THE ARCHITECTURE OF GIOVANNI MUZIO: CHOOSING, CUTTING AND WORKING OF STONE MATERIALS.

NATURAL CATASTROPHES AND WAR DAMAGE IN TIVOLI. CHANGES TO THE CITY AND PROPOSALS FOR ENHANCEMENT.

A Petrographic Study of Ancient Mortars: An Indispensable Tool for the Correct Interpretation of Archaemetric Data.

THE FORMER JESUIT COLLEGE OF AMANTEA. Analysis About the Overloading on the Masonry

RECONSTRUCTION OF VILLINO FLORIO’S WOODEN CEILING USING 3D TECHNOLOGIES
The new series of Arkos, the scientific journal specialized in architectural restoration and published for over twenty years, continues to provide a constant update on the conservation of Cultural Heritage to the subscribers and readers.

ARKOS is intended primarily to architects, engineers, technicians, construction companies, specialized in recovery and restoration, Superintendents to artistic and architectural heritage, managers of technical offices and of public works, public institutions, research and testing institutions, laboratories diagnostics, university students and student of professional courses.

Arkos is available in english and italian version.

How to purchase:
- digital version available for Apple and Android.
- on paper with "Print on demand" service.
- digital version available for PC and Mac

For more information visit our site www.syremont.it

All articles published - except the Flash section - are subjected to review by the senior management and the Scientific Committee of the magazine.

The editorial guidelines for authors can be downloaded from www.syremont.it

Other texts and materials proposed for review or information may be sent to headquarters in Rome

Editorial Director
Elena Giangiulio

Vice Editorial Director
Nicoletta Astuti

Graphic Design
Arsmind
info@arsmind.com
arsmind.planet@gmail.com

Print
Arti Grafiche Favia S.r.l.  
S.P. 231 Km 1.300 - 70026 Modugno (Ba)  
www.artgrafichefavia.com  
Tel. 080/535 5219 - Fax 080/535 8614  
C.F./P.I. 06392350721 - R.E.A. Bari 482861  
isbn. 978-88-8393-130-7  
Cosenza court authorization n. 848 12/11/2008  
advertising does not exceed 45%
Summary

Editorial

Emergency - Prevention.
by Claudio Montagni

Restoration

The architecture of Giovanni Muzio: choosing, cutting and working of stone materials.
by Roberto Bugini, Luisa Folli

Research

Natural catastrophes and war damage in Tivoli. Changes to the city and proposals for enhancement.
by Gabriele Ajò

A petrographic study of ancient mortars: an indispensable tool for the correct interpretation of archaeometric data.
by Domenico Miriello

The former Jesuit college of Amantea. Analysis about the overloading on the masonry.
by Renato Olivito and Alessandro Tedesco

Valorisation

Reconstruction of Villino Florio’s wooden ceiling using 3D technologies.
by Francesco Gabellone and Ivan Ferrari
Reconstruction of Villino Florio’s wooden ceiling using 3D technologies

by Francesco Gabellone and Ivan Ferrari

ABSTRACT

This experience is set within the broader context of the restoration of Villino Florio in Palermo, which was partially destroyed by fire in 1962. Built at the order of the wealthy Florio family by the architect Ernesto Basile and constructed between 1899 and 1902, it is one of Italy’s first architectural works in Art Nouveau, and is considered a masterwork of that style on the European level as well. Conducted by the Palermo Superintendency, the restoration also affected the monumental staircase, with the complex floral motif (“ramage”) decorating its ceiling. The lack of design references regarding the ramage section, of which only black-and-white documentation exists, necessitated studying the problem of its reconstruction in greater depth, following new and advanced scientific methods. Developed by Lecce’s CNR IBAM ITLab, the 3D model of the ramage is the information base needed for the subsequent realization of the actual object, done with the aid of numerical control machines on oak modules, assembled and finished just as they appeared in contemporary photographs. The numerical approach allowed the entire working process to be controlled, and adequate structural reinforcement works, capable of supporting the ceiling’s considerable weight, to be prepared.

