

## **In situ consolidation of a roman fresco. Ein Yael, Jerusalem.**

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**Abstract** In the spring of 1990 the Department of Antiquities of Israel carried out an in situ conservation intervention of a roman fresco from a villa near Ein Yael, in the vicinity of Jerusalem. The intervention was carried out according to the following principles: in situ consolidation of the fresco; use of products compatible with the original components; application of technique similar to the ancient ones; use of local products and equipment; roofing and protection against water as preventive measures; maintenance program. In the spring 1992 a check-out of the structure confirmed the good effectiveness of the intervention.

In the spring of 1990 the Department of Antiquities of Israel, with funds allocated by the Jerusalem Foundation, carried out a conservation intervention on a lining of one of the frescoes located in the thermal area of a roman villa near Ein Yael, in the vicinity of Jerusalem. The intervention, as per agreement with the organizers, was a chance for three local technicians to further deepen their professional experience by being part of the working team.<sup>1</sup>

The entire program was carried out according to the following principles:

- in situ consolidation of the fresco;
- use of products compatible with the original components;
- application of technique similar to the ancient ones;
- use of local products and equipment;
- roofing and protection against water and insulation;
- maintenance program.

By acknowledging these factors, we would like to stress the fact that an ancient structure must be respected not only for its aesthetics image but also for the components of which it is made up, by recognizing its original technique of construction and by keeping its structural and topographical context. The roman villa situated in Ein Yael falls into the typology of rural residences used for the production of agricultural products, in this case, roses. Built at the end of the second century, it comprises two small thermal complexes, one of which is almost 4 meters in diameter with a multicoloured mosaic floor geometrically arranged and bearing a large star in the middle.

On the walls we find a layer of frescoes of imitation marble, which is conserved for nearly 3 meters and is almost 1.5 meters high in total. In March 1990 the area had been excavated showing both the mosaic and the frescoes.<sup>2</sup>

The fresco was still damp, with a deposit of dirt covering the painted surface; large portions of fresco were detached and important deposits of dirt were penetrated in between the various strata; a large root grew in the thickness of the fresco that was partially supported by the root itself.

(see fig.1) The entire area was surmounted by an architectural structure in metal with a rain water gathering system created for protective measures against insulation and rain. The outer layer of the fresco is made of a scratch coat (arriccio) and intonaco: the first is applied directly on the wall, is dark and has a great percentage of large granulation; the second is a composed of a white paste and has a homogeneous percentage of fine granulation. This technique dated back to the Romans who applied both scratch coat and intonaco in different layers, in order to guarantee the carbonation of each individual layer.

*Scratch coat (arriccio).* In the scratch coat one can distinguish two different layers of equal thickness, roughly 1 cm. each and made of the same mixture, applied, however, in different stages. This solution was adopted in order to avoid a uneven carbonation due to the excessive width of the layers. The section clearly shows white lime putty granules not completely blended, which stand out in the faint yellow tone of the paste, colour probably derived from the sand. One can also note some stringy traces which prove the addition of vegetable fibres, which had the role of keeping out humidity in order to avoid a too rapid disintegration of the mortar detrimental to the final consistency. This was a custom used both in the west and in the east and its practicality was known already in old times.<sup>3</sup>

*Intonaco and Intonachino.* The total thickness of the intonaco and the intonachino is generally less than 1 cm. but can even be double in relation to the point where the chiselling appears on the scratch coat. In the intonaco's white mixture which is not very porous, one can probably say that there is a greater percentage of lime than scratch coat. The intonachino which corresponds to the final setting to which the colours were added, is not thicker than 3 mm. and it was applied when the previous layer of intonaco had not been completely carbonated. This can be seen when looking at the perfect adhesion, at times indecipherable, of the two layers.

The charge of the intonachino shows a compactness and a high mechanical resistance which has been incremented by the practice of dressing the surface before applying the colours. Glazing has been used to apply the colors starting from the lightest background colour to the final brush work imitating a darker veined marble. As for the pigments, natural earth has been adopted and for the colour of the sole, a mixture of black and lime.

