, the intention was to develop a central "Plaça de la Natura", as a social meeting point, with a view of the city. The plaza was in fact developed between 1907 and 1913, with a unique bench designed by architect Josep Maria Jujol. The bench is 102 meters long, composed in the form of 23 small bays, fulfilling its role in the service of social meeting. Both sides are covered with *trencadís* mosaic: ceramic fragments and some specifically designed porcelain elements on the inner surfaces, and glass fragments on the outer faces (Fig. 1).

In 1914 Güell halted the overall project, at that point with the completed reception and guard houses at the entrance, as well as the monumental staircase and park footpaths leading to the colonnades and bench, but with only two of the houses built. In 1922 the Municipality of Barcelona bought the lands for use as a public park. The park is now one of the city's most emblematic features, a highlight of Modernism, and was placed on the UNESCO World Heritage List in 1984.

"Maintenance", without considering originality

Park Güell has always been well used, however in recent decades there has been an explosion of visitation, due in part to international recognition of the figure of Gaudí. This use, and the constant outdoor exposure, has led to the deterioration of the ceramic *trencadís* of the inner surfaces, which were in any case largely prepared from used materials. The most common damages are

Fig. 1. Detail of park Güell bench, 2016 (photo A. Cusó)

the loss of glazing, but also the consumption of the underlying body.

From the beginning, the eroded ceramic pieces were substituted by others, which could be very different in materials, colour, design, or even in the form of the cut piece. Clearly there was a will to maintain the mosaics, but not a conception of preserving the true original.

In 1990 the municipality provided for a very important restoration intervention concerning the entire park, which would include the bench.

From maintenance to conservation-restoration

The task of conserving and restoring the original aspect of the bench was begun in 2011 (Fig. 2). A second intervention was carried out in 2016, and conservation-restoration actions will continue in the future.

The program involves two main aspects:

– Substitution of the deteriorated pieces and anachronistic replacements from previous interventions, using pieces prepared from period ceramics, or where none are available, from copies;
– Restoration of original and unique pieces that have lost part of their glazing.

Procedure:

– Removal of accumulated soil, earthy deposits and calcareous crusts from the grouts and surface glazing, exposed ceramic body, and the cut edges of the *trencadís*;
– Removal of non-original grouting mortars covering the glazed elements, typi-

Fig. 2. The ECRA SL team, 2011 (photo J. Mateu)

cally form thick joints that hide part of the polychrome ceramics;
- Removal of biodeterioration materials formed between the glazing and body of the *trencadís* (Fig. 3);
- Injection of acrylic resin into areas of blistered glaze;
- Volumetric reintegration of the lacunae using hydraulic lime mortar and aggregates with small grain size and colour similar to that of the ceramic body;
- Chromatic reintegration.

CHROMATIC REINTEGRATION - LABORATORY ANALYSES

We observed that through time, those who maintained the park bench had resorted to different types of paints, and that some of these materials and colours had been altered, in particular by UV radiation. On the basis of the analyses described here, we decided to use silicates for the chromatic reintegrations in the current restoration project.

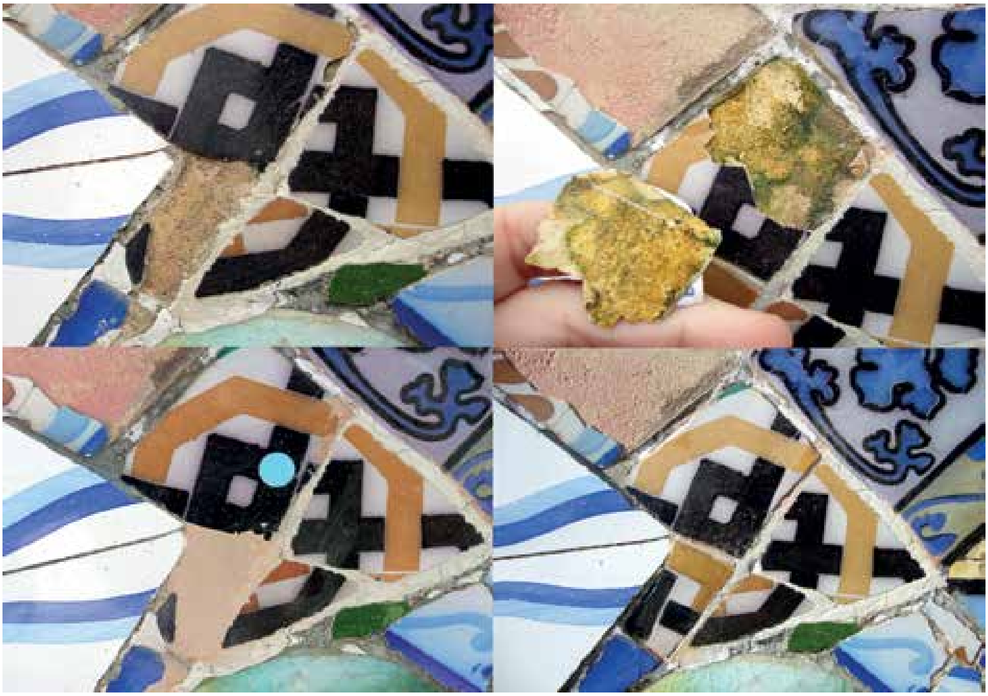

Fig. 3. Separation of glazing, cleaning, consolidation and final results, 2016 (photo A. Cusó)

Fig. 4. Samples and laboratory analyses, 2016 (photos M. Alcobé)

The analyses were designed to examine the resistance and stability of acrylic and silicate based colours, for purposes of designing the chromatic reintegration of ceramic materials during the 2011 and 2016 interventions. The test samples were exposed to the main environmental degradation factors under accelerated aging conditions, for determination of changes in their behaviour and resistance over determined periods of time. The test samples were exposed separately to the following conditions, corresponding to the main chromatic degradation factors: direct sunlight (1800 hours); gradual temperature changes over 24 hour cycles; UV radiation (UVB10%, UVA90%; 1200 hours); fluctuations of relative induced in a closed environment by nebulisation.

The diagnostic techniques were as follows:

– digital microscopy, for surface analysis (Digital microscope AM413M-FVT. UV);
– scanning electron microscopy, for micro-topographic imaging of the mortars used to level the surfaces (base material, before application of chromatic integration);
– chromatic analysis before and after the aging processes (Colorimeter RN 110, Nh3 Quantotech. Colorimetric space CIELAB);
– stove drying for analysis of the times necessary, and the effects of thermal variation on the glassy effects of the varnish (Heraeus Function Line S.7000 drying oven) (Fig. 4).

Results

In general, the accelerated aging procedures resulted in darkening of the acrylic colours in white, yellow and red, with changes the ΔE* category. The parameters Δa* Δb* tend to green, while green, blue and black colours tend to get lighter, with a slight tendency to yellow. Blue and black colours lose ΔE*, substantially getting lighter.

Some of the silicate based colours also varied in ΔE* but without changing category, and the visual effects were minimal, since the chromatic layer of these paints is diffused throughout the pigment-binder relation, obtaining a more matte and dense visual effect.

As concerns drying, the UV protection acrylic paints had an outdoors curing time of hours, during which they trap airborne particles that break the polymer chains of coverage. With time, the paints accumulate soil and become yellowish. In the case of the silicate protections, we observed that some of these can crystallise on the surface, creating a effects of whitish glaze or "micro-scales" in the paint finish.

Towards the future

The context of the park Güell bench has determined a number of degradation factors, active ever since the work was executed:

– wear from continuous usage, accelerated by recent growth in mass tourism;
– physical, chemical and biological degradation processes activated by the outdoor environment;
– acts of intentional vandalism.

The factor of vandalism is difficult to control, and the effects of the others have been discussed above. In recent years the municipality has implemented protective measures for the Park Güell heritage assets, such as implementing opening hours, controlling the numbers of visitors, and actively identifying and preventing risks. However, given the inescapable causes of degradation, no restoration intervention for the bench can ever be definitive. The action which we most strongly advise, and which is already being implemented, is a program of continuous monitoring and regular conservation-restoration interventions, preventing the onset and evolution of any new damages.

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THE MOSAIC OF THE *LOTTATORI* AT OSTIA ANTICA: A WORK WITH A HISTORY OF RESTORATION

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Abstract

In 2015-2016, a conservation-restoration intervention was carried out on a 2nd century AD floor mosaic known as the *"Lottatori"*, located in the Archaeological Park of Ostia Antica, which had been modified in antiquity and subject to at least three subsequent restoration interventions. The conservation of the mosaic was compromised due to degradation characteristic of outdoor artefacts. In this case the factors of deterioration had caused decohesion and losses of the preparatory layers, the detachment of almost all the *tesserae*, and the alteration of previous restorations. The current intervention involved surface cleaning and biocide treatment, in depth consolidation, retracing the location and readhesion of many erratic tesserae, as well as the lifting and relaying of several large areas, in some cases with treatment of the reinforcing steel from previous interventions.

Keywords: Floor mosaic, archaeological, *lottatori*, repositioning

Description, previous interventions, conservation status

In 2015-2016, conservation work was carried out on a 2nd century AD floor mosaic in white and black tesserae, known as the *Lottatori*, situated in the Archaeological Park of Ostia Antica.

The mosaic depicts four pairs of athletes engaged in the sports of boxing and the "total contest" fight of Greek origin known as the *pankration*, as can be understood from the details of their clothing and equipment. The figures are executed in black tesserae, with white tesserae highlighting the anatomical details, against a white background delimited by a series of alternating black and white bands.

Based on previous research it is considered that the first interventions on the mosaic were conducted as early as the 4th century AD. On the south side of the mosaic, the positions that would have been occupied by three figures have been replaced by infills of cement, prepared using coarse grit. The date of this work is unknown. In the 1970s the figures of the athletes were removed and replaced using four reinforced concrete panels. Further interventions were conducted in 2003 for the preventive conservation of the mosaic.

The state of conservation of the mosaic was critical, with heavy accumulations of soil, the presence of different microorganisms, and the roots of higher plants reaching through the mosaic surface to the level of the *rudus*. The mortars of the preparatory layers had generally lost their cohesion. The mechanical action of the biological patina and chemical/mechanical action of water and wind, accompanied by high summer temperatures, had resulted in the disintegration of these layers. These

Fig. 1. The mosaic of the *Lottatori* at Ostia Antica, prior to the most recent intervention (photo A. Borzomati)

deteriorations had led to the general advanced loss of adhesion of the mosaic over the *rudus.* Almost all the tesserae were detached (Fig. 1). The deterioration of the original mortars had also contributed to the expansion of the *tessellatum* interstices. The surface showed many areas of concave and convex deformation. The convexities were due to the areas of complete disintegration of the preparatory layers, leading to the subsidence of the mosaic surface. The convex deformations were concentrated along the margins of the concrete panels installed in the 1970s, and resulted from the reinstallation of tesserae conducted during the 2003 interventions. The greatest area of deformation was at the north side of the mosaic, above boxer on the right.

Restoration intervention

The restoration intervention was conducted out between September 2015 and April 2016.

The deposits of loose surface material were removed, with particular care in the areas of detached tesserae. A biocidal treatment was performed in several phases, using solutions of quaternary ammonium salts [1] and a herbicide [2]. The patinas were removed by mechanical operations, and the surfaces were then cleaned using a highly diluted surfactant [3].

In situ consolidations were carried out using injections of a hydraulic mortar [4], with interventions of filling [5] support for small areas of tesserae. However, the advanced degradation and complete loss of planarity also led to the choice to perform detach-

Fig. 2. Conservation-restoration intervention: mosaic detachment and replacement operations, direct method (photo A. Borzomati)

Fig. 3. Intervention of restoration: mosaic detachment and replacement operations, indirect method (photo by A. Borzomati)

ments over large areas. In these cases the areas of *tessellatum* were covered with acrylic adhesive in solution [6] and detached with the help of metal lances and wooden support boards, also used for overturning the pieces. The backs of the detached portions were then documented and cleaned using various mechanical techniques. The mortar in most of the affected areas was completely disintegrated and could be readily removed. The removal of partially adherent deposits was carried out with water, sponges and brushes. In some areas, inorganic salts have been used. The *tessellatum* was then consolidated with a microacrylic resin [7].

Where the mosaic had been lifted, a new preparatory layer was made using a specific hydraulic lime with added sand and pozzolana [8]. Subsequent to this, a further with suitable plasticity was applied, for the repositioning of the detached parts [9].

The detached tesserae were repositioned using two operating modes:

– direct method, placing the tesserae one by one on a mortar (Fig. 2).
– indirect method, adhering the face of the tesserae to a transparent sheet, which was then used to transfer the assembled portion into position within the lacuna (Fig. 3).

In some cases the operations for cutting and lifting the mosaic revealed the presence of steel reinforcing rods below. Where possible, these were removed. Otherwise they were treated with an oxidation inhibitor [10] and then waterproofed using an acrylic resin in solution, for purposes of slowing their future degradation.

Fig. 4. The mosaic of the *Lottatori* following the conservation-restoration intervention (photo A. Borzomati)

After the repositioning of the detached areas of mosaic, organic solvents [11] were used to remove the facing. The next step was to carry out interstitial plastering over the entire *tessellatum*, as a protective measure and for proper reading. Two different colours of plaster were prepared, for the white and black areas of tessellatum, using mixtures of coloured inerts in hydraulic lime [12]. The few lacunae in the *tessellatum* were filled with an imitation of the *nucleus* mortar, to below the level of the *tessellatum* surface [13].
The final step in the intervention was to apply a protective film [14] over the entire mosaic and conduct a final biocide treatment (Fig. 4).

Notes

1. 2,5% Preventol RI80 in deionised water
2. 2% glyphosate in deionised water
3. Desogen surfactant/fungicidal product
4. Ledan TA1
5. Mortar of fine red *pozzolana* and Moretta hydraulic lime 3:1
6. Cotton canvas and 20% Paraloid B72
7. Microacril CV40 1:10 in deionised water
8. Preparatory layer (*massetto)*: 2 pp yellow sand 0/3 screen; 3 pp red pozzolana 0/3 screen, 1 pp coarse *cocciopesto*, 1 pp Ledan Adranal, 2 pp Rabot NHL5 lime
9. Mortar: 2 pp red pozzolana 0/6 screen, 1 pp Ledan Adranal
10. Fertan anti-rust product
11. Blend of organic solvents (alcohol, ketones, hydrocarbons)
12. *Boiacca* mortar for white tesserae: 4 pp fine grey sand, 0.5 pp fine *cocciopesto*, 0,5 pp fine hazelnut-coloured tuff grit, 1.5 pp Ledan Adranal; *Boiacca* mortar for black tesserae: 3.5 pp fine grey sand, 0.5 pp fine black sand,

0.5 pp fine *cocciopesto*, 0.5 pp fine hazelnut tuff grit, 1.5 pp Ledan Adranal

13. Mortar in imitation of the *nucleus*: 7 pp unsifted grey sand, 1.5 pp *cocciopesto* 0/10 screen, 2.5 pp Ledan Adranal, 0.5 pp Moretta lime
14. 12%Rhodorsil RC80 in white spirits

AUTHORS

Claudia Fiorani received a degree in conservation-restoration from the Istituto Superiore Conservazione e Restauro (ISCR) in 2004, with a specialisation in mural paintings, mosaics, wooden sculpture, and paintings on canvas and wood. In 2008 she founded an independent conservation-restoration company. She has worked both at Italian sites and on international missions and projects on behalf of the Ministry of Cultural Heritage and Activities and the ISCR, including at the Domus Aurea, Santa Maria in Ara Coeli, the Basilica of San Clemente (all in Rome), the Archaeological Park of Ostia Antica, and the Villa di Silin in Libya.

Anna Borzomati received her degree in conservation-restoration from the ISCR in 2006, with a specialisation in conservation of mural painting, mosaics, wooden sculpture, and paintings on canvas and wood. She has worked on many projects for different units of the Italian Ministry for Cultural Properties and Activities, including at the Domus Aurea, the Villa of Livia, the Baths of Caracalla (all in Rome), Ostia Antica, Pompeii, and the Sacred Mount of Varallo (Vercelli, Italy).

INNOVATION IN GEOPOLYMERIC COMPOSITES FOR RESTORATION OF A FRAGMENT OF ROMAN MOSAIC IN OUTDOOR DISPLAY

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Abstract
After decades of display in an outdoor context, a detached Roman mosaic fragment (1st century BC-2nd century AD) had suffered severe deterioration. Following an initial intervention for stabilisation and cleaning, conservator-restorers, archaeologists and archaeological scientists collaborated in the development of an aesthetic restoration that could withstand the return to an outdoor environment. The original cement backing of the 1920s was retained. Geopolymer composites were tested for suitability, for purposes of completing a supporting frame and filling the lacunae in the mosaic backing. Variations of the geopolymers were also developed for creation of "artificial" tesserae for filling the lacunae in the *tessellatum*. Two different composites were used in the casting of the geopolymeric support, which protects the fragment from weathering and creates an aesthetically uniform surround. One of the composites was coloured by adding black and white pigments for creation of the substitute tesserae. Two years after return to the historic location of display, the geopolymers have resulted stable and unchanged, without adverse effects on the original materials.
Keywords: mosaic, geopolymers, restoration, outdoor display

Introduction
In the last years of the 19th century the Italian museologist Luigi Adriano Milani recovered a fragment of mosaic from an ancient Roman floor, during excavations in Piazza San Giovanni in Florence. The fragment, dating between the 1st century BC and the 2nd century AD, was backed on concrete in the 1920s and then placed on display in the open-air court known as the "Cortile dei Fiorentini", also designated as room XXI, of the National Archaeological Museum of Florence.
The Cortile dei Fiorentini is itself a historic monument, long a feature of the museum but then heavily damaged and closed subsequent to the great flood of 1966. The architectural space and the contents of the courtyard, representing some of the greatest monuments of ancient *Florentia,* have been restored and reopened to the public on the occasion for the 150th anniversary of "Firenze Capitale".
The mosaic fragment object of this study required restoration interventions due its severe state of degradation. The artwork was observed to consist of four main fragments. There were numerous lacunae in both the mortar and *tessellatum*, black incrustations, and extensive adhered and non-adhered deposits of dust and biological growth. The first step of the intervention was conducted to stabilise and conserve the mosaic fragments. At a later date it was possible to carry out a second "aesthetic" restoration thanks to the sourcing of specific geopolymers. This restoration intervention has pro-

vided a more accessible and correct reading of the ancient mosaic fabric for the benefit of non-experts, given that artwork will be returned to public exhibition.
Given the fragility of the degraded mosaic, the removal of the concrete support would have entailed further risks to single tesserae and the *tessellatum* fabric. For this reason all preventive and restoration interventions provided for both the antique materials and the modern concrete support.

Working plan

The preventive conservation intervention consisted of initial mechanical and chemical cleaning (Fig. 1), then readhesion of smaller portions of the overall fragment, and finally the integration of some lacunae by means of reapplying detached tesserae in their initial positions. Once the consolidation of the piece had been achieved, consideration was given to the means for achieving a legible reconstruction of the ancient *tessellatum*. The objective was to fill the remaining lacunae using a stable product, resistant to the exposed display in the Cortile dei Fiorentini: a product available with colour characteristics similar to the original materials, but distinguishable, and which could be cut to resemble the original tesserae. The search for this material required interdisciplinary collaboration between the conservator-restorers and specialists in the archaeological sciences, or archaeometry, who suggested the use of geopolymers. Geopolymers are inorganic polymers deriving from mixing a silico-aluminate powder with an high alkaline solution (Davidovits 2008). The extremely caustic environment triggers the geopolymerisation reaction and then stabilises the geopolymeric structure. The reaction and hardening occur at room temperature, and the geopolymeric binder is characterised by amorphous and/or nanocrystalline structure. To this binder, which like other traditional binders various quantities of aggregates, fibres, netting, pigments and others can be added, to obtain composite materials satisfying different needs. The geopolymers can be made in any restoration laboratory, with these various potential additions, and in

Fig. 1. Roman mosaic fragments: state of the art (photo S. Rindi)

	Binder	6D	6E	Black	White
CS (MPa)	51.4 ± 10.0	25.7 ± 5.0	31.4 ± 7.0	46.9 ± 4.0	65.2 ± 9.0
FS (MPa)	7.6 ± 4.0	5.5 ± 0.5	7.7 ± 0.3	5.6 ± 1.0	8.7 ± 1.0
BD (g/cm^3)	1.5 – 1.6	1.1 – 1.2	1.1 – 1.2	1.5 – 1.6	1.5 – 1.6
WA (%)	8.6	21.00	27.2	24.4	17.7

Table 1. Mechanical characterisation of the geopolymeric mixtures

this manner can be customised in terms of plasticity, mechanical performance and appearance, making them highly useful for certain kinds of restoration work.

Our restoration project involved the development of a geopolymer which could serve different functions. The first would be the creation of a containment panel, providing a more regular geometric shape that would make the reassembled fragment easier to read, but which if necessary would be completely removable from the historic cement backing. Second would be the production of black and white tesserae serving for integration of the lacunae.

Experimental procedure

Geopolymer formulation

Various potential geopolymers were evaluated for chemical, physical and mechanical stability by means of analysis for release of soluble salts and resistance to freeze-thaw cycles, observations at scanning electron microscopy, x-ray micro-tomography, and UV-fluorescence imaging.

On this basis a geopolymer consisting of 47.5% binder and 52.5% filler was designed. This was prepared in two variations (called GEO 6D and 6E), which could be cast in two levels to create a framing panel with the appropriate balance of strength and lightness. The difference is in the composition of the filler, which in GEO 6E is fine sand and perlite, and in GEO 6D also includes calcium carbonate powder. A final variation, for production of the black and white tesserae, involved the addition of 10% by weight of vine black and *bianco di San Giovanni* pigments, respectively, to the binder.

Table 1 presents the mechanical characterisation of the geopolymeric mixtures, representing a lightweight product with good structural properties. In this table, the water absoprtion (WA) results are also reported. The differences WA values are related to the micro-porosity and shape of the calcite grains in GEO 6E, and the presence of the natural coal-derived pigment in the black geopolymer.

Scale up of the containment panel

Before scaling up, some prototypes of the framing panel were produced for further verification of stability and resistance under freeze-thaw cycles (Fig. 2).

The geopolymer framing panel was then poured within a rectangular laminate formwork, carefully dimensioned to achieve a frame that would contain the mosaic fragment and reduce the visual disruption of the irregular edges. The GEO 6D was cast first, then a stainless steel electro-welded mesh was inserted to reinforce the panel. After this, the mosa-

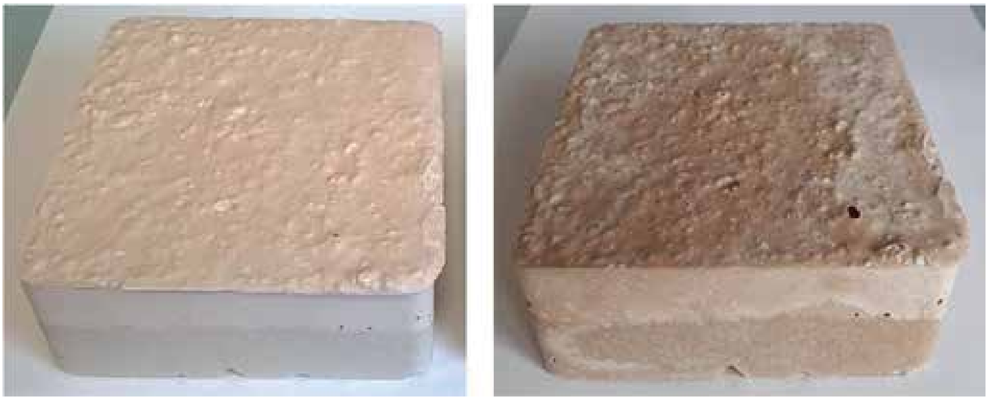

Fig. 2. Geopolymeric prototype after 800-cycle freeze-thaw test UNI EN 539-2:2013800 (photo E. Soragni)

Fig. 3. Operational sequence for casting (photo E. Soragni)

Fig. 4. Integration of lacunae with geopolymeric tesserae; final result (photo E. Soragni)

ic fragment with its cement backing was inserted in a manner avoiding contact between the tesserae and the geopolymer. Immediately afterwards the GEO 6E was cast (Fig. 3). The use of two levels of different material achieves structural strength without excessive weight, and permits more controlled removal in the case of future disassembly. After curing for 60 days the panel was removed from the form.

The next step was to apply the new coloured tesserae (Fig. 4). The geopolymeric material was easy to cut in the required shapes and the shade of white was slightly lighter than the original marble, so the filled lacunae restore the form of the original Roman *tessellatum* but remain visibly distinguishable.

Conclusions

The final result is a mosaic where the original is readily distinguished from the integration, but it is exactly this difference that transforms a fragmentary mosaic of difficult comprehension into clearly legible piece, useful in the intended musealised context.

The geopolymeric compounds selected based on experimental results have proven compatible with the concrete support. During the two years since the intervention and return to display in the outdoor courtyard, there is no evidence of any changes in the materials used for the integrations to the antique tesserae.

References

Davidovits J. 2008. *Geopolymer: Chemistry and Applications*. Saint Quentin, France: Institut Géopolymère.

Authors

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SAVING THE MOSAIC OF LALA, BEKAA VALLEY, LEBANON

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Abstract

In 1999 a remarkable mosaic was accidentally discovered in the Lebanese village of Lala (Bekaa valley), extraordinary for the entire region, characterised by beautiful ornaments and inscriptions related to a Byzantine basilica. The general area is mountainous, subject to seismic activity, security concerns, and harsh climatic conditions. The mosaic is situated in a small space within a densely constructed village, and pertains to archaeological structures extending under the surrounding buildings. The mosaic was quickly reburied, but without prior recording. A mission to temporarily re-expose the mosaic and acquire documentation was successful, and further confirmed the art-historic interest of the work, as well as the interest of the local population and government in its preservation and development. The most difficult question becomes whether to preserve and present the mosaic in its authentic environment, along with its artistic extensions under the neighbouring buildings, or to uproot it and send it to safe hiding in the warehouse of a museum, as has happened to numerous other mosaics. A planning and fund-raising project is currently under way for the *in situ* preservation.

Keywords: Lala, Bekaa Valley, Lebanon, mosaic, Byzantine, conservation *in situ*

Discovery and reburial of the mosaic

The village of Lala, situated a few kilometres from Jib Jennine, the district centre of western Bekaa, Lebanon, is renowned for its historic Grand Serail (municipal building) and unique archaeological features from the Byzantine period. The larger area is also well-known for its prehistoric archaeological sites dating back to the Late Paleolithic, and the village is also nestled among other key sites, particularly Kamed El-Loz or Kumidi, an ancient royal city of the late Bronze Age, which later became the seat of the Egyptian governor. In 1999, a mosaic was found accidentally during foundation works on a small plot of land (60 m^2) within the village. The mosaic is distinguished by beautiful ornamentation and inscriptions concerning a Byzantine basilica (Fig. 1).

In 2002 the Directorate General of Antiquities of Lebanon expropriated the plot of land and adjacent one of the same size. In 2006 the mosaic was hastily covered,

Fig. 1. Location of the Lala mosaic (photo R. Gergian)

without documentation of the reburial technique, and the land was then used as a municipal car park.

Objectives and methods for reopening the mosaic, response of the local community

In 2014 we chose the “Lala mosaic” as the applied studies subject for participation in the MOSAIKON workshop to be held in Paphos, Greece, in the same year. The first necessary step would be uncover the mosaic, improved the documentation and check its condition after years of burial.

Our team for this task was composed of three archaeologists [1] and two skilled labourers. Most of the equipment and materials had to be ensured in place with the help and assistance of the village municipality. The period selected for the excavation resulted as one of particularly rainy and cold weather. At the same time we had to deal with the welcome interest but also the security risks posed by the local community, residents, and passers-by who gathered and watched with growing interest, eager to find some buried treasures. Others were hoping that this mission would be an opportunity to transform the plot into an archaeological site allowing the mosaic to be exposed for the general public, attracting tourists and enhancing the overall economic situation of the village. Expecting that the exploratory excavations would result in risks due to potential soil instability and site security, we intended to complete the examination and rebury the mosaics in a short time.

The only documentation available prior to excavation consisted of some photographs of the mosaic. An exploratory trench revealed two levels of backfill. An upper layer, around 3 m deep, consisted of demolished building materials (cement, chunks of reinforced concrete, stones, wood, irons), which apparently had been used to arrive at road level and facilitate the creation of the parking lot. The lower level covering the mosaic was around 60 cm thick and consisted mainly of natural soil and stones. Below this layer, in contact with the mosaic, we found fragments of sheet plastic and iron boards, intended as protection.

As we arrived at this level of the mosaic, it was already late in the first day of our project and the temperature had dipped below zero degrees. We protected the mosaic with a layer of sand and large stones to prevent illegal excavations after dark. We also realised the particular problem of muddy water in the bottom of the pit, and the difficulty of rinsing the mosaic for investigation without there being any drainage system. At the same time, an incoming storm was forecast in the coming days. Given the details of this situation, we planned to complete the mission in two phases over the next two days: one each day we would remove around 45 m^3 of backfill, thereby clearing and cleaning about 15 m^2 of mosaic, making it possible to document the mosaic and any related features, and reburying it properly. The absence of an area to deposit the backfill required good synchronisation of the excavation and subsequent reburial.

Findings concerning the site

The first day we accomplished the works as planned. The eastern part of the mosaic was uncovered, surveyed and documented (Fig. 2).

The framing of this part of the mosaic, along with the presence of some original

Fig. 2. Eastern part of the mosaic (photo R. Gergian)

plaster on the remains of a northern wall, allowed us to detect the width of the original room. The central Greek inscription in this area indicated that the mosaic pertained to a Byzantine basilica, dating to 582 AD (Abou Diwan 2009).

On the second day we succeeded in removing the backfill from the western part of the 1999 works, revealing a plastered wall and the continuation of the mosaic, again with a closing frame (Fig. 3).

From this we were able to deduce the length of the room. This day also included the most interesting part of the mission, which was the extension of the investigation in the south-western corner. Here we discovered a new inscription, whose orientation and remaining letters revealed some very interesting information related to the nature of this room. From this evidence, with the assistance of Dr. Frederic Alpi [2], we were able to deduce that the room was most likely a funerary chapel or *oratorium* to conserve a relic. Moreover, the style of the letters showed that this inscription had probably been inserted around the end of 6th to the beginning of the 7th century.

The extension of the investigations also led to the identification of a part of the basilica sanctuary, found in the second of the two plots expropriated by Directorate General of Antiquities. Other features are clearly still buried under the surrounding buildings.

At the close of the different phases of these investigations we carried out the reburial using a part of the original backfill and other material more suited to the task at hand. Unfortunately we determined that we could not use the Lala mosaic as a subject for the MOSAIKON mentored field work exercises, due to the environmental, polit-

Fig. 3. Western part of the mosaic (photo R. Gergian)

ical and security-related issues prevailing in the region of Bekaa.

Conclusions

The mosaic of Lala is a rare historic art-piece that for the moment must remain buried in its original location. In Lebanon and in other nations, mosaics that have been systematically detached from their context and placed in storage are very seldom exhibited for public appreciation and benefit, due to the lack of suitable museum space and funding. Equally, the location of the mosaic at three metres under street level, in a difficult urban context and exposed to harsh weather, with much of the related site extending under the closely surrounding buildings, presents many challenges to its *in situ* preservation and presentation (Fig. 4).

Fig. 4. The extension of the mosaic under the surrounding buildings (photo R. Gergian)

The most difficult question becomes whether to maintain and preserve the mosaic in its own authentic environment, along with the other artistic expressions extending under the neighbouring buildings, or to detach it and potentially box it away, like numerous other mosaics hidden in the warehouses of museums.

Thanks to the ideas, knowledge and new experiences gained in conservation techniques and materials through our continuous participation in the ICCM meetings and MOSAIKON workshops, including in matters of management and fundraising, we are now developing a conservation project to save the mosaic of Lala *in situ* and present it to the public. The realisation of this project will definitely change the relations between the inhabitants and their heritage, firstly with these precise archaeological features, and secondly in the matter of renewing their confidence in the Directorate and its staff, through jointly engaging in such an important project. Moreover, it is expected that some expropriations can be understood as justified, in recognition of the creation of opportunities for the exploitation of the cultural heritage in enhancing the socio-economic situation of the village and the entire region.

Notes

1. In addition to the author, the two participating archaeologists were Assadour Andekian, a volunteer with very limited field experience, and Myriam Ziade, a participant in MOSAIKON 2002 - experience which proved essential in achieving the mission objectives
2. Specialist in epigraphy and Christian history, Researcher with the Centre National de la Recherche Scientifique (France), and Director of the Institute Français du Proche Orient, Beirut.

References

Abou Diwan G. 2009. “L’ère d’autonomie et le calendrier de Sidon: une révision a la lumière d’une nouvelle inscription d’époque byzantine”. *Zeitschrift für Papyrologie und Epigraphik*, 170 (2009): 113- 126. http://www.jstor.org/stable/20756718. Accessed January 22.

Author

Raffi Gergian is a Regional Director of the Directorate General of Antiquities, Lebanon Ministry of Culture, with responsibilities for the Anjar World Heritage Site, management of the archaeological sites of South Bekaa and for excavations in Beirut. He holds a PhD in Religious sciences, an MA in History and Conservation, and a BA in Arts, Archaeology and Architecture. He has specialised in the survey and analyses of ancient monuments. He is an instructor with the Lebanese University and his publications deal with religious architecture and liturgical arts.

CEMENT TILES: ORIGINS AND RECOMMENDATIONS FOR CARE, 1873-1931

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Abstract

Based on more than 15 years of extensive collecting of archival material and research into the origins and use of cement tiles, and the most important manufacturers of the Barcelona area, the author provides the advice on their conservation, as presented in the original commercial publications of 1873 to 1931.

Keywords: Flooring, tile, cement, stencil, pigment

Introduction

The word "mosaics" brings to mind a composition of small pieces of stone, ceramic or glass, of different shapes, sizes and colours, called tesserae, forming figurative or abstract compositions, typically in the classic forms of *opus vermiculatum*, *opus musivum*, *opus sectile* or *opus signinum*. However, beginning n the 19th century, the term also came to be applied to other materials and techniques, such as ceramic stoneware (Nolla tiles), cement tiles, and continuous *terrazzo* flooring. As professionals in the field, it is necessary that we open our minds to include these new forms of "mosaics" in our general conceptions. The current work contributes to this aim by reviewing the recommendations for care of hydraulic cement tiles, as provided by three of the most important manufacturers operating in Spain the late 19th and early 20th centuries.

Development of hydraulic cement tile

Cement tiles, also known as hydraulic cement tile, hydraulic tile, hydraulic mosaic flooring and hydraulic flooring, are tiles made using Portland cement mortar. Unlike ceramic materials, the production process does not involve firing. The materials composing the tiles were moulded and pressed. The term "hydraulic" derives from the property of the cement binder to harden in contact with water, called "hydraulicity", and not, as sometimes reported, from the hydraulic presses used to form the tiles.

The face of each tile can be finished in a single colour or with varied designs. Historically, the colours and designs of tiles were typically installed in a manner that would create the effect of a "carpet".

Hydraulic tiles were first developed in Italy in the mid-19th century. The first commercially important operations were in Viviers, France, also the locality for important production of Portland cement, in particular by the Lafarge company.

In Spain, the most important producers of hydraulic tile were in the Barcelona area, in particular the three manufacturers: M. C. Butsems & Fradera; Orsola, Solá y Cía; Escofet, Fortuny y Cía.

These three producers provided recommendations for the care or "conservation" of the tiles in their regularly published catalogues. The current study presents and summarises these recommendations, as found in publications dating from 1873 to 1931:

– M. C. Butsems & Fradera, 10 catalogues;
– Orsola, Solá y Cía., 8 catalogues;
– Escofet, Fortuny y Cía., 13 catalogues.

Care and conservation: paraphrases from catalogue texts

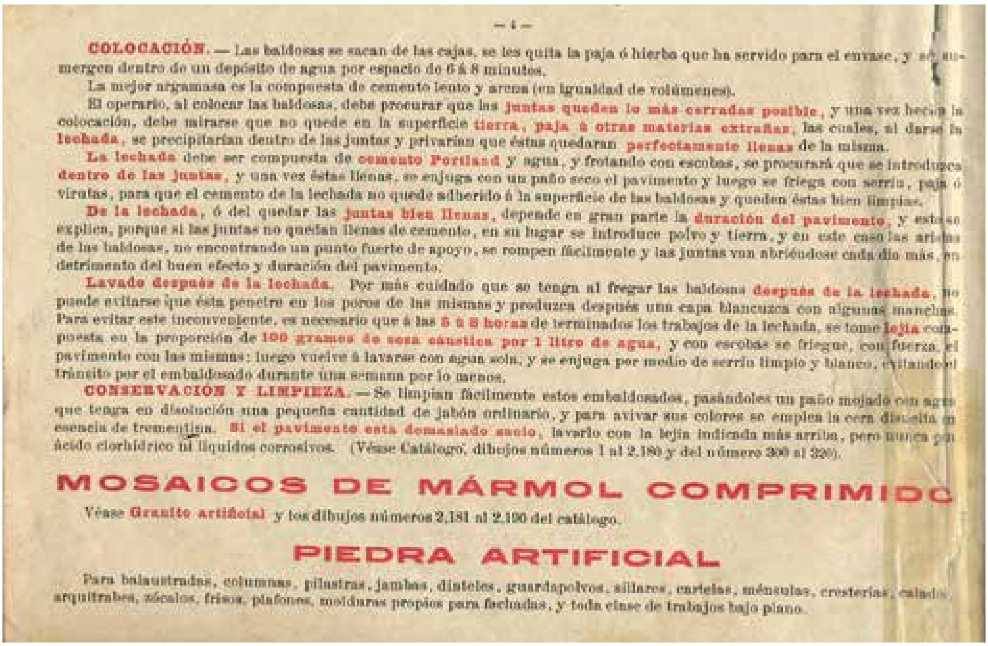
M. C. Butsems & Fradera (Fig. 1):

Undated [1] *(probably before 1896)*: These tiles are easily preserved by wiping them with a cloth dampened with water containing a small amount of ordinary soap in solution. To enliven their colours, use essence of turpentine with a polishing rag.

1897 [2] *"Maintenance and cleaning"*: These tiles are easily cleaned by wiping them with a cloth dampened in water with a small quantity of ordinary soap in solution; to extract their colours, use wax dissolved in essence of turpentine. If the floor is too soiled, wash it with bleach as indicated above.

1930 [3] *"Maintenance"*: During the first days of using the floor, it is advisable to wipe it with a cloth soaked with water and a small amount of ordinary soap, leaving the surface dry.

With these periodic washes and their proper use, our hydraulic mosaics acquire a polished surface that reveals their character of first quality; however if you wish to hasten this result or achieve greater brilliance, you can rub the floor dry with cloths slightly impregnated with oil, or better, with our product "Cement Brill", that we sell prepared in



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COLOCACIÓN. — Las baldosas se sacan de las cajas, se les quita la paja ó hierba que ha servido para el envase, y se sumergen dentro de un depósito de agua por espacio de 6 á 8 minutos.

La mejor argamasa es la compuesta de cemento lento y arena (en igualdad de volúmenes).

El operario, al colocar las baldosas, debe procurar que las **juntas queden lo más cerradas posible**, y una vez hecha la colocación, debe mirarse que no quede en la superficie **tierra, paja ú otras materias extrañas**, las cuales, al darse la **lechada**, se precipitarían dentro de las juntas y privarían que éstas quedaran **perfectamente llenas** de la misma.

La lechada debe ser compuesta de **cemento Portland** y agua, y frotando con escobas, se procurará que se introduzca **dentro de las juntas**, y una vez éstas llenas, se enjuga con un paño seco el pavimento y luego se friega con serrín, paja ó virutas, para que el cemento de la lechada no quede adherido á la superficie de las baldosas y queden éstas bien limpias.

De la lechada, ó del quedar las **juntas bien llenas**, depende en gran parte la **duración del pavimento**, y esto se explica, porque si las juntas no quedan llenas de cemento, en su lugar se introduce polvo y tierra, y en este caso las aristas de las baldosas, no encontrando un punto fuerte de apoyo, se rompen fácilmente y las juntas van abriéndose cada día más, en detrimento del buen efecto y duración del pavimento.

Lavado después de la lechada. Por más cuidado que se tenga al fregar las baldosas **después de la lechada**, no puede evitarse que ésta penetre en los poros de las mismas y produzca después una capa blancuzca con algunas manchas. Para evitar este inconveniente, es necesario que á las **5 ú 8 horas** de terminados los trabajos de la lechada, se tome **lejía** compuesta en la proporción de **100 gramos de sosa cáustica por 1 litro de agua**, y con escobas se friegue, con fuerza, el pavimento con las mismas; luego vuelve á lavarse con agua sola, y se enjuga por medio de serrín limpio y blanco, evitando el tránsito por el embaldosado durante una semana por lo menos.

CONSERVACIÓN Y LIMPIEZA. — Se limpian fácilmente estos embaldosados, pasándoles un paño mojado con agua que tenga en disolución una pequeña cantidad de jabón ordinario, y para avivar sus colores se emplea la cera disuelta en esencia de trementina. **Si el pavimento está demasiado sucio**, lavarlo con la lejía indicada más arriba, pero nunca con ácido clorhídrico ni líquidos corrosivos. (Véase Catálogo, dibujos números 1 al 2.180 y del número 300 al 320).

MOSAICOS DE MÁRMOL COMPRIMIDO

Véase **Granito artificial** y los dibujos números 2.181 al 2.190 del catálogo.

PIEDRA ARTIFICIAL

Para balaustradas, columnas, pilastras, jambas, dinteles, guardapolvos, sillares, cartelas, ménsulas, cresterías, calados, arquitrabes, zócalos, frisos, plafones, molduras propios para fachadas, y toda clase de trabajos bajo plano.

Fig. 1. Catalogue M. C. Butsems & Fradera. Barcelona. No date (probably before 1896) (photo J. Griset)

small pots. If the floor is too soiled, it should be washed with the above-mentioned soda solution or by rubbing with pumice powders mixed with water, but never with hydrochloric acid or corrosive liquids.

Orsola, Solá y Cía. (Fig. 2):

No date [4] *(probably before 1900):* The materials composing our tiles harden in water; therefore they increase their beauty and strength the more often they are washed. To clean them, a solution of soap with clear water is sufficient, or water alone, according to the soiling.

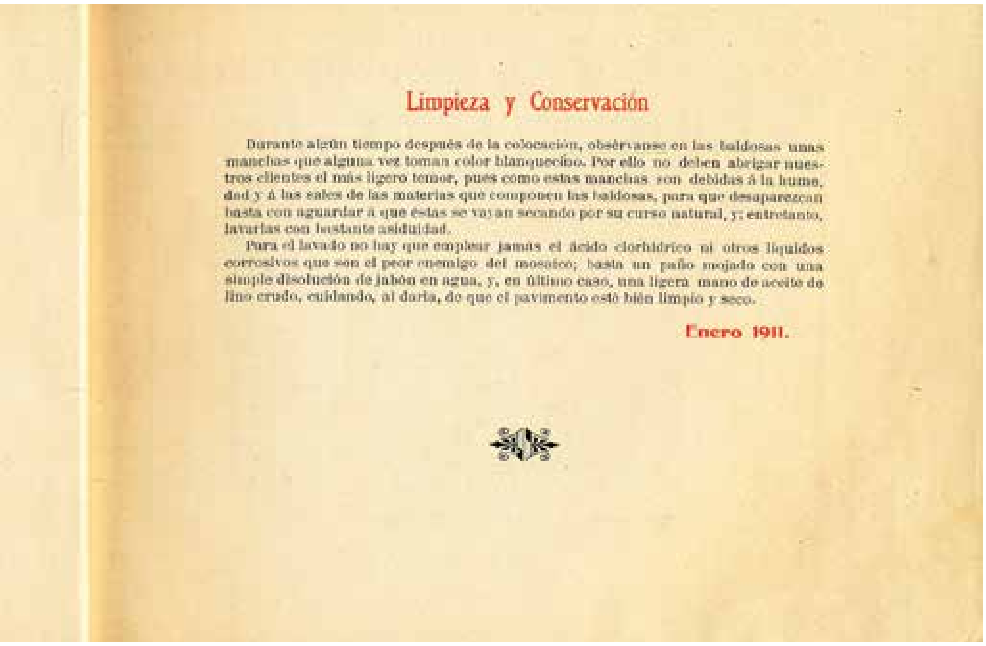
1900, 1911, 1917 [5]: For washing, hydrochloric acid and other corrosive liquids, which are the worst enemies of mosaic, must never be used. A damp cloth with a simple solution of soap in water is sufficient, and in this case a light coat of raw linseed oil, taking care that the pavement is well cleaned and dry before using it.

1909, 1931 [6] "*Cleaning and maintenance*": For washing, hydrochloric acid and other corrosive liquids, which are the worst enemy of the mosaic, must never be used; a damp cloth with a simple solution of soap in water is sufficient, and in this case a light coat of raw linseed oil, taking care when applying this that the pavement is well cleaned and dry.

Escofet Fortuny y Cía. (Fig. 3):

1888 [7]: To keep the floor clean, wash it every eight days with clear water or a water and soap solution, according to the condition.

1891, 1896 [8] "*Maintenance*": The main basis for the preservation of hydraulic pavements is cleaning. Therefore wash them as often as possible, especially in



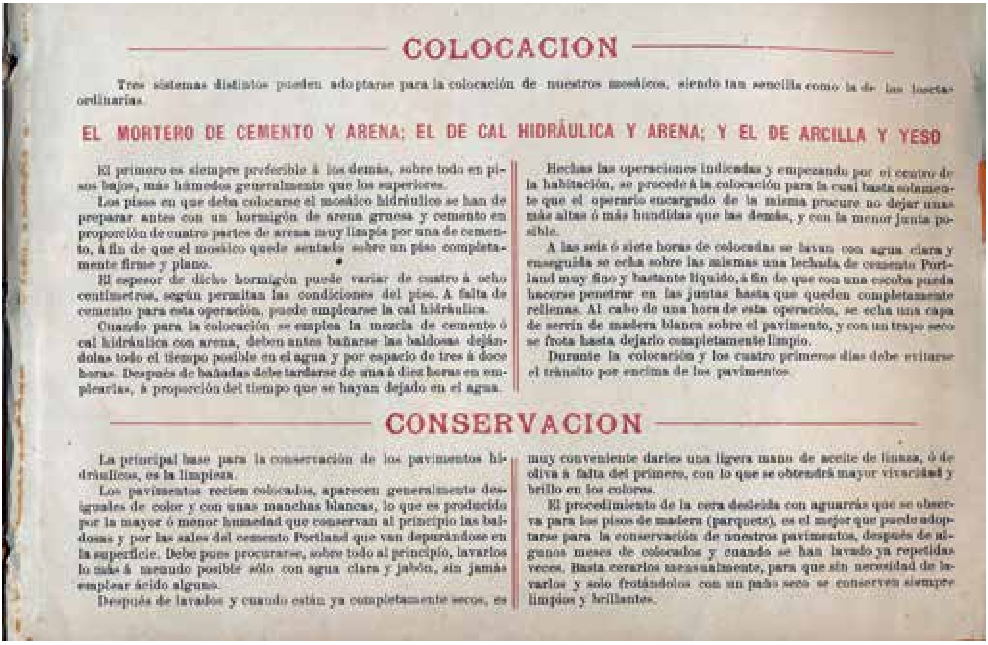
Limpieza y Conservación

Durante algún tiempo después de la colocación, obsérvanse en las baldosas unas manchas que alguna vez toman color blanquecino. Por ello no deben abrigar nuestros clientes el más ligero temor, pues como estas manchas son debidas á la humedad y á las sales de las materias que componen las baldosas, para que desaparezcan basta con aguardar á que éstas se vayan secando por su curso natural, y, entretanto, lavarlas con bastante asiduidad.

Para el lavado no hay que emplear jamás el ácido clorhídrico ni otros líquidos corrosivos que son el peor enemigo del mosaico; basta un paño mojado con una simple disolución de jabón en agua, y, en último caso, una ligera mano de aceite de lino crudo, cuidando, al darla, de que el pavimento esté bién limpio y seco.

Enero 1911.

Fig. 2. Catalogue Orsola Solá y Cía. Barcelona. 1911 (photo J. Griset)



COLOCACION

Tres sistemas distintos pueden adoptarse para la colocación de nuestros mosáicos, siendo tan sencilla como la de las losetas ordinarias.

EL MORTERO DE CEMENTO Y ARENA; EL DE CAL HIDRÁULICA Y ARENA; Y EL DE ARCILLA Y YESO

El primero es siempre preferible á los demás, sobre todo en pisos bajos, más húmedos generalmente que los superiores.

Los pisos en que deba colocarse el mosáico hidráulico se han de preparar antes con un hormigón de arena gruesa y cemento en proporción de cuatro partes de arena muy limpia por una de cemento, á fin de que el mosáico quede sentado sobre un piso completamente firme y plano.

El espesor de dicho hormigón puede variar de cuatro á ocho centímetros, según permitan las condiciones del piso. A falta de cemento para esta operación, puede emplearse la cal hidráulica.

Cuando para la colocación se emplea la mezcla de cemento ó cal hidráulica con arena, deben antes bañarse las baldosas dejándolas todo el tiempo posible en el agua y por espacio de tres á doce horas. Después de bañadas debe tardarse de una á diez horas en emplearlas, á proporción del tiempo que se hayan dejado en el agua.

Hechas las operaciones indicadas y empezando por el centro de la habitación, se procede á la colocación para la cual basta solamente que el operario encargado de la misma procure no dejar unas más altas ó más hundidas que las demás, y con la menor junta posible.

A las seis ó siete horas de colocadas se lavan con agua clara y enseguida se echa sobre las mismas una lechada de cemento Portland muy fino y bastante líquido, á fin de que con una escoba pueda hacerse penetrar en las juntas hasta que queden completamente rellenas. Al cabo de una hora de esta operación, se echa una capa de serrín de madera blanca sobre el pavimento, y con un trapo seco se frota hasta dejarlo completamente limpio.

Durante la colocación y los cuatro primeros días debe evitarse el tránsito por encima de los pavimentos.

CONSERVACION

La principal base para la conservación de los pavimentos hidráulicos, es la limpieza.

Los pavimentos recien colocados, aparecen generalmente desiguales de color y con unas manchas blancas, lo que es producido por la mayor ó menor humedad que conservan al principio las baldosas y por las sales del cemento Portland que van depurándose en la superficie. Debe pues procurarse, sobre todo al principio, lavarlos lo más á menudo posible sólo con agua clara y jabón, sin jamás emplear ácido alguno.

Después de lavados y cuando están ya completamente secos, es muy conveniente darles una ligera mano de aceite de linaza, ó de oliva á falta del primero, con lo que se obtendrá mayor vivacidad y brillo en los colores.

El procedimiento de la cera desleida con aguarrás que se observa para los pisos de madera (parquets), es el mejor que puede adoptarse para la conservación de nuestros pavimentos, después de algunos meses de colocados y cuando se han lavado ya repetidas veces. Basta cerarlos mensualmente, para que sin necesidad de lavarlos y solo frotándolos con un paño seco se conserven siempre limpios y brillantes.

Fig. 3. Catalogue Escofet, Fortuny y Cía. Barcelona. 1891 (photo J. Griset)

the beginning, using only clear water and soap, and never using any acid.
After washing the floors and when they are completely dry, it is highly advisable to give them a light coat of linseed oil, or if this is unavailable use olive oil, so as to provide greater liveliness and brightness of the colours.
The process of waste wax with turpentine, also used with parquet floors, is the best that can be adopted for the preservation of our pavements, applied some months after they have been laid and when they have been washed a number of times. It is enough to pass a dry cloth over them monthly, so that they are always kept clean and bright only by rubbing them, and without washing.
1900 [9]: Water and soap are sufficient for cleaning and preservation. After washing and drying they can be given wax, using the same procedure as for wooden parquet floors, but this is secondary and a matter of taste.

Conclusions

Over a period of almost 60 years, the three most important Spanish manufacturers remain consistent in recommending that the best method of cleaning cement tiles is to use a cloth dipped in water with a small amount of neutral soap. For purposes of "brightening" the colours, a solution of linseed or olive oil dissolved in turpentine can be applied using a polishing rag.
It should be noted that products for the care of cement tiles are available in the contemporary market, however since these are relatively new we have no experience of how they will react with the passage of time.

Notes

1. Catalogue M. C. Butsems & Fradera. Barcelona. No date (probably before 1896).
2. Catalogue M. C. Butsems & Fradera. Barcelona. Fifth edition, 1897.
3. Catalogue Butsems y Cía. Barcelona-Madrid. 1930.
4. Catalogue Orsola y Solá. Barcelona. No date (probably before 1900).
5. Catalogues Orsola Solá y Cía. Barcelona. 1900, 1911, 1917.
6. Catalogues Orsola Solá y Cía. Barcelona.1909 & Mosaicos Orsola. Barcelona. 1931.
7. Catalogue Escofet, Fortuny y Cía. S. en C. Barcelona. 1888.
8. Catalogues Escofet, Fortuny y Cía. Barcelona. 1891 & Escofet, Tejera y Cía. S. en C. Barcelona. 1891.
9. Catalogue Escofet, Tejera y Cía. S. en C. Barcelona-Madrid-Sevilla. 1900.

Author

Jordi Griset Moro has been a designer, graphic artist, and manager of a construction company. In 1996, after being captured by the art of the hydraulic mosaic, he began to study the subject in depth, as well as collecting archival material from all possible sources. Through more than 15 years of research experience he has developed very substantial knowledge in this area.

PHOTOGRAMMETRIC DOCUMENTATION OF THE MOSAICS OF STOBI, NORTH MACEDONIA

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Abstract

The mosaics of Archaeological site Stobi have typically been mapped at 1:1 scale on mylar film, however the production process is time consuming and the resulting documents present problems of distortion, management and communication. While orthophotography would be invaluable, it requires considerable investment to suspend the camera for nadir shots, and the stitching of the shots presents difficulties. We instead proposed the technique of georeferenced photogrammetry as a single form of documentation maintaining the 1:1 scale from start to finish, permitting all the subsequent analyses desired. From 2015 to 2017 extensive trials of different photogrammetric software were conducted. A system was ultimately identified that in a single day could produce high-resolution orthophotos of the Baptistery mosaic, as well as 3D data accurate to approximately 3mm, useful for AutoCAD drawings. The collection of subsequent image sets permits quantification of changes in the mosaic during and after the conservation process.

Keywords: Photogrammetry, mosaics, Stobi, Republic of North Macedonia, Late Antique

Project context

In 2008 the government of Macedonia created a National Institute for management of the ancient site of Stobi, a city inhabited from the Hellenistic to the Late Antique period. Many archaeological campaigns have been conducted at this important site, beginning under the Serbians in the 1930s, and continuing under Americans in the 1970s. The excavations, conservation and management of the site are currently under the authority of the National Institution (NI Stobi).

The Baptistery of the Episcopal Basilica, dating to the late 4th-early 5th centuries AD, features the most renowned mosaic floors of the Republic of North Macedonia. The Baptistery, excavated in 1971 under a joint Yugoslav-American campaign (Wiseman and Mano-Zissi 1973), is shown in its current state in Figure 1. Conservation measures were conducted soon after the discovery of the mosaic, however the environmental exposure over subsequent decades led to serious deterioration of the lime mortar bedding and tesserae of the mosaic making conservation and restoration necessary for the future condition and structural stability of this prominent mosaic. A new conservation-restoration project for the Baptistery was therefore launched in April of 2017 (NI Stobi, 2017).

Problem

The documentation of mosaics presents considerable technical challenges. A typical procedure is to prepare a 1:1

Fig. 1. Current state of the Baptistry mosaic (source https://www.bhfieldschool.org/program/stobi-archaeological-excavations)

tracing of the tesserae on transparent polyester film, including documentation of lacunae, cracks and distortions, prior to undertaking any intervention. However this a time-consuming task, which can also introduce distortion over large areas, and the end product is difficult to manage and communicate as a computerised document. The mylar drawings are typically scanned at 1:1 and then transformed to a larger scale (e.g. 1:20), which then causes the loss of information. The technical drawings of the Episcopal Complex and the entire site of Stobi, prepared prior to the current project, are shown in Figure 2.

Although scaled orthographic documentation would be invaluable, its production requires considerable investment in mechanical systems to elevate the camera above the mosaic for nadir shots. In addition, it is extremely difficult to avoid improper stitching when attempting to combine nadir photographs into a single orthophoto, meaning that mylar drawing would still be required.

As a solution, NI Stobi instead proposed the technique of georeferenced photogrammetry as a single form of documentation, maintaining the 1:1 scale from start to finish and permitting all the subsequent analyses desired. After three years of ex-

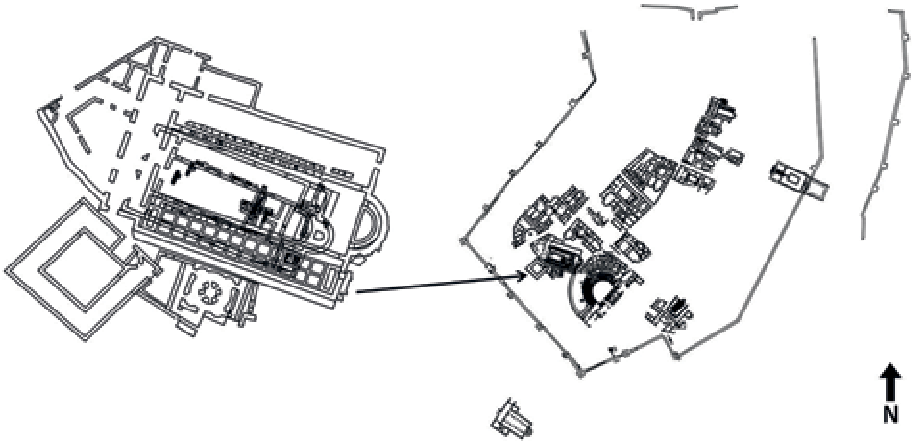

Fig. 2. Site Map of Stobi and the Episcopal complex (Source NI Stobi)

tensive trials of photogrammetric software, the ADAM Technology 3DM Analyst Research Suite, originally designed for the mining industry, was identified as an ideal system for these purposes.

Methods and results

The photography was performed using a Nikon D800E 36 megapixel digital SLR camera and with 24mm lens, mounted on a pole at 3m height. The lens was calibrated to account for distortion and to optimise the accuracy of the resulting model. For accurate scale and positioning of the 3D model within the site, a series ten centring targets were measured using a Leica TPS1201+ total station. For quality control, we performed seven random, reflectorless shots using the total station. The calculation of the deviation from these random shots to the 3D model provides accuracy of 3mm in both height and plane, which is adequate for high resolution visualisation of the mosaic and mapping at the level of individual tesserae. The limiting factor for accuracy of the georeferenced photogrammetric models is the quality of the existing survey, not the photogrammetry (Table 1).

Parameter	Value
Ground pixel size	0.6mm
Image accuracy	0.2mm
Base-distance ratio	1:2
Expected accuracy (photogrammetry only)	< 1mm
Actual accuracy (geo-referenced)	~ 3mm

Table 1. Photogrammetry Accuracies

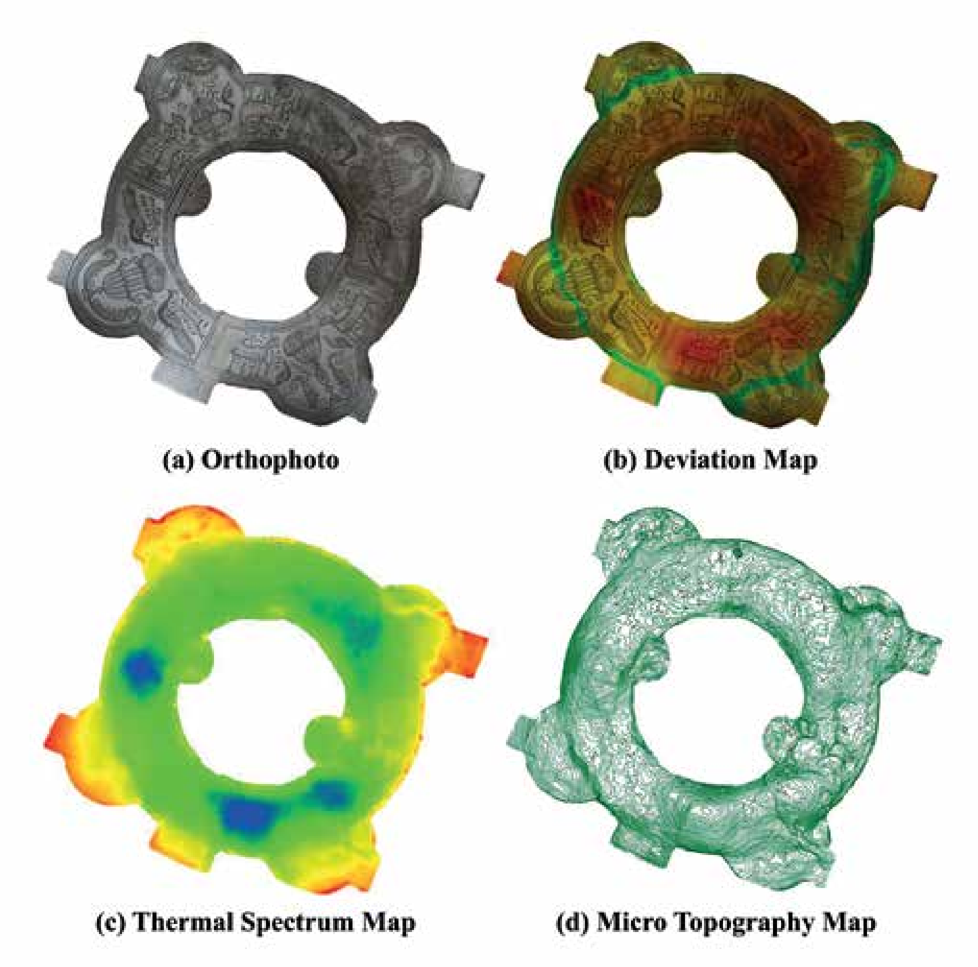

Fig. 3. Results generated from 3D data (photo Kristen Jones).

These photogrammetric methods allow efficient and accurate documentation of the mosaics at every step of conservation, as well as comparative analysis for monitoring of their alteration over time. A 3D model of the mosaic was created using ADAM Technology's CalibCam and a number of analyses were performed using 3DM Analyst and CloudCompare open source software [1-2].

A high-resolution orthophoto (Fig. 3a) of the mosaic floor was generated, which can be printed on a 1:1 scale, as well as dense 3D data that can be used for measurement. The 3D data can be used for drawing individual tesserae, quantifying the deviations from ground-level in the floor surface, and for monitoring of changes over time (e.g. on an annual basis).

The deviation map identifies the areas of the mosaic floor that are above or below

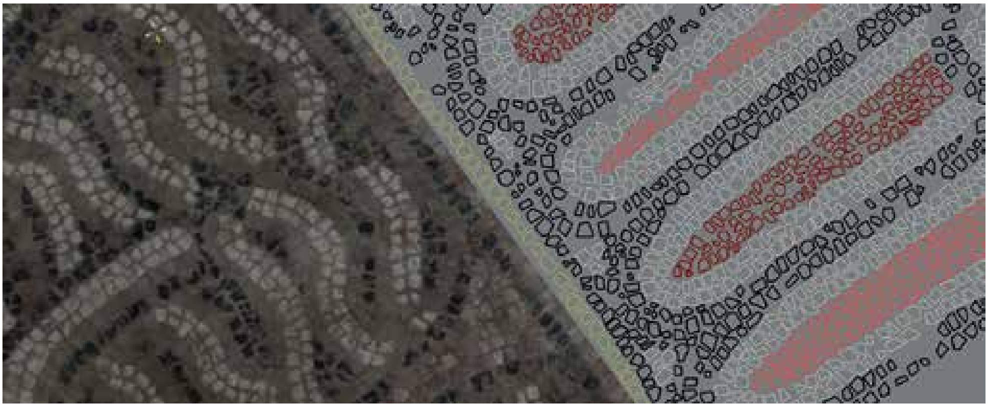

Fig. 4. Tesserae mapping visualisation (photo Kristen Jones)

a given plane (Fig. 3b). In general, we observe more deviation from sagging than from buckling, with the latter only present at the edges. The average deviation is about 2.8 cm, with the maximums reaching 5-6 cm, as evidenced in the map. A micro-topography map (Fig. 3d) was generated with a 2mm contour interval, for detection of patterns in the irregularities. The photogrammetry can fully substitute the use of mylar for 1:1 drawing, by recording the tesserae digitally directly in the 3D data. Subsequently all measurements and analysis can be performed at a 1:1 scale (Fig. 4). This data is being used as a documentation reference for the ongoing conservation project of the mosaic by NI Stobi, as well as for a virtual reconstruction of the entire Baptistery.

Conclusion

The experience of photogrammetry applied to the baptistery mosaic at the site of Stobi, Republic of North Macedonia, demonstrates the vast potential of this technology for documentation and analysis of mosaics. The computed dense 3D data provides an optimal basis for highly accurate monitoring of any changes to the surface of the mosaic and the surrounding area.

Technical Notes

1. CloudCompare (Version 2.8.1), http://www.cloudcompare.org/
2. ADAM Technology Mine Mapping Suite 2.5 (Build 1661), http://www.adamtech.com.au/3dm/analyst.html

References

Wiseman J., Mano-Zissi D. 1973. “Excavations at Stobi, 1972.” *American Journal of Archaeology,* vol. 77 no. 4: 391-403.

National Institution Stobi. 2017. “AFCP Stobi: Conservation of the Mosaic in the Baptistry.” http://www.stobi.mk/Templates/Pages/NewsArticle.aspx?page=3827 last accessed September 7, 2017.

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CONSERVATION OF AN EXTREMELY DETERIORATED MOSAIC FROM THE NEBESKE STOLICE SITE OF SERBIA

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Abstract

In 2000, two fragments of an early-Christian mosaic were lifted from the mountain site of Nebeske Stolice, in Serbia. In 2014, these fragments were assigned to the responsibility of the Central Institute for Conservation in Belgrade and the Institute for the Protection of Cultural Monuments of Kraljevo. Among the very severe damages, it was observed that a fire, demolishing the original structure, had converted the calcium carbonate of the white tesserae to quicklime. The long history of the burial environment had then stimulated various forms of aggravated deterioration. The objectives were to stabilise the fragmentary mosaic on a new, moveable support, preserving the authenticity of the material, and enabling public presentation in a museum context.

Keywords: Nebeske Stolice, early Christian mosaic, *opus tessellatum*, laser cleaning, conservation-restoration

Archaeological context, description and state of conservation

The archaeological site of Nebeske Stolice (Celestial Chairs) is situated at an altitude of 1800m, just below Pančić peak on Kopaonik Mountain in central Serbia. Excavations beginning in 1998 revealed an early Christian basilica with double apse, dating between the 4th and 5th centuries. The basilica was built using cut and broken stone with lime mortar. Apart from the foundations and the lowest levels of the walls, the site also preserved some fragmentary frescoes and mosaics. The basilica had been destroyed by fire, leading to the collapse of the wooden beams and lead roof, breaking the mosaic floor. The sole fragment of *tessellatum*, preserved along the northeastern wall of the nave, measured 272 x 51 cm. The work was executed in a style typical of early Christian floor mosaics: the surface divided in square compartments, outlined by two lines of black tesserae. Inside the compartments are rhythmically alternating motifs of flora and fauna with Christian connotations (birds, fish, fruits, etc.). The mosaic tesserae are of limestone, sandstone and terracotta.

The mosaic was found to be in very poor condition. On the surface there were traces of soot. The white tesserae had been particularly subject to disintegration. In these areas, as well as in the lacunae and the *tessellatum* interstices, there were accumulations of soil mixed with chalk.

In 2000, soon after discovery, the mosaic was lifted by the Institute for Protection of Cultural Heritage of Serbia, in two fragments. For this procedure, the *tessellatum* first faced using *colletta* animal glue, with gauze and then jute fabric. After lifting, the heavily deteriorated areas and crumbling areas of bedding mortar were removed from the reverse of the two fragments.

Mosaic condition

The laboratory examination revealed that the two mosaic fragments presented numerous lacunae, within which were detached and dislocated tesserae. The remains of the nucleus were present in the tesserae interstices and to some extent in the lacunae. The surviving areas of mortar were firm and stable. The remaining parts of the *tessellatum* were extremely damaged, in all cases covered with a layer of soot. The terracotta tesserae were eroded and in some cases showed scaling parallel to the surface. The sandstone and terracotta tesserae showed alterations in colour, due to the fire at the time of destruction. The white limestone tesserae had suffered the most severe degradation (Fig. 1). The high temperatures of the fire had converted the calcium carbonate to quicklime, subsequently transformed as slaked lime in the burial environment. The ground moisture had further contributed to the disintegration of these tesserae, so that in some places only the edges remained and the entire interior had been washed away, leaving an empty shell. Most of the limestone tesserae had been so severely damaged that, at the time of laboratory examination, the only traces were those adhering to the facing of the lifting operation.

Fig. 1. Damage to white tesserae (photo M. Jovanović)

Conservation treatment

Treatment of the mosaic began with careful cleaning of the back of the *tessellatum* from the dust deposited while the mosaic was stored. Tesserae made of terracotta were consolidated using Paraloid B72, 20% in acetone. Detached tesserae were fixed with PVA adhesive.

After preliminary cleaning, the fragments were reassembled on a movable lightweight support made of aluminium honeycomb panels, prepared with intermediate layers of lime mortar. The first layer of mortar, applied from the rear of the *tessellatum*, was prepared using powdered white marble and limestone with slaked lime and casein as the binder, resulting in a mix sufficiently fine and adhesive to achieve good cohesion with the tesserae, especially the fragile remains of white tesserae. This same mortar was also used to fill the lacunae, where the colour and texture would match the white background of the mosaic. The subsequent layer of mortar was designed to achieve stability of the fragments, and in this case was composed of NHL lime with 10% acrylic dispersion and lightweight aggregates (pumice, expanded clay and Perlite). After the mortars were dry, the backs of the fragments were reinforced with glass fabric (density of 163 g/m^2), adhered using epoxy resin. For purposes of ease in handling, the two fragments were then mounted on separate

Fig. 2. Before cleaning (photo M. Franković)

Fig. 3. After cleaning (photo M. Franković)

aluminium honeycomb panels, cut to appropriate shapes.

At this point the delicate operations of cleaning the *tessellatum* could begin, applying techniques that would preserve the maximum possible of original material. The layer of jute fabric overlying the gauze of the facing was removed first, using warm water and a steamer. The gauze impregnated with *colletta* was removed with the aid of an 18% ammonium carbonate solution, followed by further cleaning using a mixture of ethyl alcohol, acetone and water. The *tessellatum*, now free of the facing, was disinfected with benzalkonium chloride.

The unusually fragile and unstable condition of the white tesserae meant that cleaning with water was impossible. Instead, these tasks were conducted using a combination of laser and steam cleaning (Figs. 2-3). The laser cleaning was performed using a Thunder Art laser system operating in Q-switched regime. General removal of tar deposits was done with the infrared wavelength (1064 nm) at 330 mJ (Fig. 4). The same wavelength was used at 275 mJ for cleaning the terracotta tesserae. The removal of the thicker soil deposits would have required higher laser energies, with risks of resulting damage. To avoid

Fig. 4. During laser cleaning (uncleaned/ cleaned) (photo M. Jovanović)

this, the tesserae were cleaned at 380 mJ after first moistening with steam, a procedure that was found to be safe and efficient. The combination of these procedures was generally effective in removing the tar deposits resulting from the historic fire, the accumulated soil, and remains of the facing adhesive, also bringing to light some areas of heavily degraded white tesserae, without any further damage.

Where laser cleaning was insufficient for the complete removal of soil mixed with *colletta*, these deposits were moistened with water vapour from a distance of 20 cm and removed using watercolour brushes. Paper compresses moistened with distilled water were then placed on the *tessellatum* to assist with the removal of the last remains of soil and glue.

The white tesserae were consolidated using nanolime (CaLoSil IP 25). The *tessellatum* fragments, mounted on the honeycomb panels, were edged with new mortar matching the colour and texture of the original nucleus. In preparation for display, the adjacent surfaces of the two honeycomb panels were joined using embedded aluminium anchors and epoxy resin. The resulting seams and the edges of the panels were finished using the same mortar, matching the nucleus.

Conclusion

The extremely fragile and heavily deteriorated condition of this 4th-5th century mosaic required particular consideration in planning the cleaning operations, which were conducted using laser, applications of steam and paper compresses. The fragile and highly fragmentary tesserae were consolidated using nanolime. The mosaic was remounted on a moveable support, enabling presentation in the permanent exhibitions of the National Museum in Kruševac. A replica of the mosaic has also been prepared, for appreciation of the original design and technique. It is anticipated that such a replica will be presented on the archaeological site.

Authors

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THE EPISCOPAL BASILICA OF PHILIPPOPOLIS, PLOVDIV, BULGARIA: CONSERVATION AND PUBLIC PRESENTATION OF THE MOSAIC FLOORS

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Abstract

An Early-Christian basilica dating from the 4th-6th centuries, decorated with elaborate and characteristic polychrome mosaic floors, was discovered in 1982 in the centre of Plovdiv. As excavations proceeded, a number of attempts were made to protect these works. In the years following 1990 the condition of the mosaics worsened considerably. In 2015 a project for "Sheltering, conservation and display of the Episcopal Basilica of Philippopolis" was launched under the sponsorship of the America for Bulgaria Foundation and Municipality of Plovdiv. The project united architects, conservators and archaeologists in the research, conservation, display and integration of the archaeological site within the modern urban environment. The mosaics represent a particularly important element of material culture, contributing significantly to public interest and appreciation for the project.

Keywords: Mosaic, basilica, conservation, mortar, tesserae, *tessellatum*

Archaeological and art-historic context

The late antique episcopal basilica of Philippopolis was discovered during rescue excavations carried out from 1982 to 1986, to the east of ancient civic forum, in what is now the city of Plovdiv (Кесякова 2011). As of 2002 about half of the structure had been investigated, and in 2016-2017 the excavation operations were completed. The basilica was a triple-nave form, with apse to the east, narthex and atrium to the west, and overall dimensions of about 83m by 36m, making it the largest 4th to 6th century basilica of Bulgaria and one of the largest known in the Balkans (Kantareva *et al.* 2007). The lavish architectural decoration included over 2000 m^2 of mosaics, covering the floors of the triple nave and the narthex and atrium porticos. The stratigraphic examinations carried out during the excavation and conservation stages identified a succession of three superimposed installations of the floors (Fig. 1). The first consisted of pink mortar laid in *opus signinum*. The *terminus post quem* for this installation is identified by a coin of Emperor Licinius I (308-324), found embedded in the mortar. The second floor consists of a mosaic in *opus tessellatum*, executed in several stages between the mid-4th to early 5th centuries: first the mosaic of the central nave, followed by those of the lateral naves, the apse, narthex, porticos and rooms of the southern portico. The third floor, covering all the earlier mosaics, was laid in *opus tessellatum* between the late 5th and early 6th centuries.

The successive installations of the mosaics are divided in three phases, on the basis of scale, composition, iconography, decoration, materials and execution. The earliest *opus tessellatum*, laid in the

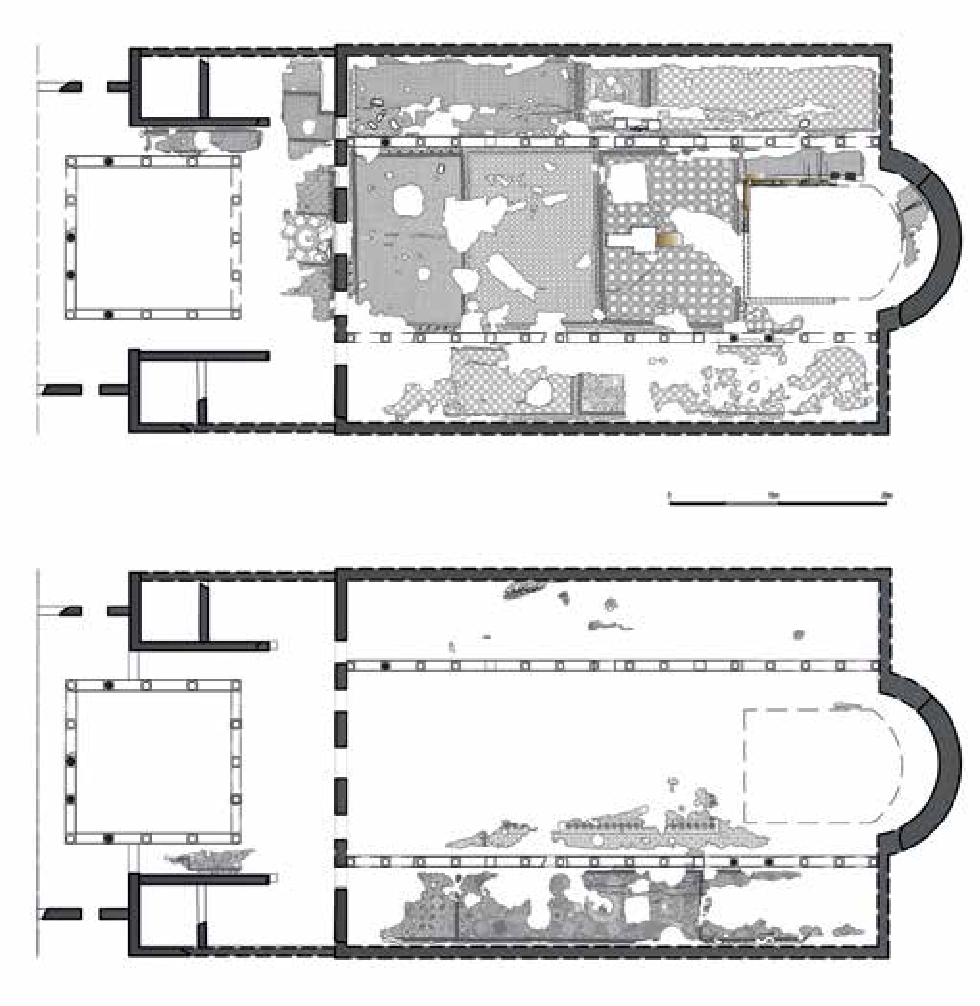

Fig. 1. Plan of the Basilica with the two mosaic layers, 2018 (M. Krachanova, E. Kantareva-Decheva)

central nave, differs significantly from the rest of the mosaics. The features are those of the early mosaics of Philippopolis, showing marked western influence: worked in monochromatic variations of a massively geometric-architectural character, in this case in very large scale. The later mosaics of the side aisles, apse and porticos are typical of the so called "purist style", developed in the late 4th to early 5th centuries under the influence of the early Christian centres of the East. In these cases the *tessellatum* presents an extremely rich polychrome decoration representing numerous pre-Christian and early-Christian ornaments and symbols within a ground of intricate ornamental geometric subdivisions and designs.

The mosaics of the final stage once again involve highly intricate geometric patterns, hosting figurative images of vases, flower baskets, plants and birds. The most impressive are the scenes of the *Spring of life* laid in the centres of both side aisles; the images of over 100 different birds regularly spaced throughout the middle panel of the nave; and finally, the peacock, within his tail opened in an intricate fan, surrounded by other birds and two *kantharoi*, situated in the middle of the narthex. The *opus tessellatum* of the more recent mosaics is worked in natural stone tesserae of four to eight colours, each with several different shades.

The new 'Sheltering, Conservation and Display' project

Various preventive conservation measures had been attempted since excavations were begun in 1982. Among these were the installation of temporary shelters, the last of which collapsed in 1999. During the economic crisis of the early 1990s, cuts were made to conservation and maintenance budgets, and the condition of the mosaics worsened considerably.

In 2015, supported by the America for Bulgaria Foundation and the Municipality of Plovdiv, a project for sheltering, conserving and displaying the site of Episcopal Basilica was launched, involving a team of architects, conservators and archaeologists. Conservation work started on site in early March of that year, following approval of the project by the National Institute for Cultural Heritage. In 2016, the road covering the north limit of the basilica was removed and the excavation of the site was completed. At the time of this report, construction of a building was under way, for protection and musealised presentation of the archaeological site.

At the beginning of operations, the conservators found that in the 1980s, the preservation of the mosaic of the southern aisle had been attempted by placing polyethylene sheeting directly on the surface and then covering this with a layer of sand. Over the years the sheeting had prevented the normal transfer of moisture between the soil, mortar and *tessellatum*, reducing the floor to an extremely deteriorated condition. In spite of great investments of time and skill in the cleaning the surfaces and stabilising the structure, it was eventually determined that it would be necessary to detach this uppermost level of flooring, and then investigate, conserve and display the lower mosaics *in situ*. The tasks of unearthing, stabilising and detaching the uppermost layer of mosaics, from the southern and central aisles and narthex, were carried out from May 2015 to December 2015 (a total area of about 800 m^2). The lifted mosaics, transferred to new supports, will be displayed on the second floor of the protective building currently being constructed over the basilica site.

Following detachment of the uppermost mosaics of the southern and central aisles, the bedding mortars were carefully removed until the lower *tessellatum* was fully exposed (Fig. 2). At this stage our team was

Fig. 2. Lower layer of mosaics in the central nave and southern aisle (photo E. Kantareva-Decheva)

Fig. 3. Mosaic during removal of incrustations (photo E. Kantareva-Decheva)

Fig. 4. Mosaic after removal of incrustations (photo E. Kantareva-Decheva)

extremely pleased to discover the epigraph of the donor, worked in the lower-level mosaic of the southern aisle, indicating the name of the bishop who had financially sponsored the works. This extremely important documentation provides conclusive evidence, confirming the archaeological hypothesis that the structure was indeed the episcopal basilica (Figs. 3-4).

The conservation campaigns of 2016 and 2017 were focused on the conservation-restoration of the lifted mosaics; urgent interventions for *in situ* consolidation and cleaning of wall paintings and stucco decorations; unearthing, cleaning and stabilising the mosaics in the newly excavated northern part of the basilica; reburial of 2000 m^2 of mosaics and architectural elements.

Conclusions

The project for "Sheltering, conservation and display of the Episcopal Basilica of Philippopolis" has united the efforts of archaeologists, restorers, architects and building contractors around the core goal of preserving and integrating the *in situ* features of the archaeological site within the environment of modern Plovdiv. In this context, the mosaics are a particularly important and communicative element of material history, contributing to wide public interest in the project. The current interventions have responded to the problematic attempts at preventive conservation conducted from the 1980s to early 2000s, and prepared the mosaics for public appreciation in a much more protective context.

References

Кесякова Е. 2011. "Мозайки от Епископската базилика на Филипопол." In Изследвания в чест на Стефан Бояджиев С., 173-209.

Kantareva E., Bospachieva M., Luk C. 2007. "Archaeological Sites with Mosaic Floors from Ancient Philippopolis, Plovdiv, Bulgaria: Problems and Condition." In *Proceedings of the ICOM SEE Regional Conference held in Kladovo*, Serbia from 23th to 27th October 2006, edited by Mila Popović-Živančević, 227 – 232. Belgrade: National Museum.

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SEASONAL REBURIAL OF MOSAICS AT THE SITE OF ANCIENT OLYMPIA: ASSESSMENT OF POTENTIAL STRATEGIES

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Abstract

The seasonal reburial of mosaics in open air archaeological sites represents costs in personnel, time and money, making this practice a challenge to site managers. In the case of the Ancient Olympia archaeological site, the practice was gradually abandoned, given administrative realities. In 2014, a new strategy was proposed for preventive maintenance of the 650 m² of mosaics, applying differing reburial practices according to the visibility of the mosaics for visitors. Those in indefinite reburial are now subject to a rotating schedule of inspections. Those subject to a winter-summer reburial cycle are covered using a newly tested technique, applying criteria of cost, preservation effectiveness, and efficiency of operation. Evaluations of the reburial techniques have thus far been conducted over a period of three years.

Keywords: Mosaic, reburial, covering, protection, maintenance

The mosaics and their recent history of conservation

Ancient Olympia, where the Olympic Games began, was an important religious and athletic centre of ancient Greece. The archaeological site of the same name hosts about 650 m² of mosaics, in outdoor contexts. The majority of these date to the Roman era. Among them are the floors of the complex of Kladeos baths, situated near the banks of Alpheios river, in *opus tessellatum* mosaic with geometric patterns, executed around 100 AD.

The mosaics at the archaeological site were subject to conservation works as part of a general project of enhancement, completed in 2004 (Pantazidou 2011). The floors were treated *in situ,* with the exception of mosaics with severe stability problems, such as those of the Kladeos baths complex. In these cases the mosaics were detached, treated and re-laid on new substrates using lime-based mortars. For almost 10 years following these works, the mosaics were reburied for the winter season and reopened for summer access. However this practice was gradually abandoned due to lack of staff resources, and the mosaics were then left covered throughout the year.

Reburial schemes

In 2014, two new schemes for the seasonal reburial of mosaics were proposed, each applying a set of easier and less time-consuming covering techniques. The central floor in Kladeos complex was chosen for experimental implementation of these two methods, in comparison with the third method, which replicated the reburial method used since 2004, which was applied to an adjacent floor (Krini *et al.* 2017). The selection of materials and methods was based on

Fig. 1. Central mosaic of the Kladeos bath complex covered with two different protective systems in October 2015 (Photo T. Matsouka, Hellenic Ministry of Culture and Sports (HMCS))

Fig. 2. Removing the white polyethylene sheet in May 2017 (photo M. Krini, HMCS)

Fig. 3. Removing the black polypropylene sheet in May 2017 (photo M. Krini, HMCS)

experiences at other archaeological sites with mosaics in Greece with similar environmental conditions, where short-term reburial has proven successful.

The three schemes evaluated are as follows:

1. A white, non-woven polyethylene sheet (Tyvek® Soft) laid on the mosaic surface, topped with a 3cm layer of sand (applied over half of the central mosaic of the Kladeos baths; Fig. 1);
2. A black woven polypropylene sheet ("Velliground") laid on the surface, topped with a 3cm layer of sand (applied over the other half of the same mosaic as method 1);
3. A plastic net sheet laid on mosaic surface, followed by a 6cm layer of perlite, another plastic net sheet, and then a 5cm layer of sand (the technique used beginning in 2004, in this case applied to a small floor of the Kladeos complex).

Assessment

The mosaics were covered on October 2014. In 2015 we carried out spring and fall uncovering-covering. In 2016 we kept the floors buried for the whole year, and in May 2017 we uncovered the mosaics to assess the different schemes.

The mosaics covered using the three methods showed significant differences in condition, as follows:

Method 1 (non-woven polyethylene sheet, sand) - The surface show no signs of vegetation nor related mosaic degradation (Fig. 2).

Method 2 (black polypropylene sheet, sand) - Low vegetation was evident on the sand layer over the black polypropylene sheet, and in some areas the roots had penetrated the sheet and in-

Fig. 4. Surface of the mosaic after cleaning: left side following covering of white polyethylene sheet; right side following covering of black polypropylene sheet (photo M. Krini, HMCS)

truded the mosaic. Furthermore, a net of thin weed roots had spread over several parts of the surface, although this was easily removed and had not penetrated the mortar layers (Fig. 3).

Method 3 (plastic net, perlite, net, sand) - The mosaic remained in good condition.

Apart from the greater complexity of installation, it was also observed that Method 3 required greater time and resources to remove the protective layers and clean the mosaic surface. Therefore, in terms of time and resources, Method 3 is not favoured.

Given the condition of the two halves of the central mosaic of Kladeos baths complex, subject to very similar preservation methods, we concluded that the method using white non-woven polyethylene sheet is much more efficient for winter protection than that using black polypropylene sheet (Fig. 4).

Design of future mosaic maintenance and site management

In the fall of 2017 we again covered all the exposed mosaics of the Kladeos complex using the method with Tyvek®. The effectiveness and efficiency will be assessed again in the spring of 2018.

As part of the current project, developed in 2014 for the entire site of Ancient Olympia, it was proposed that the mosaics along the visitation routes would be open for viewing in summer and reburied for the winter season. The mosaics not along visitation routes would be reburied for an indefinite long term, subject to a defined plan of examinations, imposed in rotating order. The purposes of the inspections is to assess the condition of the buried mosaic, assess the burial system, and identify any needs to replace the protective layers. There have also been discussions of possible alternatives to the top layer of sand.

All planning and implementation of this design for preventive maintenance takes into account the significance, communicative and aesthetic values of the archaeological site.

Acknowledgements

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References

Krini M., Pantazidou K., Sotiropoulou G. Vitsou I. 2017. "Seasonal reburial of mosaics: at what cost?" In *Proceedings of the 12th Conference of the International Committee for the Conservation of Mosaics, Sardinia, October 27–31, 2014*, edited by Jeanne Marie Teutonico, Leslie Friedman, Aïcha Ben Abed, and Roberto Nardi, 369-371. Los Angeles: Getty Conservation Institute.

Pantazidou K. 2011. "Συντήρηση λίθινων ενεπίγραφων στηλών, ψηφιδωτών και επιχρισμάτων στην Αρχαία Ολυμπία (Conservation of stone stele, mosaics and renderings at Ancient Olympia)". In Έργα συντήρησης συγχρηματοδοτούμενα από το Γ' ΚΠΣ *(Conservation projects co-funded by Greece and European Union)*, edited by Maria Krini. Athens: Ministry of Culture-and Tourism, Directorate of Conservation of Ancient and Modern Monuments.

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EXAMINATION OF HUNGARIAN ART NOUVEAU MOSAICS: THE RÓTH WORKSHOP

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Abstract

The conservation of early 20th century mosaics of Budapest executed by the Miksa Róth workshop provides valuable opportunities to study the characteristics of Hungarian Art Nouveau. The styles and iconographies of these mosaics refer to historic events and Hungarian mythological motifs. The contribution discusses the artists and artisans involved, the architectural contexts, the different characteristics of indoor and outdoor mosaics, the methods of execution, and reports on examinations of the mortar compositions and their contribution to the artistic effect. The materials discussed include glass tesserae, enamelled ceramic inlays, seashells, and coloured preparatory mortars.

Keywords: Miksa Róth, Art Nouveau, mosaics, mortar stratigraphy, indirect technique, Budapest

The artist and his technique

Miksa Róth (1865-1944) was a mosaic and stained glass artist, appointed to the Imperial and Royal Court of Austria-Hungary, also known as one of the pioneers of Art Nouveau in Hungary. He learned the art of painting on glass in the studio of his father, then continuing his education in Venice. In 1883 he established his own studio in Pest, after which he began work in mosaics. At this time he invited the Italian master mosaicists Giovanni Barbus and Pietro Labuss to join the studio – a collaboration that would survive until World War I. Róth is credited with the introduction of mosaics to Hungary, as an art of building decoration. He experimented successfully with specific stratigraphies of mortar, integrated iridescent "eosin" glazed ceramics tesserae and tiles from the Zsolnay factory of Pécs, and used Tiffany opalescent glass. His workshop also produced its own glass for mosaic tiles, including opalescent glass. He cooperated with a number of other Hungarian artists. As well his surviving production in Austro-Hungarian locations, his stained-glass works can also be seen abroad, in monuments such as the Church of Mariensdorf, Burgenland, Austria, the Royal Palace of Amsterdam, the Fageborg Church of Oslo, and in the dome of the Gran Teatro Nacional of Mexico City (Varga 1993: 75-76).

At the turn of the 19th to 20th century, many Hungarian artists had delicately designed monograms, applied as a maker's mark. The monogram of Master Róth often appears in his mosaics, in some cases in *schwarzlot* ("black lead") on a tile of glass and gold leaf (Fig. 1). One of his characteristic techniques was the so-called "checkerboard" arrangement of tiles. His style also often involved an additive colour-mixing technique, involving the interplay of different hues of glass, in some cases using material produced by his own studio.

Fig. 1. Normal and colour-inverse view of the Miksa Róth monogram, executed in *schwarzlot* technique, from the *Guardian angel* mosaic, Budapest, V. József Attila u. 24 (photo B. M. Kürtösi)

The three works in mosaic reported here were created in the studio by indirect technique. Róth (Roth 1943: 58-59) himself described the use of paper as the temporary support on which to draw the intended composition. This was the full-size, mirror-image copy of the intended mosaic (Kölber 1910), prepared from the original plan designed by the artist. The prepared drawing was cut into units of suitable size before beginning the process of applying the mosaic tesserae, adhered using starch paste or gum Arabic with honey.

The prepared sections were then transported for mounting on site, where the mosaic, at this point visible only from the reverse, was laid into the bedding mortars. Once the paper support was removed the mosaic was finally seen intended. The boundaries of the workshop sections can typically be distinguished in the finished mosaic.

Different buildings, different materials and technology

From examination by the author in the microscopy laboratories of the Hungarian University of Fine Arts, in 2014 to 2017, it results that the bedding mortars used by the Róth studio were varied, in particular in relation to the location of the mosaic in indoor or outdoor contexts.

An example is a wall mosaic designed by Róth, composing on important aspect of the entrance foyer of the Liszt Ferenc Academy of Music (architects Flóris Korb, Kálmán Griegl, opened in 1907; Kürtösi 2014). The tesserae mosaic integrates with a fountain basin carved in red compact limestone from Tardos, filled by water flowing from a gargoyle, the latter executed in "shell mosaic". The bedding mortars were lime-based, with the largest fraction being calcite marble powder. The micro-analytical examination of the joint mortars reveals the presence of deep purple, green and white coloured glass splinters used as additives, detected in the

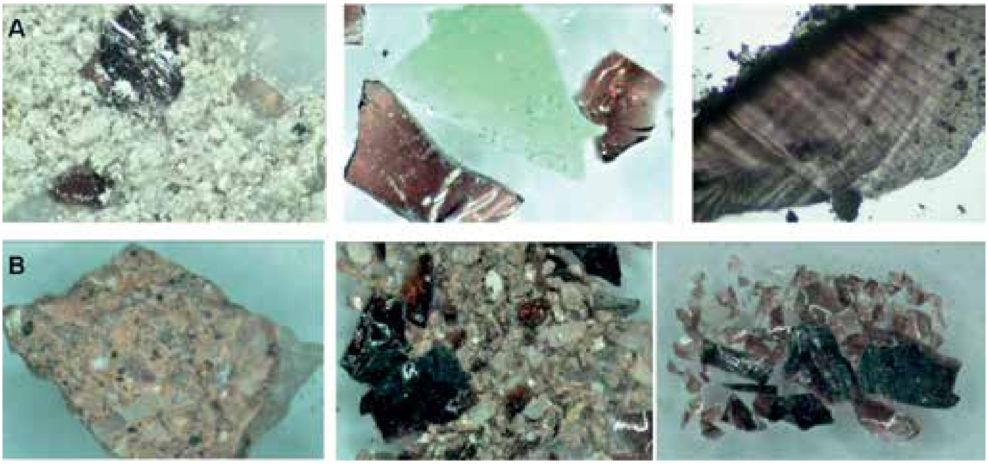

Fig. 2. Mortars of the fountain mosaics, Liszt Ferenc Academy of Music, Budapest; stereo-micrograph of glass splinters from the acid-proof residue: A) bedding mortar, B) joint mortar (photo B. M. Kürtösi)

acid-proof residues (Fig. 2). The pinkish colour of the mortar in the figurative areas was obtained using hematite. The gargoyle was executed using a wide range of seashells. The XRD examination of the bedding mortar for this part of the work showed the presence of vaterite, once of the calcite polymorphs. The encrustations covering the surfaces of the fountain area were carbonates, as were the original shells, requiring that the conservation process proceed by slow mechanical removal. The corner facade of a residential building in Budapest, in Art Nouveau style, was decorated by a figurative image known as the *Guardian angel*, designed by Károly Lotz. Both the figurative work and the name of a pharmacy, placed immediately below, were executed by the Róth workshop in around 1905. These mosaic elements were framed by enamelled tiles from the Zsolnay factory, laid in relief stucco-work. The whole of the exterior wall decoration suffered severe damage during World War II; shot holes visible in the work probably dated to the 1956 Revolution (Fig. 3). In this case the bedding layer and grout were in the same type of lime-based mortar, filled with sharply crushed limestone particles in different fractions. These mortars showed a strong reddish tint, except in the area of the woman's dress, where a darker greyish hue had been prepared. The colouring of these

Fig. 3. Preparatory mortar stratigraphy of the *Guardian angel* mosaic, revealed following removal of a glass tile inserted in a shot hole, during a previous treatment. Budapest, V. József Attila u. 24 (photo B. M. Kürtösi).

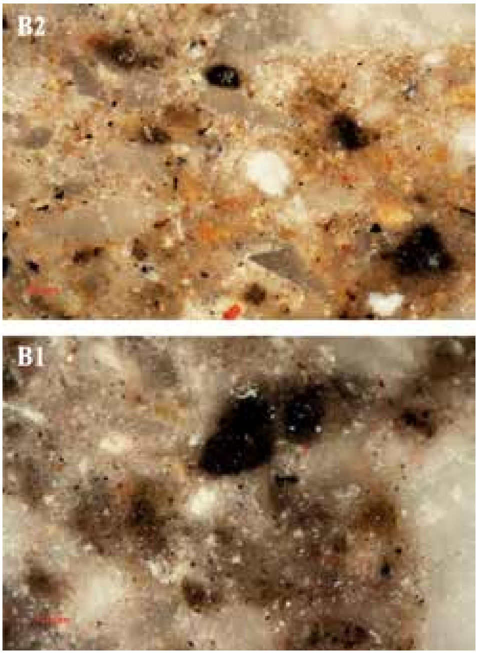

Fig. 4. Fiume Road National Cemetery Monument cross-section details of the preparatory mortars from the geometric mosaic frieze decorating the archway of the northeast dome: B1, B2) bedding mortar layers. PLM 10x obj. Budapest VIII. Fiumei út 16-18 (photo B. M. Kürtösi).

grouts had been an important element in achieving the painterly effect of the overall composition.

Funerary architecture incorporating mosaics represented an important current at the turn of the century, and the Róth workshop created a number of decorative works for funerary buildings. One of these was the complex of mosaics decorating the four domes and the archways of the Monument of the Fiume Road Cemetery of Budapest, 1906-1909, by architects Lajos Gerle, with mosaic designers A. Körösfői-Kriesch, A. Dudits, Zs. Vajda and J. G. Stein. The mosaics of a representative archway and dome were examined. The mortar stratigraphy is very complex. The basic mortar mixtures generally used crushed carbonate rock particles as aggregate. The mosaic sections were mounted on the hemispherical dome used a lime-based mortar with hydraulic components; brownmillerite (Ca_2 (Al, $Fe3^+$)$_2$ O_5 and larnite (Ca_2SiO_4) were found by XRD. We can find a composition related to that of a mixture of the early type of Portland cement and air-lime (Fig. 4), which would have served well for rapidly executed, secure work on the curved inner surface of the dome as well. This observation suggests new potentials for related uses of such mortars, subsequent to further research and examination.

Acknowledgements

All XRD measurements were performed by István Sajó, Szentágothai Research Centre, University of Pécs. Conservation of the works was in collaboration with Miklós Ernő Balázs, Doctor of Liberal Arts.

Laura Judit Hallai, a student in painting conservation at the Hungarian University of Fine Arts contributed to the examination of the mosaics of the Fiume Road Cemetery Monument, in connection with her MA thesis supervised by the author.

References

Kölber D. 1910. “Mozaikművesség.” 20. *Magyar Iparművészet*, 13-01.

Kürtösi B. M. 2014. “Reštaurovanie nástenných mozaik zo začiatku 20. storočia.” *Zborník prednášok XII. Megzinárodného Seminára o Reštaurovaní, 76-81.Tatraská Lomnica 2014.*

Róth M. 1943. *Egy* üvegfestőművész *emlékei.* 58-59. Budapest: Hungária kiadás.

Varga V. 1993. *Róth Miksa művészete*. 75-76. Budapest: Helikon.

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SEE MOSAICS MEETING III: NEW PERSPECTIVES AND CHALLENGES IN MOSAIC CONSERVATION

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Abstract

SEE Mosaics is a project of the Southeast Europe region, dedicated to developing network of conservation professionals and promoting the regional mosaic heritage. Within this framework, the third meeting entitled "New perspectives and challenges in mosaic conservation" was held from 14 to 17 September 2016 in Ohrid, Macedonia. The meeting was jointly organised by the Central Institute for Conservation in Belgrade and the Local Development Agency in Struga, Macedonia, with support from the Central European Initiative (CEI). The participants included colleagues from the eight CEI countries (Albania, Austria, Croatia, Hungary, Italy, Macedonia, Serbia and Slovenia), as well as France and Spain. The program, consisting of individual participant presentations, discussions and a round table, focused on problem-solving solutions to challenges in mosaic investigations and research, documentation, and conservation *in situ* and in museums. With the close of the Ohrid meeting, the 4th SEE Meeting was announced for Pula, Croatia, on the theme of presentation of detached mosaics.

Keywords: Mosaic heritage, Southeast Europe, networking

SEE Mosaics initiative

The mission of the Southeast Europe Mosaics project is to create a strong network of mosaic conservation professionals, improve conservation practice and promote the mosaic heritage of Southeast Europe.

Four meetings have been held from 2011 to 2017, involving an increasing number of professionals from the region and the larger European area. Initially the meetings focused on achieving an overview of the regional institutions involved in mosaic conservation and the current conservation practices, however the later meetings have increasingly turned to more specific issues in contemporary conservation practice.

SEE Mosaics Meeting III, "New perspectives and challenges in mosaic conservation," was held from 14 to 17 September 2016 in Ohrid, Macedonia (Fig. 1), organised jointly by the Central Institute for Conservation in Belgrade, represented by Maja Franković and Branislava Lazarević Tošović, and by the Local Development Agency in Struga (Ohrid), Macedonia, in the person of SEE Mosaics project team member Nikola Upevče. The meeting was supported by the Central European Initiative (CEI).

Thirty colleagues from ten countries participated in the meeting. Participants arrived from the CEI countries of Albania, Austria, Croatia, Hungary, Italy, Macedonia, Serbia and Slovenia, as well as from France and Spain (Fig. 2).

The program consisted of individual participant presentations, discussions and a round table (Fig. 3). The presentations

Fig. 1. Participants of SEE Mosaics Meeting III: New perspectives and challenges in mosaic conservation, 14 to 17 September 2016, Ohrid, Macedonia (photo Nikola Upevče)

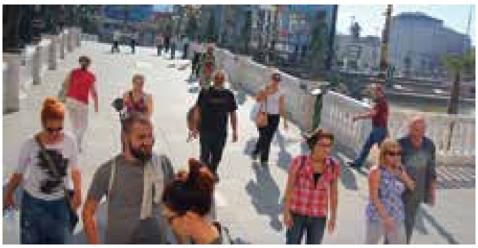

Fig. 2. Meeting participants during the study visit to Skopje (photo Blaz Seme)

Fig. 3. A session at SEE Mosaics Meeting III (photo Nikola Upevče)

showcased problem-solving solutions in the areas of investigation and research concerning mosaics, documentation, and conservation *in situ* and in museums. The discussions and the round table focused on several issues in particular:

– the contribution of conservation-restoration methodologies to gathering information on the object and context;
– contemporary documentation techniques and their practical applications;
– results from shelters for mosaics conservation and prevention of deterioration;
– techniques of mosaic covering on archaeological sites;
– conservation of mosaics *in situ*;
– presentation of mosaics in museums.

As of the date of preparing this poster,

the 2017 meeting was scheduled for Pula, Croatia, and the theme was presentation of detached mosaics in museums.
More information on upcoming and past meetings of the SEE is posted on http://www.seemosaics.org.

Conclusions

The SEE Mosaics Meetings promote the creation of contacts and exchange of experiences between the heritage professionals and institutions of Southeast Europe, thereby fostering international cooperation and advancement within the individual countries, as well as joint development of regional and larger international projects. As of 2017, collaboration on joint projects has been established between Slovenia, Croatia and Macedonia, and between Serbia, Montenegro and Bosnia and Herzegovina. Through these collaborations, projects for the conservation of about 200 m^2 of mosaics had been implemented, in both museums and on archaeological sites.

GOLD TESSERAE, FROM ROMAN TIMES TO MODERN ERA: THE INVESTIGATION OF A LUXURY MATERIAL

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Abstract

Gold tesserae comprise a distinctive category of glass tesserae, based on their manufacture technique. The rich wall mosaic with the abundance of gold tesserae was the emblematic work of byzantine art. Although a large number of Byzantine monuments survive today, gold tesserae have not been the subject of a systematic research. The aim of this work is to present the results of a PhD research on Byzantine gold-leaf glass tesserae. Particular notice would be given to technological evidence of Byzantine tesserae in comparison with modern ones, along with features of their decay.
Keywords: Byzantine tesserae, glass, gold-leaf.

Introduction

The use of gold glass tesserae began in Roman times and established with the wall mosaics that became the emblematic work of Byzantine art. Gold tesserae are produced by enclosing a gold leaf between two layers of usually transparent glass; the support glass and a second very thin, the top glass, called *cartellina* (Figs.1-2). In order to create the tesserae, a glass slab is formed and then the tesserae were cut off in a square shape.

Fig. 1. General view of the top surface of a gold tessera

Fig. 2. Same tessera side view

The technique provides an impression of gold always connected with wealth and luxury, along with its strong symbolisms – for Christian art it signifies the light deriving from God. Gold tessera was considered to be a costly product, due to its raw materials (gold leaf), dedicated for the decoration of important edifices. However today, it is recognised that the amount of gold needed for their production was

smaller than originally estimated (James 2006); perhaps the gold tessera was valued for its sophisticated manufacture technique. The production of gold tesserae necessitates high expertise of the glassworker and even nowadays specific workdays are dedicated for their production.
Previous publications mainly concerned glass composition and only limited studies discussed technique and decay (Verità 2000, Verità *et al.* 2000). The aim of this work is to present the results of a PhD research on Byzantine gold glass tesserae using a non-destructive and non-invasive methodology.

Research Methodology

The research focused on the wall mosaics of the Byzantine Monastery of Daphni (11th century) Athens, Greece. Macroscopic and microscopic examination of a large number of tesserae (*in situ* and loose) followed by the analysis of selected tesserae as received, using Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy and supplementary micro- Proton Induced x-ray and γ-ray Emission Spectrometry, performed at ATOMKI-HAS, Hungary (*via* CHARISMA-FIXLAB). Examination of tesserae was also carried out at the Monastery of Osios Loukas (10th century) and investigation of samples at the Department of Conservation and Scientific Research of the British Museum London (*via* CHARISMA -ARCHLAB). Current production of gold glass tesserae was followed at the ANGELO ORSONI srl.,'ORSONI, Smalti Veneziani', Venice, Italy.

Results-Technological features

Gold tessera colour is defined by the support glass as the layer of *cartellina* is very thin (≤1mm). In Daphni monastery the simultaneous use of gold tesserae with different shades (yellowish, roughly purple and aqua) was revealed, a feature attributed by previous workers to a deliberate choice for aesthetic reasons (Neri and Verità 2013). Furthermore, the glass hue was not always uniform, a feature frequently apparent on purple tesserae.
The gold leaf (~0.5 to 0.8 μm thick) was roughly parallelogram, usually with micro-fissures, larger breaks and occasionally additional patches. SEM images shown the presence of minute holes on the gold surface and verified a multiple application, at least near the edge of the tessera. Microscopic examination revealed also "ruby red areas" a unique phenomenon of gold glass tesserae, attributed to manufacture technique (Verità and Santopadre 2010).
A large number of tessera derived from the edge of the glass slab were detected and were classified by the shape of the cartellina's end point (Loukopoulou and Moropoulou 2013a).
Current manufacturing technique produces a gold glass slab different to the 'picture' revealed by the study of the tesserae. On modern slabs the leaf and the *cartellina* (pre-cut in a square pattern) are situated at the centre. The gold tesserae are cut only from the central area of the disc, thus no edges are created.

Results - Decay

Tesserae were classified according to their condition from well preserved to heavily decayed, while tesserae with partly or complete loss of *cartellina* and the metal leaf, were classified as a separate category. Altered tesserae exhibited a dull or iridescent surface, a whitish surface with opalescence and dark discolouration. Physical damage was limited, while the decay of the *cartellina* appeared to advance from the perimeter. Perfect bonding of the two glass layers was detected on areas where the gold was missing typically combined with better preservation of glass (Fig. 3). The most unusual phenomenon was the alteration of the gold tesserae surface into a greyish colour (Fig. 4). This was attributed to advance corrosion of the glass at the interface with the gold leaf (Loukopoulou and Moropoulou 2013b).

Fig. 3. Perfect bonding of the two glass layers due to the lack of gold

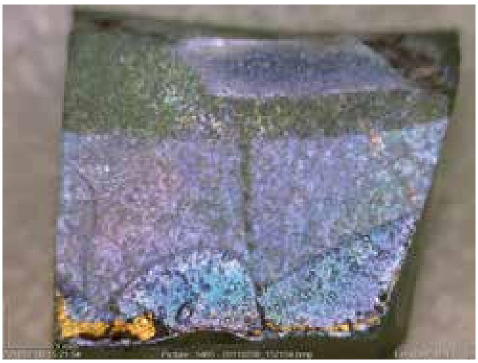

Fig. 4. General view of the top surface of a gold tessera with greyish alteration

Conclusions

The study of the gold glass tesserae verified their distinct nature and alteration. Evidence for their manufacturing technique, indicated that perhaps in Medieval period a different practice was followed. The extensive use of the slab's edges demonstrated that all available material was used, either as a deliberate choice and/or as a necessity. The appearance of the decayed gold tesserae is the combined effect of glass corrosion at the external surface and at the interface with the gold leaf. Decay occurs also at the interface with the gold as the result of inadequate joining of the two glass layers (top and support).

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References

James L. 2006. "Byzantine glass mosaic tesserae: some material considerations." *Byzantine and Modern Greek Studies*, 30(1): 29-47.

Loukopoulou P., Moropoulou A. 2013a. "Notes on the morphology of the gold glass tesserae from Daphni Monastery." In *New Light on Old Glass: Recent Research on Byzantine Mosaics and Glass*, edited by L. James and C. Entwistle, 76–81. London: British Museum.

Loukopoulou P., Moropoulou A. 2013b. “A Non-destructive analysis of altered gold leaf glass tesserae from the mosaics of the Daphni Monastery, Greece.” In *Recent Advances in Glass, Stained glass, and Ceramics Conservation, ICOM-CC Glass and Ceramics Working Group Interim Meeting: Forum of the International Scientific Committee for the Conservation of Stained Glass (Corpus Vitrearum-ICOMOS)*, edited by H. Roemich and K. van Lookeren Campagne, 31-39. Zwolle: Spa Uitgevers.

Neri E. and Verità M. 2013. “Glass and metal analyses of gold leaf tesserae from 1st to 9th century mosaics. A contribution to technological and chronological knowledge”. *Journal of Archaeological Science*, 40: 4596-4606.

Verità M. 2000. “Technology and Deterioration of Vitreous Mosaic Tesserae.” *Reviews in Conservation*, 1: 65–76.

Verità M., Falcone R., Vallotto M., Santopadre P. 2000. “Study of the Weathering Mechanisms and Chemical Composition of Ancient Mosaic Tesserae.” *Rivista della Stazione Sperimentale del Vetro*, 30(6): 33–44.

Verità M., Santopadre P. 2010. “Analysis of gold-coloured ruby glass tesserae in Roman church mosaics of the fourth to twelfth centuries.” *Journal of Glass Studies*, 52: 11–24.

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TRANSFERRING MOSAICS TO OUR COMPUTERS

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Abstract

The state of the art in high-resolution photogrammetry, digital cameras, unmanned aerial vehicles (UAVs), and computer systems makes it possible to digitise mosaics within our computers. Using red-green-blue (RGB) images and topographic points captured outdoors or indoors, digital products with metric and radiometric information can be generated, such as orthomosaics and 3D models. Applied to mosaics, this methodology allows development of inventories, reproduction or duplication of tesserae or of complete mosaics in case of destruction or for maintenance purposes, as well as sharing of information between remotely located teams, using Geographic Information Systems (GIS).

Keywords: Mosaics, high-resolution images, photogrammetry, orthomosaic, 3D model

Introduction

Currently available capture systems can easily be adapted to obtain high resolution images from very different and complex environments: outdoors, indoors, areas of difficult access, aerial elements, etc. Regardless of the environment, the overall workflow is divided into the following phases: planning, data capture and data processing (product generation and data analysis).

Photographic cameras are used as sensors to capture the images in their true colour (RGB). If needed, other sensors such as thermal, multispectral or hyperspectral cameras can be used to carry out different types of mosaic analyses.

Fig. 1. Left: High resolution image captured indoors to generate orthomosaics with a ground sample distance (GSD) of 0.0001m. Right: High resolution image captured with a sensor carried in UAV equipment, for generation of an orthomosaic with a GSD of 0.01m. (photo by authors).

	Sensor (mm)		Sensor (pixel)				
Sensor	X	Y	X	Y	Focal (mm)	Distance to object (m)	GSD (m)
Canon EOS 5ds	36	24	8688	5792	35	1,5	0,0002
Canon Mark II	36	24	5614	3744	35	1,5	0,0003
Sony A6000*	23,5	15,6	6000	4000	20	20	0,004
Sony A7*	35,9	24	7952	5304	35	20	0,003

Table 1. Configurations used in different projects * sensors also loaded in UAV.

In large areas or areas with difficult access, the data capture sensor can be loaded on an unmanned aerial vehicle (UAV). Captured images and control points (points with known coordinates XYZ in a relative or absolute system) are processed to obtain products and carry out the subsequent analyses (Fig. 1).
The main products obtained are:

– orthomosaics - metric documents in raster (image) format, incorporating RGB information on the mosaic;
– 3D Models - metric documents of the mosaic and its surroundings.

The following sections present some examples of projects using these technologies to capture and measure mosaics in different conditions and environments.

Planning

The correct generation of necessary products requires careful planning prior to data capture, considering the specific case of each area under study. The recommended photogrammetric criteria are typically to provide coverage of images with the following overlaps:

– 80% longitudinal, between images of the same strip;
– 60% transversal, between images of different strips.

This overlap between images allows stereo or 3D vision of the element, as if we were observing it with our own eyes, so that we can model each one of the areas requested. The choice of sensor must be considered, since the dimensions and focal length determine the qualities of the recording results and the eventual products. Table 1 presents several configurations used in different projects.

Data capture

A successful project requires good image quality, meaning that control of lighting is very important.
In indoor projects, continuous low-energy light systems are used. A “soft box” achieves constant light of uniform intensity over all the surfaces, minimising radiometric differences between the parts. A calibration strip is used to ensure that the colours of the final images are close to reality. Images are captured in RAW format, allowing global adjustments without loss of image quality.
All the generated information will be metric, so that we can measure the position, the distances, the orientation and the surfaces of the elements that compose it. This means that, for topographic methods, we must measure the position

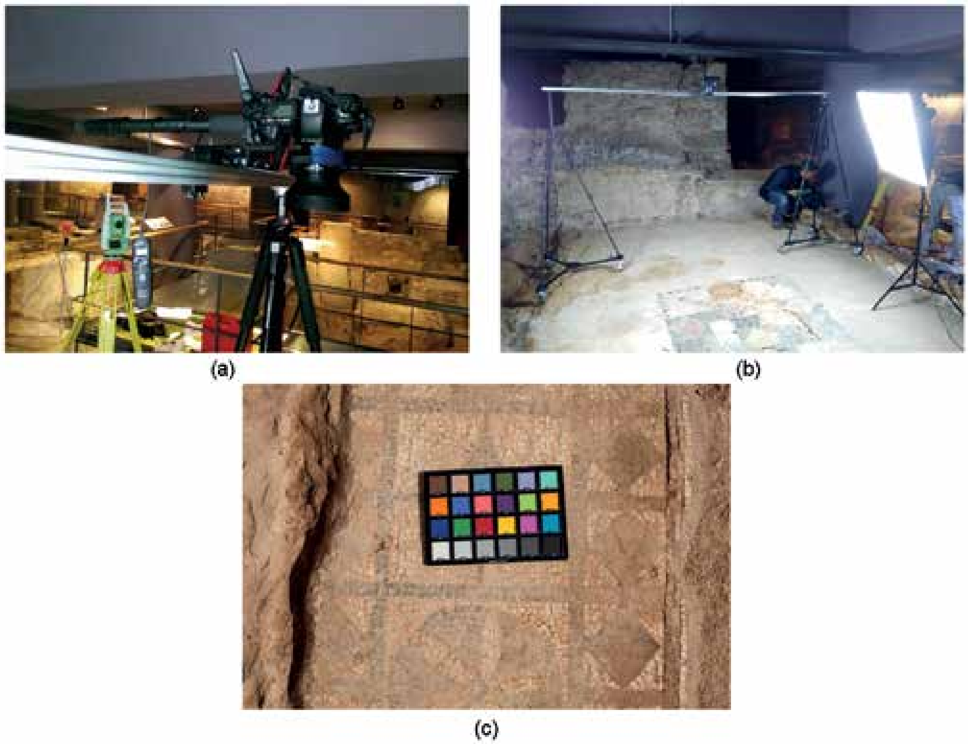

Fig. 2. a) Camera installed on support to capture images; at the bottom the total station and prism for topographic measurements; b) camera support structure and lighting system c) colour calibration template (photo by authors)

in the space of identifiable points, duly distributed, which also appear in the images. For this it is possible to work with natural points within the mosaics or with marked points (Fig. 2).

DATA PROCESSING: PRODUCT GENERATION

Prior to processing, images and other starting data need to be validated. Beyond their intrinsic quality, the relative position between them will be verified (overlap and sidelap). We will assess the image orientation, i.e. the position of the camera when capturing each image (XYZ position, ΩΘΚ rotations), also known as the aerotriangulation phase. At this point, it is possible to generate a digital surface model (DSM), a 3D model from the mosaic and the surroundings, using software based on structure from motion (SfM) algorithms. This DSM enables generation of the orthomosaics (metric documents without distortions caused by the camera, the optics, or displacements caused by the surface) using the adjustment aerotriangulation parameters and original images (Fig. 3).

DATA ANALYSIS

The orthomosaics are photographic reproductions or maps of the mosaic at real

Fig. 3. Top: orthomosaic with 0.0003m GSD; Bottom: textured 3D model (photo by authors)

scale, without geometric deformations. These allow real scale measurements using the computer, as if working directly on the object. With this information, all kinds of analyses can be conducted in the office, sharing information with colleagues throughout the world. These documents also have great archival value, since they allow reproduction of the mosaics in case of destruction or damage. All this information can be managed very easily in a GIS environment (Fig. 4).

Conclusions

The technology for transferring mosaics to our computers is fully available. It allows generation of valuable archival information, for preservation, analysis, management, sharing and dissemination of the knowledge of this type of artwork. With this methodology, the capture, processing and analysis of data can be carried out at very reasonable cost.

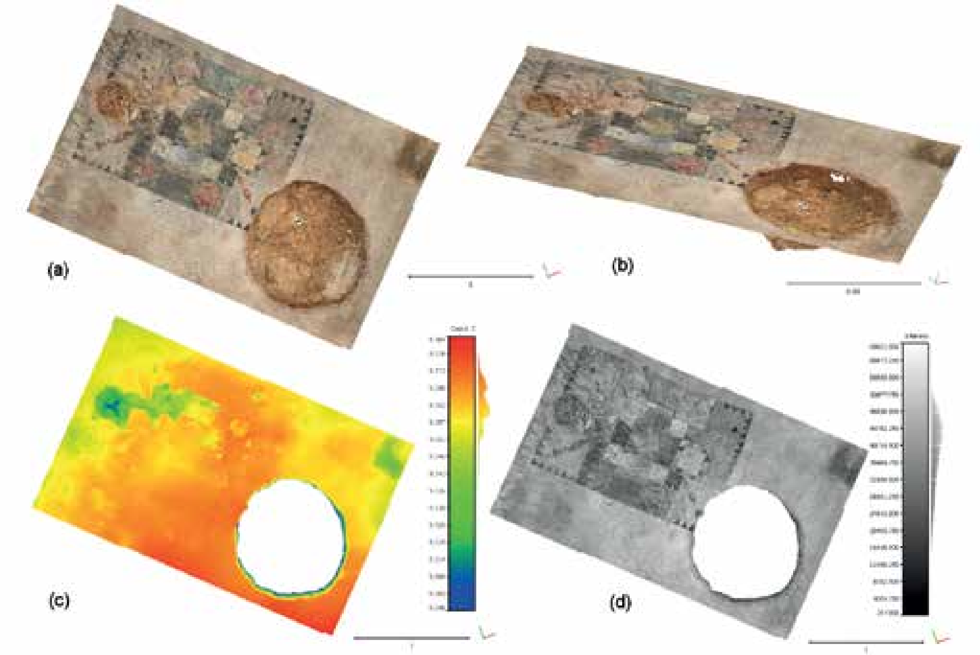

Fig. 4. a) DSM in RGB information; b) 3D modelling; c) elevation analysis; d) intensity analysis (photo by authors)

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CONSERVATION ASSESSMENT AND PLANNING FOR THE MOSAICS OF THE BARDO AND CARTHAGE MUSEUMS, TUNISIA

Fatma Naït Yghil

Abstract
The mosaics storage areas of the Bardo National Museum and Carthage Archaeological Museum lack the environmental requirements for preventive conservation and also present unfavourable physical and biological conditions. To address this critical context, the Institut National du Patrimoine (INP) is working towards development of a conservation plan, with the help of the international institutions dealing with mosaic conservation issues.
Keywords: Bardo, Carthage, storage areas, preventive conservation

Assessment

The Bardo National Museum and Carthage Archaeological Museum have hundreds of mosaic pavements and thousands of fragments stored in different spaces, generally not achieving the standards necessary for conservation.

In the Bardo Museum the panels are inside the main building and outside, in temporary storage in a metal structure near the central conservation-restoration laboratory of the Institut National du Patrimoine (INP) (Figs. 1-2).

The pavements of the Carthage Archaeological Museum are held inside the museum and in the surrounding area, but also inside a *cryptoporticus* of the Roman villas (Figs. 3-4).

None of the storage are suitable for satisfactory preventive conservation due to

Fig. 1. Internal view of the Bardo Museum temporary storage for mosaics (photo F. Naït Yghil)

Fig. 2. External view of the Bardo Museum temporary storage (photo F. Naït Yghil)

1. Impossibility of achieving the environmental requirements:
   - stabilisation of internal climates;
   - regulation of temperature and humidity;
   - control of ultraviolet radiation.

Fig. 3. Mosaic panels in one of the storage of the Carthage Archaeological Museum (photo F. Naït Yghil)

Fig. 4. The storage of the Archaeological Carthage Museum (photo F. Naït Yghil)

2. Unfavourable physical and biological conditions:

- total absence of storage structures;
  – overcrowded spaces, causing great difficulty in handling, movement and circulation;
  – great risk of biological contamination (moulds, insects, rodents) which can damage the organic components of the mosaic support (e.g. burlap, wood).

The collections present a wide range of conservation supports, generally using plaster and reinforced concrete, and many works lack proper documentation. Given these widespread problems, the fundamental lack of centralised storage spaces for the two museums, of true conservation workshops, and of qualified staff make the implementation of conservation tasks very slow.

Conservation plan

The two leading museums of Tunisia with large collections of mosaics are faced with fundamental problems of conservation, requiring first of all the training of qualified permanent staff, then development of a conservation-restoration workshop and new storage areas meeting basic standards of preventive conservation. The institutions concerned believe that an international cooperation project would support the Tunisian museum professionals in addressing this critical context. For this reason, the INP is engaged in developing a conservation plan, with the help of the international institutions dealing with mosaic conservation issues.

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THE EVOLUTION OF THE CONSERVATION-RESTORATION OF ANCIENT MOSAIC SUPPORTS

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Abstract

Since the early 20th century, a series of different materials has been used for the remounting of detached mosaics. The advantages and disadvantages of the most typical materials are presented in the view of the long-term conservation of the mosaics. For reasons of authenticity, the preferred solution remains conservation *in situ*.

Keywords: detached mosaics, new support, cement, plaster, aluminium honey-comb

Introduction

The early years of the 20th century saw the apogee of archaeological excavations, bringing to light large numbers of ancient mosaic floors. Mosaics were usually lifted and then sometimes re-laid on site, but more often stored or displayed in museums. The original preparatory mortar layers were generally completely removed during the lifting and restoration processes, since the archaeologists and conservator-restorers were exclusively focused on the *tessellatum.* The conservator-restorers focused increasingly on reassembling the mosaics on new supports, viewing this as the most effective way to preserve the detached mosaics. The most common re-backing materials were plaster and reinforced concrete.

Cement support

The technique of reassembling ancient mosaics on a reinforced concrete panel was used beginning in the first years of the 20th century. The panels were generally of 3-5 cm thickness, prepared using cement, sand and aggregate, and reinforced with iron bars or wire mesh. The rigidity and weight of the structure meant that the re-backed mosaics could placed in indoor pavements or on walls, as well as in outdoor sites. However this type of support caused serious damages to the original materials of the mosaics. The principal mechanisms of deterioration were the oxidation of the metal reinforcement bars, with consequent increase of their volume, as well as the direct effects from the highly soluble salts of the cement on the original mosaic materials. These two mechanisms result in fracturing of the cement, separation of the assembled mosaic fragments, and staining, pulverisation, detachment and loss of the tesserae. The great weight of the supports can also pose difficulties for the handling, transport, and display mounting of the mosaics.

The extensive use of reinforced concrete backing resulted in damage and threat to a vast archaeological heritage. Once the damaging effect of this type of support became evident, the conservator-restorers

Fig. 1. The oxidation of the metal reinforcement bars in a concrete mosaic backing (photo A. Ouslati)

Fig. 2. Reverse side of a mosaic panel mounted on a plaster support (photo A. Ouslati)

searched for alternative solutions to the mounting of the detached mosaics, using material other than cement.

Plaster support

This type of support was used from the 1980s to the present day. Although plaster has the advantage of lighter weight compared to cement, the resulting panel tends to be bulky, and are also unlike the reinforced concrete support in being suitable only for museum contexts, and generally mounted on walls, since they are not resistant to water.

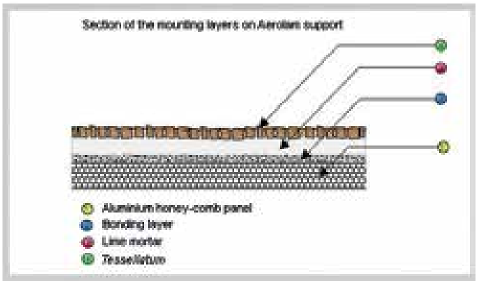

Fig. 3. Stratigraphy of the mosaic support using aluminium honey-comb panels

The plaster backing of the mosaic is frequently reinforced using natural fibres such as tow or burlap, and by mounting on a wooden frame using cleats, sometimes with the insertion of metal lathes. Conservator-restorers working in the Southern Mediterranean countries have generally found this type of support relatively effective, with a life span of approximately half a century, more if the mosaics are maintained in environments free of moisture. In the presence of moisture the plaster absorbs and dissipates humidity cyclically, resulting in damages such as detachments between the mosaic layer and the supporting panel, bulging, surface cracking and fracturing, detachments of tesserae, salt efflorescence, and deformation of the wooden frame.

The plaster panel does not promote the kinds of destructive forces seen with cement, but lacks the characteristics of chemical-physical stability necessary for long-term conservation of the mosaics. In any case, such mounting systems require continuous environmental monitoring and control.

Support in aluminium honey-comb panel (Aerolam)

The fundamental requirements for the backing of detached mosaics, allowing long-term exposure, safe handling and reversibility of the intervention are that the materials used be light, resistant, chemically and physically stable, compatible with the original tesserae and easily removable without damaging the original materials. Currently the material that best meets these requirements is the aluminium honey-comb panel, which has found many applications in modern conservation due to its characteristics of strength, complete planarity, and low weight. The honeycomb structure serves to reinforce the resistance in vertical compression while guaranteeing maximum lightness. Mosaics conservators have used this material since the mid-1980s, mainly for works held in museums. The resulting structure can be installed on both walls and floors. A limiting aspect of this material is its high costs, putting it out of reach for many of the operations in some countries.

Conclusion

The operation of lifting is a damaging intervention, no matter what type of support is used for the subsequent reassembly. The mosaics lose a large part of their original materials, and the connection with the architectural context and the original function is destroyed. Reapplication on a panel flattens and inevitably enlarges the surface of the *tessellatum*. In spite of this loss of authenticity, making the practice of lifting inappropriate, the practice still continues today. The solution of support using honey-comb panel would generally be considered as appropriate only for re-backing mosaics lifted in a historic era.

