

Zippori. In situ conservation of a floor mosaic in polychrome stone and glass paste.

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Introduction

During the 1991 excavation campaign of the University of South Florida, directed by Prof. J. Strange, in the National Park of Zippori in Israel, archeologist brought to light the main room of a public roman building. The floor of the 100 square meter room is a polychrome mosaic dating from the III century A.D. The mosaic is exceptional for its artistic quality and technique it required. A very elaborate geometric frame encloses 60 figured panels representing animals, fruit, games and musical instruments. These were created with tesserae in stones and vitreous paste in more than 20 different colors. Some of them are as small as 1 sq. mm. (photo 1)

As soon as it was excavated, the mosaic was protected by a temporary covering until the conservation intervention could begin.

During the summer of the 1995, the C.C.A, Centro di Conservazione Archeologica of Rome carried out this intervention in situ using conservation techniques that respect both the materials and the technique of the original execution of the mosaic. Lifting synthetic materials were not used.

This article will describe the methods and techniques that were used during the intervention.

Special emphasis is given to those aspects that are peculiar to in situ conservation, in terms of planning and investment of human and economic resources.

The Bird and Fish mosaic: description of techniques and its state conservation.

The mosaic is in the main room of a public building of the roman era that is still being excavated.

There is as yet not complete description of the building, nor is its function fully understood.

The building, visible upon entering Zippori from the main visitors' path, stands very near the ancient city street. Richly decorated with representation of fish, birds, animals, fruit and games and enclosed by an elaborate, decorative frame, the mosaic is an example of highly advanced technique. Tesserae of more than 25 different shades were used by the artists to build the sense of volume and to create shadows: browns, reds, pinks and grays, vitreous pastes for the greens and blues.

The more detailed panels were made using tesserae measuring from 1 to 5 square millimetres. (photo 2)

The mosaic underwent many restorations and much repair in ancient times, exhibiting a variety of means and tendencies in the repairs. This demonstrates that the room was much used and would confirm the hypothesis that the building itself was an important public structure.

There is a cistern beneath the mosaic that had been used to collect water.

The foundation layer of the mosaic floor, made out of hydraulic mortar and calcareous stones, rests on the external side of the cistern vault. The second preparatory layer of the mosaic, therefore, is made of lime, pozzolana and ash, particularly suitable for a mortar that must be light and must have hydraulic characteristics. The use of ashes might also depend upon the need to lengthen the normal hardening time required by the mortar. Examining the preparatory layers where there were *lacunae* in the mosaic surface, it was possible to study the technique used in creating the mosaic itself; the conclusion was that the entire decorated surface was executed in situ. Contrary the usual method of making *in situ* usually in the mosaicist's laboratory from where it was transported and subsequently placed *in situ*, the panels representing animals and musical instruments, made with tesserae measuring just a few square millimetres, were not individual elements but refined images that were created in place.

The second preparatory layer shows incisions made to divide and square-off spaces for the iconographic composition. This layout was used to define the work in work-days to be done at one time. Each day's section was covered with a thin layer of lime mortar and fine stone powder where the preparatory drawing was sketched

using various colors. Subsequently the tesserae were laid. The incisions and the very shallow (very few millimeters thick) bedding layer exclude the possibility that the panels were made elsewhere and then inserted within the geometric decoration that was prepared in situ.

The alterations found were those that are usually associated with mosaics in excavation, and mainly affect the preparatory layers:

- pulverization of the second preparatory layer and resulting hollow areas beneath the tesserae;
- detachment, or lifting, between the second preparatory layer and the bedding layer;
- pulverization of the bedding mortar and consequent lifting, or detachment of the tesserae;
- *lacunae*;
- mechanical breakages and settling;
- formation of thick carbonate surface deposits.

The intervention

The intervention was carried out following the principles of in situ conservation, without using destructive techniques and irreversible operations such as the lifting of the tesserae. In other words, it was limited to the least possible direct intervention on the surface to mend the damage and make the decoration legible by using traditional techniques and materials that were compatible with the original structure. Historic traces of the life of the building, its previous existence, were preserved, such as the signs left by the collapse of the structure and various subsequent restorations. At the same time, measures to prevent future damages and a maintenance program were planned for the long term preservation of the mosaic. Corollary to these aspects, particular attention was given to informing visitors who could watch all the phases of the work from a terrace-platform built for this purpose along the visitors' path.