Methodological problems of scientific transparency in 3D reconstruction project

Digital restoration or reconstructive archaeology projects always have a certain level of uncertainty, because one of the objectives of this discipline is precisely that of “proposing” plausible solutions. No reconstructive study would be reconstructive at all if all the original construction and decorative details were known. It would no longer be reconstruction, but restitution. To obtain high scientific rigour in virtual archaeology projects, it is essential to gather the documentary bases and to transparently present the entire working process: objectives, methodology, reasoning, origins and characteristics of the research sources, results, and conclusions. A full transparency of methods, techniques, and documentation accompanying a virtual archaeology project is necessary for the purposes of defining quality standards raising the scientific value of a discipline that promises to inform, astound, and fascinate with ever greater effectiveness and rigour. The analysis methods, surveying techniques, and interpretations must all be declared, comprehensible, and reusable. Only analysis of the preliminary data will be able to validate the outcomes of a reconstructive study and guarantee for new generations a revision of the results without necessarily having to start the work again from the beginning. In this study process, the contribution made by 3D modelling software is not confined to merely generating and manipulating polygons in space, but is highlighted in its ability to ease the interpretative processes. Many reflections on the balance of proportions, on the juxtaposition of volumes, on the application of the laws of statics, would certainly not be possible with the short time frames imposed by many projects, nor would it be a simple matter to deal with these problems on a vast scale using traditional drafting.
methods. It is therefore essential to recognize the considerable contribution that 3D modelling software makes to the study and reconstruction of ancient monuments. The greater three-dimensional awareness of the architectural body that the modelling environment provides makes it possible to more deeply analyze and efficiently monitor the various reconstruction phases, with considerably greater accuracy, productivity, and ability to respond to specific problems imposed by the observation and study of monuments in space. It would be wrong and reductive to confine 3D modelling to being one of the new representation instruments that simply replace the drafting table or pencil. The specialist’s role in virtual archaeology is closely connected with the dialectical relationship between humanistic knowledge and the possibilities these instruments offer for 3D simulation and modelling. Only a continuous 3D verification of the aspects of technique and construction, dimension, and space makes it possible to validate certain hypotheses that come to life from the philological study of the sources, from the archaeological data, and from contemporary comparisons. Many original results achieved by heterogeneous teams of humanists and specialists in virtual archaeology
**Figure 2**
Villino Florio, Architectural Detail of Exterior

**Figure 3**
The Main Staircase Before The Ramage Reconstruction
FIGURE 4 and 5
3D MODEL OF WOODEN CEILING.
were made possible thanks to this moment of verification and study of the monuments in a 3D environment, because only a minimum part of the reconstruction hypotheses is plausible and compatible with the functional logic and the constructive and stylistic principles in use by a given civilization in a precise historical period. In an overall setting dominated by the general need to have to establish quality standards and methods for the transparent reading of analytical and interpretative data, there is, however, a critical aspect that merits further discussion. As mentioned earlier, virtual reconstruction relies on the combined contribution of the results emerging from various disciplines, but what attitude is to be maintained in the presence of missing archaeological data? We often find ourselves dealing with sites that provide only fragmentary and patchy information that, although extremely important and precious on the scientific level, is often not enough to formulate realistic reconstruction hypotheses. To be sure, reconstruction must always grapple on various levels with missing data, because the rarest circumstance is precisely the one in which the available data are abundant and sufficient for defining with certainty a scientifically unassailable and unambiguous proposal. That said, there is no denying the charm of attempting to “imagine” possible solutions of use for nourishing a constructive debate on what buildings looked like in the past. The reconstructive study thus proceeds without sacrifices, pooling many data that although apparently negligible, are indispensable when there are so few in number. The analysis continuously weighs them on the technological and functional level, making an effort to find a plausible reason for their existence. Doubtlessly, however, given the communicative force and the plausibility of the computer-generated images, the effort to be made in proposing reconstructive solutions is perhaps more difficult than what took place in the past. Rendering represents reality as it has never been represented before today, and this is actually its real weakness. Indeed, the representation of a 3D model must resolve every detail realistically, also in this term’s connotation associated with the possible and plausible – that is, with something that can indeed exist. To the contrary, line drawing provides only information on shape, solely outlining the objects’ contours, or at most some shading. These elements may leave room for the interpretative imagination of those observing them, and take on connotations that differ from one another. Virtual reconstruction, then, with its ability to present photorealistic ancient settings, becomes “too pretty,” perhaps because it ventures beyond the possible, beyond those responses that scientific rigour requires us not to formulate. In truth, what is represented is reliable based on a percentage, and therefore, although the reconstruction of the structural apparatus might be plausible, the solution adopted for the facing and finishing might not be. