Transactions on the Built Environment vol 66, © 2003 WIT Press, www.witpress.com, ISSN 1743-3509

Extraordinary maintenance work carried out on the arch of Titus in Rome

M. L. Conforto[1] & S. D'Agostino[2]
[1]*Ministero per i Beni Culturali, Italy*
[2]*Università degli Studi di Napoli Federico II, Italy*

Abstract

The Arch of Titus on the Palatine is known to us today in the form defined by Valadier in about 1830. It stands as the classic example of the philosophy of restoration that prevailed in Rome in the first part of the 19th century, in the hands of Stern and subsequently Valadier. It is thus not only one of the outstanding examples of a Roman triumphal arch but also a milestone in the history of restoration. The maintenance work carried out recently had to fulfil two objectives: consolidation and cleansing of the stonework, especially in the oldest parts, and an assessment of the monument's static condition, both overall and in those points in which crumbling and cracks pointed to possible problems. In particular lesions to a column and in some blocks of travertine added during restoration in the 19th century raised the possibility of damage to the inner core of the stonework.

1. Introduction

The Arch of Titus is a classic case of restoration not merely for the celebrated frieze of figures, which holds an unfailing fascination for scholars and lay onlookers alike, but also for the well-documented process of its restoration and reconstruction, proposed by Raffaele Stern in the first decades of the 19th century and completed, following his death, by Giuseppe Valadier. Views of Rome down through the centuries show the monument incorporated in a succession of walls and edifices, and supported by a buttress. Working from drawings, it was reconstrued as a prototype of a single-arched triumphal arch built in *opus quadratus*; gaps in the original structure were made good with masonry masked by slabs of travertine.

We can identify as original the visible blocks of stonework comprising the south pillar and part of that of the north pillar, the blocks which constitute the archway bearing the famous scenes of the sack of the temple of Jerusalem and the triumphal procession, the coffered intrados, columns, friezes and capitals which frame the east-facing side of the arch, and part of the frieze at the base of the attic room. Cornices, coffers, friezes, capitals and figured scenes were all fashioned in enormous blocks of marble constituting the fabric of the monument itself. Inside the structure a stairway led to an attic room inside the north pillar. We can longer make hypotheses about the southern pillar, since apart from the main block it was entirely reconstructed.

We found all the stonework surfaces, whether original or 19th century, in an advanced state of deterioration on account of erosion, exfoliation, fractures and thick layers of black grime.

The static assessment concerned the state of conservation of the monument as a whole and in particular the south pillar, which had a deep crack in the base of the travertine column on the side facing the Colosseum and some extensive patterns of cracks in the travertine slabs. Furthermore a careful analysis was made of the intrados of the archway vault, which revealed disintegration and disjointing in the voussoirs. Finally the poor state of surface conservation of original and 19th century stonework required scrupulous examination in situ to establish the true stability of the individual components and the measures to be taken to ensure an adequate conservation and safety coefficient for the monument.

2. The intervention

Our detailed assessment of the monument made it possible to establish the state of deterioration of the travertine slabs incorporated by Valadier. The principal cause was the action of atmospheric agents which have not only corroded the external surface of the stonework but also caused the various components to become disjointed. This has led to infiltration by rainwater, causing the thick metal brackets inserted to fasten the slabs to the original masonry to become rusted. One of the travertine slabs was removed, revealing both the swelling of the metal brackets, causing localised fractures in the slab, and also the excellent state of conservation of Valadier's integration of the ancient stonework to provide a smooth bed for the new facing (figure 1). We found that the rusting of the metal brackets was the prime cause of the deterioration of the modern facing. This could be observed both in its manifest effects and by means of a large magnet with which it was possible to locate all the brackets and ascertain that they corresponded to the crack patterns. The deep fracture in the base of the column on the side facing the Colosseum was also found to be due to metal elements inside the structure, but this was not investigated more closely for fear of causing further damage (figure 2).

All the analyses showed minimal structural loads, as one would expect in view of the construction concept behind the original monument. Thus the cases of decay were due to the gradual deterioration of the original marble and the much more

rapid deterioration of the travertine facing, on account partly of its rather poor quality and also of the metal bars inserted to pin the exterior to the core structure.

Figure 1

Figure2

Inspection of the site, and in particular of the massive foundation slab of the arch itself, which showed no sign of deterioration, ruled out any possibility of weakness in the foundations and guaranteed the perfect stability of the monument overall. The disjointedness of the large blocks comprising the intrados can be attributed not to recent subsidence but to the intervention of Valadier. He actually restored the arch leaving the blocks disjointed, apparently because it had been dismantled without due care and attention, according to some evidence. During reassembling it proved impossible to fit the blocks together again perfectly. We decided to close up the interstices, inserting stone voussoirs where necessary, so as to restore the compacting effect of the blocks.
The extant evidence from drawings and paintings and the data collected during the survey carried out alongside the conservation work have enabled us to map every component of the arch and proceed to a series of static tests using both traditional methods and calculus of finite elements. We established the state of stress under normal conditions, considering the weight of the structure both for the direct bearing and for the whole arch using the traditional method. The calculus of finite elements was carried out on the basis of the following stress conditions: overall weight plus wind, overall weight plus seismic activity.

