

quaderni di assorestauro



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ACTA OF THE INTERNATIONAL WORKSHOP

**THE RESTORATION OF THE SURFACES
OF HISTORICAL ARCHITECTURES:
FRESCOES, MOSAICS
AND STONE ARTWORKS**

SOFIA

18

JUNE

19

JUNE

20

JUNE

Project financed by the Italian Institute for Foreign Commerce & Assorestauro



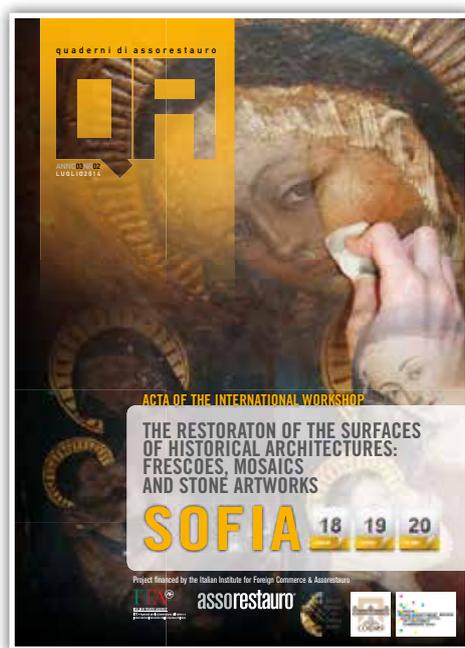
ITALIAN TRADE AGENCY
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Restoration and discoveries
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sponsor presentation



ITALIAN TRADE AGENCY

ICE - Agenzia per la promozione all'estero e l'internazionalizzazione delle imprese italiane

The ICE-Italian Trade Promotion Agency is the government organisation which promotes the internationalisation of the Italian companies, in line with the strategies of the Ministry for Economic Development. ICE provides information, support and advice to Italian and foreign companies.

In addition to its Rome headquarters, ICE operates worldwide from a large network of Trade Promotion Offices linked to Italian embassies and consulates and working closely with local authorities and businesses.

ICE provides a wide range of services overseas helping Italian and foreign businesses to connect with each other:

- identification of possible business partners
- bilateral trade meetings with Italian companies
- trade delegation visits to Italy
- official participation in local fairs and exhibitions
- forums and seminars with Italian experts



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associazione italiana per il restauro architettonico, artistico, urbano
italian association for architecture, art and urban restoration

Assorestauo is the first association established in Italy for materials, equipment and technology producers and service providers for the restoration and heritage conservation sector. Among the associations involved in this sector, which includes various institutional bodies that represent designers or restorers, **ASSORESTAURO** is the first to finally give voice to the industry and the sector of specialised services, promoting their interests in promotional, legal and cultural areas. **ASSORESTAURO** seeks to represent the sector, both nationally and internationally. In regard to the Italian market, an increased sensitivity towards our architectural heritage, together with the diffusion of new technologies, point to a growth in the sector in recent years, both from the cultural point of view (debates, magazines, conventions, exhibitions) and from that of technology (innovative materials, machines and equipment, software, plant design etc.). This provides the industry with a great opportunity for increasing and strengthening the occasions for dialogue, which are often lacking, with professionals, on the one hand, and with institutions (Government departments, Universities) on the other. As far as foreign markets are concerned, there is a clear perception of the need to capitalise on the great prestige that Italy enjoys abroad in matters of cultural heritage and on the remarkable investment in cultural technology that Italian companies have made in recent years, in order to translate specialist skills and know how into business opportunities abroad.

ASSORESTAURO therefore has the scope of coordinating, protecting and promoting the interests of its associated companies, and fostering their progress and development, endorsing their products and services and representing them in their relations with the institutions and organisations working in the field of research and training, regulations and promotion. It also acknowledges the support and patronage of the main restoration Italian Trade Show and Events, recognising, together with its associated companies, the value of a trade fair appointment that has become an international point of reference.

The company carries out the following specific activities:

- it promotes studies and research and collects news, items and statistical data useful for sector information, and carries out studies, monitoring and analysis of the situations and developments in the markets;
- it participates in the elaboration and publishing of international regulations for the qualification of associated companies, assisting them and protecting them in the certification of the quality and security systems of their products and services;
- it directly and indirectly organises training or updating courses, research and conferences for the development and dissemination of technologies and the use of their products;
- it promotes and holds conventions, synergies and agreements among associations throughout the world.





Cinzia Bruno
Director of ICE Sofia

■ Italian excellence in the restoration of Sofia

Relative to its potential, Bulgaria is not a very well-known country. Few people realise it is ranked third in Europe for richness of historical and cultural heritage, after Italy and Greece. Its geographical location at the crossroads between east and west, its natural beauty and its favourable climate have always attracted different populations throughout history. Today, we can still admire historical monuments dating back to many different eras and civilizations – Thracians, Greeks, Romans, Ottomans. This small country boasts a notable heritage, numbering some 40.000 historical monuments and 200 museums, which contain over 5 million historical artefacts. This inheritance demands to be looked after, not only so that its historical value may be preserved, but also so that it may contribute to the revival and economic development of the country and to the growth of its tourism industry. Interventions to restore its artistic heritage have therefore become a strategic priority for the Bulgarian government. Its new 2014-2020 plan, funded by the EU, contains various operational strategies specifically aimed at the conservation and restoration of historical and cultural monuments, with interventions on 165 sites out of 1400, and this bears witness to Bulgaria's capacity for investment of EU funds.

Italy can make a huge contribution to the valorisation of this heritage, having always been a global leader in the conservation and restoration of historical monuments. The Italian concept of restoration is based on respect of authenticity, and Italian enterprises. With the collaboration between Italy and Bulgaria already going strong in other sectors, this seminar is intended to act as a starting point for future collaboration in the field of restoration. The seminar-workshop "Restoration of historical surfaces: frescos, mosaics and stonework" is organised by ICE-Agenzia with the invaluable collaboration of Assorestauo, and the support of the Historical Museum of Sofia and the Italian Institute for Culture. It covers the whole cycle of a restoration project, from the theory to the practice. The theoretical classes will be led by Italian teachers from the School of Mosaic in Ravenna and the Semiprecious Stone Factory in Florence – two of the leading schools in Italy, and indeed worldwide, in the field of restoration – in collaboration with Bulgarian teachers. For the practical sessions, we have organised hands-on teaching workshops in restoration led by representatives of top Italian production firms, who will guide you in the use of innovative tools and technologies. This event is aimed at archeologists, architects, students and individuals or institutions working in the area of restoration. This event is also intended to create a link between the cities of Ravenna and Sofia, both nominated to be European Capital of Culture in 2019 and historically connected since the times of the Roman Empire.

I hope that this seminar will mark the start of a fruitful collaboration and that ICE-Agenzia and Assorestauo, with their experience and expertise in the field of restoration, may contribute to the conservation and valorisation of Bulgaria's artistic heritage. I hope that, together with Bulgarian institutions and agencies, we may build projects of international collaboration such as those we have built in other countries.

Antonella Ranaldi

Director of Superintendence
 for Architectural Heritage and
 Landscape Ravenna, Ferrara,
 Forlì-Cesena, Rimini and
 Venezia, Belluno, Padova e
 Treviso

Director of The Ravenna's
 School of Mosaics

■ Giovan Battista Cavalcaselle, Giuseppe Gerola and Cesare Brandi: tendencies in the restoration of Ravenna's mosaic

In a long-term perspective, I shall highlight some tendencies that define the School of Mosaic Restoration in Ravenna:

- The importance given to the investigating and documentary apparatus. To that effect, Corrado Ricci's *Tavole Storiche*, published starting from 1930 and dedicated to the main Early Christian and Byzantine monuments, with particular emphasis on mosaics, provide a method that is still recognized as valid, despite the evolution undergone by representational systems;
- the preeminence of on-site, rather than detachment-based, restoration practices;
- the principle of recognizability of restorations, especially through integration with pictorial technique, that reveals a common thread in the recommendations of Giovanni Battista Cavalcaselle and Cesare Brandi—a line of thought that was adopted in the first place in Ravenna, and consciously implemented both in restoration sites and in teaching at the School of Mosaic Restoration.

No less important is restorers' training, based on methods practiced by Corrado Ricci and handed down to the current Superintendent.



These tendencies demonstrate the existence of a common and recognizable method of operation that characterizes the restorations conducted by the celebrated Superintendency of Ravenna and the School's teaching method for mosaic restoration.

Under Giuseppe Gerola, Superintendent in Ravenna from 1910 to 1919, mosaic restoration acquired greater awareness in following its own tendencies and guidelines, that arose from a critical evaluation and technique of past restorations, primarily Felice Kibel's 19th Century works, with the purpose of attaining methods that would preserve the overall reading and preserve the authenticity of the artwork.

The break that resulted in respect to the recent past consisted of the technical preference for pictorial integrations, in lieu of Felice Kibel's "Roman" technique with mosaic tesserae.

Starting from 1910—and particularly with the restoration of the Cappella Arcivescovile—pictorial integration on faux-mosaic painted plaster, already experimented in the past, began following the ministerial guidelines circulated in a 1884 memorandum more regularly, with a few notable exceptions, such as the restorations performed in Sant'Apollinare Nuovo, after the fall of entire pieces of mosaic caused by an air raid that struck the front of the Basilica in February 1916.