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BAROQUE *TARSIA* OF VENICE: TWO CASES OF A UNIQUE CONSTRUCTION TECHNIQUE

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Abstract

Floors in ornamental *tarsia* work are common in the baroque buildings of Venice. Recent conservation-restoration works have brought forth a wealth of information on the technologies used in their execution, which have previously been little reported. Such works must be understood as complex three-dimensional structures, composed of layers of different materials, designed and selected to ensure the resistance and aesthetic qualities of the floor through time.

Keywords: Baroque floors, *tarsia*, Basilica della Salute, resin, Venice

Basilica of Santa Maria della Salute

The Basilica of Santa Maria della Salute is an iconic Baroque building of Venice, designed by Baldassarre Longhena, who supervised its construction from 1632 until his death in 1687. Extensive renovations were conducted in 2013, including detachment of large areas of *tarsia* stone flooring for insertion of under-floor heating and conservation-restoration measures (Pannunzio 2018). The current report provides observations on the most interesting aspects of the techniques of execution.

The sanctuary has a marble floor composed of many types of local limestone, imported materials, and stone salvaged from previous monuments. The *tarsia* slabs were laid over many different kinds of mortars (Fig. 1). The first of these was generally a layer of *cocciopesto*, often using *terracotta* elements for greater robustness. The majority of *tarsia* slabs were then laid over grouts composed of slaked lime and sands, applied in two layers.

Fig. 1. Example of use of many different mortars for the floor of the sanctuary (photo E. Pannunzio)

Small fragments of stone slabs were often found placed between the two layers, clearly inserted one by one to achieve highly precise levelling. The use of different mortar compositions does not follow specific patterns, such as in relation to the thickness of the slab or the depth of fill, since as many as three different grouts could be observed side by side in restricted contexts.

Fig. 2. Mortar using resin and white lime binder for the laying of the altar *tarsia* (photo E. Pannunzio)

The floor with the most complex structure is that of the main altar. The marble *tarsia* elements composing stars designs were laid over larger limestone slabs, known as *steleri*, which provide support and greater resistance for thin and fragile *tarsia* elements. The pieces composing the stars are encircled by a square frame of thicker elements, in white marble. The tarsia pieces were generally laid using a mixture of limestone powder and vegetal material, identified by FT-IR analysis as vegetal resin, given the characteristic presence of abi-

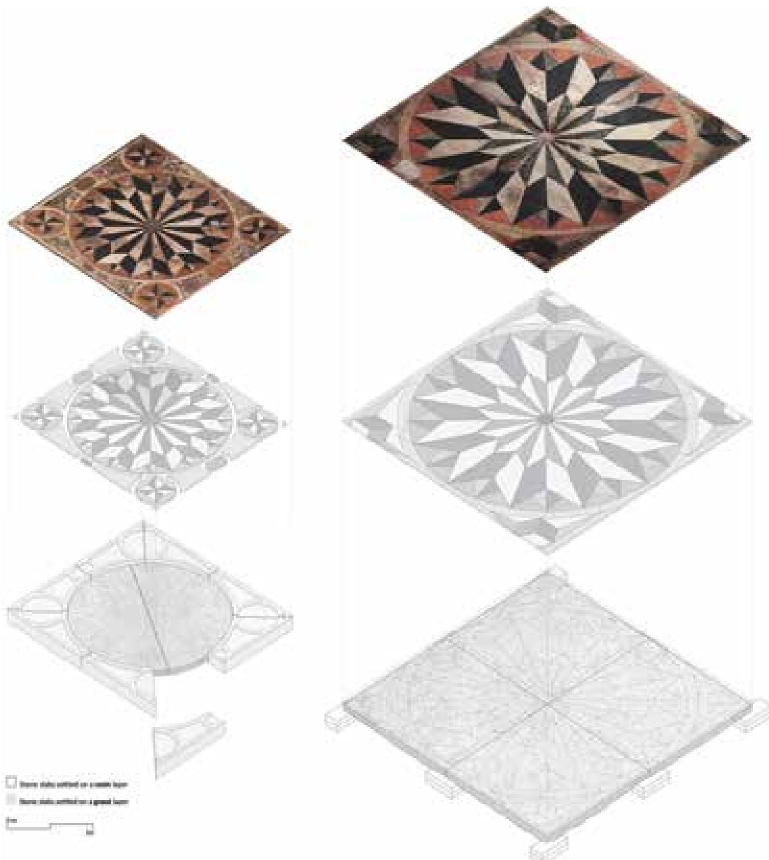

Fig. 3. Comparison of construction and decorative pattern of the altars of the Basilica della Salute (left) and Basilica dei Frari (right) (drawings by D. Favaron)

etic acid. This mixture is known to have been applied while hot. A small number of slabs were found to have been laid over a thinly applied white mortar: these were probably the last elements added, in which case the mortar would have allowed for longer working times, useful for fine work involved in completing the composition (Fig. 2).

Basilica dei Frari, Altar of Sant'Antonio

The floor of the Altar of Sant'Antonio in the Basilica of Santa Maria Gloriosa dei Frari has many similarities to that of the main altar of the Basilica della Salute (Fig. 3). The work was executed in 1673, to a design by Longhena, once again with a star pattern.

The floor was heavily damaged in the areas near the exterior walls and altar steps, due to rising damp and migration of salts from the ground. Many of the *tarsia* slabs had been previously re-laid using a mortar with gypsum binder, which had dramatically accelerated their degradation.

On detaching the slabs we observed that the *tarsia* elements had been laid over massive Istrian stone *steleri*, each one comprising one quarter of a star shape. These slabs had been isolated from the ground by means of small supporting walls in brick (Fig. 4), serving to protect the floor from rising moisture. Where the original mounting system survived, this was found to consist exclusively of the mix of stone powder and resin binder, identified by the analyses of the Antique Materials Analytical Laboratory of the IUAV University of Venice. This material would have helped to further protect the slabs from the effects of moisture and high tides, given its hydrophobic properties.

Fig. 4. *Steleri* of Istrian stone with marble *tarsie* laid over resin (photo E. Pannunzio).

Similar systems are reported to have been adopted for other altar floors and stairs (Pellizzari and Basso 2018; Favaro 2018), and appear to have provided useful protection. However we could also observe that the degradation of the resin mortars had not been uniform. In many areas the original bright yellow colour had transformed to dark brown and the material was now soft, sticky, completely imbued with water, and almost without adhesive qualities. Only a small share of the mortar remained in good condition, with a granular appearance. Differential deterioration had also been observed in the mortars of the Basilica della Salute. Since plasticisers were used in the preparations of these mortars (typically honey, wax or molasses), a possible explanation is that these were not uniformly blended, and that the better preserved areas were prepared with lesser shares of the plasticiser.

Conclusions

The uses of raised structures for altar floors, as well as the employment of resin mixtures, have been frequently observed in the Baroque marble floors of Venice. An interesting question concerns the or-

igins and evolution of the technique large *steleri* used to support the *tarsia* floors. Even more interesting is the widespread use of vegetal resin as a binder. Many Renaissance construction manuals contain recipes for the use of resin mixtures as a glue for stonework, especially in Florentine *commesso* works (Del Riccio 1996) [1]. Questions arise as to how this usage spread to Venice, and then was so effectively adapted to the local environmental characteristics and aesthetic language.
When originally prepared the resin served as a strong adhesive, and offered good hydrophobic properties, however these qualities were lost as the material aged. It would be useful to obtain data on the ageing processes, particularly in cases where the resin was used as binder in floor construction, subsequently subjected to salts and moisture. Would it be possible to conserve this natural mixture, now centuries old, or is replacing it the only way to maintain the integrity of the floor structures?
The authors are currently in the early stages of a more comprehensive study of Renaissance and Baroque floors. The more opportunities we have to observe these magnificent works, the more we are faced with questions. Their complexity is not limited to their surfaces. One of our aims is therefore to provide full reporting and illustration of the original techniques of execution.

Note

1. The oldest known and richest example of *commesso* work in Venice is in fact found in the Basilica dei Frari, near the main altar. The funeral monument of Francesco Contarini is a richly carved headstone with floral elements in marbles, laid over a thick layer of vegetal resin. Given the very early date of this work, of 1579, and its characteristics, it has been credited to a Florentine community of craftsmen. See A. Augusti 2000.

References

Augusti A. 2000. "Il Monumento Contarini alla Basilica dei Frari." In *Le chiese di Venezia*, edited by A. Augusti. Roma: Editalia.

Del Riccio A. 1996. *Istoria delle Pietre*. Torino: Allemandi.

Favaro T. 2018. "Il restauro del pavimento marmoreo della chiesa di Santa Maria Assunta dei Gesuiti a Venezia". In *I pavimenti barocchi veneziani*, edited by Lorenzo Lazzarini, Mario Piana e Wolfgang Wolters, 163-172. Verona: Cierre edizioni.

Pannunzio E. 2018. "L'intervento sulle pavimentazioni barocche della Basilica della Salute". In *I pavimenti barocchi veneziani*, edited by Lorenzo Lazzarini, Mario Piana e Wolfgang Wolters, 179-188. Verona: Cierre edizioni.

Pellizzari G., Basso E. 2018. "Il restauro conservativo del pavimento del presbiterio della chiesa di San Pantalon a Venezia." In *I pavimenti barocchi veneziani*, edited by Lorenzo Lazzarini, Mario Piana e Wolfgang Wolters, 173-178. Verona: Cierre edizioni.

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RESTORATIONS OF ANTIQUITY AND THE NAPOLEONIC ERA ON MOSAIC FLOORS OF POMPEII AND HERCULANEUM

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Abstract

The archaeological evidence illustrates the practice of restoration in Antiquity, particularly following the damages to the floors of Pompeii and Herculaneum due to the earthquake of 62 AD. In the case of Pompeii, specific techniques were developed. In the House of the Tuscan Colonnade in Herculaneum we find an unusual case of post-62 AD restorations using stone tesserae painted in yellow. Two *emblemata* from Herculaneum, of very different manufacture and subject, show further examples of "historic" restoration. The first, with a neutral field and Dionysian symbols, has been extensively restored during the Roman era. The second also shows extensive losses, but was restored in the Napoleonic era by the Officina delle Pietre Dure in Naples, using stones imitating the original micro-mosaic tesserae.
Keywords: Herculaneum, mosaic framework, ancient restoration, Dionysian symbols, micro-mosaics.

Introduction

The majority of the wealthy *domus* of Pompeii and Herculaneum preserve the floors executed from the First Building Period (3rd-2nd centuries BC) up to the destruction of the city in 79 AD. The floors were generally made in *caementicium* on a fictile, lava or travertine base, and since the villa owners carried out continuous maintenance, they are fairly well conserved. After their original execution, some were modernised with insertions of mosaic bands of marble and large or small fragments of different materials (Pisapia 2016: 406-412). With the earthquake of 62 AD and subsequent seismic events and resulting collapses of roofs and walls, the floors suffered serious damages. The owners then carried out more substantial restorations, intending to return the rooms to use as soon as possible.

Restorations in Pompeii

Given the context of extensive and heavy damage, an effective restoration system was invented, consisting in filling the lacunae with an *impasto* very similar to *intonaco* plaster, and then polishing the surface, to re-establish the entirety of the floor. The *impasto* in the most prominent houses (e.g. House of Menander, of Paquius Proculus, of Vettii, of the Small Fountain, Forum Bath) was a highly refined, powdered volcanic material of a slate colour, (Pisapia *et al.* 2018). In some houses this material was laid over the entirety of the pre-existing floor, creating a uniform shiny surface, such as for example in the peristyle of the House of Menander (Fig. 1).

Fig. 1. Detail of restoration of the floor of the peristyle in the House of Menander in Pompeii (photo G. Albano, National Archaeological Museum of Naples)

Restorations in Herculaneum

This shiny *impasto* restoration technique was not used in Herculaneum, where the floors had mainly been executed in mosaic. Instead, the ones that were seriously damaged (Guidobaldi *et al* 2014:107-133, pls. LXXXV no. 64, LXXXVI nos. 65, 65a, 66, 71-72, 73, 76 and pl. LXXXVII nos. 73, 74-75, 78, 79, 80) could undergo a complete remake with careful imitation of the previous mosaics, or be repaired by filling in with similar tesserae or embellishing marble insertions.

The great "triclinium 13" of the House of the Tuscan Colonnade shows a particular form of restoration, very likely done after the earthquake of 62 AD. The original floor was in white *tessellatum*, with a border of two black bands and a false central *emblema* of an eight-pointed star. The lacunae and many sunken areas of the original white surface were largely filled in with tesserae of the same colour. This floor also show the peculiar use of yellow paint on the space between the black borders and the centre of the stars (Fig. 2).

Fig. 2. House of the Tuscan Colonnade, Herculaneum: detail of the use of tesserae for restoration of the mosaic in Triclinium 13 (photo G. Albano, National Archaeological Museum of Naples)

Two *emblemata* in Herculaneum

The site of Herculaneum also provides two further examples of historic restorations. Both of these are *emblemata,* of different subjects and manufacture, which were reduced to a very poor state of and then restored in similar ways but in different eras. The first mosaic, excavated by Amedeo Maiuri in the Samnitic House in 1927 (Fig. 3), shows Dionysian symbols on a neutral background with a black serrated notched edge and a checkerboard motif. The *emblema* is of rather mediocre manufacture, likely of the 1st century BC, when this sort of mosaic was no longer fashionable, the new preference being for various types of panels in marble. After the earthquake of 62 AD Herculaneum suffered

Fig. 3. *Emblema* with Dionysian symbols from the Samnitic House of Herculaneum (photo G. Albano, National Archaeological Museum of Naples)

the same social changes as at Pompeii, and the once aristocratic Samnitic House was divided into various apartments. Our *emblema* comes from the second floor, which was used as quarters for slaves. The centre with Dionysian symbols had on the whole was preserved, but the greater part of the field of the mosaic shows integration of losses using tesserae similar to the original ones. The border has been integrated in several points, including with glass paste tesserae, which would more typically have been material for wall mosaics of the mid-1st century AD (Fig. 3).

The second mosaic, whose exact provenance is not known, very likely represents Hylas between Mercury on the left and a nymph on the right in a mountain landscape. Hylas holds an amphora flowing with water; the panel is bordered by an

Fig. 4. Detail of the restored part of the mosaic representing Hylas between Mercury and a nymph (photo G. Albano, National Archaeological Museum of Naples)

undulated ribbon. The mosaic is of a good workmanship, but the heavily damaged right side and border have been restored with tesserae of material different from the original in both quality and size. In the case of the nymph on the right side, the restoration was limited to reintroducing the outline of the figure (Fig. 4), while the fabric of the original *tessellatum* was mimicked by means of incisions. Rather than being of the Roman era, this particular restoration was most likely executed by the Real Opificio delle Pietre Dure during the Neapolitan reign of Gioacchino Murat (1808-1815), brother-in-law of Napoleon. The Opificio was specialised in micro-mosaics and also produced true masterpieces of restoration, such as the Medusa Table now in the Capodimonte Museum. In this case the restorers added a border with Napoleonic symbols to a mosaic from Pompeii, with the head of the mythical monster.

References

Guidobaldi F., Grandi M., Pisapia M. S., Balzanetti R., Bigliati A. 2014. *Mosaici Antichi in Italia, Regione Prima*, "*Ercolano"*. Pisa: Fabrizio Serra Editore.

Pisapia M. S., Tirelli G., Lugli S. 2018. "Una forma sconosciuta di restauro antico dei mosaici: la patinatura a Pompei". In *Atti del XXIII Colloquio dell'Associazione Italiana per lo Studio e la Conservazione del Mosaico (AI-*

SCOM), Narni 15-18 marzo 2017 edited by Claudia Angelelli, Chiara Cecalupo, Marco E. Erba, Daniela Massara, Federica Rinaldi, 527-534. Roma: Edizioni Quasar.

Pisapia M. S. 2016. "Integrazioni e restauri antichi nei pavimenti delle città vesuviane". In *Estudios sobre mosaicos antiguos y medievales, Proceedings of the XIII Colloquium of the Association Internationale pour l'Étude de la Mosaique Antique, Madrid 14-18 September 2015* edited by Luz Neira Jiménez, 406-412. Roma: "L'Erma" di Bretschneider.

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THE MOSAICS OF EUBOEA ISLAND, GREECE: 'FROM ANTIQUITY TO TODAY'

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Abstract

The archaeological sites of the island of Euboea preserve mosaics dating to the Hellenistic period. With the aim of promoting the conservation of this heritage and the further development and continuation of mosaic arts, the Hellenic Society for Near Eastern Studies organised the exhibition 'Mosaics - From Antiquity to Today' in Chalkis, the island's capital. More than 550 visitors of all ages explored mosaic art through three thematic sections on the origin and history of mosaics, the techniques of execution, and their potential for modern artistic expression. The latter section included the possibility of hands-on participation. The feedback collected from visitors indicated the success of the endeavour. The intention of the organising team is to build on this basis, with the local community, for the development of a centre of mosaic art.

Keywords: Mosaics, Chalkis, Euboea, art history, modern art

Antique mosaics of Euboea

The island of Euboea has a long history of important archaeological finds, particularly from the ancient cities of Chalkis and Eretria (Dunbabin 1999). Eretria is the site of some the most impressive Hellenistic-era pebble mosaics of Greece. The best known are those of the 'House of the Mosaics', dating to the 4th century BC (Ducrey *et al.* 1993). These are composed of naturally smoothed pebbles, roughly 1-2 cm in diameter, mainly in black and white but also in yellow, orange and red, setting out geometric patterns and portraying themes of mythological, human and animal figures.

Promotion of ancient and modern mosaic art

Rescuing, conserving and enhancing cultural heritage are matters that best involve the participation of local communities. For this reason, in 2016, the Hellenic Society for Near Eastern Studies organised the exhibition 'Mosaics - From Antiquity to Today' in the Town Hall of Chalkis, capital of Euboea Island. Our exhibition presented the art of ancient mosaics from the point of view of both archaeology and conservation of antiquities, with the aim of promoting and developing ancient and modern mosaic art. More specifically, the objectives were to create a discourse with visitors on three topics:

- the history and origin of mosaic art, with special reference to discoveries on Euboea;
- the technologies and materials of mosaic making, historically and today;
- the potential for artistic expression through modern mosaic work.

Explanatory brochures were provided at

Fig. 1. Panorama of the exhibition (photo K. D. Politis)

the entrance, and guided tours were provided on a daily schedule. Emphasis was placed on specially tailored small workshops for both children and adults.

The exhibition space was designed with a specific syntax for achievement of the communication objectives (Fig. 1). At entrance, visitors were guided to an area with informative panels on four themes: Origins of mosaic art; Development of mosaics art; Mosaics of Euboea; Production techniques of ancient mosaics (Fig. 2). The visitors next entered into an area displaying artworks by the contemporary mosaicist Elli Mantzana, a resident of Chalkis (Fig. 3). This featured more than 40 mosaics, carefully chosen to illustrate modern materials and techniques. The last part area provided a workshop set-up with all types of mosaic materials and tools, as well as tables. Visitors were encouraged to participate in actually making mosaics, using these resources (Fig. 4).

Fig. 2. Explanatory panels on mosaics of Euboea; visitors in the area of the information panels (photo E. Almaliotou)

Fig. 3. Mosaic (70x70cm) by the artist Elli Mantzana (photo E. Mantzana)

Figure 4. Adults and children during workshops in working table area. (photo by K. D. Politis)

Results from visitor feedback

Visitor feedback was collected through a written questionnaire and personal discussions. Over the 10 days of the exhibition almost 50 primary school students and 500 other individuals visited the exhibition. The most remarkable revelation was that only 20% of these participants had ever seen a mosaic. Most of them stressed that the combination of historical information and interactive mosaic workshop was very interesting and enlightening. Some were pleasantly surprised by the potential of modern mosaic techniques and almost the 30% expressed a strong interest in themselves learning the art of mosaic-making.

Conclusions

Our exhibition had a positive impact on the local community. Given the very encouraging results we would like to repeat the event in Chalkis, and offer similar ones in Eretria and Kymi, the other main cities of Euboea Island. Our main purpose would remain that of arousing awareness of the artistic value of mosaics throughout history. The evaluation of the first event suggests areas for improvement, in particular concerning the feedback mechanism. In this regard we would like to take a more scientific approach in the designing the questionnaires, so as to gather quantitative and qualitative data serving in the analysis of the visitors' personal experience. Such information would be useful for evaluation of potential future cultural activities concerning ancient and modern mosaic art, organised in the local communities.
Our team's long-term plan is the development of a multi-purpose centre of mosaic art, serving for activities such as theoretical seminars, thematic exhibitions and instruction in modern mosaic work. Such a dedicated space would encourage and inspire local communities to maintain and develop their cultural heritage in mosaic art.

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References

Ducrey P., Metzger I. R. and Reber M. 1993. *Le Quartier de la Maison aux mosaïques. Eretria Fouilles et recercher, VIII: Ecole Suisse d'archéologie en Grèce.* Lausanne: Editions Payot.

Dunbabin K.M.D. 1999. *Mosaics of the Greek and Roman World.* Cambridge: Cambridge University Press.

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CONSERVATION-RESTORATION OF A FLOOD-DAMAGED CONTEMPORARY MOSAIC FROM AN ELEMENTARY SCHOOL, OBRENOVAC, SERBIA

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Abstract

A ceramic mosaic originally created in 1979 for a public school in Obrenovac, Serbia was severely damaged by the flood of 2014. As well as its value as a work by the well-known artist Ljubiša Petrović, the mosaic also had symbolic importance to the school and its history. The floods had resulted in the destruction of the entire town, and the Institute for the Protection of Cultural Heritage of Serbia chose to carry out the restoration as part of a larger program of humanitarian assistance. The conservation-restoration intervention utilised a variety of methods to identify the original design and its components, design replicas, and produce the individual ceramic pieces for reassembly of the entire artwork.

Keywords: Mosaic, contemporary, conservation, restoration, presentation

Damage to a ceramic mosaic originally executed in 1979

After the devastating floods that hit Serbia in 2014 the Institute for the Protection of Cultural Monuments of Serbia received a call from the elementary school of Obrenovac, asking for the inspection a damaged mosaic and the possibility of assistance for its repair. We were told that the mosaic had been made of specifically designed ceramic pieces in 1979, and that it had great value to the school, such that for successive generations of students it had served as the setting for their graduation photography. Upon arrival, the signs from the receding floodwaters left evident that the water level had exceeded two metres. The debris carried by the waters had struck the mosaic with force, causing significant losses and damage. From photographs, information provided by the teachers, and the remains of mosaics, we could understand that the structure of the mosaic consisted of a series of elements, assembled in one large roughly rectangular work, and two circular ones on the adjacent walls. The large rectangular work, over two metres in height, had suffered significant damage, while the two circular mosaics were completely destroyed. Luckily, after the flood, one of the first persons to arrive with the rescue team had been an art teacher, who managed to salvage several pieces of the circular mosaics. This assisted us greatly in their reconstruction (Figs. 1-2).

Reconstruction

In view of the art historic significance of the work and its importance to the school, the Institute for the Protection of Cultural Monuments of Serbia agreed to carry out a complete reconstruction of the mosaics. The pieces recovered from the mud

Fig. 1. Detail of the mosaic after the flood (photo M. Protić)

Fig. 2. Pieces of the mosaic after the flood (photo M. Protić)

were first transferred to a studio suitable for undertaking the project. At first we hoped to collaborate with the original artist, given that he was still alive, obtaining the original moulds for production of new parts. However the artists was elderly and in poor health, and the moulds had been destroyed not long after 1979.

Having realised the impossibility of involvement by the original artist we developed other approaches to the problem. First, the collected parts were preserved and restored, then used for making new imprints to be used as moulds for casting the missing components. For the types of elements of which no exemplar had been recovered, we designed their replacements based on photos of the original, in particular from the many photos of generations of students taken in front of the mosaics. The geometry and precision of the original construction imposed the necessity of accuracy in dimensioning the replacement parts. The technique of casting from a mould was chosen as the fastest and simplest means of producing the large number of pieces necessary for reconstruction. For this purpose, model pieces were first designed and prepared in dimensions 20 percent larger than the original, consistent with the expected shrinkage during drying. A Dutch semi-porcelain clay was used, facilitating imitation of the original textures. The model was then fixed to a smooth surface and allowed to dry. Around this a frame was constructed, and then the mould was poured using a gypsum modelling plaster. After drying, the model was destroyed and removed from the interior, including any residual dust, making the mould ready for production. The clay "plates" for production of the final pieces was then pressed into the mould surface. Once the clay is dried it is reduced in weight and detaches readily from the mould. After biscuit baking, the clay is dehydrated and ready for colouring and a final firing. It was identified that the original glazing is a mixture of copper oxide and iron oxide glazed transparently. After a series of tests we were able to select a very similar compound for use in glazing the replica components.

The missing irregular concave shapes were reproduced in a similar manner, but without working from moulds. Instead the

Fig. 3. General view of the round mosaic after treatment (photo M. Protić)

design of the replicas was prepared in dimensions 20% greater than the original, corresponding with the expected shrinkage. Each new piece was constructed from semi-porcelain clay, using the "sausage" technique, in which the clay is prepared in strips and then used to gradually build the form in the original form and finish, but 20% larger. These pieces were dried and fired, then glazed using the same formulas as the original. The glaze was purposely produced with less glassiness than the original, making the replica pieces easy to distinguish. The elements thus prepared were attached to the circular plate of plywood serving as the sculpture backing.

The large rectangular mosaic was cleaned *in situ*, using a mild solution of soap in water. After this procedure, which achieved excellent results, a final disinfection was carried out against harmful biological infestations that might have been left by the flood. The broken panels of the large

Fig. 4. General view of the main rectangular mosaic after treatment (photo M. Protić)

rectangular mosaic were replaced with the moulded and cast parts, prepared as described above. After installation, a retouch was carried out with same methodology as on circular mosaics (Figs. 3-4).

Conclusions

The Institute for the Protection of Cultural Monuments performed this conservation-restoration intervention without charge, using a mixture of innovative and traditional methods. We were very pleased to provide this service so that the children of Obrenovac could return to school in safe and familiar environment, after the devastation caused by the flood of 2014, and to prevent the loss of as significant work of art.

Authors

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BUTRINT NATIONAL PARK, ALBANIA: A SCHOOL OF EDUCATION AND TRAINING FOR A GENERATION OF ARCHAEOLOGISTS AND CONSERVATORS

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Abstract

Butrint National Park in Albania contains archaeological monuments dating from the Roman era to the 19th century. In 2000 the Butrint Training School began operations, promoted by the Butrint Foundation, the Packard Humanities Institute, the Albanian Institute of Archaeology, and the University of East Anglia. Over the next 12 years more than 500 students participated, taking training in both archaeological and conservation-restoration theory and techniques, at the same time as promoting contemporary conservation ethics. Butrint is now the best example of a managed heritage site in Albania, and over 40% of the archaeologists currently active in the country once attended the Training School.

Keywords: Albania, heritage management, conservation

Introduction

In 1991, after the collapse of the communist political system, Albania was among many other countries facing serious problems, including in the scientific and academic sectors. Archaeology, conservation and cultural heritage management in general, including even the country's previous achievements, were threatened by the changes. Given this context, one of the most important goals of the Albanian institutions has been to advance the training programmes for students. To assisting in facing the practical challenges the institutions sough the involvement of foreign partners and exchange programs involving universities of Western Europe and North America. These brought new and challenging philosophies, integrating contemporary archaeological thought and debate, going beyond the previous concentration on material cultural studies. Integration of young archaeologists and students in different foreign projects all over Albania brought new experience and inspiration for the future years. Butrint National Park has played an important role in this process.

The school of field archaeology

The ancient town of Butrint was first proclaimed a Cultural Monument in 1948, and in 1992 was designated as a UNESCO World Heritage Site. In 2003, a larger area of cultural and natural landscape was declared a National Park. In 1993 the Butrint Foundation was formed, based in the United Kingdom. The foundation supported a series of archaeological excavations and surveys in and around Butrint over a period of 18 years. Since the beginning of the collaboration between the Albanian Institute of Archaeology and the foundation, the joint Albanian-British team saw the need to involve Albanian students in excavations, by integrating a

Fig. 1. Participants at the field work at the Roman bath adjacent to the theatre

Fig. 2. Introduction to post-excavation processes

training programme as part of the project. It was agreed to begin this new initiative by opening a school of field archaeology, and in 2000 the Butrint Training School began operations. The training school operated under funding of the Butrint Foundation and the Packard Humanities Institute, from 2000 to 2012 (Fig. 1). In the early years it was also linked with education abroad in the junior years of the University of East Anglia's School of World Art Studies (Butrint Foundation 2002). There were considerable investments in postgraduate training funded from the same sources, but in essence the school was intended as a basic undergraduate introduction to fieldwork. The Butrint Training School worked to expand the types of courses offered to Albanian students, providing them with a greater range of opportunities. It aimed at imparting the key elements of modern archaeological excavation including:

– health and safety in field archaeology (Hysa and Molla 2009);
– elementary surveying techniques and instruments, including the theodolite and level;
– excavation techniques;
– stratigraphic recording systems;
– archaeological draughtsmanship;
– archaeological photography;
– processing and recording of archaeological artefacts;
– introduction to post-excavation processes (Fig. 2).

From the outset, one of the aims was for the training program to be taken over by its own alumni. Thus, in 2008 an Albanian team took over instruction of the Butrint Training School, organised by Butrint National Park and the Albanian Heritage Foundation. In 2012 the program was wound down, at the close of the major excavation campaigns.

The on-site conservation activities were mainly focused on monument and mosaics conservation, and over the years many students participated in the projects. In the summer of 2010 a pilot program was organised in parallel with the excavation program to deal with basic conservation issues and cultural heritage management at Butrint. In 2010 direct interventions were carried out on the monuments of the Vrina Plain, in particular a 5th-6th century basilica and underlying Roman villa (Fig. 3) (Butrint Foundation, Annual Report 2010). A part of the apse of the basilica, which has survived for centuries, was being damaged by winter

Fig. 3. Conservation work on the mosaic pavement of the Roman villa in the Vrina Plain

Fig. 4. Albanian university students

weather. In 2011 students and specialists joined in a conservation project for the remains of the Ali Pasha castle (15th-19th century), and in 2012 there was a further project for the city walls of Butrint.

The students of the conservation program were selected on the basis of their previous participation in the archaeological excavation program of Butrint Training school. The goal was to train a group of Albanian students in the basic theory and techniques of excavation and conservation, whose awareness of the management of archaeological and conservation problems of Butrint would contribute to their genesis as future professionals. Similarly, the Butrint Foundation and then the Butrint Training School also involved workmen from local communities, in particular the village of Shën Dëlli, so as to educate them about ancient sites, help them understand the importance of the World Heritage site of Butrint, and develop them as stakeholders of the whole process. Armenian specialists were also sent to Romania for participation in a parallel project in collaboration with the Transylvania Trust of Romania (Butrint Foundation 2009). In October 2007 the International Centre for the Study of the Conservation and Restoration of Cultural Property (ICCROM) held its annual South East Europe conservation course in Butrint for the first time, in collaboration with the Butrint National Park and Butrint Foundation. The participants included two specialists from Butrint, as well as 20 students from Serbia, Bosnia, Bulgaria, Croatia and Georgia. The courses provided seminars and lectures by Italian, Albanian and British experts, supported by site visits and hands-on conservation work. Following introductory sessions on the ethics and practical basics of conservation, the course concentrated on the methods and techniques for diagnosis and conservation of the stone and mortars in the structural remains of archaeological sites.

Conclusion

The Butrint Training School contributed substantially to the archaeological excavations and application of correct conservation techniques in Butrint. Moreover, it produced a constant flow of new potential archaeologists and conservators, and gave Albanian university students the opportunity to take part in the sort of field project not common elsewhere in the country (Fig. 4).

Over a period of 12 years, more than 500 Albanians and foreign students participated in training sessions focused on the different excavations and conservation tasks. The Butrint Training School served as an essential complement to conventional classroom based teaching, inculcating a sense of teamwork, transferable skills, discipline and a work ethic, in addition to the practical benefit of learning archaeological and conservation techniques in the field. This investment in local students has been extremely successful in creating a new generation of archaeologists. As of 2010, 40% of the professional Albanian archaeologists working in state institutions and the civil sector, including the current author, had begun their careers at Butrint.

Acknowledgements

I am grateful to the Butrint Foundation for their support of my participation in this poster session.

References

Butrint Foundation. 2002. "Annual report". https://docs.wixstatic.com/ugd/215a2c_2b53974ba91a448baa671ba8a932a9cc.pdf

Butrint Foundation. 2009. "Annual report". https://docs.wixstatic.com/ugd/215a2c_106a9158cbd04ea09f4e886a0aadd13c.pdf

Butrint Foundation. 2010. "Annual report". https://docs.wixstatic.com/ugd/215a2c_106a9158cbd04ea09f4e886a0aadd13c.pdf

Hysa V. and Molla N. 2009. *Manual mbi praktikat arkeologjike në terren*. Tiranë: Albanian Heritage Foundation.

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Erjona Qilla graduated in History-Archaeology from the Faculty of History and Philology at Tirana University in 2004. She has also participated in several training programmes in conservation and management of archaeological sites with mosaics. Since 2005 she has served as the staff archaeologist for Butrint National Park, a UNESCO World Heritage Site. In this role she has worked as field supervisor for several archaeological projects at Butrint and in the surrounding region.

A DATABASE OF THE CHEMICAL AND STRUCTURAL COMPOSITION OF POST-1880 GOLD MOSAIC TESSERAE

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Abstract

Gold mosaic tesserae, mainly from Germany from 1880 to 1920, are reviewed and analysed concerning their composition. The examination of the morphology and thicknesses of the glass layers by electron microscopy, and the chemical analysis using EDX, demonstrate the relationship between glass composition and damage patterns. The glass analysis enables determination of chemical stability and provides a basis for understanding the glass characteristics. Over 100 samples of predominantly historical gold tesserae were analysed and the results entered into a database, which can now serve for comparative investigations.

Keywords: gold mosaics, database, analysis of the composition

Problems in the conservation-restoration of "gold mosaics"

The so-called "gold tesserae" or "silver tesserae", used in "gold mosaics" are fabricated in a structure consisting of gold or silver foil sandwiched between two layers of glass (Fig. 1). The production process for the gold tesserae has remained virtually unchanged over recent centuries, but the appearance of the modern pieces differs substantially from historic tesserae. The modern tesserae are of uniform colour and size, making them difficult to use for the integration of damages during restoration interventions. One of the often observed damages in historic works is the loss of the cover glass, following which the metal leaf will also flake off. Given this context, the authors participated in the analysis of more than 100 gold tesserae from predominantly historic mosaics, and the entry of the glass chemical compositions into a database. The database of the glass chemical characteristics can now be consulted for comparative investigations and conservation-restoration purposes.

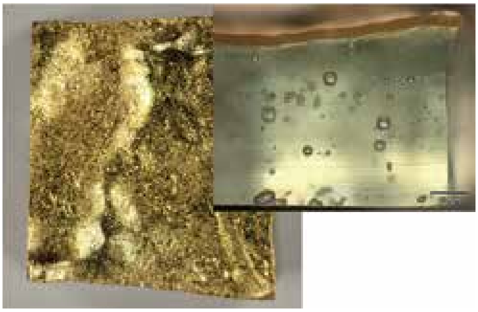


Fig. 1. Historic gold mosaic from the *"Empolyees' Gate"*, 1896/97 with the side view showing the principal structure of gold mosaics (photo M. Raedel)

Objectives and source material for the database

More than 110 samples of gold tesserae were collected, including many colours and shapes used in works from 1880 to the present, with the aim of analysing the

Fig. 2. AEG Beamtentor, *Employees' Gate*, Berlin, 1896–1897 (photo Georg Slickers)

chemical composition and production procedures of the glass. One of the intended uses of the data was as a basis for reproduction of tesserae to be used in restorations. The majority of tesserae were obtained from historic works in Germany, but there were also samples from France, Austria and Italy, in some cases consisting of sales samples. The samples from Germany included those from prominent buildings such as St. Mary's Cathedral and Brahms Kontor Haus in Hamburg, and the Clerks' Gate of the former AEG factory in Berlin (Fig. 2). For each sample the data recorded included the origin, the age, the general appearance, the colour of the glass layers, the tessera size, the metal foil used (silver, copper, gold), the categorisation and description of any deterioration, as well as photographic images. The often-observed loss of the cover glass is a typical damage and if it flakes off, consequently the gold leaf will flake off too.

Analytical methods, characterisation of glass11

The examinations of the individual tesserae were conducted using optical stereomicroscopy, scanning electron microscopy (SEM), and energy dispersive x-ray spectroscopy (EDX) with ScienceGlass Software (1998-2000) [1]. The SEM analysis served for dimensional measurements of the cover glass and metal foil, while the EDX quantitative analysis served for identification of the composition. The elements contained in the glass were detected together with the qualitative composition of the metal foil. The analyses were performed in high vacuum mode (FEI-

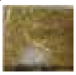
Object, Year	St. Mary's Basilika Hamburg, c. 1880 		Muse of Art Berlin, c. 1892 		AEG Berlin, c. 1896 		Sample Germany, c. 1960 		Sample Italy, c. 2000 		Sample Italy, c. 2000 	
Manufacturer, Doc.-No.	Manufacturer unkown, GM52		Puhl & Wagner Berlin, GM18		Puhl & Wagner Berlin, GM64		Mittinger Darmstadt, GM75		Dona & Figlio Italy, GM56		Orsoni Italy, GM83	
Support glass SG Cover glass CG	SG	CG	SG	CG	SG	CG	SG	CG	SG	CG	SG	CG
T_g [°C] (Priven2000)	483	487	477	453	493	500	483	493	470	437	434	436
$\alpha \cdot 10^6$ [K-1]	9,4	9,2	10,2	8,4	11,3	10,9	11,4	11,1	9,6	9,9	11,9	10,4
PbO [mol%]	1,5	1,2	4,8	7,5	1,5	1,5	1,9	1,8	2,6	10,2	5,4	7,6
BaO [mol%]	5,7	3,7	1,2	0,9	-	-	-	-	-	-	-	-
K_2O [mol%]	0,4	0,2	1,3	4,4	2,8	2,6	2,9	2,7	1,6	13,5	1,9	5,6
Na_2O [mol%]	14,9	15,2	12,8	7,7	15,9	15,1	16,0	15,4	14,1	1,3	20,2	12,2
Σ Alkali [mol%]	15,3	15,4	14,1	12,1	18,7	17,7	18,9	18,1	15,7	14,8	22,1	17,8

Table 1: Selected examples of historic and modern gold tesserae

XL-30 ESEM) on carbon-coated polished cross-sections.

Table 1 shows selected examples of historic and modern gold tesserae. The support glass (sg) of most gold tesserae was found to consist of glass with a lead content of up to 18.6 mol % (46 wt %), while in most samples the cover glass (cg) shows a similar or slightly higher lead content. The thickness of the support glass varied between 2.5 mm and 5 mm. The cover glass showed a greater range of thickness, from 80 μm to 515 μm.

The support and cover glass with yellow and green colouration were found to have used manganese and iron as colouring agents. The modern Italian gold tesserae contain a considerable amount of copper, achieving a distinct blue in the support glass. It can be observed that the composition of modern glass tesserae from Mittinger, Germany and Orsoni, Italy are similar to those produced in 1896 by Puhl & Wagner, leading to the conclusion that the mix of compounds has changed little over time.

In about 70% of the samples (named "Type 1"), the two layers of support and cover glass were found to have a similar or identical composition, while the remaining 30% (named "Type 2") showed a considerable differentiation (in Table 1, sample 3, 5 and 6; Raedel *et al.* 2009: 127-130). In particular, the Type 2 samples show a significantly higher fraction of lead in the cover glass, a method generally used to lower fusion temperature (Wedepohl 2003). The two typologies were found in all ages of historic tesserae.

Characterisation of metal foil

All samples examined contain a metal foil of gold, silver, or metal alloy leaf. No colloidal gold was found. In the samples up to about 1920, besides pure gold leaf, various alloy foils were identified. In samples from about 1930 onwards, the foil was generally pure gold or silver, and alloys were rarely used. The use of various metals is presumably one of the reasons for the observed greater variety in colour of historic gold mosaics. The thickness of the metal foil is quite similar for the whole period, at 0.1-0.5 μm. Arsenic was found in the cover glass of samples dating to around 1900, in particular in "art nouveau" mosaics, overlying silver foil. The arsenic would have been used to obtain the desired "gold" appearance (Fig. 3).

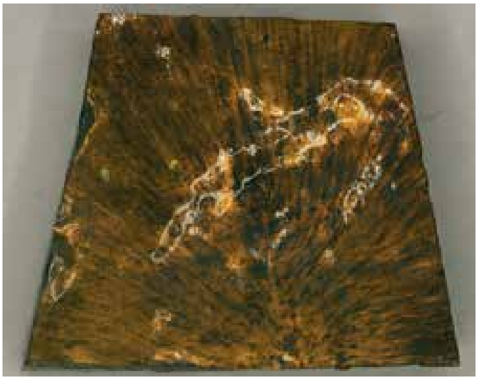


Fig. 3. Art nouveau gold mosaic from c. 1900: the content of arsenic in the cover glass gives a golden appearance to the silver foil (photo M. Raedel)

Conclusions

The database developed provides an overview of the appearance of gold mosaic tesserae in relation to the chemical composition of the glass, the types of foil used, and the dimensioning of the glass layers and overall form of the tessera, as used in mosaics from 1880 to the present day. The study shows continuity in the production process, demonstrating similarities in the three-layered structure and general manufacturing technique, independent of the provenience. Two variations in the basic methods were observed, continuing over the entire 135 year period: “Type 1”, in which the support and cover glass have a very similar composition; Type 2, in which the two glass layers have different chemical compositions. The greater variation in colour in the earlier era is probably due especially to the greater variety of embedded foils. In the modern era there has also been a tendency towards more uniform colour in bulk production of glass, and lesser variability of shape.

Note

1. ScienceGlass program, 1998-2000. Version 6.5, build 6.50.08.086, ITC Inc.

References

Raedel M., Unger B., Feldmann I., Bücker M. 2009. “Untersuchung historischer Goldmosaike, Herstellungstechnologie und charakteristische Schadensbilder”. In *Metalla, Archäometrie und Denkmalpflege*, *Symposium Proceedings No. 2*, 127-130. Bochum: Deutsches Bergbau-Museum.

Wedepohl K. H. 2003. *Glas in Antike und Mittelalter: Geschichte eines Werkstoffs.* Stuttgart: Schweizerbart.

A DETACHED MOSAIC FROM THMUIS, EGYPT: RESUMPTION OF A CONSERVATION PROJECT, WITH OBSERVATIONS ON THE CONSTITUENT MATERIALS

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Abstract

An important Hellenistic mosaic discovered in the Nile Delta in the early 20th century, and now held in the collections of the Graeco-Roman Museum of Alexandria, required intervention for reasons of preservation and to improve its legibility. In 2013 the previous cement backing was "de-restored" and the mosaic was consolidated on a new backing. However the process of cleaning was interrupted in view of the fragility of the faïence tesserae and the presence of ancient traces of paint, compounded by the presence of a cement "wash" over the surface, executed in the early 19th century. The cleaning was conducted by scalpel, allowing precise adjustment for particularly delicate parts of the decoration. The minute examination permitted by this work, supported by infrared luminescence photography, has better identified the ancient techniques for this particular piece, as well as identifying the modern repairs. Most surprising is the insertion of modern lead strips in place of disappeared ancient strips. Further scientific analyses could support more general conclusions concerning the ancient use of pigments in mosaics.

Keywords: painted mosaic, faïence, Hellenistic period, Thmuis, Alexandria, Egypt

Initial intervention, 2013

A Hellenistic *opus tessellatum* dating to the 2nd century BC was discovered in the early 20th century at a site of the Nile Delta. The mosaic was detached and is now held by the Graeco-Roman Museum of Alexandria (Daszewski 1985, n. 41). The Egyptian Supreme Council for Antiquities commissioned the Centre d'Études Alexandrines (CEAlex-CNRS) to undertake its restoration. An initial operation was conducted in 2013 to "de-restore" a previous attachment of reinforced cement and to transfer the *tessellatum* onto a new support. Concurrently, a series of examinations led to the identification of the materials used in the work, in particular revealing the presence of lead strips, traces of ancient painting and of Egyptian blue (Guimier-Sorbets and Tewfick 2017) (Fig. 1). Moreover, the classic composition of trichromatic cubes in perspective had been enriched by the addition of further colours in diagonal arrangements, thus creating effectively a new style of motif (Guimier-Sorbets 2007). This mosaic was clearly of major interest for its exemplification of the materials and procedures employed in a pavement of the Hellenistic era, but at the same time it faced a serious problem of preservation. Work was begun on the surface in 2013, but was interrupted because of difficulties in cleaning. It appeared that during restoration undertaken at the beginning of the 20th century in the Graeco-Roman Museum of Alexandria a cement wash had been applied over all the *tessellatum*, with the intention of

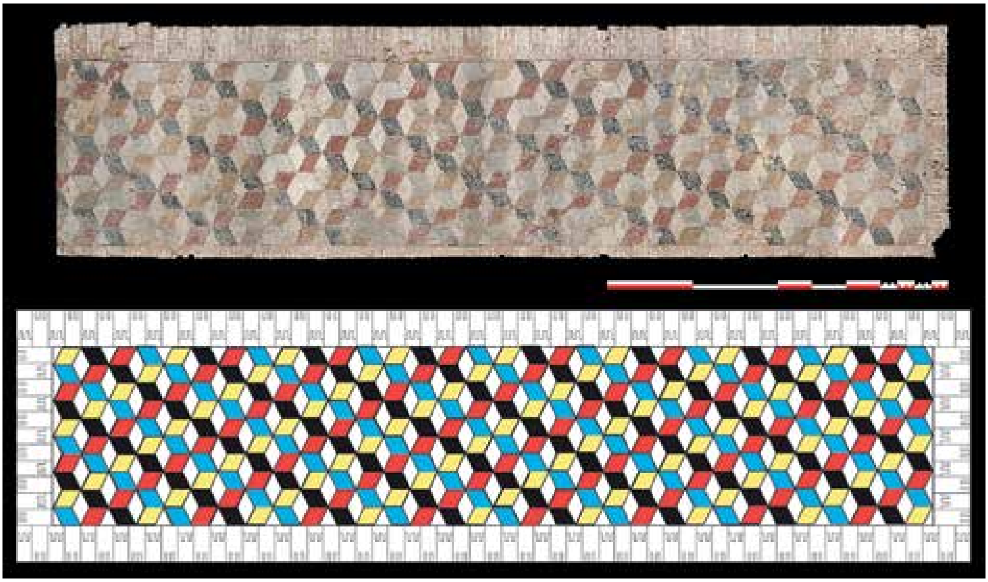

Fig. 1. Thmuis pavement, photo and coloured drawing of the composition (P. Soubias, CEAlex-CNRS)

rendering the surface more uniform. The task became that of finding a cleaning method that would remedy this loss of legibility while also ensuring preservation of the traces of historic paint.

In 2015, a second campaign looked at the essential steps required for enhancing the state of this exceptional mosaic. As part of a collaborative project with the workshop of the Musée Départemental Arles Antique, Marion Rapilliard spent three months working alongside Hanaa Tawfick, head of the Laboratoire de conservation-restauration, Centre d'Etudes Alexandrines, in Alexandria.

A new protocol for cleaning, 2015

The first phase of the 2015 project was to establish a protocol for cleaning the *tessellatum* that would account for several constraints:

– the fragility of the materials and presence of traces of ancient paint (Fig. 2);
– the tools and means available;
– the limited time period of the restoration programme (3 months).

It became apparent that the cement could not be completely eliminated without causing damage to the pavement. It was therefore accepted that it would be sufficient to "recalibrate" the aim of the cleaning to that of reducing the most intrusive visual impacts of the cement and harmonising the overall *tessellatum*. The correct identification of the balance between the removal of the modern material and the preservation of the ancient materials required that we work with a simple, precise and perfectly manageable tool. Given this, we set about the removal of the cement using scalpels, so that we could adapt all actions to the specificities of the *tessellatum*. In particular, we were able to adjust

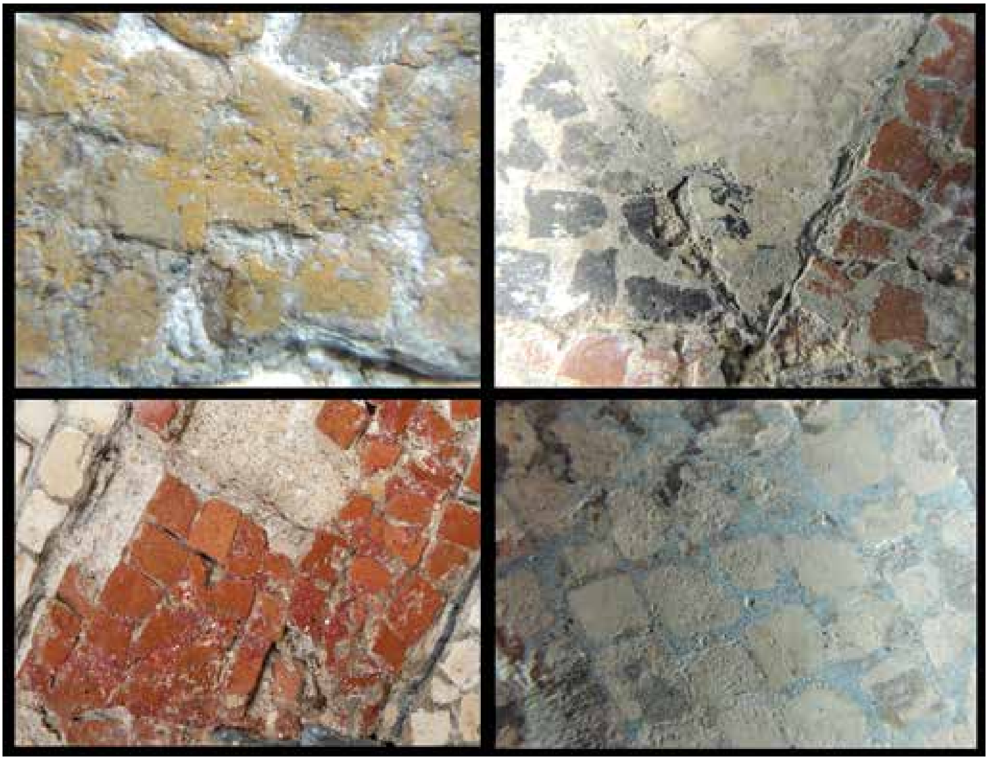

Fig. 2. Thmuis pavement, traces of polychromy on tesserae and joints (M. Rapilliard, A. Guimier)

the level of cleaning on those parts of the decoration with faïence tesserae and traces of paint. The cleaning process continued until we had reached a stage satisfactory for good reading of the decoration.

Conclusion of protocol, identification of original materials and techniques

The next stage of the conservation-restoration protocol consisted of:

– rectifying irregularities in the *tessellatum* surface;
– filling lacunae using a mortar;
– consolidating the most fragile tesserae;
– finishing the support in a manner suitable for museum presentation.

To complete these steps it was necessary to continue with a very gradual and fine cleaning process, always with a view to the laboratory context with its available technical means and time limits, and the plans for future display. At this time we were able to make more precise observations on the techniques of use of the faïence tesserae, as well as the presence of preserved traces of paint – evidence of a pictorial technique that originally extended over the entire work. We now understand better how in this mosaic panel, colour was rendered not only by the stone and faïence materials of the tesserae, but also by additions of paint and coloured mortar.

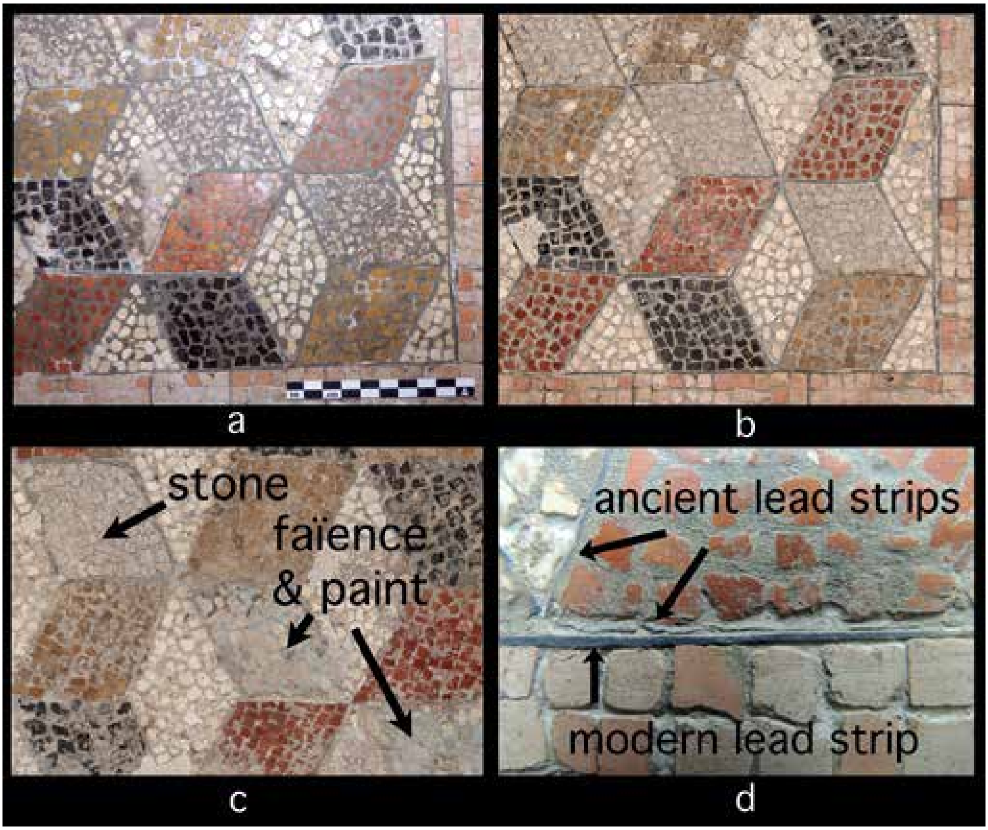

Fig. 3. Thmuis pavement: details before (a) and after (b) removal of the cement; (c) modern tessera of white stone and ancient blue tessera with faience and paint; (d) ancient and modern lead strips (all photos M. Rapilliard)

Fig. 4. Thmuis: modern repairs of the pavement (purple zones) (M. Rapilliard)

We identified two types of paint traces:

– in certain places the pigment was found in the recesses of the joints, where the body of the jointing mortar appears tinted;

– elsewhere the traces of paint are very superficial, overlying a very finely textured white mortar.

However it remains difficult to confidently propose any general theories about the ancient procedures of applying colour to the *tessellatum*, on the basis of this pavement alone. On fragments of Hellenistic mosaics from Delos, more or less contemporary to the Thmuis panel, infrared photography has revealed places where Egyptian blue was applied only to the joints and other places where it was present in bedding mortar beneath blue glass tesserae (Guimier-Sorbets 2016). Given the lack of lacunae in our *tessellatum*, it was impossible to conduct infrared photography in search of the potential application of Egyptian blue beneath blue-coloured tesserae, and at this point we could only conclude that it was on the surface and joints. Nevertheless it would be useful to conduct further scientific analyses for the characterisation of the materials used on this panel, in particular concerning the potential use of pigments other than Egyptian blue, and regarding the methods of application (fresco, with organic binding agents, etc.).

Our observations also revealed the nature and extent of the restorations performed at the beginning of the 20th century. In the central motif, certain blue tesserae with particularly deteriorated faïence had been replaced with white stone tesserae. Certain lacunae had been refilled with coloured stone tesserae but without the addition of paint. The most surprising observation was that the lead strips are modern replacements for disappeared ancient strips (Figs. 3-4). The outer band of the central motif area, decorated with light red on white crenelated towers, which is of unequal width on the different edges, seems to be for the most part modern.

(translation Colin Clement, CEAlex)

References

Daszewski W.A. 1985. *Corpus of mosaics from Egypt I: Hellenistic and Early Roman Period.* Mainz am Rhein: P. von Zabern.

Guimier-Sorbets A. M. 2007. “De la peinture à la mosaïque: problèmes de couleurs et de techniques à l’époque hellénistique”. In *Peinture et couleur dans le monde grec antique* edited by Sophie Descamps-Lequime, 204-217. Paris: 5 Continents Editions.

Guimier-Sorbets A. M. 2016. “Ajouter de la couleur aux mosaïques à l’époque hellénistique : emplois de peinture et de mortiers colorés”. In *Estudios sobre antiguos y medievales, Actas del XIII Congreso Internacional de la AIEMA,* edited by Luz Neira Jimenez, 222-228, pl. 7. Rome: “L’Erma” di Bretschneider.

Guimier-Sorbets A. M., Tawfick H. 2017. “Conserver, dé-restaurer les mosaïques d’Alexandrie : nouvelles problématiques, nouvelles découvertes”. In *The Conservation and Presentation of Mosaics: at what cost? Proceedings of the International Committee for the Conservation of Mosaics, Sardinia, October 27-51 2014* edited by J.M. Teutonico, L. Friedman, A. Ben Abed, R. Nardi, 364-366. Los Angeles: The Getty Conservation Institute.

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MOSAICS IN EGYPT: DIFFICULTIES, CHALLENGES, PROGRESS

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Abstract

The rich history and monumental heritage of Egypt including sites such as the Giza pyramids, temples of Karnak and Luxor, making it a "national open-air museum". However many of the mosaics, from the Ptolemaic, Roman, Byzantine and Islamic eras, have been detached and are held in collections in different parts of the country. Until recently there has been no organised survey of their origins and distribution, or current conditions. Considering this, the Ministry of Antiquities has established a Centre for Archaeological Information and Preservation of Mosaics in Alexandria, to serve as a platform for the study, documenting and cataloguing of the mosaics distributed throughout the nation. An initial project has been the commencement of a national database in Excel form, annotating each work. The first phase of cataloguing has concentrated on the mosaics of the Ptolemaic and Roman eras, and have resulted in the identification of important works at high risk of damage, as well as significant observations on the historic production and current distribution of the national mosaics heritage. The inventory is now continuing with the cataloguing of works from the Byzantine and Islamic eras.

Keywords: Alexandria, Graeco-Roman Museum, Kom El-Dikka, scientific archive, museums

The context of mosaics heritage in Egypt

Egyptian heritage institutions are responsible for large numbers of mosaics originating from or still located *in situ* in different parts of the country, from Alexandria to al-Buhaira, Thmuis near Mansoura, Ismailia, to North Sinai. Most of these works were created during the Ptolemaic, Roman and Byzantine periods. The 6th century mosaic of the Transfiguration in Saint Catherine's Monastery on Mount Sinai is a particular masterpiece of the Byzantine, however there are also important works of the Islamic period, such as the 15th century geometrical mosaics of the Citadel of Qaitbay in Alexandria.

The majority of the mosaics are preserved as detached panels in museum displays and storerooms throughout the country. The mosaics of the Villa of the Birds (first half of 2nd century AD) in Kom El-Dikka, Alexandria represents a case of good preservation *in situ* (Kolataj *et al.* 2007; Rodziewicz 1984). Here, the execution of the conservation project included construction of a protective shelter, operating as a small "mosaics museum site", now open to the public. Other examples of *in situ* preservation include two black and white geometric mosaics (Kolataj and Kolataj 1975) from the 5th century AD, re-laid in cement at the entrance to the Roman amphitheatre in Kom El-Dikka, and a mosaic floor with fish and dolphin panel in the temple of Karnak, dating to the Hellenistic period (Boraik 2009).

Fig. 1. Queen Berenice mosaic from Thmuis (Hellenistic period) held in the Alexandria National Museum (photo Alexandria National Museum, Ministry of Antiquities of Egypt)

Among the most notable of the many mosaics preserved in museums are the Sitting Dog and Athletes mosaics preserved in the Bibliotheca Alexandrina Museum of Antiquities, recovered quite recently from the site of the new library in Shatby, Alexandria (Ling 1998). Also remarkable are the Medusa (Guimier-Sorbets 1998) and Queen Berenice mosaics preserved in the Alexandria National Museum (Daszewski 1985) (Fig. 1), and the geometric and Phaedra and Hippolytus mosaics (Fig. 2) held by the Ismailia Museum (Cledat 1915).

The Graeco-Roman Museum in Alexandria holds a large collection of mosaics, including panels of fish, the goddess Clio, Queen Berenice (Dunbabin 1999), and a *symplegma* scene (Daszewski 1985). Unfortunately these collections have been unavailable to the public since 2005, when the museum was closed for renovations and the mosaics were moved to storage. Considering the importance of the

Fig. 2. Phaedra and Hippolytus mosaic from Sinai (mid-4th century AD), held in Ismailia Museum (photo Ismailia Museum, Ministry of Antiquities of Egypt)

national heritage of mosaics, the Ministry of Antiquities had in fact begun a project for the establishment of a museum dedicated exclusively to these works. The planning for the museum is largely complete, including the display design, however the development program has been halted since the onset of the economic crisis in 2011.

In general, the mosaics distributed in many different places require greater study, control and in many cases intervention for conservation. Even in the case of the most recently discovered mosaics with figurative scenes and geometric designs, some have been restored and others not.

In view of this situation, the Egyptian Ministry of Antiquities has identified the priority of establishing a "Centre for Archaeological Information and Preservation of Mosaics" to serve as a platform for research, documentation and preservation of the mosaic heritage throughout the country, however the founding of the centre has again been halted due the economic crisis.

Given the overall context, the author has recently assumed the responsibility of taking the first steps for development of a scientific archive of the national mosaics heritage. One of the aims of this project is to support the identification of priorities for intervention on mosaics at particular risk of damage. The first phase of development is focused on the national holdings of detached Ptolemaic and Roman panels, with the documentation of works from other periods expected to continue in later years.

Methodology for a national database

1. Collect the available data on the individual mosaic works as described in all previous studies, including photographs.
2. Photograph each mosaic from different views, for entry in the database.
3. Enter new data on the mosaics where this is lacking (dates of execution and discovery, provenance, type, technique, bibliography, description), including drawings of the works (Fig. 3).
4. Insert and maintain the information on the individual works in an excel database.
5. Define conservation priorities for the works at highest risk.

Examples of priorities

The development of the database has already identified many mosaics in precari-

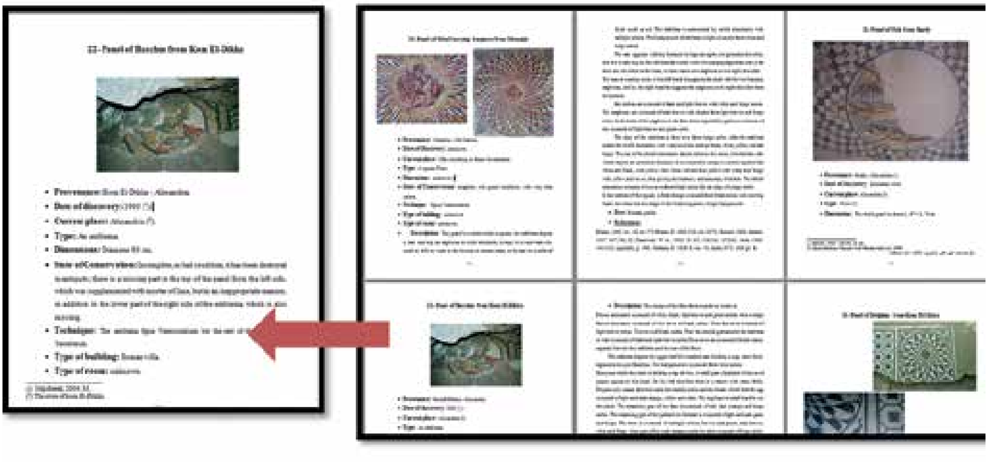

Fig. 3. View of the mosaic pavements database, showing fields of collected information (photo Eman Shahawy)

ous condition, of high priority and requiring rapid intervention, among these:

– a black and white Roman pavement with geometric decoration, from the 2nd century AD, discovered by the Egyptian archaeological mission of 1982-1986 in Kom el Giza-al-Buhaira, which was detached and replaced *in situ* with an incorrect change in the iconography;
– a pavement with polychrome geometric decoration, discovered at the site of Pompey's Pillar in Alexandria in 1998 (El- Fattah 2001) and dated to the 2nd century AD, now held in the offices of the Inspector of Antiquities, without conservation;
– a pavement with polychrome shield from Gabbary, Alexandria, dated to approximately 50 BC, (Fig. 4; Daszewski 1985), discovered in 1846 and now mounted on the wall of the Inspector of Antiquities, without conservation or maintenance.

