Conserving Built Heritage Damaged by Armed Conflicts in the Age of Technological Innovation

ALESSANDRA ALVISI, Sapienza University of Rome, Italy

On January 2017 the Tetrapylon and parts of the Theatre proscenium in the ancient city of Palmyra, Syria, were destroyed. These are only the most recent in a series of dreadful actions perpetrated by terrorist groups. After the destruction of Palmyra’s Triumphal Arch at the end of 2015, this monumental symbol of the Syrian archaeological site has been digitally reconstructed and then replicated using 3D printing technology. The exposition of the artifact, made in Carrara, took place in London and in New York, receiving a warm-hearted welcome by the people.

This contribution focuses on one of the critical topics that the international scientific community must face: the incessant threat that afflicts Syria and Iraq (just to mention the most recent events) is causing the damage and loss of significant and unique ancient buildings and artifacts of local culture. International and worldwide institutions are already moving for the prevention of attacks and the protection of the cultural heritage represented by the sites considered endangered. Unfortunately, many monuments are already damaged by modern war and others have been completely burned to the ground.

Therefore, the problem arises of how to deal with the situation, which criteria to apply for restoring the ruins and especially if to undertake the actual reconstruction. Recent experience shows a compelling potential in the use of new technologies to digitally reconfigure the lost monuments: a conscious approach must guide their application, clearly outlining the aims.

This contribution intends to analyze the theme on a theoretical level and consider with a critical approach the opportunities offered by the innovative technologies that today scientific progress makes available. The purpose is to outline how to tackle this challenge with an informed and conscious use of technologies in the transmission of cultural heritage values to the future.

Key words: Cultural Heritage, Armed Conflict, Cultural Identity, Technological Innovation, 3D Printing.

INTRODUCTION

On January 2017 the Tetrapylon and parts of the Theatre proscenium in the ancient city of Palmyra, Syria, were destroyed¹ (Fig. 1). These are only the most recent in a series of dreadful actions perpetrated by terrorist groups².

After the destruction of Palmyra’s Triumphant Arch at the end of 2015, this monumental symbol of the Syrian archaeological site has been digitally reconstructed and then replicated using 3D printing technology. The artifact, made in Carrara, has been exhibited in London, New York, Dubai and Florence, receiving a warmhearted welcome by the people (Fig. 2). This episode concerning the strong answer to the destruction of a well-known monument requires a careful consideration.

Fig. 1. a) The ancient Tetracylon of Palmyra, Syria, before its destruction, occurred on January 2017; b) The Theatre of Palmyra, Syria: parts of its proscenium have been seriously damaged in the same occasion.

Fig. 2. a) The Triumphant Arch of Palmyra, Syria, before its destruction; b) The replica of the Arch made in Carrara, Italy, using 3D printing technology.


2 The replica was made by the international Institute for Digital Archaeology ([http://digitalarchaeology.org.uk/](http://digitalarchaeology.org.uk/), February 13th, 2018) using 3D computer models based on photographs of the original arch. Carving robots of the Italian contemporary art studio Torart ([http://www.torart.com/](http://www.torart.com/), February 13th, 2018) then used the 3D modeling to re-create the finely carved arch out of Egyptian marble. About the exposition and reception: [http://digitalarchaeology.org.uk/media/](http://digitalarchaeology.org.uk/media/) (February 13th, 2018).


HISTORICAL EXCURSUS: EVOLUTION OF THEORETICAL APPROACH AND OPERATIVE PRACTICE

The dramatic situation of built heritage threatened and damaged by terrorist attacks recalls the aftermath of the Second World War, when one of the answers to the conflict has been the reconstruction. The strong sense of identity and attachment to the own culture, traditions and places led people to rebuild, to bring back to life significant monuments razed to the ground, often ending in the so-called reconstruction “where it was, as it was”. This meant operating resorting to style rules and mimetic criteria entirely outdated, at least on a theoretical level [Sette 2001, 165-74].

In the first half of XX century the international debate on conservation had found theoretical reference in the well-established dictates of scientific restoration, summarized in the Athens Charter for the restoration of historic monuments (1931). However, criteria like minimum intervention hardly applied in front of building partially devastated or completely destroyed. These episodes are examples of what Roberto Pane called “istanza psicologica” (psychological request): the wounded sensibility of people prevailed and guided the choices on how to deal with the destruction [Pane 1959, 102-04]. Some of the outcomes of this phenomenon have been the reconstruction of Santa Trinita Bridge in Florence, Italy (1952-58), Castelvecchio Bridge (also called Scaliger Bridge) in Verona, Italy (1945-51), a whole part of Warsaw’s historic center, Poland (1945-mid 1960s) and Dresden Frauenkirche, Germany (1994-2005). All these monuments have been rebuilt repeating the ancient forms and their appearance today is the same as the original one (Figs. 3-4).

Among the effects of the Second World War, the awareness of the severe damages suffered by cultural heritage during the armed conflict and the consequent necessity of taking protective measures led to The Hague Convention for the protection of cultural property in the event of armed conflict signed at The Hague, Netherlands, on May 14th, 1954.

Since then, the progressive evolution of theoretical discipline moved forward on just from the post-war debate and from the issues arisen during the reconstruction, leading to the vision known as Critical Restoration [Carbonara 1997, 285-301].

Its principles are summarized in the Venice international charter for the conservation and restoration of monuments and sites, drawn up in Venice in 1964, and in the Italian restoration chart, emanated by the Italian Ministry of Education in 1972. These two documents constituted the basis for the development and maturation of the current scientific debate.

Besides, in the conservation field, a disconnection between theoretical progress and operative practice has been observed most of the time. Just the aftermath of the Second World War has been the proof of that, in many cases turning back to the early nineteenth-century stylistic criteria, as already explained. The situations of urgency and damage due to force majeure, like wars, earthquakes, fires, didn’t always see the conservation principles internationally shared applied. Analyzing examples also referred to the recent past, the value of identity that people recognize in the lost monument raises the willingness of erasing the dramatic event, bringing back the artifact to the previous situation.

---

Fig. 3. a) The destruction of Santa Trinita Bridge in Florence, Italy, then rebuilt “where it was, as it was” (photo from http://www.intoscana.it, February 13th, 2018); b) The remains of Castelvecchio Bridge or Scaliger Bridge in Verona, Italy, before its reconstruction.⁹

Fig. 4. a) The Dresden Frauenkirche, Germany, in a painting from XVIII century (B. Bellotto, Dresden Market with the Frauenkirche, 1749-51); b) Warsaw’s historic center, Poland, before its reconstruction (picture from Baldini 1978-81, vol. II, 107).

Fig. 5. a) A fake photography by A. De Paoli showing the collapse of San Marco Bell Tower in Venice, Italy, on July 14th, 1902; b) The interior of La Fenice Theatre in Venice, Italy, then burnt by an arson (Stabilimento Fratelli Treves postcard).

Fig. 6. a) Sant’Andrea Apostolo Cathedral in Venzone, Italy, rebuilt after an earthquake, according to an exceeded concept of anastylosis\textsuperscript{10}; b) San Nicolò Cathedral in Noto, Italy, devastated by a seismic event too\textsuperscript{11}.

Some of the many cases\textsuperscript{12} are: the reconstruction of San Marco Bell Tower in Venice, collapsed for structural reasons (1903-12); the rebuilding of Sant’Andrea Apostolo Cathedral in Venzone, Friuli-Venezia Giulia, destroyed by an earthquake and reconstructed according to an exceeded concept of anastylosis (1988-95); the rebuilding of La Fenice Theatre in Venice, burnt by an arson (2001-03); the reconstruction of San Nicolò Cathedral in Noto, Sicily, likewise devastated by a seismic event (2000-07) (Figs. 5-6).

Significant is the example of the Stari Most, the Ottoman bridge of Mostar, Bosnia and Herzegovina, that crosses river Neretva connecting the two parts of the city (Fig. 7): it was destroyed in 1993 by Croatian military forces during the Croat-Bosniak War and rebuilt reproducing the ancient bridge in forms, materials and construction techniques under the auspices of UNESCO (1996-2004).

\textsuperscript{10} photo from https://www.archecartafvg.it/portfolio-articoli/venzone-ud-il-duomo/, February 13th, 2018.


\textsuperscript{12} The following examples are all referred to Italian monuments.
Fig. 7. The Ottoman bridge Stari Most, Bosnia and Herzegovina, crosses river Neretva again after its reconstruction supported by UNESCO (photo from www.bosnia.tlreporter.com, February 13th, 2018).

Fig. 8. a) One of the fourteen Timbuktu mud Shrines, Mali, reconstructed after the devastation accomplished by Islamic extremists; b) one of the Buddhas of Bamiyan, monumental statues of standing Buddha carved into the side of a cliff in the Bamiyan valley, Afghanistan, before and after the destruction (left photo UNESCO/A Lezine, 1963; right photo C. Montgomery 2008).