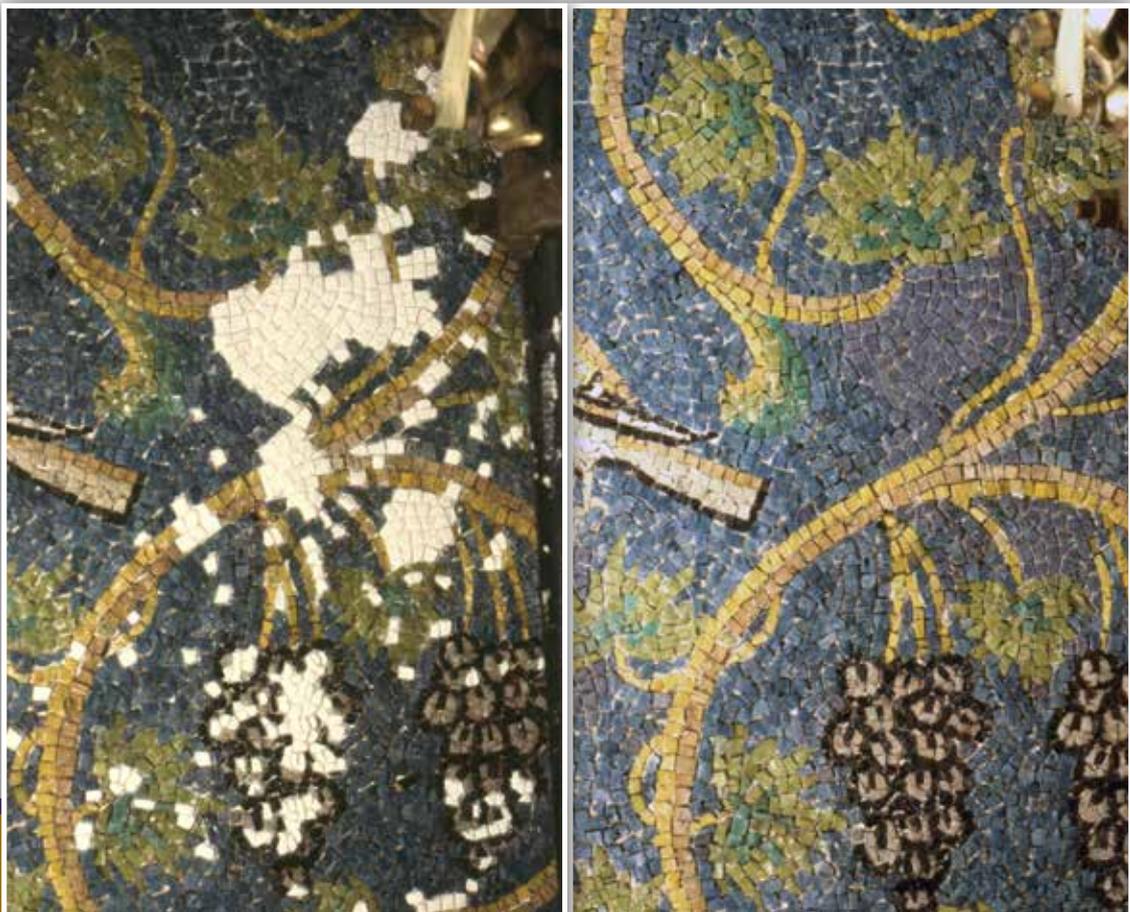
Integration with pictorial technique was the recommendation given by art critic and historian Giovanni Battista Cavalcaselle in his "Sulla conservazione dei monumenti e delle opere d'arte e sulla riforma dell'insegnamento accademico" (Rome, 1875), subsequently included in the ministerial memorandum of 1884. This recommendation originated from the awareness of damages deriving from incautious interventions. Cavalcaselle alluded to mosaic restorations conducted by Felice Kibel in 1860 at the Orthodox Baptistry, which he had the opportunity of viewing and criticizing at the time.

Before restorers of ancient mosaics were available, restorations were performed with pictorial integrations. However, while the 1884 memorandum recommended this method as temporary, it ended up being adopted permanently, as it would make new interventions recognizable. Being different in materials and technique from the ancient oeuvre, this method would preserve its authenticity. As Gerola contended, the badly made restorations of the past would not risk being mistaken for originals. Conversely, if greater mastery were attained in reproducing the ancient technique, the risk of deceiving the observer would be greater.

After the intense season of detachment-based restorations, which predominated between the 1930's and the 1970's, on-site consolidations were preferred in the 1980's. Accordingly, for the San Vitale mosaic, restorers used the seemingly new gap-filling system with pictorial technique, using lime paste inserts onto which tesserae were carved, and then painted in watercolor or frescoed.

In the light of both Giuseppe Gerola's theoretical and methodological contributions, and of more recent experiences, resorting to gap integration with carved and painted tesserae, as experimented in S. Vitale in 1988-1990, a 1936 report written by Cesare Brandi on the occasion of an inspection at San Vitale acquires new significance. Speaking of the Theodora and Justinian

mosaic, he explained that if for any special reasons it became necessary to resort to gap filling, it should never be made with tesserae of the same type as the ancient ones, nor with smaller ones, and he also considers it pedantic to use different-color lines or metal foil edges. Instead, he would recommend completing the missing parts with gesso tesserae of the same type as the ancient ones, applied by hand on the spot using the same technique and painted in watercolor. We already knew Cesare Brandi's important contribution to painting restoration with his so-called "streaking" (rigatino) technique. Now we know that he also had a "recipe" of his own for mosaics, or rather a method for the integration of parietal mosaics. Consistent with the ministerial memorandum of 1884, Cesare Brandi improves Cavalcaselle's and Gerola's guidelines, and for the San Vitale mosaics he recommends a technique that remained unknown for a long time. This recommendation reappears in a rare essay from 1956, published in the *Bollettino dell'Istituto Centrale del Restauro* (25-26, 1956, pag. 3-9). Brandi had just returned from Jerusalem, where he had been appointed by Unesco to examine the mosaics at the Dome of the Rock. Among other observations on the mosaics, Brandi warned those who thought that "because of the ostensibly incorruptible and unalterable nature of the materials, restoration could do without the precautionary measures that are also much needed for mosaic restoration". As for technique, he is interested in the "position of the tesserae in the body of the mosaic", and for "position" he means the contingent slant, the greater or smaller adjacency between the tesserae, the degree of immersion of the tesserae in the mortar, the ductus with which they were arranged. For gap integration, he also confirms his recommendation to proceed with pictorial technique, which he had expressed in 1936 when dealing with the mosaics of Theodora and Justinian. In Ravenna, the painted faux-mosaic integration method is now a precise guideline that is



implemented in restoration sites as well as in teaching at the School of Mosaic Restoration. During the restoration works of the chancel in the Basilica of San Vitale (1988-1990), restorers had the chance of improving consolidation techniques, by resorting to fixing injections and ceramic anchor bolts. On-site restoration may be defined as a one-way choice, a tendency that derives from the awareness that mosaics are not limited to tesserae, but they also include the less precious frame, which however retains traces of every single restoration, thus representing a tangible proof that includes the brickwork, the base, the underpainting, and the mortar bed. For the restoration of the chancel of San Vitale and subsequent works, the method used was integration with lime mortar and marble dust, shaped using copper molds in imitation of the mosaic, followed by the painting of tesserae. Initially watercolor was used; later, fresco painting was considered to be more durable. However new the system appeared, it was in fact deeply rooted in Giuseppe Gerola's training, as described above—a method that was improved through time, and readjusted to fit each context, which still represents a valid operative orientation. It is different from the restorations performed in the early decades of the past century in that it better reproduces gauges, frameworks and textures. While in the past reintegration was understood as actual reconstruction of mosaic parts (however large), today gap-filling takes on a minimal scope and may be compared to mending adjacent parts of a fabric. Gap filling is not excluded a priori when applied to serial, geometric layouts and decorations if necessary to support the overall reading.

■ Restorers' training. Worksite Schools at the Superintendence of Ravenna and the recent international experiences

A School of Mosaic Restoration was opened in 1984 at the Superintendency for Architectural and Landscape Heritage of Ravenna. In 2004, the School became a branch of the Opificio delle Pietre Dure, located in Florence.

Each worksite school conducted by the Superintendency between 2004 and 2007 has provided an opportunity for hands-on and theoretical teaching organized in three phases;

- 1) Study of mosaic surface to collect and archive useful information for the understanding of the artwork, with particular focus on previous interventions, the historical and critical background of the artwork and restoration project design, through cross-curricular insights and by drawing heavily on lab investigations, in order to understand the state of preservation of the mosaics at hand and the decay undergone by their tesserae;
- 2) Restorations are organized based on minimal-intervention guidelines: pre-consolidation,

cleaning, consolidation, and protection, by testing samples of working materials, especially hardeners;

- 3) Final scientific balance, updating of the Tavole Storiche using the collected data; interpretation of the collected data, in order to produce an overall reading of the artwork that takes into account historical and critical information, as well as the technical observation acquired directly on the site.

Each worksite school was followed by the publication of results in monographs.

The fundamental drive towards restorers' training combines with the international experiences we have had over the last few years. To this regard, I would like to mention the 2010 Musiva Veritas convention and exhibition in Tokyo. The preservation and restoration of mosaics at the Mausoleum of Galla Placidia, declared World Heritage Site, at the Istituto Italiano di Cultura, in association with the University of the Arts, Tokyo.

In 2012 we travelled to Antakya, Turkey, to start a cooperation program for the preservation of mosaics at the Museum of Antakya, for which a new museum was being built. More recently, in May 2014, the international convention "Ravenna Musiva - Preservation and Restoration of Decorated Surfaces - Mosaics and Frescos" took place in Ravenna.

Alumni of the School of Ravenna that currently work either in Ravenna, in Italy, and across the globe, serve as important vehicles for spreading the knowledge acquired and for new experiences. Some of them have later served as instructors at the School: Claudia Tedeschi (who participated into Saint Peter's Cupola restoration in Rome, Santa Sofia in Istanbul, and collaborated to the study of Westminster Abbey mosaics in London, as well as in the Tlos Excavations, Turkey, and in Ravenna for the latest restoration of the Mausoleum of Galla Placidia mosaics); Ermanno Carbonara (who worked for several years in Tunisia in worksites sponsored by the Paul Getty Foundation). Some of them got involved in contemporary mosaic art, such as the Ravenna-based CaCo3 Group.