Fig. 4. Polychrome shield mosaic from Gabbary district, Alexandria (photo Eman Shahawy)

NEW KNOWLEDGE GAINED FROM THE DATABASE

The first phases of survey and cataloguing of the Ptolemaic and Roman mosaics enable some early observations:

1. The mosaics from the Roman period are more numerous than those from Ptolemaic era.
2. More mosaics originate from the Lower Egypt and the Nile Delta than from Upper Egypt.

3. Alexandria, the capital of Egypt throughout both the Ptolemaic and Roman periods, is the location with the largest quantity of Graeco-Roman mosaics.
4. The single most productive archaeological site is Kom el Dikka in Alexandria (McKenzie 2007), particularly for mosaics of the Roman period.
5. Mosaics with geometric designs are much numerous than those with figurative scenes.
6. Among the figurative scenes, particularly abundant are those with iconography concerning the Nile (Guimier-Sorbets 2009), as also seen on mosaics throughout the former Roman Empire.

Future of the database

In the near future the work of developing the database will extend to the mosaics of the Byzantine and Islamic eras.

References

Boraik M. 2009. "Ptolemaic Baths in front of the Temple of Karnak: a brief preliminary report- November 2007". In *Les bains collectives en Egypt*, edited by Marie-Francoise Boussac and Thibaud Fournet et Berangare Rodon, 73-86. Cairo: Institut Français d'Archéologie Orientale (IFAO).

Clédat M. J. 1915. "Fouilles à Cheikh Zouède (Janvier- Fevrier 1913)". *Annales du service dell'antiquités de l'Égypt (ASAE)*, Tome15: 15-48, pl. 3-5.

Daszewski W. A. 1985. *Corpus of mosaics from Egypt*, I, *Hellenistic and Early Roman Period.* Mainz am Rhein: Verlag Ph. von Zabern.

Dunbabin. M. D. K. 1999. *Mosaics of the Greek and Roman world*. Cambridge: Cambridge University Press.

El-Fattah A. A. 2001. "Une fouille rècente au Sarapèion d' Alexandrie". *Etudes Alexandrines*, 2: 25-30.

Guimier-Sorbets A. M. 1998. "Le pavement du triclinium à la Méduse dans une maison d'époque impériale à Alexandrie (Terrain du théâtre Diana*)*". *Etudes alexandrines*, 1: 115-139.

Guimier-Sorbets, A. M. 2009. "Scènes nilotiques: expression de l'abundance et vision de l'autre". In *Du Nil à Alexandrie*. *Histoires d'eaux,* edited by Isabelle Hairy, 659- 670. Alexandrie: Harpocrates Publishing.

Kolataj A., Majcherek G., Parandowska E. 2007. *Villa of the birds. The excavation and preservation of Kom al Dikka mosaics*. Cairo: The American University in Cairo Press.

Kołątaj W. and Kołątaj T. 1975. "Polish excavations at Kom el-Dikka in Alexandria 1967. Report on the reconstruction of the theatre". *Bulletin de la Société Archéologique d'Alexandrie (BSAA)*, 43: 79–97.

Ling R. 1998. *Ancient Mosaics*. London: British Museum Press.

McKenzie J. 2007. *The Architecture of Alexandria and Egypt (300 BC-700 AD)*. New Haven and London: Yale University Press.

Rodziewicz M. 1984. *Alexandria III*. *Les habitations romaines tardives d'Alexandrie* à la lumière des *fuilles polonaises à Kôme el-Dikke*. Warsaw: Éditions Scientifiques de Pologne.

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CONSERVATION-RESTORATION OF A ROMAN MOSAIC, WITH *IN SITU* REPLICATION, AT MEDIANA, SERBIA

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Abstract

A 4th century mosaic with Christ monogram had been reburied following excavation, in 2007, at the archaeological site of Medina. The mosaic was executed with previously used tesserae. Given its deteriorated condition, the condition of the archaeological structures, and the progress of site development, it was apparent that conservation *in situ* was no longer possible, and the decision was made to detach it. The detached mosaic has been prepared for museum display, while a copy has been made for re-insertion in the original context.

Keywords: Mosaic, detachment, copy, *in situ*, museum

Reopening of the previously excavated mosaic

The archaeological site Mediana is situated near the modern city of Niš (ancient Naissus) in southern Serbia. The territory of the site includes the residential complex built by the emperor Constantine at the beginning of 4th century and occupied until at least the mid-5th century. Over recent years the site has been the subject of conservation-restoration works and construction of protective shelters. As part of these operations a previously excavated mosaic with Christ monogram from "Church 1" was reopened. The mosaic surface had been protected by a sheet of nylon, over which was a layer of sand. A particular problem during the exposure of the mosaic was the discovery of snake eggs, however experts from the Nature Protection Administration in Niš were able to determine that these pertained to a non-poisonous species, and that works could continue without risk to the conservation team.

After removal of the reburial materials it could be observed that the mosaic had originally been made with previously used tesserae, with a quite rough quality of execution, consistent with the previous identification of dating to the 4th century AD. It was also observed that the mosaic had undergone structural damage since the original excavation. In particular, the *tessellatum* and mortar bedding had suffered changes in level due to the action of colonies of ants. The mortar bedding was largely disintegrated and had lost its binding properties. Approximately one third of the *tessellatum* was no longer present, and the entire surface was unstable.

Detachment for museum presentation of the original

The decision for detachment was made in consultation with the team of archaeologists and architects, with the aim of mounting the work on light support and

Fig. 1. Mosaic before conservation treatment, *in situ* (photo by N. Smičiklas)

Fig. 2. General view of the original mosaic after the treatment (photo by N. Smičiklas)

installation in the site museum, on display. It was also agreed to fabricate a copy, faithful to the stratigraphic imperfections and lacunae, for placement *in situ* after conservation of the bedding mortar. In this way the original would be conserved and made available to the public in the museum setting, while the archaeological structure would still be complete with the replica in the original context (Figs. 1-2).

The sand used for the reburial of the mosaic was removed carefully, avoiding damage to the *tessellatum*, and sifted to avoid loss of tesserae. The *tessellatum* surface was cleaned and consolidated prior to lifting, for better adhesion of the facing and maximum preservation of original structure. All incrustations, soil deposits and other impurities were carefully removed. Tesserae detached from their original positions were re-adhered using a synthetic binder. The *tessellatum* was documented in detail for preservation of all data on the existing situation. The mosaic structure and state of conservation were recorded. The documentation included photo and video recording, as well as full scale (1:1) tracings, using the COREDO software for conservation and restoration documentation developed by the Institute for the Protection of Cultural Heritage of Serbia.

Replicating the original for *in situ* installation

For purposes of full replication of the irregularities in the mosaic surface, the team prepared an imprint of the mosaic surface in clay, prior to detachment. A layer of moistened cotton paper was lain over the surface of *tessellatum,* then gently pressed into position against the shapes of the individual tesserae. The role of the paper wadding was to isolate the mosaic surface from the clay mould, while still respecting all the details of the surface, enabling full replication and ease of separation of the mould. The clay was applied in two layers. The dried mould was raised and transferred to the atelier. A copy of the mosaic was then created by using original tesserae of appropriate colours and stone materials,

Fig. 3. Mosaic clay imprint (photo by N. Smičiklas)

Fig. 4. Copy of the mosaic after filling of the joints (photo by N. Smičiklas)

gathered from different parts of the site but lacking association with any specific mosaics. The tesserae were cleaned, washed and classified by colour, organised on the tracing of the mosaic, and then transferred to the mould. The mould provided a negative of all individual tesserae, enabling insertion of tesserae of identical form to the originals. The replica mosaic was backed with a manufactured mortar mix. After the application of the first layer, a fibre-glass mesh was added as reinforcement and another layer of the same mortar was applied. After drying the mosaic was turned face up and the clay mould was mechanically removed. As final consolidation, the joints were filled with lime mortar mixed with crushed brick, achieving a colour and composition similar to the original mortar. Retouching was done in the same places and in the same manners as on the original (Figs. 3-4).

Conclusions

Lifting, moving and replicating the mosaic with Christ monogram at Mediana has combined innovative approaches, classical methodologies and new technological products, achieving optimal results. The replication of the mosaic *in situ* preserves the original architectural context. The methodology for the detachment has respected the conservation principle that the surface of the original work be placed in contact only with reversible materials, with the preference of compositions and properties equal to the original. The advanced technological materials used in the deeper layers below the mosaic can be readily removed, so that the mosaic can be returned to the pre-intervention state.

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MOSAICS IN LEBANON 20 YEARS AFTER CONSERVATION-RESTORATION: EVALUATIONS OF EARLIER DECISIONS AND PLANNING OF NEW ACTIONS

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Abstract

In 2014-2017 the Polish conservation mission in Lebanon analysed the state of preservation of several mosaics that had been excavated in the 1980s and 1990s, at a late-antique/early-Byzantine basilica near Chhim and a basilica of similar dating in Jiyeh. At Chhim the majority of the mosaics were still *in situ,* and had been reburied. At Jiyeh, a lifted mosaic had been transferred to outdoor display in a museum context. In both cases, after some twenty years, damage has resulted as consequence of earlier decisions, in particular for the choice of cement backing materials, and because of a lack of preventive care. The assessments documented the specific damages and led to projects for better conservation of the mosaics. The experience demonstrates the value of assessments for identifying high priority needs and effectively targeting the allocation of resources.

Keywords: late-Antique Lebanese mosaics, Chhim, Jiyeh, preventive conservation

Context of mosaics in Lebanon

Periodic monitoring is particularly important in the case of mosaics in outdoor contexts that are not the object of continuous preventive maintenance. In Lebanon, mosaics are exposed to such situations in two main contexts: on archaeological sites where research works are no longer in progress and the mosaic has been left without conservation-restoration intervention; in sites that are open as outdoor exhibitions, where the mosaics have been re-laid on concrete supports. In both cases, the passage of long periods without monitoring leads to the accumulation of damage and aggravates the original losses.

Fig. 1. General view of the mosaic from Chhim basilica, 1999 (photo Archives of Polish Centre of Mediterranean Archaeology, Mission in Chhim)

Assessment, intervention and reburial for mosaics of the basilica at Chhim

The archaeologists of the Polish mission in Lebanon has been active at the site of a late-Antique to Byzantine basilica in a rural area near Chhim, since 1996 (Waliszewski 1999), with the constant support of conservators directed by Dr. Krzysztof Chmielewski (Fig. 1).

The years 1996-2000 were particularly active. It was at this time that the *tessellatum* of an early Byzantine mosaic was detached, rolled up, and unrolled *in situ* on new mortar. At approximately the same time, the mosaic of the cathedral bema was lifted and removed to storage. The practice followed was also to rebury the exposed *in situ* mosaics at the close of each archaeological season (Chmielewski 2005). Given the limitations of time and financial resources, the only part of the site provided with protective structures was the northern nave.

During the years 2014-2017, some 20 years after these works, conservators were able to evaluate the state of the mosaics at the Chhim archaeological site. The first operations consisted of excavating several pits that would allow observation. By this means it was concluded that the mosaics of the southern nave were stable and did not require intervention. The mosaic of the northern nave was in much poorer condition, (Fig. 2). The option of transferring this mosaic to a new *in situ* mortar was not available, given the limited scope of the project. The decision was therefore made to implement protective actions, primarily replacing deteriorated mortars and grouting by injection of lime-based mortar, following the first step of complete removal of the reburial layers. The process of uncovering the buried mosaic revealed that the plastic mesh placed below the backfill had provided good protection against penetration from the roots of grass, but not the thicker roots of larger plants. For this reason, a heavy geotextile was selected to provide a barrier, in place of the plastic mesh. The first step of reburial was to cover the *tessellatum* with fine sand, then the geotextile. The final layer consisted of 15 cm of salt-free sand obtained from mountain quarries.

Fig. 2. One of the exploratory assessment excavations in the northern nave, 2014 (photo A. J. Tomkowska)

The lifted mosaic of the bema had been transferred to storage at the Beit ed Dine Museum after several years of holding at the archaeological site. The inspection of this mosaic showed that the work was still stable and well protected, thanks to the double protection of gauze facing on the *tessellatum* and a thin layer of mineral mortar applied to the reverse side.

Assessment and intervention for a detached mosaic from a basilica at Jiyeh

In 2015, assessments were also carried out on the state of preservation of a mosaic from the site of a Byzantine basilica at Jiyeh. The mosaic had been detached at the close of the 1980s, then re-laid on con-

Fig. 3. General view of the mosaic from Jiyeh basilica displayed at the Beit ed Dine Museum, before treatment in 2013 (photo A. J. Tomkowska)

Fig. 4. General view of the mosaic form Jiyeh basilica displayed at the Beit ed Dine Museum, after treatment in 2017 (photo A. J. Tomkowska).

crete support and displayed in the garden of the Beit ed Dine Museum (Jounblat *et al.* 1989). The mosaic, with its concrete support, had been suspended above a concrete foundation by means of attachment to small iron hooks. Over the course of more than 20 years, sand had accumulated and grass had grown in the void between the mosaic on its support and the concrete foundation, deforming the horizontal plane of the mosaic. A crack had appeared in the central area (Fig. 3).

On the basis of the assessment, it was determined that the main factors placing the object at risk were the use of concrete for the backing support and the choice of the gardens as the exhibition area. The desired conservation program would have involved installation of a protective roof and re-backing of the work on a more appropriate support, however logistical and financial difficulties made these steps impossible. The conservation-restoration intervention was therefore largely limited to removing the soil and plants from under the mosaic, repairs and reconstructions in the area of the crack, and stabilisation of the surface. An important addition to these basic steps was the design and insertion of a system of steel profiles around the periphery of the mosaic. The space between outer edges of the mosaic and the inner surface of the steel profiles was lined with geotextile, and the resulting "gutter" space was filled with fine gravel, thus ensuring drainage away from the mosaic but also providing better blockage against infiltration of soil and growth of vegetation. The gravel also provides an aesthetic element for presentation (Fig. 4).

Conclusions

The assessment of the mosaics at Chhim indicated the short-term necessity of re-laying the entirety of mosaics in the northern nave mosaic on new mortar. The insertion of a new geotextile as part of the reburial system, in 2016, will allow comparison of the effectiveness of this material relative to the plastic mesh used in the original reburial of the 1990s. Until the re-laying operations can be completed, the mosaics should be subject to regular monitoring, including measurement and testing of the security of the reburial system.

The intervention on the detached mosaic from Jiyeh, held at the Beit et Dine Museum, is considered to have achieved a stable status for the mosaic, meaning that the replacement of the concrete support can be avoided. However an inexpensive and effective protective system should be designed for protection of the mosaic during the winter season.
The 2014-2017 assessment project demonstrates the value of inspection and evaluation for purposes of identifying urgent problems, potentially requiring immediate intervention. Especially in a country where material heritage protection is insufficiently financed, regular assessment can assist in focusing the available resources on urgent needs, and effective management of finances over the long term.

References

Chmielewski K. 2005. "Conservation of Byzantine floor mosaics form Shhim Lebanon: Technic and aesthetic problems, present state and prospects for the future". In *Wall and Floor Mosaics: Conservation, Maintenance, Presentation, Proceedings of the VIIIth Conference of the International Committee for the Conservation of Mosaics (ICCM) Thessaloniki, 29 October-3 November 2002,* edited by Charalambos Bakirtzis, 147-153. Thessaloniki: European Center of Byzantine and Post-Byzantine Monuments, Ephoreia of Byzantine Antiquities of Thessaloniki.

Jounblat F., Seeden H., Atallah M. eds. 1989. *Beiteddin: past and present.* Lebanon: Express International.

Waliszewski T. 1999. "Du temple païen à la basilique chrétienne à Chhîm (Liban Sud). Évolution tardive du sanctuaire (fin IIIe – VIIe siècles apr. J.-C.)", *Topoï,* 9 (2): 595-606.
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A MAP IN MOSAIC OF THE HISTORIC CITY OF OHRID

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Abstract

The Lake Ohrid region including the city of Ohrid is one of only 35 territories designated by UNESCO for inclusion in the World Heritage List in consideration of both its natural (1979) and cultural (1980) heritage. The idea of developing a map of Ohrid in mosaic technique was conceived in 2006, with the development of the Google Maps application. The design is based on actual geographic coordinates and visuals in Google Maps. The map, derived from modern technologies and traditional mosaic techniques, visualises the interweaving of centuries in the living city of Ohrid.

Keywords: site map, monuments, mosaic, enamel tesserae, Via Egnatia, 2nd century BC

Historic character of Ohrid

The modern city of Ohrid, North Macedonia, stands over the remains of ancient "Lichnidos", probably meaning "city of light", from the Greek λυχνίς (*lychnis*, gen. *lychnidos*), "a precious stone that emits light", from λύχνος (*lychnos*), "lamp, portable light". The name "Ohrid" in place of the earlier "Lichnidos" is known from 879 AD. The new name probably derives from *vo hrid*, meaning "on the hill", referring to the hilltop location of the city. The settlement is noted in the writings of distinguished ancient scholars (Strabon, Ptolemy, Livy) beginning in the 5th century BC. The city was positioned on Via Egnatia, constructed in the 2nd century BC during the Roman era. This important road crossed Illyricum, Macedonia and Thrace, passing through territories that are now within Albania, North Macedonia, Greece, and European Turkey. With the early adoption of Christianity in the area following missions by Saints Paul and Erasmus, many bishops from Lichnidos participated in multiple ecumenical councils.

Archaeological excavations conducted in Ohrid for more than 100 years have resulted in the registry of 25 sites within and around the old city, demonstrating its historic importance.

Within the citadel walls there are:

1. Triple-nave basilica beneath Church of Saints Clement and Panteleimon, in Plaoshnik;
2. Clover shaped basilica, Plaoshnik;
3. The Baths of Cleon, Roman thermae;
4. Early Christian episcopal seat, Plaoshnik;
5. Cathedral church of Saint Sofia;
6. Holy Mother of God Peribleptos Church;
7. Early Christian basilica at Deboj;
8. Church of Saint Nikola Gerakomija;
9. Church of Saint Nikola Chelnichki "Wonderworker";
10. Church of Saint John "Arbanashki";

Fig. 1. The "Map of Ohrid" in mosaic technique, in the execution stage in 2006 (photo Nikola Upevche)

11. Holy Mother of God Pandonos Church;
12. Ilindenska, Boro Shain, Hristo Uzunov streets;
13. Klimentska, Ilindenska streets;
14. Manchevi (Manevci) early Christian basilica;

Other sites within the old city:

15. Early Christian basilica under Ali Pasha Mosque;
16. Early Christian basilica under Haji Turgut Mosque;
17. Church of Saint Demetrios of Thessaloniki;

Sites surrounding Lake Ohrid:

18. Early Christian basilica of Saint Erasmo;
19. Early Christian basilica at the archaeological site of K'ldrma, Livada village, Koroshishta;
20. Early Christian basilica at Tashmarunishta;
21. Early Christian basilica under the Church of Saint Nikola Talalej, Oktisi village;
22. Early Christian basilica, Radolishta village;
23. Early Christian basilica in Lin (Albania);
24. Early Christian basilica Manastirishte, Raica, Ljubanishta village;
25. Early Christian basilica at Studenchista.

Concept of the map in mosaic technique

The Lake Ohrid region including the city of Ohrid is one of only 35 territories designated by UNESCO for inclusion in the World Heritage List in consideration of both its natural (1979) and cultural (1980) heritage. The idea of developing a "Map of Ohrid" in mosaic technique was conceived in 2006 (Fig.1), with the devel-

Fig. 2. Details of the map include stairs leading among ancient buildings (photo Nikola Upevche)

Fig. 3. Detail of the church St. John the Theologian (photo by Nikola Upevche)

Fig. 4. Enamel tesserae are used for geographic and spatial emphasise of natural phenomena, buildings and archaeological sites (photo by Nikola Upevche)

opment of the Google Maps application. The design is based on actual geographic coordinates and visuals in Google Maps. The mosaic map provides a distinctive birds-eye view representing all of the trails and roads of the city, at its location on a hill surrounded by Lake Ohrid. Details include stairs leading along streets between historic houses, under which are archaeological sites (Fig. 2).

Foundation, façade and side views and three-dimensional representations of historic sites appear unexpectedly. These include fortresses, the Upper Gate, the Antique Theatre, early Christian basilicas, tombs, churches, mosques and hammams

grouped in landscape contexts with the characteristic buildings of the city and the most influential and picturesque ensembles of objects and surroundings: the early Christian complex at Plaoshnik with three squares and early Christian basilicas, the cathedral church of Saint Sofia, Holy Mother of God Peribleptos Church, the Deboj archaeological site, the Church of Saints Constantine and Elena, Saints Cosmas and Damian, The Forty Martyrs of Sebaste, Saint Nikola Gerakomija, the churches of Holy Mother of God Bolnichka and Saint Nikola Bolnichki, the Robevi family house with lapidarium and museum of archaeology, the Church of Saint John the Theologian (Kaneo) (Fig. 3).
Gold plated enamel tesserae are used for geographic and spatial emphasis of natural phenomena, buildings, archaeological sites, and other sacred and secular points of interest. Note should be made of the use of lapis lazuli and 25 shades of blue enamel and stone tesserae for the lake (Fig. 4).

Conclusion

The modern map, derived from contemporary technologies and traditional mosaic techniques, visualises the interweaving of centuries in the living city of Ohrid.

Author

Nikola Upevche is a mosaic artist and professional freelance conservator-restorer of cultural heritage. He graduated in 2003 with a specialty in painting from the Faculty of Fine Arts, Saints Cyril and Methodius University in Skopje. He has worked as a mosaics conservator-restorer on numerous archaeological sites in the North Macedonia, Slovenia and Croatia, and is author artist of several mosaics as works of public art. He has organised three SEE Mosaics meetings in Ohrid.

CASA BATTLÓ: CONSERVATION OF THREE SKYLIGHTS OF THE *PIANO NOBILE* PATIO, COVERED IN GLASS TRENCADÍS AND CERAMIC DISCS

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Abstract

Casa Batlló, by the architect Antoni Gaudí, is an icon of Barcelona, since 2005 inserted in UNESCO World Heritage List. The building is now operated as a facility open for public visitation and functions. Between 2010 and 2012 the current owners provided for a major conservation-restoration program. At this time it became evident that large fissures in the decorative elements of three skylights, inserted in the patio of the main apartment, were allowing infiltrations of rainwater into the level of the building below. As well as disrupting the building functions, the infiltrations were putting the heritage skylights at risk. The conservation-restoration choices presented challenges, including in terms of the accepted codes of ethics.
Keywords: Antoni Gaudí, architecture, Barcelona, modernism, mosaic

Historical introduction

In 1904, industrialist Josep Batlló purchased a residential apartment building situated in Passeig de Gràcia, Barcelona. With the intention of constructing a unique home, Batlló contracted Antoni Gaudí, who by this time had established a reputation as an innovative architect. Gaudi preserved the existing structure but subjected it to renovations, including the addition of two floors and the complete renovation of the main and rear façades. The *piano nobile* was developed as the private apartments of the Batlló family, with exclusive use of the adjoining inner patio. On the patio were three skylights, providing light to the garage areas at the level below. The skylights were capped by sinuous mounds covered in glass *trencadís* and glazed ceramic discs, of different sizes, embedded in mortar. Finally, each skylight was capped by an elevated structure in mild steel, executed in a semicircular form (Fig. 1).

Fig. 1. Skylight before the restoration (photo N. Zapata)

Changes in building ownerships and uses

Both the usage and the maintenance needs of the building have changed radically over the years. In 1954, the heirs of the Batlló family sold the building to *Sociedad*

Iberia de Seguros, which transformed it as the head office of their business. In 1992, the building was acquired by the Bernat family, who are still the owners. The family maintains the Batlló apartment and other building sectors as a museum space, open to the public 365 days per year. Certain spaces are available for rental for private and public events, among these the former garages. In 2010-2012 the management of the building provided for a major program of conservation-restoration. In 2010, following several days of intense rain, leaks were entering from the garage from the skylights, at a moment when it had been rented for a social event. The owners contracted a specialised company to execute the waterproofing of the skylight structures, and asked our company, ECRA SL, to carry out the restoration-conservation of the facing of *trencadís* and ceramic discs.

Conservation status of the three skylights of the *piano nobile* patio

The expansion of the mild-steel bars inserted in the upper part of the skylights had provoked cracks in the mortar. As a consequence, a number of *trencadís* in orange glass and blue case glass had been detached and lost, or were cracked or exfoliated. Descending from the top of the skylights were long, deep cracks that allowed the infiltration of rainwater, causing the leaks in the former garage area. As the cracks continued their trajectory of development through the mortar, that had also broken the embedded ceramic discs and caused the loss of glass *trencadís*. The imprints left by these losses, of various sizes, had led to ponding of water in the indentations (Fig. 2).

Fig. 2. Deep cracks, biological growth and loss of glass *trencadís* (photo N. Zapata)

Smaller cracks had formed in the base mortar due to the effects of infiltrating moisture, atmospheric humidity and temperature changes. The moisture infiltrating between the mortar and glass had stimulated the growth of moss, which in turn had caused detachment of some pieces. Many *trencadís* were severely fragmented and some were missing. The surface of the mosaic was generally soiled and covered by concretions that obscured their true colours.

Two of the three skylights had been subject to previous repairs. These interventions had included sealing some of the cracks and fixing some of the discs with black silicone adhesive, applied to the mortar. There were also splatters of grey paint, possibly from repainting the metal bars of the skylight or those of the balconies overlooking the patio.

Analytical studies

For better understand of the origin of the cracks, the company Patrimoni 2.0 was commissioned for to a series of analyses.

A stratigraphic sample of the support mortar for the *trencadís* pieces was examined by optical microscopy of the polished section, and by X-ray diffraction the component layers. Three overlapped layers were detected, as follows.

– A relatively rough mortar was applied in direct contact with the brick masonry, composed of hydraulic lime and silica aggregates (quartz and feldspar grains + some grains of metamorphic rock).
– A 1 cm layer was applied over the face of the first mortar while it was still moist. This mortar was composed of hydraulic lime and finer, sub-millimetre aggregates (schist and phyllite + some calcareous grains).
– Once the lower layers were dry 2 to 3 mm of adhering mortar were applied. This was composed of air lime and a very fine aggregate (schist and phyllite of 400 micron), with the addition of animal glue to facilitate the mounting of the glass pieces.

Magnetometer inspection

Taking advantage of a very deep fissure in the mortars of the central skylight, a magnetometer sensor was introduced to verify the potential use of any metallic elements as reinforcement, which could now be causing structural tensions. The result was negative.

Endoscopy

By means of endoscopic examination we were able to determine that the skylights had been constructed over a superstructure of small diameter rods. This system had left the concave and convex forms of the skylight subject to weakness, worsened by the tensions of the inserted steel bars. This explained the appearance of the many cracks and fissures in the different layers of the facing mortars.

Conservation-restoration process

The process was divided in three phases:
Phase 1: Initial in situ operations (Fig. 3)

- Initial photographic documentation (photo documentation was continued the conservation-restoration processes progressed);
- Sample collection for laboratory analysis of mortars and the types of original glass;
- Study of colours and textures;
- Tracing of the *trencadís* requiring removal for installation of the waterproofing, using acetate and permanent markers;
- Numbering and coding of the *trencadís* and ceramic discs to be detached;
- Facing the ceramic discs with gauze, preparatory to detachment;
- Detachment of *trencadís* and ceramic discs from the parts subjected to waterproofing procedures, preparatory to subsequent return of these components to their exact original positions;
- Substitution of the more heavily damaged *trencadís* in the areas subject to waterproofing;
- Surface cleaning of all *trencadís* and ceramic discs;
- Removal and cleaning of moss, lichen and dirt accumulated in the mortars, with application of biocide;
- Elimination of remnants of silicone and other products, from previous repair works.

Phase 2: Workshop operations

- Cleaning and restoration of the detached original pieces;
- Cutting reproduction *trencadís* from glass selected in keeping with the original characteristics, for replacement of the missing *trencadís* (cut to the origi-

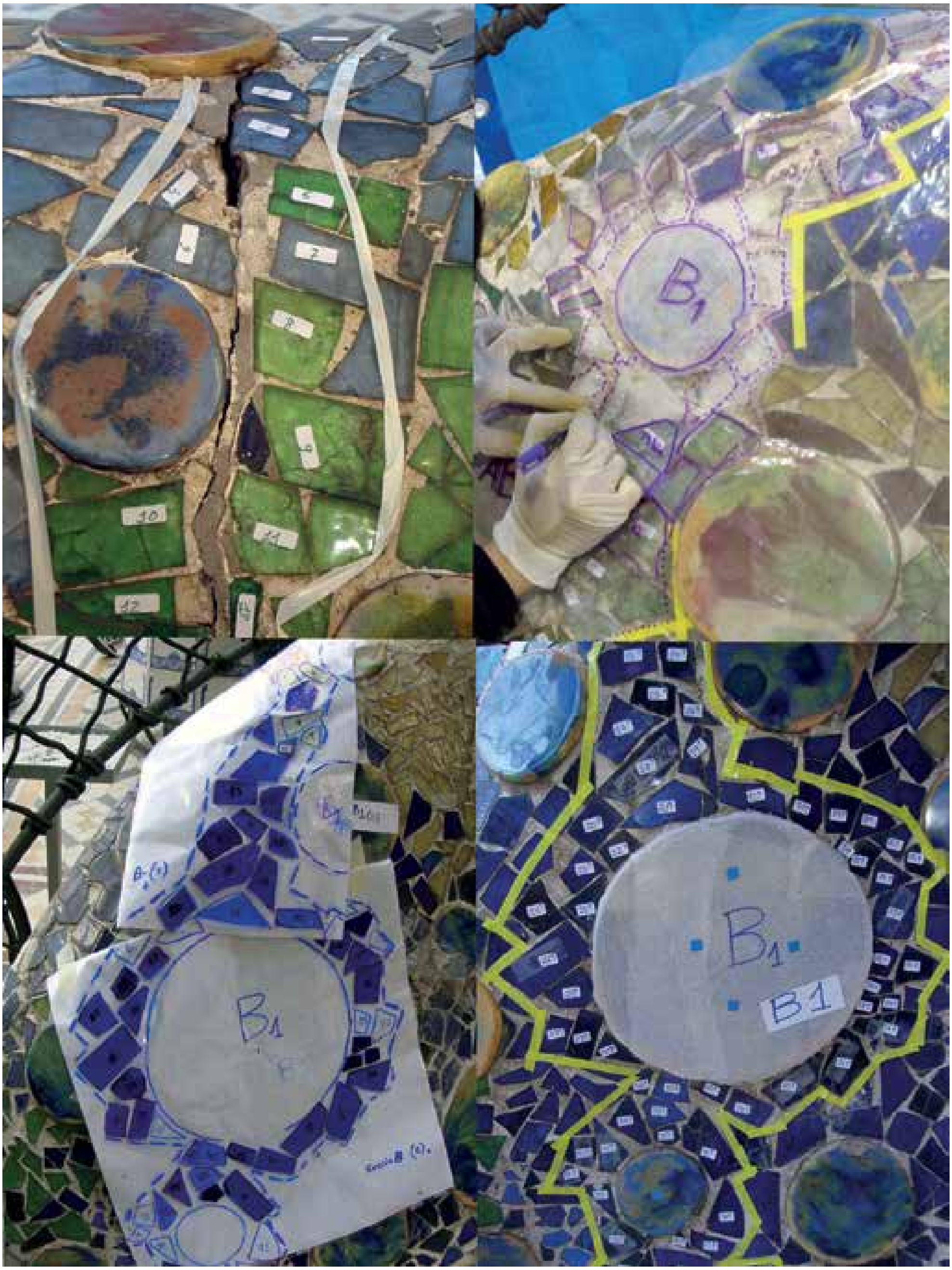

Fig. 3: Mapping and exact reinstallation of the *trencadís* (photo N. Zapata)

Fig. 4. Final cleaning posterior to regrouting the glass *trencadís* and ceramics elements (photo N. Zapata)

nal profiles, revealed by imprints in the adhesion mortar); cutting *trencadís* for substitution of those subject to severe and irreversible damage;
- Conservation-restoration of the fragmented ceramic discs, both damaged *in situ* and accidentally broken during the extraction process (despite the use of gauze facing);
- Reproduction of missing ceramic discs by Manel Diestre, of the SOT Ceramic Studio.