#### **Description of the state of conservation of the fresco (fig.2)**

A. Faults in the cohesion of the intonachino. This deterioration is due to the repeated cyclic phenomenon of the crystallization-solubilization of the soluble salts on the surface of the fresco. The salts found in the structure and in the ground are solubilized by the water and move towards the surface where they crystallize once the water has evaporated. The thermo- hygrometric changes both in daytime and night time determine a cycle of condensation evaporation of the vapour followed by a salt movement and a deterioration of the superficial layer of the fresco.

B. Faults of cohesion between the intonaco and the intonachino. Areas of limited extension. The detachment of these two layers is due to minute infiltrations of water which can only be seen in the cracked areas where the scratch coat has fallen off the wall.

C. Faults of adhesion between layers of mortar and the support of the wall free of earth infiltrations. Areas of limited extension with an intermediate deterioration between the whole areas and those which are most detached. The different porosity between the stone of the wall and the mortar of the intonaco has determined a front of water evaporation which is higher in the inside than on the superficial plane of the fresco. This phenomenon tied to the salt crystallization, is called sub florescence and it has caused the detachment of the mortar layers of the support of the wall.

D. Faults of adhesion between layers of mortar and the support of the wall with partial detachment of the intonaco. Areas limited by broken edges and by areas concerned with a type C deterioration. Once the balance produced by the adhesion of the mortar to the wall is broken, the earth and minute root infiltrations have given birth to both lifting and bulging. These are areas of intonaco, at times very large, that on their reverse side are completely covered in earth but still manage to keep a partial contact with areas which have not been detached.

E. Faults of adhesion between layers of mortar and the support of the wall presenting a total detachment from the intonaco. Areas completely surrounded by broken edges. The natural growth of the roots and the increasing infiltrations of both water and earth have resulted in fractures of the intonaco and often at times also overlapping of fragments which entirely compromised the adhesion to the support of the wall. These areas all show broken edges, a result of either the collapse of the wall, the destruction of the wall itself or the penetration force of the same roots.

F. Faults of adhesion between the layers of mortar and the support of the wall. Areas found along the edges of the fresco. The collapse of the wall structure has left in situ some fragments of intonaco void of their original support. These fragments were preserved like knife blades, and in certain case they jutted out with respect to the trampling floor.

### **The intervention.**

#### Graphic survey

The fresco has been surveyed on a 1:1 scale on polyethylene placed in contact with the surface with indelible markers in order to have a precise documentation of the state of the fresco, to be used during the actual intervention.

#### Preliminary cleaning

Removal of the superficial deposits of earth with a brush, used dry and with the aid of a wet pad containing NeoDesogen.5

#### Consolidation of the areas presenting a type C deterioration.

The areas which were meant to be consolidated were initially cleaned with water infiltrations and alcohol injected through existing minute cracks or by creating holes in the areas which showed colour abrasions. The consolidation was started from the deepest spots of fault of adhesion to the more superficial ones, moving from the lower parts of the fresco towards the top and from the areas which presented a minor degree of detachment towards those which were completely detached; in this way the most deteriorated areas were isolated by consolidated areas to which the next infiltration of consolidant could easily adhere. For this intervention, an hydraulic mixture of aerial lime made of lime putty and brick dust was used, a mixture capable of adhering also in the presence of humidity to the innermost layers of the intonaco. All the products used were found on site: the lime putty had been slaked for the past six months; the brick dust was made on site by crashing the bricks and sifting the fragments of both ceramics and bricks.

#### Removal of the earth from back of areas presenting a type D and E deterioration and velatura of the areas presenting a type E and F deterioration.