The School discontinued its teaching activities in late 2009, until university-level restoration training programs would be redefined into actual curricula. Mostly by request on the part of prospective students, who were among the first to call for a reactivation of the School, in September 2013 the teaching activities resumed at the Restoration Labs of the Superintendence in Ravenna as part of a new program in Conservation and Restoration made available by the University of Bologna. The Workshops at the Superintendence back up lectures in Art History, Applied Chemistry, Petrography, etc., taught as part of the curriculum. The student-teacher ratio is 5 to 1. Workshops take the greater part of the total amount of taught hours each year: 250 hours during the first year, and 500 from the second to the fifth year. The degree in Conservation and Restoration of Cultural Assets also includes a qualification for professional restorers. Italian Law has recently introduced strict requirements for such qualification (see Section 29 of Codice per i beni culturali e paesaggistici, Leg. Dec. 42/2004). Only restorers who have followed

approved curricula are qualified to work with cultural assets. Additionally, the reform brought about by Min. Decree No. 87 of May 26, 2009 has created specific curricula that include hands-on activities in Restoration Workshops as part of their programs.

Today, Corrado Ricci's Tavole Storiche method is updated thanks to the digitalization of surveys, current state, materials, decay state, and interventions. This year, the Active Workshops at the Superintendency have introduced the Sicar digitalization method developed by the Ministry: an excellent program that imposes a better grounded, shared and scientific methodological basis on restorers.

Cooperation within Europe can be stimulated. Adriatic IPA is a EU-funded program that sees the participation of countries on both sides of the Adriatic Sea to compare and share the best practices in mosaic restoration. As part of this project, the convention "Ravenna Musiva - Conservation and Restoration of Decorated Surfaces - Mosaics and Frescos" took place this year in Ravenna, on May 8-10.

The ultimate aim is to strengthen the team of experts and teachers, whose expertise accrued within the School can be shared and enriched.

The project I propose, "Mosaic Watch - Mosaic Work", places the School (now Workshop for the Conservation and Restoration curriculum) in the position of reference point to share these experiences within the EU and worldwide, thus creating jobs, cooperation, and providing guidance. These specialist restorers will be able to work as trainers, as well as to help monitoring and providing guidelines on restoration projects. The scheduled monitoring of mosaic state is an effective way to promptly identify the necessary—sometimes minimal—maintenance interventions based on the best practices, which represent the best measures to guarantee preservation through time, without having to face more radical and expensive restorations.



Alberto Felici
Opificio delle Pietre Dure
Firenze

Taken from:
I. Barbetti, A. Felici,
Applicazioni di sistemi laser
Nd: YAG per la pulitura,
in I dipinti murali.
Applicazioni di
nanotecnologie e Laser,
a cura di M. Patti, S. Siano,
Firenze 2013

■ Reviews and comparisons between different methods of cleaning for wall paintings used in the laboratories of the Opificio delle Pietre Dure in Florence

The mural paintings in the left transept of the Basilica of Santa Croce in Florence: comparative tests of laser cleaning

The activities of experimentation and validation of the project TEMART related to the field of wall paintings have been performed on the paintings located in the left transept of the church of Santa Croce, above the chapel Tosinghi Spinelli. These paintings has been restaured by the sector of Conservation and Restoration of wall paintings and stucco Opificio delle Pietre Dure. These paintings were created by different authors and at different times, the main figurative scene is the *Assumption of the Virgin* was painted in the first half of the fourteenth century, is attributed to the Master of Figline, the upper part of the window frames, made almost exclusively with decorative elements, it's late and it is conceivable to have been painted by Agnolo Gaddi, the author of the adjacent Cappella Maggiore. It is possible to observe that some deterioration processes have, a considerable burden on the state of preservation. It may be noted that the pictorial text shows traces of numerous restorations over the centuries that have marked the complex preservation history. On the surface of the painting there are sporadic residue of a layer of dull probably applied during a restoration of the eighteenth century and then removed in the followingrestauration in the end of the nineteenth century. At this time also derive a series of overlapping and repainting the application of fixatives, later partly removed On the whole surface of the paint is a layer of film-forming organic nature, to date considerably darkened, which constitutes an obstacle to the correct reading of the pictorial text . In addition, it can be observed that the state of conservation of paintings presents a situation quite heterogeneous, which basically corresponds to the diversity of paiting techniques used.

DESCRIPTION AND PROBLEMS IN THE TEST AREA

The intent was to remove from the surface of the paint layer a film forming a layer of an organic nature, probably a fixative applied in a previous restoration, and repainting consisting of a mixture of earths, ocher, carbon black and traces of overseas. The pictorial layer had a generally good state of preservation with the exception of the green earth, with widespread exfoliation,



delamination and lifting of the paint. Laser cleaning tests were carried out in some areas of various sizes ranging from 210 x 90 cm and 70 X 45 cm.

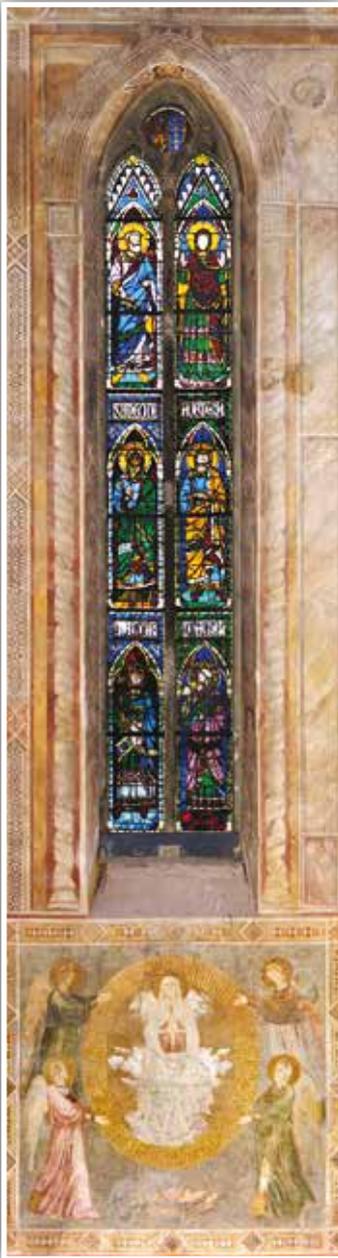
On various patterns are pictorial tests were performed to evaluate the efficacy of ablation and to compare the results achieved by most laser devices Nd: YAG each characterized by wavelengths and pulse durations of different devices used were the following:

- **SFR** (trade name - Smart Clean II El.En Spa): wavelength 1064 nm, pulse duration of 40-120 μ s ns, nominal 200-2000 mJ energy, beam transport optical fiber;
- **LQS** (trade name - Eos 1000 LQS El.En Spa): wavelength 1064 nm, pulse duration of 120 ns, nominal energy 150 mJ, beam transport optical fiber;
- **QSII**: wavelength 532 nm, pulse duration of 8-10 ns, nominal maximum energy 250 mJ, beam transport with articulated arm.

The operational fluences were obtained by varying the size of the spot diameter and , in the case of the SFR, also the selected energy.

RESULTS AND CONCLUSIONS

The tests carried out have shown that the different laser systems have achieved different degrees of cleaning The investigations have shown that using the analytical instrumentation QS , the amount of ablated material seems to be greater than that removed by the LQS, while using the laser the SFR removal is almost nothing appreciable. Other evidence is the considerable color difference, between the surface material remaining after ablation with a wavelength of 1064 nm and 532 nm, in fact in both cases has been shown an increase in brightness L^* , and a decrease in the values of a^* and b^* Using laser with pulse duration and wavelength different,



each characterized by its own rate of ablation, we can obtain various levels of cleaning. The microscopic observation of the irradiated areas has confirmed what has been observed with naked eyes examination: the color differences that are observed correspond to a different degree of removal of material at the surface. In this respect, between the tests performed with the LQS, QSI and QSII you notice that the last test, the cooler color corresponds to a higher level of removal only at the residue of the paint film, while the gaps always remains a thin continuous film of material. The different sequences of cleaning show that it is possible to calibrate the operation of removal of surface material by performing multiple steps of cleaning and using different fluences and repetition rate. It can be concluded that in the cleaning of the area of the bottom of the scene using the QS laser at 532 nm has led to a cleaning more advanced compared to that obtained with laser LQS and QS to 1064 nm. This result was considered particularly appreciable in the case of losses, where the reduced thickness of residues corresponded also to a light shade and cold. This effect is achieved both in the case of removal of material from the surface of the paint film that combines abrasion of the latter; precisely this factor, together with the possibility of extremely selective action, did consider this type of cleaning a possible method to extend to the entire surface of the bottom of the scene.

As regards the area of the Madonna almond should be recalled that in this case the removal has not involved a layer-forming, but rather placed on the thinning of the repainting of worn paint residues original. In this case no differences were noted chromatic function of the length wavelength used, as laser systems have been used in the IR region at 1064 nm, where color differences were detected, they may be attributable to a greater or lesser rate of ablation obtained as a function of different pulse duration of the laser employed. As regards the comparison of the sequences of cleaning, the best results were obtained with more consecutive steps. The action of the QS laser at 1064 nm proved to be too much aggressive and sometimes uneven due to the transport of the beam through an articulated arm, absolutely best results were obtained through the sequence of two steps. In this case it is exploited the action of a filter which transmits 25% of the beam energy, to work at low fluence also with a spot by the very small diameter. This arrangement proved to be extremely beneficial, allowing a high precision, thanks to which it was possible to irradiate areas of reduced dimensions and size also influences the operation with very low. In this way it was possible to remove accumulations of repainting the dark color, which remained after the first pass with the LQS, in an extremely timely without incurring a further thinning of all the pictorial layer.



Petar Popov
Head of The project
for the Restoration
of Mosaic Floor,
Santa Sofia Church

■ Conservation problems of the mosaic from the Martirium at the underground level of the Basilica of St Sophia in Sofia

The relics, discovered in the last 120 years at the early Christian Martyrium under the church of St Sophia, are accompanied with the revealing of large number of fragments of floor mosaics from the interior of the temple.

it is difficult to determine the exact date and to make attribution to a particular workshop of t mosaics. The research carried out prior their conservation led us to the assumption, that the mosaics were created around the middle or in the second half of 4th century. We believe that the west part of the Martyrium was open, with no wall, unlike the some of the scientific theories, which suggest existence of a square building with a semicircle Eksedra.

The mosaics were created in several stages. The western part was built by one artist. Soon afterwards another part was built to the west. According to the specialist, who carried out the archaeological research, this part became a Naos of this earliest Christian temple of Serdica Necropolis. Nowadays we can only regret about the destruction of this most probably earliest Christian temple in Serdica.