The international institution supported the choice of reconstruction also in the case of fourteen Timbuktu mud Shrines in Mali (2014-15), previously devastated by Islamic extremists. Fairly discussed has been also the destruction of the Buddhas of Bamiyan, Afghanistan, dynamited in March 2001 by the Taliban, whose possible reconstruction has been the object of a heated debate shared at international level. In this last situation UNESCO opposed the rebuilding (Fig. 8).

CONTRIBUTION OF TECHNOLOGICAL INNOVATION

At the same time, the continuous progress of scientific research and the consequent evolution of technology opened, also in the field of restoration, possibilities once unthinkable about information-gathering studies, cultural heritage survey and data elaboration in order to study, monitor, but also reproduce the artifact [Alvisi 2015, 61-86]. Especially three-dimensional rapid prototyping techniques allow, for the first time, the realization of copies morphologically identical to the original. This interesting goal is deeply affecting the present context of conservation, restoration, possible reintegration and even reconstruction of monuments highly damaged or completely wiped out by warlike and terrorist attacks. The replication of Palmyra’s Triumphant Arch (Fig. 9), made using 3D computer models based on photographs of the original arch and carving robots that re-created the finely arch with Egyptian marble\textsuperscript{14}, is only one of the most representative actions that exploit technological opportunities currently available. Some of these experiences have been supported by relevant institutions and influential personalities in the field of archeology and conservation. A recent example is the exhibition Rising from destruction. Ebla, Nimrud, Palmyra organized at Colosseum in Rome (2016) with the involvement of Paolo Matthiae and with the aim of raising awareness exposing full scale copies of some destroyed monuments of Nimrud, Palmyra and Ebla\textsuperscript{15} (Fig. 10).

![Fig. 9. The process of replication of Palmyra’s lost Triumphant Arch, Syria (left image Iconem, DGAM; top-right image from www.artstation.com, February 13th, 2018; small images from the left from www.telegraph.co.uk, February 13th, 2018 and www.torart.com, February 13th, 2018).](image)

\textsuperscript{14} See the note 4 of the present contribution for more details.

\textsuperscript{15} The exhibition, organized by the Italian association Incontro di civiltà, took place on October-December 2016, exposing the reconstructions of the Bel Temple ceiling in Palmyra, Syria, the Bull of Nimrud, Iraq, and the Hall of the State Archives in Ebla, Syria. See: http://www.incontrodiciviltà.it/ (February 13\textsuperscript{th}, 2018) and http://www.tryeco.com/ (February 13\textsuperscript{th}, 2018).
Fig. 10. a) Full-scale reproductions of the winged human-headed bull from Nimrud, Iraq, exposed is the exhibition Rising from destruction. Ebla, Nimrud, Palmyra at Colosseum, Rome, Italy (photo A. Solaro) b) 3D printing of half roof of the Bel Temple in Palmyra, Syria, exposed in the same occasion (photo G. Stabinger).

THE NECESSARY THEORETICAL APPROACH

Undoubtedly these experiences promote the debate about the possible reconstruction of what was destroyed and the restoration of what survived. International and worldwide institutions are already moving for the protection of cultural heritage considered endangered and for the implementation of intervention strategies in the event of damage already occurred\[16\].

About the reconstruction issue, is necessary assess whether the fact that the technology today enables us to rebuild from the ground up monuments even completely wrecked, resembling the original in a way previously inconceivable, is reason enough to give the green light to reconstruction? In other words, the technical capability scientifically reached, alone, can legitimize the recreation of artifacts completely disappeared? Firstly, the issue requires a theoretical and methodological approach [Alvisi et al. 2014, 116].

With reference to Cesare Brandi’s *Theory of restoration*\[18\] [Brandi 1963], still considered the basis for the current theoretical debate, this is the definition of restoration: «Restoration consists of the methodological moment in which the work of art is recognized in its physical being and in its dual aesthetic and historical nature, in view of its transmission to the future\[19\]» [Brandi 2005 edited by Basile, 48].