The group that carried out the work consisted of 6 professional conservators from CCA, and four local technicians. The intervention was completed in 8 weeks.

The stages of the intervention were: planning, documentation, pre-consolidation, consolidation of in-depth detachments, surface cleaning, consolidation of the spaces between the tesserae, treatment of *lacunae*, final revision.

Planning and documentation

Closely connected, these two operations are fundamental to a successful intervention. Following the inspection of the mosaic and the registration and classification of all the alterations noticed, using symbols on the prepared drawings, it was possible to plan the intervention. Documentation before, during and after the actual work is the primary and necessary instrument of conservation. By studying the alterations in the mosaic that have occurred through the years, the traces of the use of the building and the life that went on within it, and the techniques that were used throughout, it is possible to move backwards from existing damages to their causes and consequently to establish priorities, and from that point to choose the most suitable methods and techniques of the intervention. During the planning phase, besides the steps to be taken to strengthen the structure, the techniques to be used for each single operation were defined, the materials were chosen, the time and cost of the operation were established. At the same time, a maintenance program was scheduled for future conservation and damage prevention.

The planning and the documentation of the work are precious instruments for conservators: constant control of the intervention from the moment it begins, means avoiding wasted efforts caused by not having an overall view of the problems and is not the only benefit; the results, positive or negative as they might be, become observable over a long period, allowing the conservator to update and modify his strategies, particularly regarding preventive measures, as he sees unexpected reactions or errors.

Pre-consolidation

Before proceeding with the consolidation of deep detachments, those areas where the tesserae were detached from the bedding layer were temporarily stabilized. These were areas where minuscule tesserae had been used and had lost adherence to the sub-layer, or that were held in place only by earth and without mortar. Protective cotton gauze was applied over these areas. A slight cleaning with dry brushes and delicate air spraying was carried out before applying the cotton gauze and the solution of 15% Paraloid B72 dissolved in acetone. The

tesserae along the edges of the lacunae and that risked dispersal were fixed with lime-based mortar (1/2 Lafarge hydraulic lime, 1/2 lime putty, 2 parts sifted stone dust) applied in a fine coat perpendicular to the mosaic surface.

Consolidation of the deep-level detachments

This operation was carried out to restore adhesion between layers in detached areas and to compensate in those areas where the mortar in the second preparatory layer was completely disintegrated or missing. By tapping the surface, hollow areas and places where detachment had occurred were discovered. In order to keep a 'control' element during the consolidation, these areas were marked on the surface with masking tape and noted on the drawings and 'maps'.

Most of the deteriorated areas were found near lacunae in the mosaic. In these cases it was possible to approach the underlying layers from the inner edges of the lacunae and remove the disintegrated mortar or earth deposits with a vacuum-cleaner and repeated washing with water using fine flexible metal tubes inserted in the empty areas.

In some cases, the cotton gauze alone, applied during the pre-consolidation phase, was sufficient to maintain the tesserae in place, avoiding collapse during the work. Where there were no lacunae near the detached areas, small approach holes were created by removing 4-6 tesserae from the surface. Numbered, classified and their exact location documented, the tesserae were temporarily kept on a clay support until replaced *in situ*. Fine, flexible plastic and metal instruments were introduced through the access holes to remove all the loose deposits. The cleaning phase continued removing deposits with air suction and ended by rinsing out the area with water.

The areas prepared this way were consolidated using an hydraulic consolidant mixture based on lime, whose components were similar to the original mortars (Lafarge hydraulic lime, sifted brick dust 1:1, and sufficient water to create a fluid mixture). The consolidant was injected through the holes using hypodermic needles, moving from one hole to another until the entire hollow was saturated. Where it was possible to reach the hollow areas from *lacunae* edges, the same consolidant mixture was used with less water and it was applied instead with spatulas. The process started from the back of hollow and moved up towards the edge. Some fragments surrounded by *lacunae* were raised and then replaced on a new layer of mortar.

