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ZEUGMA MOSAICS RESTORATION PROJECT

SUMMARY

From the site of Zeugma, Turkey, 800 m² of ancient mosaics have been removed prior to inundation by an artificial lake. The technical treatment adopted for the reapplication of the mosaics are discussed in detail, describing methods and materials used.

PREMISE

Before starting with the description of the technical operations carried out at Gaziantep for the restoration of 800 m² of polychrome mosaics coming from the site of Zeugma, the following premises have to be made:

The so called Zeugma Project, started in the summer 2000 thanks to the support of the PHI, Packard Humanities Institute; it has been a large program, characterized by the realization of numerous activities in contemporary, all co-ordinated in one common strategy. A great part of these activities have been carried out on site, during and after the archaeological excavation, during and after the inundation of the site by the water of the dam reservoir, while a part has been carried out in a laboratory at Gaziantep Museum.

This last part concerned the restoration of 800 m² of mosaic. It has been an exclusively technical restoration treatment. The specific themes of removal from the side and reapplication are presented by C. Küçük and the present paper. The papers of G. de Felice and R. Nardi present the documentation and general strategy on site, during and after the excavation, the principles and the methodologies.

The second premise regards one of the authors of the present paper, Antonio Cassio, whom we express all our gratitude for the enthusiasm and the generosity with which in every moment of this long project he has participated at all technical phases, passing to us younger conservators his vast experience and competence.

INTRODUCTION

Zeugma is the name given to two cities, Apamea and Seleucia, founded by Seleucus I (312-281 BC) on opposite banks of the Euphrates in south-eastern Anatolia, Turkey. The two cities were linked by a bridge, for which they were named Zeugma, which means bridge in Greek.

In the first century BC, the two cities came under Roman control. The IV legion was posted in this region to control the bridge, the only stable crossing of the Euphrates for hundreds of kilometres.

For 200 years, the cities were an important trade link between the Roman and Parthian empires. At its peak, Zeugma had between 50,000 and 75,000 inhabitants and covered more than 2000 hectares on the west bank.

As the power of the Roman Empire waned in the 3rd century AD, the city was sacked and burned (AD 252) by the Sassanids.

The site was identified in the 1970s by the German archaeologist Jörg Wagner. Research excavation, conducted by David Kennedy of the University of Western Australia, Catherine Abadie-Reynal, Professor at the University of La Rochelle, and the Turkish Ministry of Culture - Gaziantep Museum, took place during the 1980s and 1990s.

During the same period, Zeugma was affected by a major regional hydroelectric project, which involved the construction of various dams. One of these, the Birecik dam and its reservoir, would submerge 30% of the surface of the ancient city during the summer of 2000. The flooding was scheduled to take place in two phases, the first (June 2000) would submerge the so-called Area A; the second (end of October 2000) would submerge the so-called Area B.

In May 2000, partly due to exceptional finds of movable objects and of two villas richly decorated with frescoes and mosaics, the efforts of a local newspaper editor in Gaziantep [1] manage to attract the attention of the international press, and an appeal for Zeugma rapidly circles the globe. The Packard Humanities Institute (PHI), based in California, responds to the appeal, immediately offering the economic and human resources to organize and co-ordinate a rapid action plan with the Turkish Ministry of Culture (TMC).

Due to these funds the CCA Centro di Conservazione Archeologica of Rome was assigned the restoration of 800 m^2 of mosaic. The present paper describes the conservation and restoration treatment of the mosaics, treatment started in the winter 2001 and now completed.

The facilities

During fall 2000 - funded by PHI under the technical supervision of GAP

(The Great Anatolia Project) - the construction of 2 new laboratories was undertaken at the Museum of Gaziantep and finished in 3 months time. They were designed ad hoc to meet the needs of mosaic and fresco restoration with a minimum disposal of money. One large working area, a temporary storage area, a kitchen, an office and a toilet made up the internal division. A sufficient quantity of natural and artificial light, large passages in all working and storage areas, a well distributed power plug network and in the case of need a forced air-suction system were part of the design.

The two laboratories were divided by a large (4,80 meters) corridor, which was used as open air working area. Right behind the second lab a sandblasting room was constructed which was used for the cleaning of the reverse sides of the mosaics.

Recovery and recognition

In December 2000 almost one month was spent to recover the nearly 700 m^2 of mosaics removed from Zeugma prior to the PHI project, which were still piled in the museum garden and in the subterranean museum deposit.

During the early stages of the project the underground storage was completely reorganized. The different archaeological collections were divided by material category and stored in different locations, while in the main space of the deposit ready-made iron shelves were installed to be used for the mosaics storage.

The material outside in the museum garden had been covered best as possible with some heavy plastic sheeting, but not protected from frost, moisture from the ground, and - due to the resulting damp conditions under the plastic covering – from microbiological attack (fig. 1). The fragments were transported to the main laboratory and spread on the ground. A first recognition was carried out trying to establish the identity, the number of fragments and the extension of the single mosaics. Once identified they were divided by single pavement and stored in the re-organized storage room.

It became immediately clear that one year storage in open-air conditions had taken its toll on the already compromised conservation conditions of the mosaics. Numerous microbiological attacks had occurred on the materials used to detach the mosaics – glues, canvas covering, and timber panels – making them fragile or weak. In addition the extreme temperature conditions (-5 to +45 °C) had hardened the polyvinyl glues employed resulting in the loss of tesserae, detachment of entire sections of mosaic still in place from the canvas, etc.

Restoration of mosaics removed from the site during the excavations prior to the PHI project

As a premise to the description of operations of restoration of the mosaics from Zeugma we have to say that they have been transmitted to us in a multitude of conditions, both of detachment as of conservation. So it will be easier to depart with the description of the objectives and only successively come to the description of the single operations.

The final result of the treatment is to have the mosaic applied on panels of about 1 m^2, cut following the composition outlines of the original design. In this way the single panels are easy to move and to store, while when reassembled they restore the integer image of the mosaic floor. The panels are made of a sandwich structure of aluminium honeycomb in between two layers of glass fibre reinforced epoxy resin, covered with a lime based brick powder mortar (*cocciopisto*) functioning as a remounting layer for the tesserae.

The succession of the operations can be synthesized as follows:

- Verification of the adherence of the tesserae to the temporary support, which is the canvas covering applied during the removal from site;
- Documentation;
- In the case of need transfer of the tesserae on clay in order to integrate the lacunae caused by the operations of detachment and the lack of adherence of the applied canvas, and successively reapplication of a new cotton gauze covering with colla pasta/wheat flour glue;
- Partial or complete removal of the preparatory layers from the reverse side of the tesserae;
- Application of the single fragments on lightweight sandwich panels;
- Removal of the canvas/cotton gauze covering and integration of sporadic lacunae using original tessarae;
- Mending of the lacunae resulting already existing on site with lime mortar;
- Cleaning of the surfaces;
- Reconstitution of the mortar filling between the tesserae;
- Surface protection.

The first operation is the verification of the adherence of the canvas covering applied during the removal of the mosaic from the site: often it is necessary to apply a temporary layer of clay to the reverse side of the tesserae, remove the old canvas covering and apply a new covering made of a double layer of cotton gauze using colla pasta/wheat flour glue to glue it to the tesserae. This operation while on one side augments the work time necessary, permits to check the conservation condition of the tesselatum and if necessary

to proceed with preliminary operations of restoration. In the case of fragments detached in dimensions excessively big the fragment is subdivided in smaller pieces of dimensions adequate for reapplication.

In the next phase the fragments are turned around and the reverse side of the tesselatum is cleaned from the remaining original mortar, if it results cracked or inconsistent. The objective is to create a levelled, stable surface, ready to receive the mortar of the new setting bed layer. This operation is carried out by hand, using chisels and three different types of pneumatic instruments able to reach different types of finishing. In the majority of cases, as the original mortar is cracked and seriously compromised the cleaning of the reverse sides is continued right down to the level of the tesselatum. Only in rare cases, where the conservation conditions of the mosaic permit it, the cleaning removes just the deeper, preparatory layers (rudus and statumen) and the layers of armed concrete applied during or after the removal from site, while leaving the original setting bed layer in direct contact with the tesserae untouched. For the removal of the concrete layers diamond enforced cutting blades mounted on electrical angular cutters are used. With these a 5 by 5 cm mesh is cut into the concrete and then the thus created concrete cubes are demolished by hand using chisels or air compression tools. The final passage in the cleaning of the reverse sides is sand blasting at 4 atmospheres using fine abrasive materials.

The methods of application of the mosaic to the panel are of two types, depending on the fact if the original application layer has been removed or not: application from the front (which means the sandwich lightweight panel is prepared on the floor and the tesselatum is applied face up) or from the reverse side (which means that the tesselatum is face down and the sandwich lightweight panel is applied on top). Due to the heavily compromised state of the original mortar the method used in the majority of cases has been the application from the front.

Let's see the technical operations executed to reapply the detached fragments to the sandwich lightweight panels:

- *Preparation of the lightweight panel outlining the dimensions of the single fragments:* once all the fragments are cleaned and ready for application, they are assembled temporarily face down on a single sandwich lightweight panel of the dimensions of the entire mosaic. The lightweight panel is assembled using epoxy resin and glass fibre bolts with which a sufficient number of standard lightweight panels (measuring 146 x 300 cm). The thickness of the panels used is in

dependence of the thickness of the tesserae of the mosaic to apply. Normally lightweight panels of 25,4 mm are used. On this unique panel the outlines of the single fragments are traced, the single fragment number and all references needed for the application. The panel is than divided cutting along the traced outlines with a jig saw.

- *Preparation of the adherence layer for the mortar with gravel and epoxy resin:* the lightweight panels, once cut, receive a layer, which will guarantee the adherence between the panel and the lime-based mortar of the new setting bed for the tesserae. The adherence layer is made of gravel of volcanic mineral earth (pozzolana) glued on the panels with epoxy resin. The gravel of volcanic origin substitutes the traditional stone gravel for a question of overall weight. An experiment carried out using three different gravel types – stone, gravel, expanded clay (LEKA) with small granolumetry and volcanic mineral earth gravel – has led to the following results: 30% difference in weight between the stone gravel and the other two materials used. The choice finally fell on the volcanic gravel because it combined the advantages of minor weight, with being easily to provide as of local extraction, together with an excellent adherence function. An analysis of eventual soluble salts resulted negative confirming the suitability of the material.

- *Application of the fragments from the front on lime-based mortar:* the thus prepared panels are ready for application. Following the planning of the succession of the single panels to apply the application starts with the central panel of the mosaic positioned according to its collocation in the mosaic on a timber working table stretched over the floor. Being in direct contact with the floor limits the vibrations during the beating and other work phases. The lightweight panel is framed with stripes of wood and metal fixed to the underlying timber panel layer. The framing stripes are of the same height for the complete mosaic, based on the height of the lightweight panel, the depth of the tesserae and of the mortar necessary. The depth varies from mosaic to mosaic from a minimum of 2,5 to a maximum of 5 cm. At this point the mortar is applied. It is a hydraulic mortar made of the following components:

Mortar for the application from the front and the reverse (measure unit 2 litre):

Parts	Component	Notes
1	Marble powder	Not sieved
1	Volcanic earth (pozzolana)	Not sieved
1	Brick powder	Not sieved
0,5	Hydraulic lime (Lafarge)	-
1	Lime putty	-
3%	Acrylic emulsion (Primal AC33)	Pure

The application of the mortar is carried out with the utmost care to compress and thoroughly work the material with spatula and trowels in order to obtain a very compact layer, neatly applied to the lightweight panel and absent of voids or air bubbles (fig. 2).

- Mounting of the fragments on the panels: the fragments, placed face down, are slightly wetted and then covered with the "buiacca", a liquid mortar with the function to penetrate the spaces in between the tesserae and to function as a connection between the tesselatum and the new setting bed (fig 3).

The "buiacca" has the following composition:

Parts	Component	Notes
1	Marble powder	Not sieved
1	Volcanic earth (pozzolana)	Not sieved
1	Brick powder	Not sieved
0,5	Hydraulic lime (Lafarge)	-
1	Lime putty	-
6%	Acrylic emulsion (Primal AC33)	Pure

The thus prepared fragment is positioned on a compressed wood fibre panel, turned front side up and than posed on the new setting bed. At this point the fragment is pushed into the lime-based mortar with the help of modified, heavy finishing trowels. This operation is repeated until the tesselatum is perfectly aligned with the elements in timber and iron making up the frame prepared for the mounting.

- *Removal of the canvas/cotton gauze covering:* the removal of the canvas applied for the detachment and of the cotton gauze applied after the integration on clay is executed by the creation of a humid chamber obtained through hot water vapour pushed under a polyethylene sheet put on top of the fragment. After about one hour the hot vapour has dissolved the glue to a point, where a gentle removal of the covering is possible; this is followed by a patient, mechanical operation of removing the remains of glue on the mosaic surface (fig. 4).
- *Integration of sporadic lacunae and mending of antique lacunae with mortar:* the troubled history, which these mosaics have passed through from their removal from side, the transport to the museum and their storage there has caused a considerable number of detachment of tesserae, more or less recovered between the single layers of mosaic. These lacunae, normally small but present in great number, have been closed after an accurate documentation using the original tesserae recovered. The lacunae present at the moment of excavation (individuated by the scarce photographic documentation available) have been mended with mortar.

Once the mounting of the first fragment is complete, the process proceeds with the successive ones, mounting about two or three fragments a day. After mounting the last fragment the mosaic is left untouched for about a month giving the mortar the time to set up and harden (figs. 5 - 6).

At the end of the repose for letting try out and set up the mortar the final finishing is carried out: the cleaning of the surface, the reconstitution of the mortar filling between the tesserae and the surface protection.

- *Cleaning*: this operation is carried out using chemical and/or mechanical systems according to the kind of surface deposits present. In the case of carbonized surface deposits cellulose fibre poultries soaked with ammonium carbonate (30 g/l), EDTA (25 g/l) and a detergent (Neodesogen 10 cc/l) are applied. The chemical cleaning is followed by a mechanical finishing using plastic brushes - operated by hand or by an electric, modified, low velocity angular cutter or by a drill driven by compressed air – and scalpels. The water used for scrubbing the surfaces and the successive rinsing is immediately removed together with the dirt and the chemical substances applied by an industrial vacuum cleaner.
- *Reconstitution of the mortar filling between the tesserae*: in the case that the mortar filling between the tesserae has been lost, a new layer of liquid mortar is applied by brush and then, having partly set up,

removed with the help of sponges. These operation can be limited to the zones, where the mortar filling has been effectively lost without being applied on the whole surface of the mosaic.

Mortar for the reconstitution of the filling between the tesserae:

Parts	Component	Notes
1	Marble powder	Sieved
1	Volcanic earth red (pozzolana)	Sieved
1	Volcanic earth black (pozzolana)	Sieved
1	Brick powder	Sieved
All the components are mixed and then jointed with hydraulic lime (Lafarge) in a 1,5 filling: 1 hydraulic lime		

Surface protection: once the mortar applied between the tesserae has set up on the clean surface a protection layer of 1,5% of acrylic resin (Paraloid B72) in acetone is applied by brush.

In the case of floors for which it has been decided to leave a layer of original mortar of the setting bed, part of the mounting process is carried out from the reverse side according to the following procedure:

- *Levelling:* the original setting bed of the mosaic, covered with canvas/cotton gauze and face down, is levelled in order to obtain an even mortar layer of continues depth. If this is not realisable through levelling the original mortar layer the even level is obtained by applying a mortar similar to the one used for the new setting bed, levelling out the reverse side to a uniform depth.
- *Consolidation:* before the application of the lightweight panel the original mortar and the eventual new mortar used to level out the reverse side, are consolidated using acrylic resin emulsion (Primal AC33) until saturation.
- *Application of the lightweight panel:* once the consolidation has been completed and the eventual new mortar has completely dried out and hardened, the lightweight panel is applied – mosaic still face down – using epoxy resin mixed with sieved sand.

Once the epoxy resin has set up, the mosaic complete with its lightweight panel is turned around. Now the mounting of the other eventual fragments proceeds using the method of application from the front with all the other operations just described. It is important to specify that mounting from the

reverse side is applicable only on a single fragment, no matter if this is an entire floor or the central scene of a mosaic, around which then the other fragments of the mosaic are mounted using the method from the front. So while the method from the front allows with a single coherent method to mount an entire floor, the method of mounting from the reverse side has to accept, or the application of the whole floor in a single piece (with all its inherent problems), or the mounting using a mixed technique with the central fragment mounted from the reverse side and all the others mounted from the front.

Conclusions

A mosaic removed from site is an artefact to which has been imposed an irreversible operation: it has been separated from its original context of appurtenance (site/monument), stripped of some of its original parts (original preparation layers), radiated in its evidences left by time and in its relations with the architectural life, to which it belonged (irregularities in the levels, historic traces).

On these premises, taking into account the radical transformation from architectural-archaeological element into an object stripped of its antiquity in order to assume a new nature, the conservator/restorer has to plan his recovery treatment. The artefact has changed its physical state and hence the guidelines to follow for the conservation treatment have to reflect this change.

The reference points to keep track of are:

- The conservation of the historical and technical data contained;
- The chemical and physical compatibility of the materials used to recreate a setting bed for the tesselatum and the complete reversibility of the treatment;
- The logistic concerns of handling, moving and storing the mosaic in a safe and practical manner;
- The presentation giving the possibility to appreciate the surface as close as possible to their true essence.

These have been the principle constraints we referred to during the project.

We conserved the historical information still present through the documentation: the data, which would have been lost through the operations of removal from site first and restoration after, or the ones which have been lost, have been tracked and archived through all the forms of documentation available (see paper of G. de Felice).

We believe that we have respected the criteria of material compatibility between ancient and restoration materials employed by applying the

tesselatum on a setting bed made of cocciopisto, similar to the original support the mosaics had on site. Reconstructing a layer of lime-based mortar we have reproduced the conditions of chemical and physical interaction between the materials similar to the original ones. This assures the durability in time with the full respect of the ancient materials and reaches the objective of complete reversibility of the treatment and reproduces a visual effect equivalent to the original one.

We believe to have resolved the logistic concerns by applying the mosaics on supports, which are light, rigid, stable, following the outline of the geometric and figurative design of the mosaics themselves, in small fragments in a way that permits to handle them easily without the risk of damage. The relatively low weight of the single fragments will facilitate all operations of storage, transport, assemblage for display and disassembling for eventual maintenance operations.

Finally we believe that we have replied to the necessities of presentation by adopting mimetic cutting lines, which follow the design outlines of the composition. This solution restores once assembled in the final destination a visual unity, which is indispensable for the correct fruition of the mosaic surfaces.

But maybe the element which has characterized more than anything else the restoration treatment of the mosaics from Zeugma, is the complete reversibility of the materials and techniques used and the absolute transparency of the operations carried out thanks to the documentation and to the diffusion of information on the project.

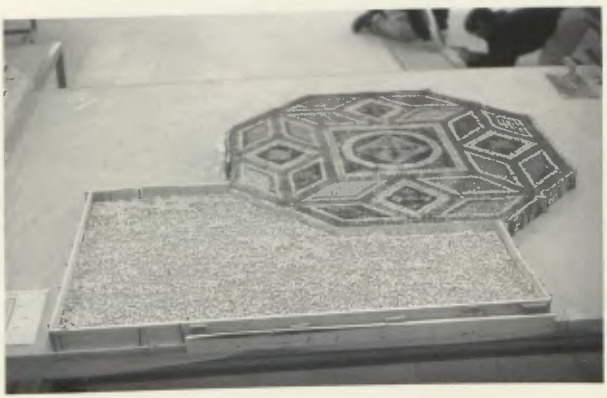
FIGURES

1. Mosaics stored in the Gaziantep Museum garden.

2. Application of mortar on a lightweight panel.

3. The mosaic fragment is set on the fresh mortar.

4. The canvas covering is removed.



5. The second panel is fit to the first one.

6. The final panel is being prepared with buiacca.