The sentence «the work of art is recognized in its physical being» means that, in order that the artifact with its historical and artistic values is perceived and then recognized as such, its physical being, the material of which it is

---


\[17\] The application of 3D laser scanning and 3D printing technologies to restoration field opens technical opportunities unthinkable before, like the possibility of rebuilding an identical copy of a destroyed monument.

\[18\] Here the English translation of *Teoria del restauro* edited by Giuseppe Basile (2005) is used as reference.

\[19\] The definition of restoration in the original language (Italian) is «il restauro costituisce il momento metodologico del riconoscimento dell’opera d’arte, nella sua consistenza fisica e nella sua duplice polarità estetica e storica, in vista della sua trasmissione al futuro» [Brandi 1963, 6].
made, is required. Brandi defines material as «epiphany of the image» [Brandi 2005 edited by Basile, 51]: it is responsible of communicating the work of art values. The material of the artifact has then the role of guaranteeing the authenticity, one of the essential principles of restoration.

The conservation of material is direct at perpetuating the work of art values over time. When the ancient material is missing, the recognition of the work of art like one it’s not possible anymore. If the lack of material is limited to part of the monument (lacuna), the potential oneness «that refers to the whole and not the unity that is reached by the sum of its parts» [Brandi 2005 edited by Basile, 55] can still be developed by the intervention because «it will continue to exist as a potential whole in each of its fragments» [Brandi 2005 edited by Basile, 57], even if the work is physically fragmented.

In the re-establishment of the potential oneness, the «treatment should be limited to the evidence of the original that is implicit within the fragments themselves» [Brandi 2005 edited by Basile, 57] in order to avoid the creation of «an historical fake or an aesthetic outrage» [Brandi 2005 edited by Basile, 57] through the modulation of the dual cases, historical and aesthetic. If so little material is left as to not allow recovery of the original oneness, the reintegration is not possible.

THE LICIT REINTEGRATION

An intervention that rebuilds the destroyed monument or a part of it with materials, construction techniques and forms that imitate the original ones, without declaring itself as an “act of our time”, creates an historical fake because it harms the artifact authenticity and betrays its user which has no way to distinguish the ancient parts from the integrations.

Interesting solutions for declaring the intervention without affecting the expressive authenticity of the whole provide an appropriate use of diacritical marks and codes. These are elements aimed at recognizing integrations from the original text, like forms simplification promoted by the vision known as philological restoration [Sette 2001, 81-84], rigatino developed by Cesare Brandi [Brandi 1963, 74], chromatic abstraction and selection elaborated by Umberto Baldini [Baldini 1978-81, vol. 2, 6], but also the use of boundaries, diversified superficial treatments and different materials. If drawn up with coherence to the specific context, these expedients can lead to fair solutions, both in terms of historical honesty and of overall aesthetic perception (Fig. 11).

Fig. 11. Some examples of diacritical marks. First line from the left: lacuna treatment called “tinta neutra”, mosaic from the Memorial Church of Moses, Mount Nebo, Jordan (photo A. Alvisi); rigatino, fresco from Domus Pinar
Cerialis, Regio III, Insula 4, Pompeii, Italy (photo A. Alvisi); chromatic selection, Beato Angelico, Madonna in trono e Santi, detail, Museum of San Marco, Florence, Italy (picture from Baldini 1987-81, vol. I, 106); chromatic abstraction, Cimabue, Crocifisso, detail, Opera’s Museum, Florence, Italy (picture from Baldini 1987-81, vol. I, 99).

Second line from the left: forms simplification, Alte Pinakothek, Munich, Germany, main facade detail (photo F. Barone and M. Fontana); use of boundaries, Basilica of San Savino, Piacenza, Italy, apse detail (picture from Carbonara 1997-451); use of different material and texture, Solomon’s Tower, Visegrád, Hungary, detail of one of the facades (picture from Carbonara 1996-2011, vol. I, 27); surfaces chiseling, Pantheon, Rome, Italy, detail of masonry external face (photo A. Alvisi).

Some successful interventions that declare themselves like act of our time without compromising the expressive authenticity interested: Alte Pinakothek in Munich, Germany (1946-57); Solomon’s Tower in Visegrád, Hungary (1963-66); Crypta Balbi in Rome, Italy (1983-2003); Santa Cruz Church in Medina de Rioseco, Spain (1988-91); Portonaccio Temple of Apollo, Italy (1992); Piarist School of San Fernando, now Cultural Center of the Piarists in Lavapiés in Madrid, Spain (1996-2004); Neues Museum in Berlin, Germany (1997-99); San Filippo Neri Oratory in Bologna, Italy (1998-99); the Moorish Wall in Alto Albaicín, Spain (2000-2006); San Pietro Basilica in Ortigia, Italy (2008); Bagrati Cathedral in Kutaisi, Georgia (2011-12); the alternative Andrea Bruno’s proposal for the Mostar Bridge reconstruction (Fig. 12).