At the end of the intervention, once the consolidant had hardened, the cotton gauze that had been applied during the preconsolidation phase was removed using acetone soaked compresses. The tesserae that had been removed in order to create access holes were replaced using a lime based mortar. (photo 3)

Cleaning

Mechanical and chemical cleaning techniques were used in conjunction. The loose, or semi-loose, deposits were removed by air suction, water, hand-held plastic brushes. After this initial cleaning a more thorough cleaning took place using nylon brushes and jets of air and water. The thicker deposits (up to 5 mm thick) were reduced using air-powered micro-vibrators.

Further cleaning was carried out by using paper pulp compresses soaked in a slightly alkaline solvent (30 gr. ammonia carbonate, 25 gr. EDTA, 10 cc. NeoDesogen per litre of deionized water) applied to the surface for 4 hours. When the compresses, or pack, was removed and the surface rinsed, another pack of paper pulp and distilled water was applied to remove eventual residues of the cleaning solvent. (photo 4)

Consolidation between the tesserae

This operation was carried out to improve adhesion among the tesserae in areas where the embedding mortar was pulverized. This surface change was widely diffused throughout the mosaic, particularly in areas near the lacunae. The earth or mortar residues in the places between the tesserae were removed mechanically with a specillum and suction and light water spray. Between the tesserae themselves, a liquid, lime based mortar (Lafarge hydraulic lime, sifted calcareous stone powder, 1:1) was brushed on to fill the empty spaces. Any excess of consolidant on the surface was removed using dampened sponges once setting had started (one hour after application). (photo 5)

Treatment of *lacunae*

In order to create a homogeneous surface, all the *lacunae* among the tesserae were stuccoed with lime mortars. Closing these spaces was necessary to prevent infiltration by water, earth and debris, that would give rise to destructive processes. At the same time, closing the *lacunae* with mortars chosen to accompany the general shades of the background color lessens the visual impact created by a broken or interrupted surface, and ideally speaking, re-unites the decorative texture. The stucco-work was done in several thin layers in order to avoid the formation of cracks in excessively thick mortar. The first layer, from 1 to 5 cm. thick, was a mortar composed of 2 parts of non-sifted stone dust, 0.5 parts Lafarge hydraulic lime, 0.5 parts lime putty. A final layer of mortar was placed on this one. It was composed of 2 parts sifted light-colored stone dust, 0.5 Lafarge hydraulic lime, 0.5 parts lime putty and was applied in layers only a few millimeters thick, leaving a slight depression with respect to the tessellated surface. The mortar was smoothed repeatedly with spatulas to create a smooth-enough surface to resist dust and humidity. (photo 6)

The small *lacunae*, where only a few dozen tesserae were missing were filled using sporadic tesserae. Where there was no doubt about the interpretation of the design, this was recreated with the tesserae. Otherwise, even in the case of small *lacunae*, the spaces were stuccoed with mortar.

Maintenance program

This was a fundamental stage of the intervention. Without a maintenance plan, the intervention executed and the cost sustained would have become useless once destructive processes connected to the natural deterioration of the materials involved set in, and also given the fact that the mosaic was not destined to a specific and continued use. Current damages were compensated both and conditions were established for future conservation: specific treatment involving periodical revision of the materials, inspection of the surfaces and prompt substitution of decayed materials, localized consolidation, will assure the existence of the mosaic for the future.

Four local technicians worked alongside the conservators for the duration of the intervention. They were trained in consolidation techniques, cleaning, stuccoing the *lacunae*, and were prepared to face the most important mechanisms that are involved in the disintegration process. They were made responsible for ordinary maintenance to be carried out monthly.

Ordinary care consisted in :

- dusting the surface with brushes and vacuum cleaner;
- cleaning surfaces with water-dampened sponges;
- checking the state of the mortars used during the intervention (cracks, mechanical damage, etc.) and repairing if needed;
- checking for biological growths (plants or algae) and possible appearance of soluble salts.

These simple operations carried out regularly can ensure the future survival of the mosaic without resorting to massive and costly interventions.