As the consolidation moved on, it became possible to start taking away the earth by using scalpels, spatulas, and metal wires flattened out at the extremities resembling long and flexible micro spatulas. In certain points along the upper part of the fresco one noticed that the earth had penetrated for over 50 cm. Before removing it was necessary to use velatino on the entire area and on the adjacent parts. Working with props which held the intonaco in place, it was possible to keep on removing the earth till the point in which one encountered the wholesome areas or the ones already consolidated. The structure of the wall, permanently damp, did not allow for a good penetration and a firm setting of Acryloid B72 used to apply the velatino. By using acetone it was possible to dehydrate the surface of the fresco and from the very beginning a high concentration of Acryloid B72 was used in order to take the best advantage of its superficial setting. 6 (see fig.3)

#### Roots cutting and consolidation of the areas presenting a type D deterioration.(see fig.4)

The roots deeply embedded in the wall have been sawed off and a chemical herbicide (local production) for killing infested plants has been applied. The consolidating intervention called for the restoration of the outer layer, the preliminary coating which was partly lost due to infiltrations from behind. It was used lime and brick dust, where the brick dust was used as a charge to make an hydraulic mortar which would have been capable of isolating in a mild way the humidity from the

structure. The only drawback to the use of lime mortar as a consolidant was, in this particular case, the waterproof barrier created by the velatino and the 20% of Acryloid B72 which prevented a homogeneous front of evaporation for the exchange of humidity between the structure and its environment. This problem was solved by doing the entire intervention of dampening and consolidating one area in the span of half a day, in order to then have the time to take off the velatino, before the lime mixture started its action of carbonation. In this way it was also possible to disregard the irrelevant incompatibility of the Acryloid B72 with water: in the essential intervention of dampening the entire area concerned with the consolidation, the quantity of water used was not limited although it could have compromised the adhesion of the acrylic resin. The consolidation was always carried out in different stages: starting with a liquid mixture capable of filling the minute cracks, the density was increased according to the size of the detachments. To fill the back of all the upper edges of the fresco, after an initial infiltration of liquid mortar, a mixture of lime, local sand and brick fragments was applied.<sup>7</sup> This mixture was applied in different layers, depending on the depth to fill, and each layer was repeatedly shined on the surface with metal spatulas. Some props have been placed behind the back of the areas which had been filled.(see fig.5)

#### Detachment and consolidation of fragments presenting a type E deterioration

For the area on the right of the root, once this had been uprooted, it was possible to take away the earth from all sides, until reaching the complete detachment of the entire fragment. A prop of the same size was used to secure the edges of the velatino: the fragments were removed from their support just enough to make it possible to clean their back. The removal of the earth was done mechanically and with spouts of water which contemporarily prepared the surface for receiving the mixture of liquid lime and brick dust. After having applied this first liquid layer which acted as a final setting, the surface was ready to receive the actual new outer layer made of equal proportions of lime, sand and brick dust.(see fig.6)

#### Consolidation of areas presenting a type A and B deterioration and final stuccoing

As the consolidation of the deeper layers was completed, work began on the more superficial detachments, still using the same mixture and the same technique of application. Only in connection with the decorated parts, where the surface of the intonachino was damaged, a liquid suspension of hydraulic lime was applied drop after drop with a syringe. A mixture of lime and sand (1:2.5) was finally used to stucco the cracks and the holes on the plane of the fresco and to close all the edges of the breaks, thus covering up the layer of lime, sand and brick fragment compound ("coccipisto") and the infiltration mortar which was still visible.

#### Protection

When the consolidation of the fresco is concluded, its chance of survival is obviously depending on the protective measure taken to prevent further deterioration. First of all, the water, as rain and as migrating water from the surrounding earth. Then, the insulation and visitors. As protection against rain water and insulation it has been maintained in situ the metal roof previously built. This structure is strong enough to resist the wind, but not so "heavy" to disturb the landscape of the site; it is opened and high to avoid the risk of producing a "green house effect" and has an efficient gathering system to collect rain water away from the fresco. The earth platform which rests on the back of the wall is an obvious vehicle of infiltration for humidity, migrating from the surrounding earth. To limit this phenomenon it has built a draining ditch all along the external perimeter of the wall. This ditch, deeper than the wall, takes in and disperses the humidity of the earth platform before this reaches the fresco, allows the structure to dry off and to gain airing on both sides (not simply on the surface of the fresco), and made it possible to restore the outside of the wall using a lime based mortar and plaster. After the consolidation, the draining ditch has been filled up with gravel at various granulometry. This way it has been obtained a double effect: to consolidate the wall and to limit the circulation of water in the structure. At the same time it has built up a structure capable to allow an easy access to the public to enjoy the monument without getting too much in touch with the structure, cutting the risk of damage given to circulation of visitors in unplanned places (see

fig.7).