CONCLUSION

This contribution aims to highlight the importance of a historical-critical and methodological approach in undertaking a process of conservation, restoration and, in some cases, also reintegration. Far from preconceived and dogmatic stances, it is necessary to analyze the specific context and its issues on a case by case basis. The examples earlier mentioned mainly consist of architectures, buildings bound to be used, rather than archaeological sites, witnesses of past ages and subject to another kind of fruition. Carrying historical and artistic values, however, they should be recognized, as Brandi explained; therefore, methods of intervention need firstly a theoretical reflection, that only after materializes in technical-operative choices.
Fig. 12. Some example of successful interventions that declare themselves like act of our time without compromising the expressive authenticity of the work interested the following buildings. First line from the left: Alte Pinakothek, Munich, Germany (photo F. Barone, M. Fontana); Solomon's Tower, Visegrád, Hungary (photo from Carbonara 1997, 451); Portonaccio Temple of Apollo (photo from Carbonara 1996-2011, vol. IX, 32); San Filippo Neri Oratory, Bologna, Italy (photo from Cervellati 2009). Second line from the left: Moorish Wall, Alto Albaicín, Spain (photo V. del Amo); Neues Museum, Berlin, Germany (Vv. Aa. 2009, 61); the alternative Andrea Bruno’s proposal for the Mostar Bridge reconstruction (photo from Carbonara 1996-2011, vol. IX, 227); Santa Cruz Church, Medina de Rioseco, Spain (photo from www.linazasoro-arquitecto.com, February 13th, 2018). Third line from the left: Crypta Balbi, Rome, Italy (photo from Carbonara 1996-2011, vol. IX, 255); Piarist School of San Fernando, now Cultural Center of the Piarists in Lavapiés, Madrid, Spain (photo from www.linazasorosanchez.com, February 13th, 2018); San Pietro Basilica, Ortigia, Italy (photo L. Rubino); Bagrati Cathedral, Kutaisi, Georgia (photo from Bruno 2013, 90).

This is the right step in which the constantly evolving scientific contribution could find appropriate application, serving a choice primarily theoretical. The technology indeed is only one of the tools of possible use to pursue an objective previously defined.

As the Second World War demonstrated, is not possible to overlook the sense of identity, collective memory and attachment that hurt people often show towards destroyed monuments. At the same time, is necessary the awareness of cultural differences between Eastern and Western world about, for example, the flow of time, linear and continuous for the first, cyclic and repetitive for the latter. These visions deeply influence the concept of authenticity, in one case identified with the material (as illustrated) and, in the other, with a symbolic and spiritual dimension [Carbonara 1997, 6]. This explained the ritual reconstruction repeated across the centuries of Japanese Shinto Temples [Bevan 2017].

A significant example of an innovative use of digital technology is the already mentioned case of the Buddhas of Bamiyan: the evocative value that the empty niches arouse20 is enhanced by the reconfiguration of the lost statues through light projections [Delman 2015]21, generating a “virtual restoration” which doesn’t operate directly on the artifact physical material (Fig. 13).

Even a hypothetical replica of a loss artifact, if resulting from an appropriate theoretical consideration, could be correct as copy, as long as it declares itself, without replacing the original artifact but proposing itself as an evocative tool aimed at keeping the monument memory alive, encouraging the debate and raising awareness on a such actual and difficult issue.

Fig. 13. The reconfiguration of Buddha statues in Bamiyan Valley, Afghanistan, through holograms (photo Xinhua/REX Shutterstock, from www.dailymail.co.uk, February 13th, 2018).

---

20 Already highlighted by arch. Andrea Bruno.
21 This is only one of the many articles about the topic.
REFERENCES


Pier Luigi Cervellati. 2009. Auditorium San Filippo Neri. Un intervento di recupero e di reinterpretazione del patrimonio storico, presentation at the conference *Costruite in sicurezza con il legno su terreni sensibili*, Perugia.


Imprint:


ISBN 978-3-200-06160-6

Editor/Publisher: Museen der Stadt Wien – Stadtarchäologie

Editorial Team: Wolfgang Börner, Susanne Uhlirz

The editor’s office is not responsible for the linguistic correctness of the manuscripts.

Authors are responsible for the contents and copyrights of the illustrations/photographs.