Informing the public

An essential part of the intervention was to draw up a program to inform the public. Visitors were able to watch all the phases of the intervention from a terrace built for this purpose along the visitors' path. Guided tours and illustrated information panels transformed this conservation intervention into a cultural event, making the public aware of the questions of safeguarding the mosaic and at the same time making the work available for close observation. (photo 7)

Conclusions

We feel that the archaeological site of Zippori represents the changes that are slowly coming about in the actual choice of intervention among those who are directly responsible for the conservation and safeguarding of cultural properties.

In just a few years' time, many monuments of great historical and artistic value have been discovered in Zippori. Simply since 1989 to today an aqueduct and 5 buildings have come to light; the buildings made even more precious by the existence of about 20 floor mosaics of extremely high technical and stylistic quality. This is an archaeological site which annually welcomes a number of archaeological campaigns that continue to discover a great quantity of artifacts. All these historical and artistic properties should and will be conserved for the future, protected and presented to the visiting public. Available economic resources will be distributed so as to obtain the greatest possible level of safeguarding and use of all the monuments. Starting from the 'restoration' of simple

mosaics (and by restoration we mean lifting the mosaic, resetting the tessellated work on cement, taking into consideration only the aesthetic aspects of the object, etc.) , there has been a tendency towards *in situ* conservation of entire monuments in overall, comprehensive of long-term preservation programs. The characteristics of this kind of intervention can be summed up:

- *in situ* conservation with minimal intervention, whose purpose is to restore the conditions necessary for the future conservation and to maintain the visible traces of the monuments' existence in-time;
- the use of materials and techniques that are compatible with the original structures, or at least materials whose compositions are exactly like the originals, easily to be obtainable and not costly;
- organisation of maintenance programmes to be respected through the years and entrusted to local technicians trained during the intervention;
- plan of the measures to be taken in order to prevent future damage;
- inviting public visitors to the site and providing them with relevant information;

Acting this way is advantageous from many aspects.

From the economic viewpoint: the investment is limited regarding both the techniques and the materials used as well as the employment of local technicians and workers for maintenance. This prevention programme is even more convenient considering how high the risks of damage can be, with the consequent need for costly future restorations.

But the most significant aspect, we feel, lies in the ability to preserve the monuments as they have been given back to us from the ground and to pass on, as much as possible, the historic information we receive from them. To limit meddling to the minimum, to exalt the traces of the monument's life in its previous existence, to awaken public opinion to the conservation of our historic memory by direct involvement and through accurate information: these, we believe, embody the greatest of all possible investments for the future.

Captions.

Photo 1. General view of the floor after the intervention

Photo 2. Detail

Photo 3. Consolidation of the deep-level detachments

This operation was carried out to restore adhesion between layers in detached areas and to compensate in those areas where the mortar in the second preparatory layer was completely disintegrated or missing

The areas prepared this way were consolidated using an hydraulic consolidant mixture based on lime, whose components were similar to the original mortars (Lafarge hydraulic lime, sifted brick dust 1:1, and sufficient water to create a fluid mixture). The consolidant was injected through the holes using hypodermic needles,

Photo 4. Cleaning

Mechanical and chemical cleaning techniques were used in conjunction. The loose, or semi-loose, deposits were removed by air suction, water, hand-held plastic brushes. The thicker deposits (up to 5 mm thick) were reduced using air-powered micro-vibrators.

Further cleaning was carried out by using paper pulp compresses soaked in a slightly alkaline solvent and followed by packs of paper pulp and distilled water.

Photo 5. Consolidation between the tesserae

This operation was carried out by applying a liquid, lime based mortar

Photo 6. Treatment of *lacunae*

In order to create a homogeneous surface, all the *lacunae* among the tesserae were stuccoed with lime mortars

Photo 7. Informing the public

An essential part of the intervention was to draw up a program to inform the public. Visitors were able to watch all the phases of the intervention from a terrace built for this purpose along the visitors' path. Guided tours and illustrated information panels transformed this conservation intervention into a cultural event, making the public aware of the questions of safeguarding the mosaic and at the same time making the work available for close observation.

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