The restoration work comprised cleaning the various materials, eliminating the caking of grime, consolidating the decaying areas and filling in and plastering over the gaps that had opened up (Figure 3).

Figure 3

Cleaning: the surfaces both of the marble and the Travertino have been cleaned with atomized water, in a diversified process, of the more exposed Travertino parts, going from the simple rerinse to the an application 4 hours long. More tenacious encrustations have been treated, after the Atomized water treatment, with compress of a watery ammonium-carbonate solution kept in suspension

with cellulose pulp. Not soluble residuals or calcareous encrustations or not suitable stucco or overedging stucco insisting on the original surface, have been mechanically removed with Vibro-engraver, micro-drills or manual tools. Consolidation, on the South side, of the capital seriously fractured, supported by unsuitable coupling element made in copper: cleaning and consolidation of the object with ethyl-silicate after the disassembly of the unsafe fragments ; reassembly of the smaller fragments with Epoxy resin; anchorage to the structure of the three greater fragments with as much pivots in Titanium (cm 12 x 22).
In this way we avoided any unjustified or radical attempts at substituting parts of the structure. The traditional appearance of the monument was left untouched, for it has undoubtedly acquired its own *raison d'être* over the last century and a half.

3. Guidelines

The guidelines for the static restoration we carried out can be summed up as follows: (a) identify the original construction concept of the monument; (b) verify any transformations that have taken place; (c) analyse the state of construction as it has come down to us. Furthermore all operations should adhere to the criterion of minimal intervention and use compatible materials, as far as possible of proven durability. Our static calculations showed the monument's excellent state of stability, even under the maximum conditions of seismic stress stipulated in current security specifications. All the considerations set out above led us to conclude that no significant static interventions were necessary; instead, we drew up indications for a project of programmed maintenance which can retard the effects of inevitable deterioration while safeguarding the current appearance of the monument.
Routine maintenance work, to be carried out every three years, basically follows from the conservation strategies adopted in the extraordinary maintenance that has just been completed. It can be summarised as:

a) elimination of encroaching vegetation and any organic and inorganic deposits;

b) cleansing of caked grime;

c) careful inspection, if necessary using an elevator platform, to determine the onset of decay in the ancient marble; verification of the crack patterns in the facing slabs, paying particular attention to the corners held by metal brackets, and also of the state of conservation of the inter-slab joints and the plastering;

d) drawing up of a report on the deterioration encountered so as to trace its progress over time;

e) renewal of the plastering, elimination of surface cracks and local making good where necessary;

f) as the triennial cycles progress it may be necessary to carry out further extraordinary maintenance work, and in particular: treatment of marble in the vicinity of the veins of mica; consolidation of decorative elements which risk being dislodged; dismantling and reassembling, replacing any parts that need it, of travertine slabs or sections of columns.

4. The capital

One substantial intervention had to be carried out on the right capital, east side. A corner section had fractured into several pieces and was held in place by two copper brackets that were badly rusted and only tenuously joined to the capital itself (figure 4).
Other parts of marble were held together by cement, which filled up and sealed the cracks, but which had come away from the surfaces. Unfortunately it was not possible to find any evidence of the previous restoration work. Once the cement rendering had been removed it was found that the metal brackets had virtually no hold on the ancient structure. The fragments were dismantled, and this revealed a metal pin which was also badly rusted and had to be removed. The fragments were cleaned and consolidated; the larger ones were stuck together using epoxy resin. At this point we were faced with two alternatives: the fragments could either have been put on display in a museum, or put back on the monument after reintegrating the capital. Conservation in a museum would have ensured a longer life for some of the original fragments, but seen out of context they would have been meaningless.

Figure 4

Whereas putting them back meant avoiding a drastic mutilation of the capital, and programmed maintenance of the monument offered sound hopes of conserving them for a long period of time. It was decided to replace the capital *in*

Transactions on the Built Environment vol 66, © 2003 WIT Press, www.witpress.com, ISSN 1743-3509

situ. The volute, in two fragments, was bound together by three titanium brackets. It was then fixed to the capital using two further titanium brackets.

References

D'Agostino, S., Archeologia e storia materiale:criteri guida per la conservazione strutturale, *Tecniche Edili Tradizionali*, Alinea Ed. Firenze, pp 15-18, 1999

D'Agostino, S., Bellomo, M., Excavation, restoration and conservation of archaeological sites. The Villa dei Quintili on the Appia Antica in Rome, *Proc. of the fourth International Conference on Structural Studies, Repairs and Maintence of Heritage Architecture, Stremah 1999*, Wit Press, pp451-460, 1999

Bellomo, M., D'Agostino, S., Improvement as a criterion for the antiseismic safeguarding and structural conservation of historical sites: methodology and examples, *Proc. 12 WCEE*, New Zealand, 2000

Conforto, M.L., D'Agostino, S., Some observations on the concept of construction, *Proc. of the 6th International Conference on Structural Studies, Repairs and Maintence of Heritage Architecture, Stremah 2001*, Wit Press, pp 593-597, 2001