The archaeological interest to explore all the cultural layers until reaching the so-called “sterile earthen layer” was the reason for the lifting of the mosaics in 1994. At the very end of the 20th century the idea of making accessible to the public the underground level of the church of St Sophia became popular. Unfortunately, the archaeological excavations resulted in complete loss of the original context of the ruined structure under the now-existing church.

We are now focused on the current condition of the mosaics, the possibility for conservation-restoration, and exploring the opportunities for an appropriate exposition of this unique cultural heritage. One of the tasks is to present to the public the messages coming from the dawn of the Christianity in our lands.

Today we face the limits, coming both from extended archaeological excavations, and of the transformations of the space, made during the building of a museum environment in the acropolis under the church of St. Sophia.

The presentation discusses some technological conservation problems along with ethical ones. This is in regard of the changes made in-situ in the underground level of the church in last decade.



Nikolay Sotirov
Freelance artist and restorer

Creation of a copy of the Raya Mosaic

1. The original of the mosaic was photographed by a digital camera.
2. A tridimensional computer scale model of the mosaic was created.
3. A tridimensional prototype was constructed with the use of environmentally friendly certified materials.
4. The surface was treated in such mode as to resemble the original as much as possible. Natural inert materials, acrylates and emulsions were used.

The construction of the mosaic with size approximately 2 x 2 m took a period of about 5 months. This is the first time when such technology was used in the construction of a cultural treasure copy. So far this technology was used in the construction of design objects (not in the process of moulding).

Artists: Nikolai Spirov and Gabor Stanchev

A few words for the mosaic (original): The 'Paradise' apse mosaic was part of the first single-nave church which was investigated under the 'St. Sofia' basilica. The mosaic was discovered by V. Dobruski in 1893 and was dated back to the third period of the first church which had most probably been demolished during the Gothic invasions in 376-382. The mosaic had also been used throughout the existence of the second church. The mosaic consists of pictures of birds which drink water from a kantharos-shaped pot, placed between two cypress trees and depicts the image of heaven according to the notions of early Christians.



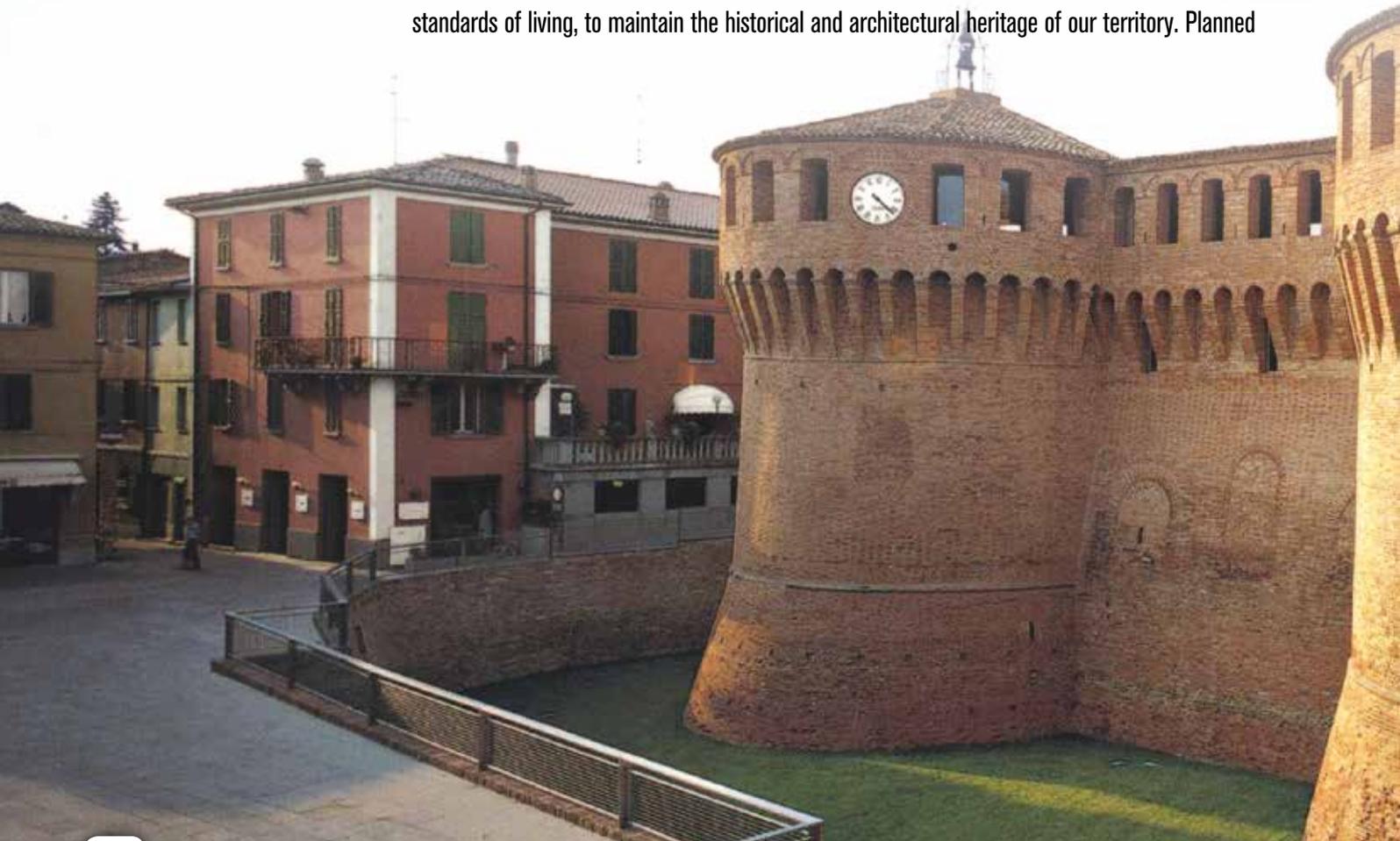
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■ The General Contractor Role in the Restoration Works

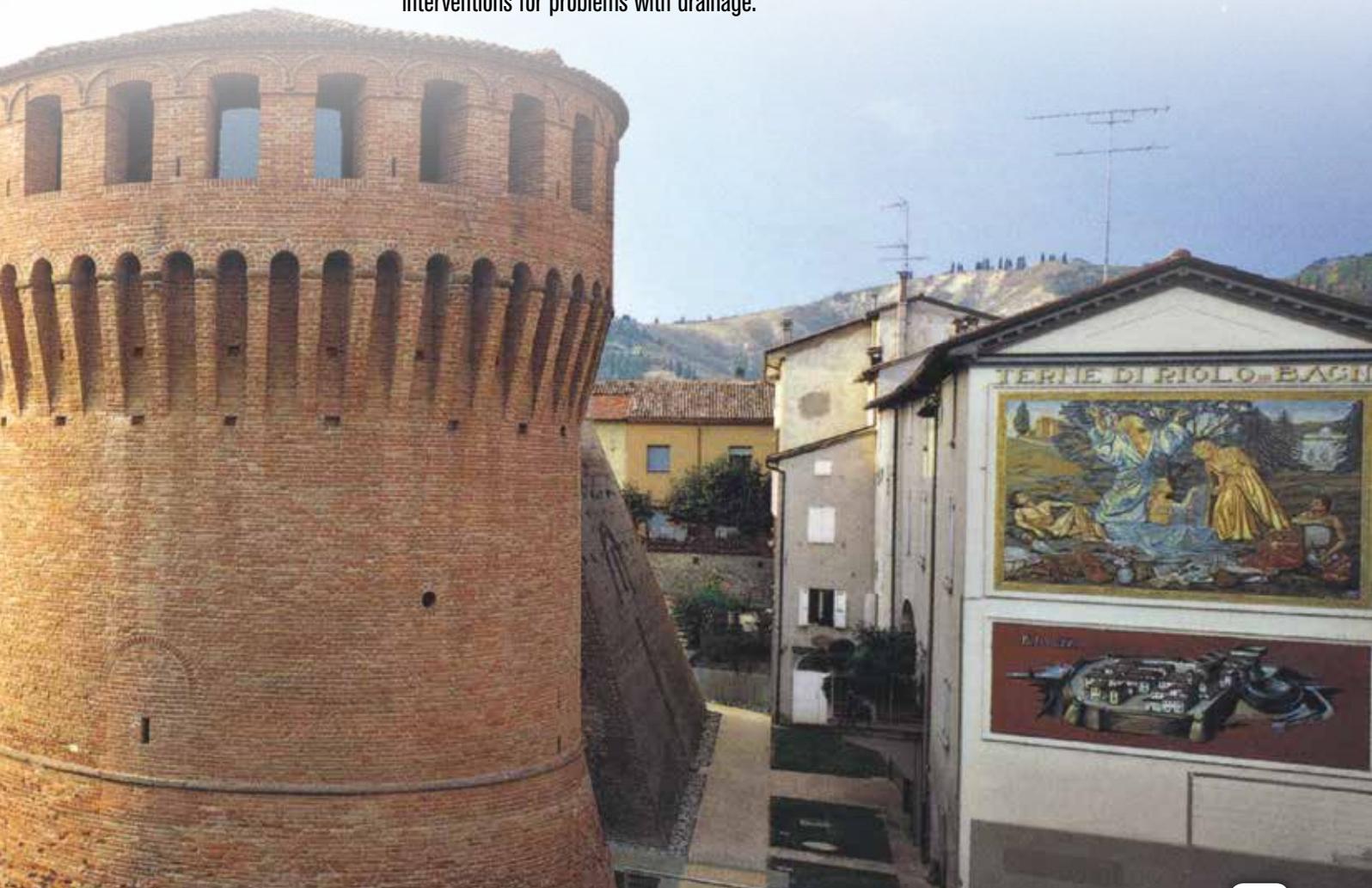
From diagnostic analysis and restoration engineering to planned conservation program and scheduled maintenance

Ediltecnica has over seven decades of experience working in Italy, especially in the North-East of the country, specializing in maintenance and enhancement of the Building Heritage, particularly if historically esteemed, through the maintenance, restoration and creation of value according to environmental and energetic sustainability. EdilTecnica has created throughout the years a reliable team of highly trained and experienced people who excel in their fields of service.