Phase 3: Final in situ operations
- Adhesion of the *trencadís* and ceramic discs with a mortar formulated for compatibility with the original, using the 1:1 tracing and photographic documentation for exact positioning;
- Adhesion of *trencadís* on the original mortar where this preserved the original imprints, using epoxy resin;
- Integration of the lower parts of skylights 2 and 3 with restored glass *trencadís* and ceramic discs; in skylight 2 the mortar was prepared using hydraulic lime and marble powder (CTS *giallo oro, verde alpi, rosso verona*); for the other skylights the company executing the waterproofing selected a commercial mortar product;
- Final cleaning prior to the regrouting the glass *trencadís* and ceramics elements (Fig. 4).

Ethical considerations

The codes of ethics for curators and restorers state the principle of clearly discerning the original parts and materials of the conserved object from those used in the modern procedures, however this can lead to problematic choices when working with cultural heritage that is a living part of our collective memory. This is the case of two of the skylights that had previously had water filtering problems and where some glass *trencadís* had been substituted and some ceramic discs had been broken. Unfortunately, it was impossible to find any source of documentation about the earlier restoration interventions.

After repairing the cracks, we faced the problem of how to solve the ponding of water in the indentations left by the losses, which were up to 30 centimetres in width. In this case, using a single neutral colour of glass for the reintegrations would have been sufficient for the mechanical purposes of establishing correct drainage. However the use of materials and colours different than the original *trencadís* for the reintegrations would have been visually disruptive and problematic to the understanding of visitors. Ultimately we decided to do carry out the reintegration using *trencadís* in materials very similar to the originals, documenting all our interventions in detail.

Conclusions

Heritage artworks in outdoor contexts are exposed to cycles of alternating environmental conditions, leading to physical, chemical and biological deterioration. Only periodic monitoring for detection of changes, accompanied by timely interventions for damage control, can avoid losses to the works. The effectiveness of periodic monitoring depends on the possibility of consulting of meticulous graphic recording, as well as detailed documentation of all restoration-conservation interventions, for comparison of the short, medium and long-term evolution of the status of the works and the behaviour of the materials used, whether these are of traditional or new composition.

Authors

Neus Zapata Tena holds a degree in Fine Arts with a specialty in Restoration from the University of Barcelona, and is a graduate of the five-month course on Diagnosis and Methods for Preventive Conservation in Museums, offered by the Department of Art of the Autonomous University of Barcelona. She is co-director of Especialistes En Conservacio i Restauracio Arqueologica (ECRA) SL, Barcelona.

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CLIMATE SURVEY FOR MOSAICS IN ARCHAEOLOGICAL SITES, CONNECTED BY THE INTERNET OF THINGS

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Abstract

A weak point of climate surveys on remote sites has been the follow-up on climate loggers, and this has not been different for the Roman site of Orbe-Boscéaz. The paper describes the realisation of an inexpensive remote climate survey system, based on open-source hardware and software. The method uses the Internet of Things application Thing Speak, a reliable and free method for initial data storage and triggering actions in the cloud. Through the employment of the ClimateLog App and the representation of the data through the Plotly library, climate plots are easily generated and explored.

Keywords: Orbe-Boscéaz, Roman site, climate survey, IoT, open-source

Introduction

Climate and condition surveys are crucial tools to understand deterioration phenomena and trends of architectural surfaces such as mosaics, and have therefore been widely employed in conservation practices. We consider these tools very important for the site of Orbe-Boscéaz, since the mosaics there encounter significant salt crystallisation and frost cycles.

A weak point of climate survey in the past has been regularly following up with climate loggers. Those who have ever been involved in climate surveys have likely encountered inconsistent, faulty, or simply forgotten loggers, some of which were out of order for weeks or months, leaving gaping holes in the climate data. Furthermore, locally-stored climate recordings cannot trigger reaction from the remote conservator.

The Internet of Things (IoT), describes the interconnection of all objects via the Internet: a phenomenon that extends to archaeological sites. The following sections present our open-source hardware and software approach for reliable and inexpensive remote climate monitoring based on the IoT.

Context

The Roman archaeological site of Orbe-Boscéaz contains several mosaics dating from the late 2nd century AD, conserved in protective buildings designed as one-room houses (Fig. 1). Due to the significant challenge of variable environmental conditions, climate control systems were installed in two buildings in 2001. The system is basically an air-exchange unit drawing cold humid air from trenches under the building and injecting the air into the room, with the goal of maintaining a stable relative humidity at around 80-90%. This project was presented during the ICCM conference at Thessaloniki by Weidmann and Girardet (2005).

Fig. 1. Mosaics are conserved in protective buildings designed as one-room houses (photo Anjo Weichbrodt, 2016)

The Site et Musée romain d'Avenches has the responsibility of monitoring and maintaining the mosaics at Orbe-Boscéaz, but arriving there requires a 45 minute drive. Our conservation staff generally visit the site about four or five times per year, which is insufficient for discerning the extent of ongoing salt crystallisation cycles or for determining the effects of frost during long cold spells. Similarly it has been impossible for us to know when climate system malfunctions, or if it is truly doing what it was designed to do. Additionally, in the coming years we would like to monitor the influence of some modifications, such as: 1) lowering glass barriers around the mosaics to the ground, to generate a cold lake effect; 2) temporarily shutting down the air exchanging unit; and 3) insulating the walls and ceiling. For these purposes we require a remote climate monitoring system which is: GSM-compatible, inexpensive, modular. In consideration of these requirements, we opted for an open-source hardware and software approach with IoT integration.

Hardware, software, method

Data logger

We decided to use the well documented open hardware from Yoctopuce [1], a Swiss startup. Their relatively inexpensive climate logger ($52 in 2018) contains high quality

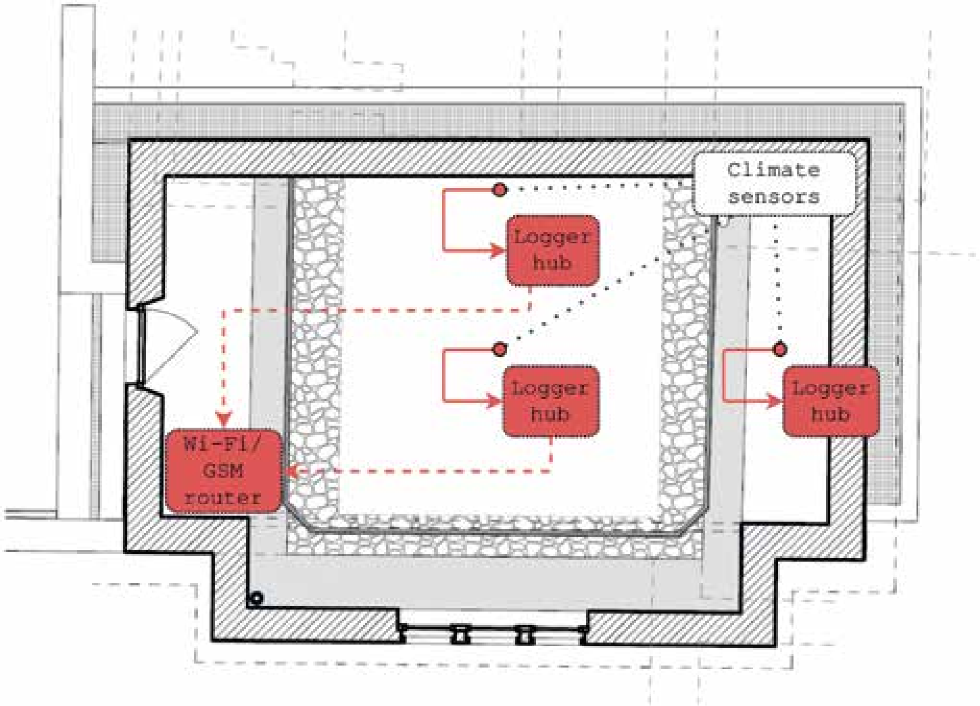

Fig. 2. Climate loggers communicating with logger-hub and Wi-Fi/GSM router at Pavillon 4 (drawing Anjo Weichbrodt, 2017)

temperature and relative humidity sensors from the renowned sensor producer Sensirion. These modules can communicate through a corresponding hub with Wi-Fi or GSM data networks. All the modules can be managed through a web interface or by an application programming interface (API) drawing on a myriad of languages, without requiring specific software.

Site setup

Figure 2 presents the example of Pavillon 4, containing the mosaic *Les Divinités*. As visible, there are hubs in three locations, which communicate via Wi-Fi with a Wi-Fi/GSM router. Three climate loggers are connected with each hub, at heights of 5 cm, 80 cm, and 200 cm above ground. The loggers are configured to send temperature and relative humidity values every 15 minutes.

Posting data

The data is sent out by the hub through the Wi-Fi/GSM Router in the form of a HTTP POST request (Fig. 2). Such a request feeds the data to a web server configured to listen for it. In our case the web server is the IoT platform *Thing Speak* [2] and the request looks like: http://api.thingspeak.com/update?key=XXXXXXXXX-&field1=70.1&field2=7.4&created_at=2017-10-17T01:02:03Z

Piece of POST request	What it represents
http://api.thingspeak.com/update	address
?key = XXXXXXXXX	key to the data channel
&field1 = 70.1& field2 = 7.4	logged values of relative humidity and temperature
&created_at = 2017-10-17T01:02:03Z	time at which the values were logged

Table 1. The POST request in detail

The POST request is discussed in detail in Table 1.

Our actual POST requests look slightly more packed because we squeeze the climate data of three loggers into one request. The GSM network traffic generated is very low for current standards. For three loggers we estimate a total amount of 1.3MB/month. As we are using a prepaid service which offers 10MB per month for free, we do not incur any fees for the GSM traffic.

Storing the data and making it do something

As we described in the previous paragraph, once the climate measurement is taken the data is transmitted via POST request to the Thing Speak platform (Fig. 3a), an established open-source IoT application and API, which stores and retrieves data using HTTP over the internet. The climate data is accessible online and works perfectly for quickly checking and sharing elements of the climate survey. It is also possible to configure Thing Speak to send notifications via Twitter. We use this function to generate notifications like daily reports, and alarms when a logger fails and on reaching critical values of temperature or relative humidity (Fig. 3b).

Local server and user interface

While it is useful to have quick access to climate survey data online, it is crucial to have a local copy as backup and to transform the data into report-ready output. For this we use the ClimateLog App [3] (Fig. 3c), a Django-based open-source software that facilitates access of the different climate logger channels on Thing Speak, as well as the use and representation of the data. This is how it works: the user queries a specific logger in a browser interface; the ClimateLog App then checks whether new data is available on Thing Speak and downloads it; raw data and report-ready visualisations can now be accessed; the climate graph is generated using the Plotly library, which allows for interactive exploration of the visualised data (Fig. 4) and exports archive-ready climate plots.

Conclusions

By combining open hardware and open-source applications, we are able to follow up on environmental monitoring for the Roman mosaics at Orbe-Boscéaz. The method described uses inexpensive but precise open-hardware modules. Using the open-source IoT application Thing Speak, we have a reliable and free method for initial data storing and triggering actions in the cloud. Through the employment of the ClimateLog App and representation through the Plotly [4] library, climate plots can be easily generat-

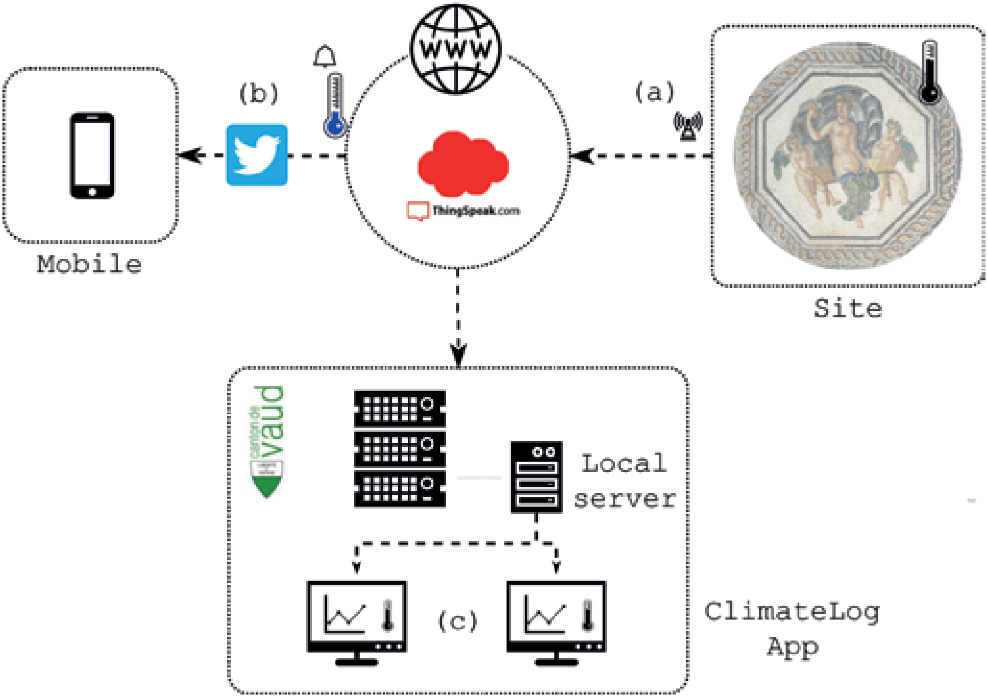

Fig. 3. The climate data is sent to the Thing Speak cloud; (b) alerts and reports are transmitted via Twitter; (c) the data is transferred to a local server and can be explored and elaborated in the ClimateLog App (drawing Anjo Weichbrodt, 2017)

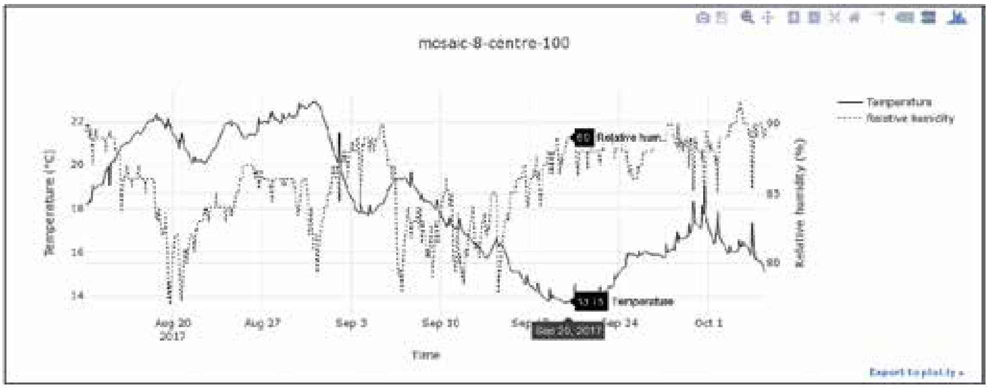

Fig. 4. Example of an explorable graph output generated by the Plotly library (Anjo Weichbrodt, 2017)

ed and explored. The modular construction of the system is a great strength as each module, hardware or software, can be exchanged at a given time by another product if necessary.

We have just gotten closer to our mosaics.

Acknowledgments

We thank all our colleagues who have been involved in the work at the mosaics of Orbe-Boscéaz in the past and present, especially Myriam Krieg. The project would not have been possible without the support of Marie-France Meylan Krause and Catherine May-Castella.

Technical Notes

1. Yoctopuce website - http://www.yoctopuce.com/
2. Thing Speak website - https://thingspeak.com/
3. Repository of the ClimateLog App - https://github.com/anjoweichbrodt/ClimateLog_App/
4. Plotly website - https://plot.ly/

References

Weidmann D., Girardet F. 2005. “Contrôle climatique de mosaïques *in situ* sous abris.” In *Wall and Floor Mosaics: Conservation, Maintenance, Presentation, Proceedings of the VIIIth Conference of the International Committee for the Conservation of Mosaics, Thessaloniki, 29 October-3 November 2002* edited by Charalambos Bakirtzis, 359-366. Thessaloniki: European Center of Byzantine and Post-Byzantine Monuments, Ephoreia of Byzantine Antiquities of Thessaloniki

Authors

Anjo Weichbrodt is a conservator of architectural surfaces. He first dove into the world of mosaic conservation during an internship at the Getty Conservation Institute investigating alternative backing materials. He has continued working in the areas of documentation, maintenance and intervention planning for mosaics. Anjo is currently active as a freelancer with close ties to the archaeological sites of Aventicum and Augusta Raurica in Switzerland.

Noé Terrapon, joined the Site et Musée romain d’Avenches after 14 years with the archaeological department of Freiburg and two years in Ostia as an independent contractor. On site, he co-manages the conservation-restoration laboratory. His main research areas are the development of mortars and injection grouts, *in situ* conservation-restoration, GIS documentation and analysis, dry ice blasting, and ultraviolet germicidal irradiation.

EXPERIMENTAL COMPARISON OF SIX METHODS OF *IN SITU* MOSAIC REBURIAL

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Abstract
Reburial of mosaics is widely used as a method or preventive conservation, however there is a lack of systematic data and study of the systems used. The objective of the current research is to better understand the problems encountered and results achieved by the reburial techniques currently in use. A literature survey identifies six systems applied in Turkey since the 1980s. The different systems are replicated in an experimental setup on the mosaic floor of a monumental hall identified as *basilica thermarum* (so-called Claudius Piso Hall) of the Southern Baths in the archaeological site of Perge (Pamphylia). Sensors are used to collect data on the performance of the systems in regards to the key parameters of: water/humidity, wetting-drying cycle, temperature and plant density/diversity. The preliminary results are reported.
Keywords: Reburial, mosaic pavements, *in situ*, Perge, Pamphylia, experiment

Introduction
Reburial has become the most commonly used method for protection of mosaics, however the current techniques are insufficient for provision of moisture equilibrium and prevention of penetration by plant roots. Although studies focused on observation of archaeological sites have been conducted since the 1990s, these have been very few, relying on restricted numbers of monitoring devices, with limitations in methodology. Comparative field testing is clearly necessary for purposes of obtaining technical knowledge and practical improvement. To gain better understanding of the conditions in the six different reburial techniques commonly used in Turkey, an experimental setup was created at the archaeological site of Perge and data were collected over the course of a year. The so-called Claudius Piso Hall was selected as the experimental location (Fig. 1), in consideration of: i) the sufficient size of the pavement; ii) its attribution to a single mosaic workshop (Işıklıkaya 2010); iii) the characteristics of its mortar (Uğur 2011).

Design of the experiment
A search of the literature obtained information on the trends of reburial systems in Turkey. In particular there were 144 brief mentions of reburials in the proceedings of the *Uluslararası Kazı, Araştırma ve Arkeometri Sempozyumu* [International Symposium of Excavations, Surveys and Archaeometry], published annually since the 1980s, and *Müze Çalışmaları ve Kurtarma Kazıları Sonuçları Sempozyumu* [Annual Museum Rescue Excavations Symposium], issued since the 1990s. Excluding repeated mentions of the same systems

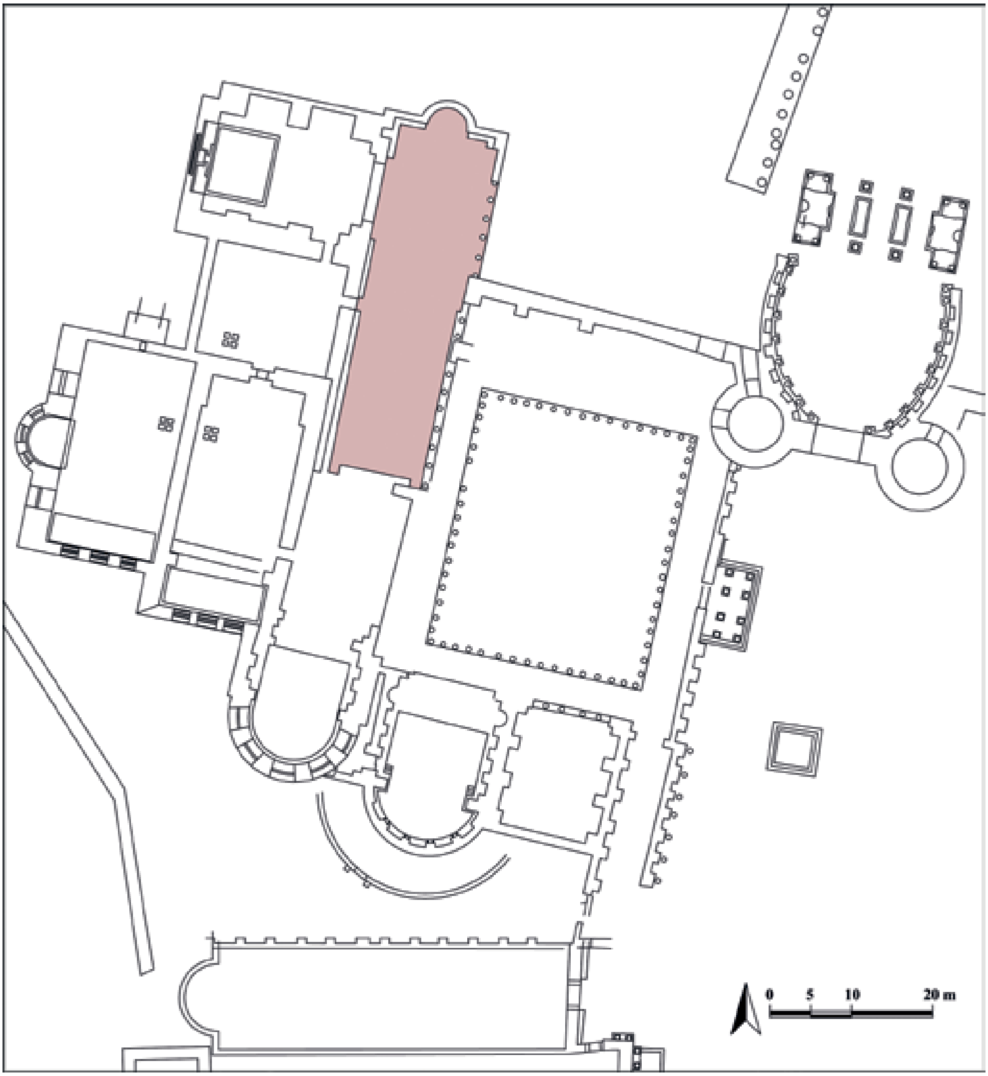

Fig. 1. Plan of the Southern Baths at Perge, indicating the experimental area (Prof Dr Haluk Abbasoğlu, Archaeological Site of Perge)

and minimal annotation of maintenance on reburials and mosaics, 124 different comments are detected. The notations include those describing: i) first reburial shortly after discovery (91); ii) notations on existing reburial systems encountered during maintenance, restoration, lifting or documentation of pavements (17); iii) alterations for improvement of separators, fill material or other aspects of existing systems on pavements (16).

Eighteen of the 124 papers note that the mosaic was reburied with the aim of protection, but do not describe the separator,

System no	System design (from the mosaic surface upwards)	Experimental Modules (each 2x3 m in size)
1	**Soil** (approx. 25 cm high sieved soil)	1 / 10 / 17
2	**Sand** (approx. 25 cm high natural river sand)	2 / 9 / 14
3	**Geotextile** (200 gr/m², non wowen, polypropylene-based, needle punched) and **sand** (approx. 25 cm high natural river sand)	3 / 7 / 15
4	**Geotextile** (200 gr/m², non wowen, polypropylene-based, needle-punched), **sand** (approx. 15 cm high natural river sand) and **gravel**, (10 cm high)	4 / 8 / 13
5	**Geotextile** (200 gr/m², non wowen, polypropylene-based, needle-punched) and **pozzolana** (approx. 25 cm high)	5 / 11 / 16
6	**Sand** (approx. 5 cm. high natural river sand), **geotextile** (200 gr/m², non wowen, polypropylene-based, needle-punched) and **sand** (20 cm high natural river sand)	6 / 12 / 18

Table 1. Experimental modules

fill material or otherwise characterise the system, while 12 papers omit to note the separator used. The remaining 94 papers provide sufficient information for comprehension of the entire system used, and serve as the basis for the current analysis.

The fill material most frequently used is sand; progressively less frequent are soil, *pozzolana* and gravel. The most commonly used separator is geotextile, followed by plastic sheet (8 cases), synthetic or jute tarpaulin (3), membrane (2), mesh (1), and mosquito net (1). Unfortunately the publications do not provide technical information on the types of geotextile used. For this reason we referred to restoration materials manufacturers and suppliers, who informed us that the preferred geotextile type has been non-woven, polypropylene-based, needle-punched material.

In a majority of cases (54) the reburial system involved the joint use of a separator and fill, however the design of the system could vary even within a single site. A total of five systems were identified based on the literature search. The most commonly reported design is reburial with direct application of geotextile on the mosaic, and then sand (13 cases), followed by geotextile, then *pozzolana* (8), and finally geotextile, then sand and gravel (4). In the 40 instances of reburial using fill without barrier, the most commonly used materials were soil (13) and sand (14). The authors were also aware of a further reburial system developed in recent years and not yet mentioned in the symposia publications. Experience has shown that when geotextile is laid directly on the mosaic it permits the passage of plant roots and attachment of the textile to the surface of the work. In consequence, conservators have also adopted a system in which a thin layer of sand is first applied to the mosaic, then the geotextile, and finally a thicker layer of sand (Yeşil-Erdek 2014). Accordingly,

Fig. 2. Experimental area of the Basilica *thermarum* (so-called Claudius Piso Hall) of the Southern Baths at Perge (photo Ş. Yeşil-Erdek)

this sixth design was also included in the experimental procedure (Table 1).

The experiment was designed as follows: Eighteen rectangular modules, each 3 x 2 m, were laid out on the mosaic floor of the Claudius Piso Hall. Each of the six reburial systems was applied over three of these modules, for purposes of statistical validity of information (Figs. 2-3). Capacitive sensors for measurement of humidity and temperature were installed in the fill layer each of the modules, and a small meteorological station was installed at the site for collection of environmental data in correlation with that from the capacitive sensors.

The six systems tested are:

1. Sieved soil (depth approximately 25 cm);
2. Sand (depth approximately 25 cm);
3. 200gr/m^2 geotextile and sand (approximately 25 cm);
4. 200gr/m^2 geotextile and sand (approximately 15 cm), then gravel (approximately 10 cm);
5. 200 gr/m^2 geotextile and tuff *pozzolana* (approximately 25 cm);
6. Approximately 5 cm sand, then 200gr/m^2 geotextile and 20 cm sand.

RESULTS

The experiment was still in progress as of the date of this report, however the first

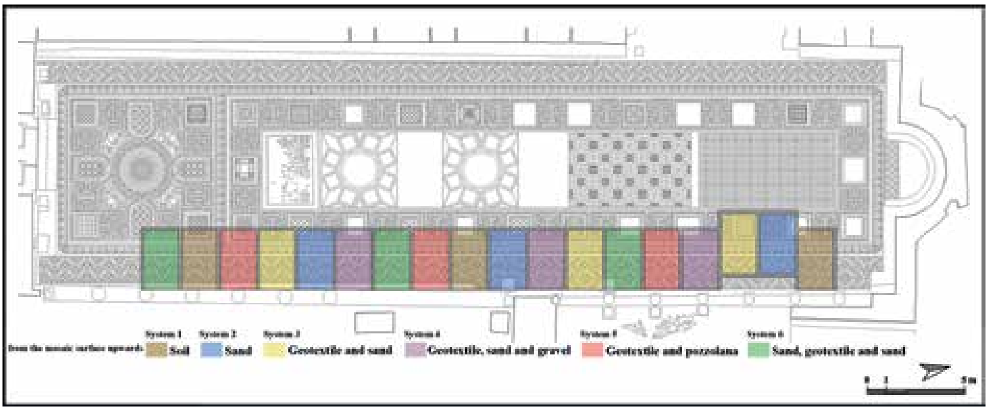

Fig. 3. Experiment design (drawing Ş. Yeşil-Erdek, originally in Işıl R.Işıklıkaya, 2010)

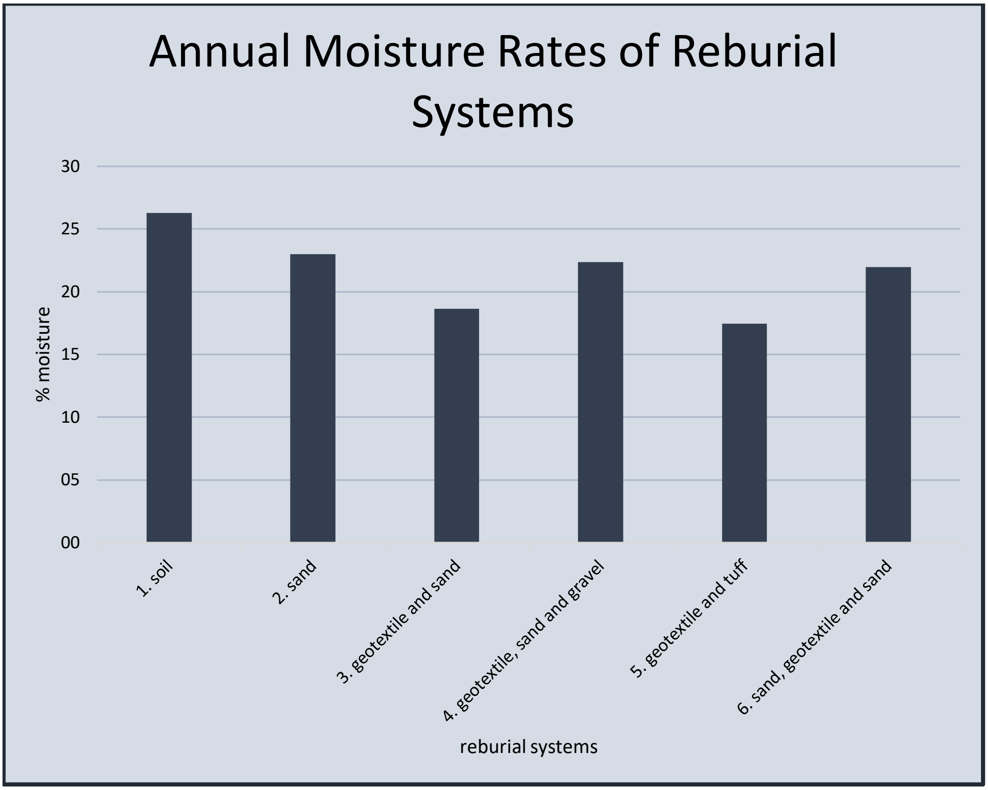

Table 2. Annual moisture rates of the reburial systems

results indicate that systems 3 and 5, with geotextile placed directly on the mosaic floor, then sand or *pozzolana*, are the best in terms of filtering water and controlling humidity. Although system 4 also uses geotextile in direct contact with the mosaic surface, the capacity for filtering water and controlling humidity is lower than in systems 3 and 5. This can be explained by the gravel layer on the top, causing a decrease in the evaporation level. However, all of systems 3, 5 and also system 4 provide better results in this regard than systems 2 and 6, in which sand is applied directly to the mosaic surface. Finally, system 1 (direct application of soil) achieves the poorest results in terms of filtration of water and balancing humidity (Table 2). These results demonstrate that the direct application of geotextile to the mosaic surface is the best choice among the systems that have been used, in terms of ensuring filtration and control of humidity. Interestingly the difference between the results from systems 2 and 6 is very limited, suggesting that the application of the thin layer of sand prior to the geotextile separator, rather than laying it directly on the mosaic surface, has hardly any positive effect on reducing humidity.

Plant samples were systematically collected from all 18 test modules during the months of March, April and May, 2016 and 2017. These analysis of the species is being performed by Dr Ali Kavgacı, as of the date of this publication.

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TECHNICAL NOTE

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REFERENCES

Işıklıkaya I. R. 2010. *Perge Mozaikleri, Macellum, Güney Hamam ve Geç Dönem Meydanı Doğu Portiği*. Unpublished Ph.D. dissertation, Istanbul University, Istanbul.

Uğur T. 2011. *Perge Antik Kentine Ait Mozaik Harçlarının Karakterizasyonu*. Unpublished MA Thesis, Istanbul University, Istanbul.

Yeşil-Erdek Ş. 2014. "Perinthos-Herakleia Bazilikası Taban Döşemelerinin Konservasyonu/ Conservation of Floor Pavements of Basilica in Perinthos-Herakleia". *Journal of Mosaic Research 7*: pp. 61-76.

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