### Conclusions

The intervention was carried out by five restorers in the span of three weeks. During this time, the consolidation of the fresco and of the wall was completed. This intervention did not get rid of the possibility of new problems of deterioration, but at least it created a stepping stone from which, with the aid of the protective measures adopted, one can assure to the entire structure, wall-fresco-mosaic, the stability of a balanced system comprising healthy and homogeneous structures. But a real and effective protective action is represented by a simple and economic program of survey and maintenance, to be guaranteed to the fresco in the future years. This program has been planned on a base of two working days every two years. The field experience will tell us the feasibility of this estimation. During spring 1992, a first survey has been done. It was possible to ascertain the absence of humidity on the fresco: only few localized deep consolidation and some bordering was required in places where the detachment was the result of drying of the wall. Very few points required an application of a biocide for algae. 8

A light cleaning was done in some areas which were whitish in colour, probably due to soluble salts migrating when the outside surface of the wall, slowly dried. During this first survey, we had the impression of a general good state of the monument, also considering that winter 1992 was for Israel extremely cold and rainy. The time required for the first maintenance survey was, after two years, of two working days. We will keep on monitoring this experience in the next years, always keeping in mind that the direction of our working is: minimum intervention, prevention and maintenance.

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### Figures

Figure 1. The fresco was still damp given to humidity migrating from the back of the wall.(white arrow) Important deposits of dirt were penetrated in between the various strata (black arrows). A large root grew in the thickness of the fresco.

Figure 2. The state of conservation of the fresco. A. Faults of cohesion of the intonachino. B. Faults of cohesion between the intonaco and the intonachino. C. Faults of adhesion between layers of mortar and the support of the wall. D. free of earth infiltrations. E. with partial detachment of the intonaco. F. presenting a total detachment from the intonaco. G. areas found along the edges of the fresco.

Figure 3. Velatura of the areas presenting a type E and F deterioration.

Figure 4. Consolidation of the areas presenting a type D deterioration.

Figure 5. Consolidation was carried out in stages, starting with a liquid mixture, increasing the density and using some props.

Figure 6. Detachment and consolidation of fragments presenting a type E deterioration. After having applied a first liquid layer, the surface was ready to receive the new outer layer made of equal proportions of lime, sand and brick dust.

Figure 7. The monument at the end of the intervention: a roof with a gathering system protect from rain and insulation; a draining ditch protect from humidity migrating from the soil; a balustrade show visitors the view point.

## Notes

1. The restoration works have been executed by Tedy Mazzola, Graleb Abu Diab, Marc Goodman, from the Israel Antiquities Authority and by Roberto Nardi and Andreina Costanzi Cobau, from Centro di Conservazione Archeologica, Rome.
2. Gershon Edelstein, "A luxurious roman villa in rural Jerusalem", in Biblical Archaeology Review, 1989, pp.1-11.
3. Vitruvius, "De Architectura", VII, chapter III.
4. L.P.Mora ©P.Philippot, La conservation des Peintures Murales, Bologna 1977, pp.1-15.
5. NEO©DESOGEN, Ciba Geigy, a 10% solution. Used diluted in water at 0.2% (20 cc. in 1 litre of water). It has the role of a surface active, increasing the cleaning action of water.
6. Velatino was applied with Acryloid B72 diluted at 20% in trichloroethane, applied on a preparation coat at 15%.
7. Coccipisto: 1 part lime, 2.5 of sand, to which one adds roughly 20% of the entire volume, of brick fragments.
8. Lito 3. Ciba GEIGY.