Concerning the maintenance of a building the most urgent topic is to keep efficiency, integrity and functionality. This in order to develop economy, to respect the environment, to keep high standards of living, to maintain the historical and architectural heritage of our territory. Planned



maintenance, as well as recovery and restoration, cannot be superficial and fragmented. Experience, competence and research are needed. EdilTecnica answers with a multidimensional structure that responds to all the needed technical and managing skills. This Cooperative gets its origin out of a real vocation and commitment in carrying out a respectful recovery of the existing buildings and a careful building action. Clients have the opportunity to work with a unique society to achieve different company qualifications and experience different competencies. EdilTecnica aims to work with the vertical integration of the different specialist expertises. A unique reference, a unique track as distinctive traits together with diverse competencies and professionals. Clients have the opportunity to work with a strong and unique society and to experience different competencies. The social structure of the society is made of artisan businesses and cooperative companies, these companies are vertically integrated in order to offer all the professional figures included in the building cycle. Each figure is working in EdilTecnica's different activities, creating a complete pattern of the restoration works in an articulated project. Our maintenance works on historic buildings have focused on both the public and private sector. From repairs involving dehumidification to waterproofing without demolition, from reconditioning upholstery to structural strengthening, reinforcing, painting or decorating: thanks to our specialized staff we can carry out all works related to buildings. Maintenance works on buildings also include renovations and plastering, leaks, reinforced cement, roofs and foundations, and interventions for problems with drainage.



The strength of our activity is the capacity of being a general contractor in the restoration sector. The project management and maintenance starts from the diagnostic analysis, with particular attention also to the restoration engineering. All the datas collected in this phase are then archived in a software with whom we manage all the information to create a working plan and the all the scheduled maintenance afterwards; this system is then linked to our call center which manages all the planned or urgent intervention. The goal is to be kept updated about the post-Industrial real exigencies. The main purpose of this system, beside handling the works in the more efficient and in accordance to the best practice, is to offer an answer to the new market needs concerning maintenance evaluation.

All the phases of our restoration works is controlled by the archiving software. To archive the documentation of realized works and to plan the subsequent maintenance, EdilTecnica adopts a software developed to handle the design, the execution of works and facilities management services. The aim is the one of integrating and updating the variations which take place in the work execution phase and having an overall knowledge of the building that will allow us to manage properly the scheduled maintenance and the planned conservation. The use of an archiving software allows us to record on time each intervention and variation to the executive project, while collecting data and documents from the Superintendence for Archaeological Heritage, the Project Manager, the Workforce and all the Professionals working on the project. The executive project, as-built documentation, is thus complete and updated by ensuring an effective implementation of the building. To describe the building the software uses a six-level hierarchical tree-structure, which is numerically represented by a code.



A detailed description of the building is divided into a representation structured on levels : technological classes, types of elements and technological elements. For each element we can record (and update through time) information about:

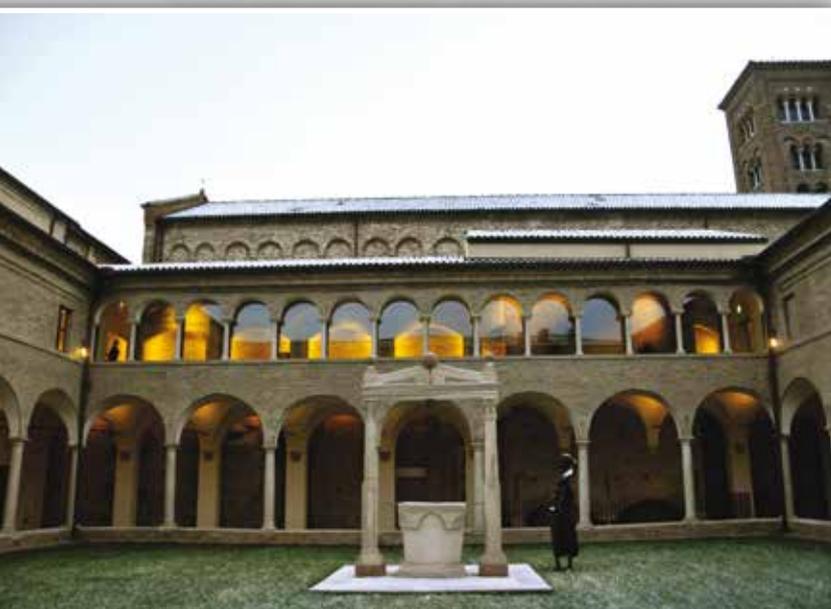
- **Materials Techniques:** constituent materials and construction techniques;
- **Damages/Deteriorations:** quantitative and/or qualitative information on the forms of ongoing deteriorations;
- **Activities:** inspections or maintenance interventions before and during the programming implementation;
- **Diagnostics:** specialistic activities carried out before and during the programming implementation;
- **Problems:** vulnerability analysis and risk evaluation concerning the occurrence of damages/deterioration over time;

Interactions: relationship of an element interacting with others.

We have implemented this system through time and through a variation and enhancement of all the technological instruments and by remodeling the steps according to the upgrading experience granted. From the beginning, it was necessary to consider all the aspects related to the management of the workflows complexity. Starting from the challenging restoration works carried out in the Basilica of Sant'Apollinare Nuovo, for the Great Jubilee of 2000, where we faced the different intervention going on at the same time, such as the rehabilitation of the building, the structural reinforcement, the carbon fiber reinforcement, the dehumidification ultrasound and the use of antiperspirants floors to protect the frescoes. Then in the Rocca di Riolo Terme, where we managed the diagnostics and restoration project, coping with the structural consolidation of the foundations, the restoration of decoration and external and internal masonry, the insertion of piles, micro piles and reinforced concrete walls to support the neighboring buildings and not to subject the ancient wall to the pressure of the soil. At that time we had to manage also the discovery of an ancient Roman bridge and its archaeological preservation. Some years later we led the restoration works of the Chiostrì Danteschi in Ravenna, where we implement the use of diagnostic analysis and the restoration engineering through the consolidation of the foundations, the strengthening of masonry structures and the strengthening of columns (we inspected them with innovative ultrasound systems), the injection of epoxy resins and the use of reinforcing fibers. The project expected also a part of construction of new concrete and metal structures, the supply and installation of doors, light fixtures, floors and coverings. All this with a very sensible and caring awareness of the preexistence and all the restoration works that were done before. Moreover in the project regarding Palazzo Guiccioli, one of the most fascinating historical sites in the center of Ravenna, all the diagnostic analysis were performed as part of the structural conservative restoration project. All the information gathered were archived creating a map of

all the problems to be faced. These data regarded analysis on mortar, endoscopies, cracks monitoring devices, GPR (ground penetration radar), humidity measures on wooden beams, sclerometer on mortars and floors, termography and cameras for floor inspection. Based on the information collected and subsequent evaluation we defined the controls and operations to be planned in the Conservation Program. Then a Program/Costs file was elaborated in order to plan the operations to be performed on the element, specifying the activity execution time and necessary resources, with the possibility to compile the Costs Report with reference to the bill of quantities. Once defined the activities to carry out on each maintenance element according to set intervals, we developed the Conservation Program by producing the Activities Plan on a specific period of time. The Gantt chart allows a graphical representation of the activities plan before the generation of Work Orders.

Since the beginning Ediltecnica has moved forward to augmenting its profile of a general contractor company handling the new methods of restoration engineering integrated with diagnostic analysis, with the passion and expertise necessary to accurately evaluate buildings and structures and produce detailed specifications for their successful restoration. The professional engineering staff is proficient in all structural systems, design standards, current material technologies, testing, project costs and construction methods. Our staff is knowledgeable of market-place trends, regulatory agency mandates and specialty contractors. Our state-of-the-art and unique solutions to restoration problems have earned us a loyal and repeat client base. Through our assessment, design, and project management expertise we keep our clients facilities operational with minimal disruption while meeting the restoration goals of the project.





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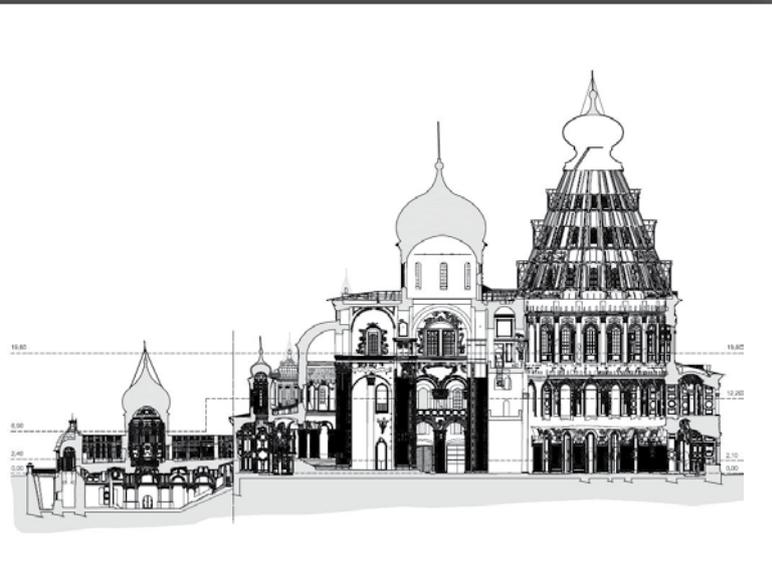
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■ The evolution of architectural detection

During recent years, the architectural detection has methodologically changed especially for the innovation in technology of measuring instruments. Although up to the last decade the detection of details had been tough and required complex and expensive procedures in order to get closer to details up to touch them, as some laser diastimeters were produced this aspect was less demanded and by the laser scanner technology which currently acquires up to a million points per second it is basically possible to detect single details of the architecture including the RGB colorimetry of each measured point.

The acquiring process of these data transfers each accessible part of the building onto a scaled database close to the reality used either as a digital folder or for the indexing of an item by freezing its status either to produce documents, or detect details in any scale, and mainly at any time even after long time with no need to have a new detecting campaign. A significant example for the application of this technology was the detection on the Cathedral of the Resurrection that our study has carried out in Istra (Russia) near Moscow inside the monastic residence of New Jerusalem.





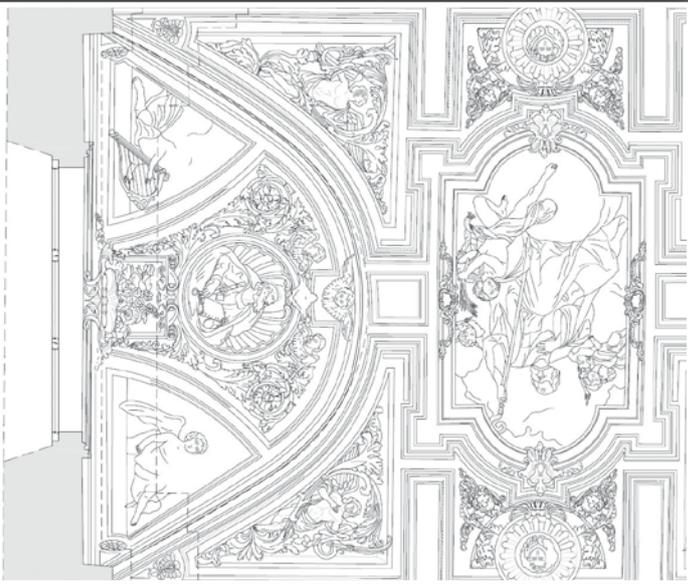
The cathedral was built between 1656 and 1685 but during the Second World War a part of it was destroyed by German army who blew up the dome and the bell tower.

When the current Russian government decided to start the restore of the church the scientific committee claimed that the detection by laser scanner was the most appropriate method and they contacted us admiring our over-a-decade detecting experience.

As it is shown in picture 1 and 1a the residence is very complex and structured.

To carry out a detection in the site almost 20 day were necessary on the field to acquire 600 laser scanned scans and 4800 frames for coloring point clouds.

After the acquiring step on the field, a couple of months were necessary for photo and topographic elaborations in order to have a colored point cloud; the additional elaboration of the point cloud let us draw almost 35000 sqm of surfaces and have all the maps, sections and tables required by project managers to draft the restoring project that cost 13-20 billion Russian rouble. The pictures 2 and 3 describe the level of detail that can be reached through using this instruments.



At present time, the current technology does not permit the automatic two-dimensional reshaping as for architectural canons; all pictures are executed by specialists who starting from the point cloud draw the required tables.

This step permits an accurate control on the final delivery of drawings by giving the possibility to customize the style and shape in order to adapt to culturally-different habits.

The same methodology applies successfully to the detection of frescos on walls, ceilings and vaulted surfaces that as it is written in picture 4 and 5 they can be drawn with proper metric and used either as two-dimensions graphics or ortho-photo.

The development of technology for non-conventional aircrafts is bringing to a new innovation within architectural detecting.

Currently, we are successfully experiencing multi-rotors drones that through sophisticated softwares for photogrammetry permit the delivery of point clouds with a good metric precision in areas where the access with a different type of instruments would be difficult or impossible.

Claudia Tedeschi
Diocesan Mosaics Cultural
Assets Consultant

Thoughts on restoring mosaics guidelines and methodologies

READING A MOSAIC (fig. 1-2)

Reading a text mosaic is a very complex phase of the restoration. For its natural shape, the mosaic is the result of a composite nature of the materials that is expressed in its construction phases through a series of overlapping layers of mortar (structure) and cards inserted into it (surface).

The reading of the text mosaic is developed with a careful and meticulous observation and analysis of some identification parameters for the weaving, such as the size, the shape, the color and the pattern of the tiles and finally the gap between them. All the parameters are closely related to each other and are therefore representative of each artifact.

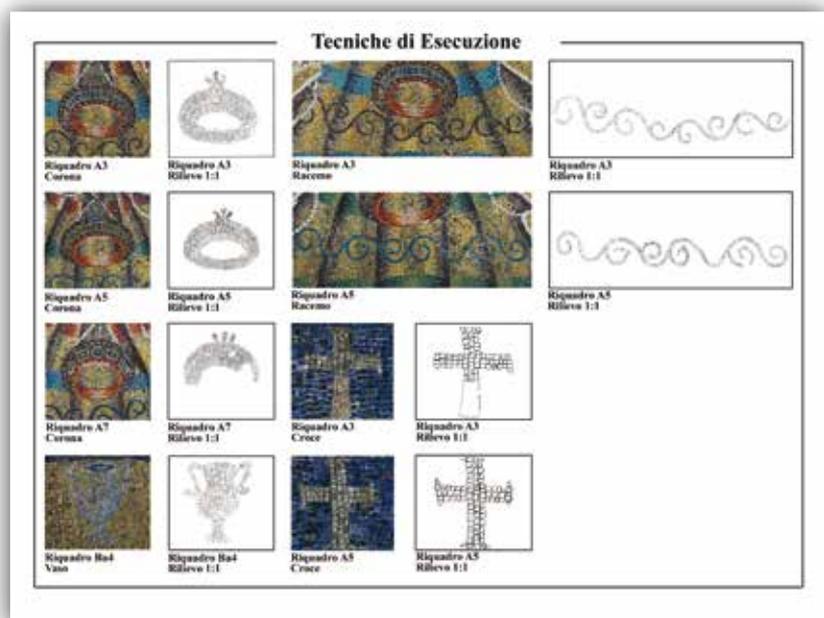
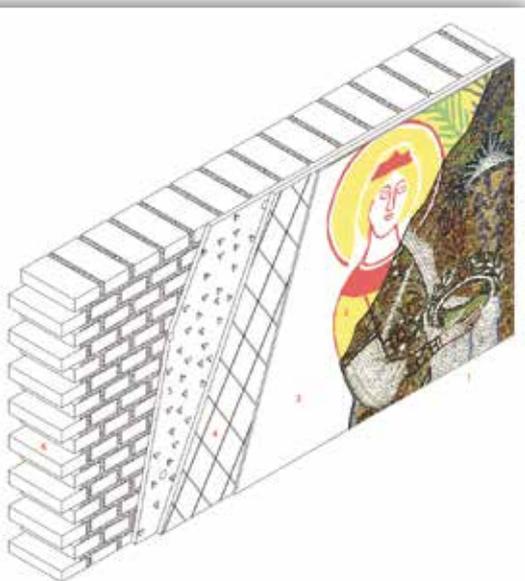
As part of the investigation of artifacts mosaics, reading the mosaics is the discrimination of the interventions between the original editorial work and the later ones (restoration work). This stage is configured as a key step because, in addition to creating an historical and artistic context, it addresses the choices and criteria of the restoration.

DOCUMENTING A MOSAIC (fig. 3-4)

The production of graphic and photographic documentation, it is often still provided in an extremely fragmented and mostly not significant way.

In Ravenna, we have been engaged for a long time, with the Superintendence and the School for

fig. 1-2





↑ fig. 3-4

the Restoration of Mosaics, in the creation of real atlases, places where all the data generated by the various stages of research come together.

We have established the true structural grids of information that have been organized for themes and levels (the ordinary operations of restoration, the historical records, the execution techniques, the materials, etc..).

In the case of Neoniano Baptistery it was intended to go beyond the limits held with the latest technical documentation, using some already known software packages (GIS), already known for some time in other disciplines.

INTEGRATING A MOSAIC (fig. 5-6)

The presence of gaps in a mosaic, in addition to causing an interruption of the mosaic fabric, causes a risk to the conservation work. Integration techniques have been, from a historical point of view, cyclic and heterogeneous and governed by different aesthetic criteria. The historical overview to the present day integration techniques has allowed us to evaluate the pros and cons of the operations although we are still far away from using a homogeneous method (such as done for the frescoes), which could be considered as effective and satisfactory. However, Ravenna, over time, has validated the method of mortar molded and painted with which the gaps can be compensated (where possible) in the wall and floor mosaic heritage in our museums in Ravenna.



fig. 5-6

fig. 7-8

THE RESTORATION OF THE MOSAIC ABROAD (FROM THE ITALIAN POINT OF VIEW)
 (fig. 7-8)

A first reflection is about considering the restoration discipline in different countries: in Europe the situation is not homogeneous, and a lot depends on the history, the traditions of the countries, the internal debates and therefore we are still far from homogeneous behavior: good examples are the much sought after lexical uniformity about how to express certain degradation, or in other contexts the study of ancient terminology which is still in progress, or the various technical and methodological approaches (*in situ* storage or tear/detachments?) and anything else.

And then there is the case of non-European countries in which, when you are lucky, the restoration is generally conducted by European experts, often supported by local young people, or in other cases a sort of unfortunate or forced “do it yourself”.

It is clear that the restoration of the mosaics is therefore conducted at different levels of application; however, you should be able to ensure a standard of quality by a methodical realisation.

We use the verb ‘to realise’: the restoration, despite its emancipation in the modern era, remains a profession that makes manual dexterity one of the most important features. Add to this, however, the ‘method’, as the applied attitude without a rational process, as in the case of a discipline like the restoration, is not plausible.

The most important issues related to restoration work abroad remain the procurement of materials, products and their proper application. However this can be faced in a rational manner and with positive results solving many of the conservation problems through the use of traditional raw materials, generally available in most countries, rediscovering their features and very high quality.



Peron Francesco Maria
Preservation and Restoration

Guidelines for drawing a fair proposal for mosaics integration

How does it fit?

What is the proper methodological approach for the material integration?

Aware of the fact that each case has its own peculiarities now you want to convey a “*recipe-model*” in order to develop a proper proposal for mosaics integration.

“Recipe-Model”

PRELIMINARY STUDY

Formulate a proper diagnosis by a complete and thorough study of the work of art:

- Analyze the historical and artistic context in which the work was developed.
- Analyze the iconography of the mosaic.
(where did this gap develop? On a bottom? in a geometric edge? In a face?)
The study examines the concept of artistry or the repetition of an iconographic model
- Analyze materials and performance techniques.
- Study the historical events that happened to the work: previous restorations, ...
- Analyze and detect the state of conservation of the work and the factors that have led to its degradation.

REQUEST OF INTERVENTION

Evaluate the most appropriate operational decisions based on the results of the previous analysis.

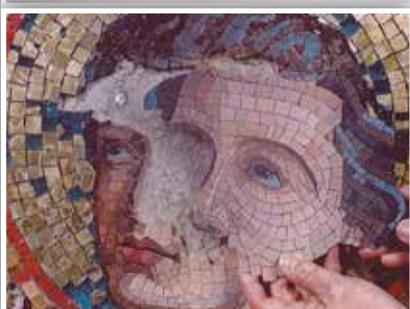
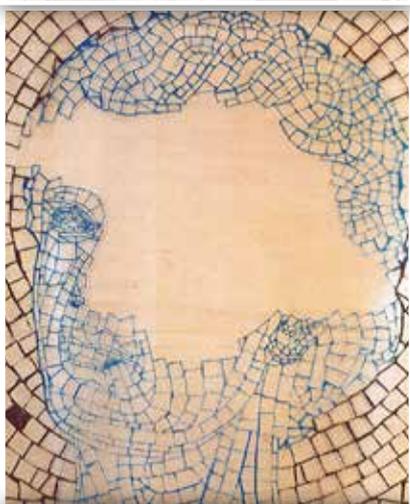
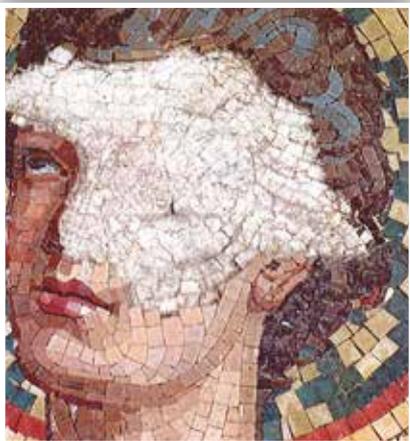
- Definition of the mosaic texture and the gaps to be integrated.
- Definition of the color and size of the tiles of the gaps to be integrated.
- Definition of materials to be used to achieve integration.
- Definition of the support of the gaps to be integrated.
- Definition of the degree of recognition of the new integration.

Develop a suitable methodology for intervention.

Aware that the methodological choices of integration may vary based on aesthetics / conservative that you want to follow, by applying this “*recipe-model*” you may create a proposal of non-invasive and completely respectful integration in the original mosaic, so recognizable and reversible as required by the modern theories of the restoration.

The workshop will give participants a chance to see concretely applied the “*recipe-model*” integration of several mosaic fragments.

We will also show some restoration-models, which have addressed this issue, as carried out by our company.





TryeCo 2.0

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Innovative technologies for restoration of monuments damaged by the earthquake in Abruzzo. A new technology to creating internal support system for “Madonna di Pietranico”

“The development of integrated procedures for cultural heritage documentation and preservation takes advantage of technologies for the conducting of surveys that can be updated with geometric, morphological, textural and protective equipment, providing analytical information exhaustive as possible but always open.”

The obtained databases, organized through the interplay of the substantial capital of 3-dimensional coordinates with the data quality of architectural and artistic artefacts and their environment, may be subject to multiple levels of interpretation that need not be intended in a short period of time, but can be repeatedly built and developed over time.

The case of “Madonna di Pietranico” has experienced the creation of a support for the assembly of the fragments resulting from industrial systems, through processes such as rapid prototyping and 3D laser scanner attached to the relief. This text will highlight the technical and methodological support that allowed the realization of the interior of “Madonna di Pietranico” and will illustrate the second phase of work, from preparation for the release of the 3D digital model derived from ‘Isti CNR of Pisa, to the physical realization of the support. To make the transition from the digital model to the physical model, we must make an analysis to determine what the



before-earthquake

After RED



3d-reconstruction-internalsupport RED



correct criterion is, based on the precision that we want to obtain, the cost, and the purpose. In this case, the model had to have a purely structural function and minimum development costs, so two methods were considered: rapid prototyping in “chalk” powder, and the numerically controlled engraving. The 3d print system by powder has been used successfully since 2000 in making copies of works of art, a task made possible through research by several Italian universities. This criterion is the most popular and appreciated by museums and governments for the protection of the historical and artistic heritage by the use of stone material, which allows direct intervention with all tools and methodologies normally used in the restoration.

The mathematical model represents the “empty” interior of the statue, obtained from a series of scanned fragments of the model, and determination of a surface, showing the empty interior of the statue.

The surface is 2 mm in thickness, determined over years of experimentation as the best value for structural strength, one which allows subsequent manual processing such as holes, sanding or cutting, the possibility expressed by the client for better adherence of the statue’s parties to the support. New Zcorp 650 3D printer uses maximum a print size box of 25 x 38 cm with a height of 20 cm, but the support dimensions were 29.2 x 44.3 cm with a maximum height of 43.3 cm, and this imposed the support division into 4 parts. In the modeling stage, done in constant contact with the restoring crew, cuts were made in the assembly to facilitate the integration of components with large undercuts.

In the vertical contact walls (designed to facilitate bonding or fastening with screws) windows were opened that would provide the opportunity to work with fixing systems (for the fragments), and possibly fixing an internal bandage on carbon fiber to make the support definitive. On the horizontal contact faces, coinciding holes with a 10 mm diameter were opened for the passage of a threaded bolt for securing and consolidating the assembly.

A window was opened on the flat top, always following the conservators’ advice, as well as a hole of 15 mm on flat surfaces of the head’s supports, which was drilled to allow coupling bolts. The digital files were then loaded in the 3D printer software and processed. Each of 4 pieces

took on average 13 hours of release: 2 hours for the extraction and cleaning from the excess powder, 2 hours to resin at high temperature (max temp 60°C) and 48 hours of “rest” for a complete cure of the epoxy resin.

The printing system uses chalk powder and water-based adhesive.

The system consists of two pistons, a model construction box and a powder deposit required and a motion system with a cart that houses the print heads. The heads are in ordinary printer cartridges empty of original ink, which work with a water-based adhesive. The motion system takes a first step from the storage piston to the building piston and lays a layer of chalk of 0.085 mm; coming back, the printheads prints on this “film chalk” one of the sections controlled by the software model (for the head second support almost 600 pages were needed). The repetition of this movement, while the piston construction slowly descends, generates the solid model, which once completed will be immersed in the powder bin (which stands also as a model support). During the printing time, we also consider the one-hour break at the end of layers “writing” in which the model is dried at a temperature about 40°C. After the drying period, with the help of a brush, a vacuum cleaner and an air jet, the excess powder is removed, taking care not to damage the part and removing all the excess powder to lighten it and move easily. The removed material can be reused for subsequent printings. The consolidation process involves the exterior coating and a consolidation period that takes about 2 hours at 40°C and the following 12 hours at room temperature; after this step the model is reset to 60°C and the procedure is repeated for the inside, taking care for the resin to absorb at any point on the surface. The strength characteristics are improved with the spraying of a transparent protective. After the protective drying process is complete, proceed with the assembly test to verify the correct conformation of the substrate. During a meeting with the project leaders, the statue

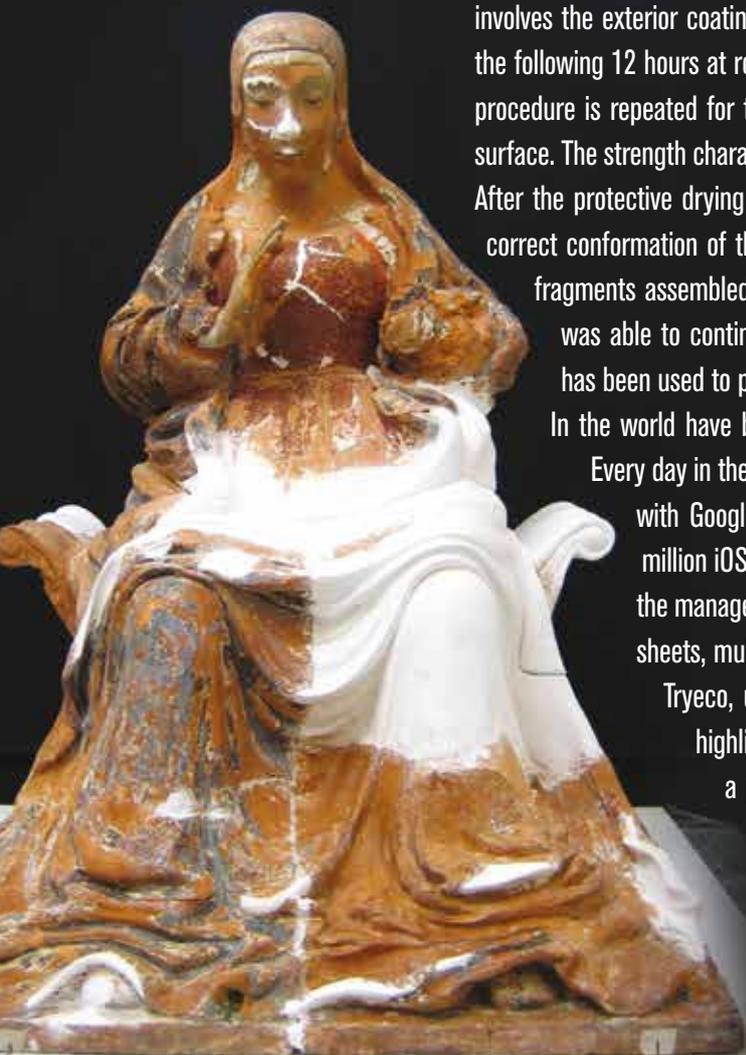
fragments assembled on the support prototype were verified, then the restoring crew was able to continue the statue restore. After the restoration process, the 3D model has been used to promote a new system with a case study: an Augmented Reality app. In the world have been sold over a billion mobile devices (smartphones and tablets).

Every day in the world are activated 1 million and 300 thousand smartphone devices with Google Android operating system, and in 2012 has sold more than 400 million iOS devices. The simple interfaces, icons and touch screen mode allows the management of complex geospatial data such as maps, POI, waypoints, fact sheets, multimedia and interactive 3D modelss.

Tryeco, using the detailed model, then created a lightweight model, which highlighted the rebuilt part and fragments. This model has been linked to a pamphlet used to illustrate the case study; also inside were linked more video content.

The emotional experience of the curious look that sees through your smartphone the model, provides a high interest to the recovery of this sculpture.

partial reconstructionRED



restorator
work whit new
support RED



CREDITS

Funding: *Italian American Museum, New York*

Ministry of Heritage and Culture, Directorate General for the promotion, Dott. Mario Resca

Contracting Authority: Office of the Deputy Commissioner for the protection of BC, Department of Civil Protection, Presidency of the Council of Ministers, Ing. Luciano Marchetti.

Construction Supervision: dott.ssa Lucia Arbace, Soprintendente per i Beni Storici e Artistici dell'Abruzzo.

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Realization missing parts of the sculpture and adaptation of remakes: Marco Appicciafuoco, Teramo

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Implementation of support (rapid prototyping): TryeCo 2.0 Srl, Ferrara

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Direction and editing video: Michele Bevilacqua, Roma



augmented Reality RED



complete support RED



estraction of 3Dprinted part RED



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■ The use of cleaning laser in the conservation of the archaeological heritage

Laser technology, after several decades from the first applications in the field of restoration, is a procedure well-established and widely spread among the Italian restorers. Even in Europe, this cleaning method is widely used, but still mainly focused in the construction site for the architectural restoration of the stone.

In the last decade the Italian national research centers, in close collaboration with the conservatory and the industry, have instead developed a new generation of lasers specifically designed and tested in the pipeline for new applications of particular delicacy. First of all, were implemented lasers suitable for action on metal surfaces, gilded bronze, silver, iron, etc.. Other types of lasers have proven to be extremely efficient for the cleaning of the frescoes.

In this way the use of this equipment has greatly expanded both in Italy and abroad.

In the field of archeology interventions, cleaning with laser technology, are still less systematic than in the restoration of historical, artistic and made it follow its spread. This does not depend on a decrease in the efficiency of this method, but only the approach still predominantly traditional restorers and the increased presence of mobile objects of the most varied nature for which there is still no systematic experimentation.

fig. 1

fig. 2



fig. 4



fig. 3

A quick excursus of what has been done so far has to start from famous and extensive work done to Palace of Diocletian in Split, Croatia. Here, a number of lasers for different years were used in the cleaning of the capitals of the columns, from black crust of considerable thickness (Fig. 1). Another intervention in monumental Roman architecture was to the Temple of Hadrian in Rome.

The interventions on stone floor mosaics are not many, but all with very positive results. Among others, we underline the importance of a polychrome mosaic from Savignano sul Panaro found in a large structure of the late Roman period. This was evidently a fine building witnessing the presence in the territory of Savignano, of the elite society of late antiquity (Fig.2). Another building site that has just ended is the villa of Livia at Prima Porta, in Rome where we worked for the removal of earthy concretions. Perhaps the most important monument is one of the underground basilica of Porta Maggiore, dating back to the early decades of the first century AD. We proceeded with the simple cleaning of the floor mosaic in black and white by removing tenacious and thick earthy mineralized concretions (Figs. 3 and 4). Here, the laser has proved very useful for the removal of the same concretions on the surfaces of the pillars decorated with fine stucco relief (Fig. 5).

The process of laser cleaning of the frescoes in medieval and Renaissance Italy has developed and has now established its application in a number of sites, in order to solve the most different problems, also the removal of chemical treatments laid out in the past decades.

From there it caught on with success, the use of lasers for cleanings of the wall paintings of ancient Roman times. One of the most significant cases is one of the recent use of lasers for the cleaning of the frescoes in the Villa of the Mysteries in Pompeii (Fig 6), a much wider and more systematic application is the cleaning of the frescoes in almost all the Roman catacombs.

It was thanks to this new methodology that we have been able to read and discover new scenes and depictions of the Roman catacombs, otherwise we wouldn't have had the possibilities as it can not be cleaned with chemical or mechanical methods (Fig. 7).

With regard to the findings of metal, the research center of the CNR - Florence IFAC has developed in collaboration with the El. En. SPA a type of laser specifically dedicated to the operations of this class of works of art. This makes the experience accumulated on Renaissance bronzes - Verrocchio's David, and David Attis by Donatello, and so on. Cleaning by the laser is extended to archaeological bronzes conserved in Florence, the Minerva of Arezzo and the statue of the Orator. The most recent case and also one of the most interesting, is that carried out at the Laboratory of restoration of the Archaeological Superintendence of Tuscany in Florence for the cleaning products of alteration of the monumental bronze head of the Emperor Antoninus Pius (Fig. 8).

An extremely complex type, is the field of cleaning of archaeological ceramics. Here of course the different production techniques and surface treatments play an important role. This does not mean that on the mainly ceramic mixing or the achromatic ceramic will not be able to obtain excellent results for the removal of concretions earthy or biological in nature (Fig. 9).

Finally, a very special case is that of the removal of surface layers of paraffin and protective chemical from a group of furniture Herculaneum (fig. 10).

The laser cleaning of monuments and archaeological artefacts, with instruments implemented and optimized for this purpose, is not only possible, but as we have seen it has achieved excellent results for different applications. What is needed, is only a greater awareness of the potential of this technique and a greater involvement of the restorers specialized in archaeological restoration.



fig. 5



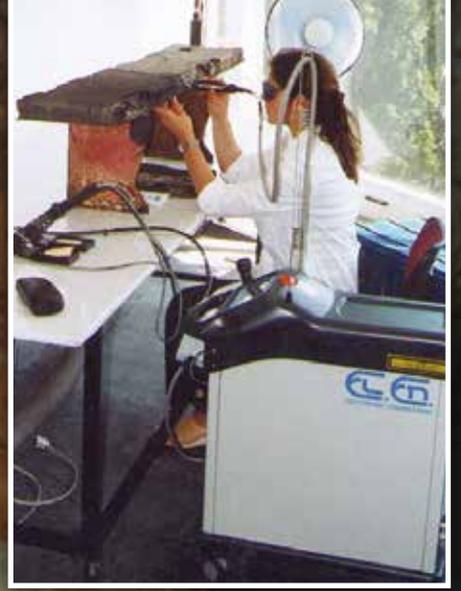
fig. 8



fig. 6



↑ fig. 9



↑ fig. 10

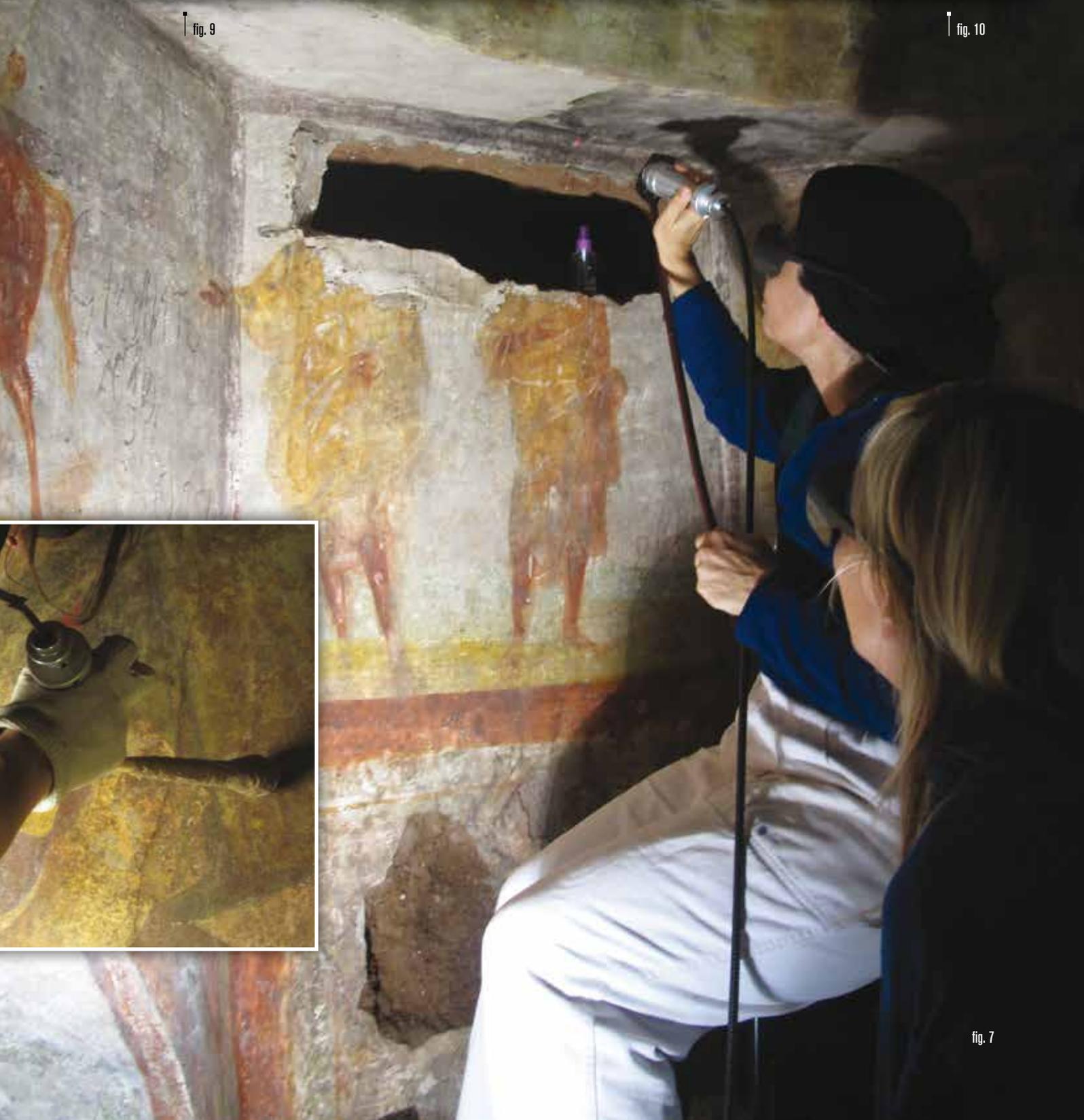


fig. 7

QA

quaderni di assorestauro



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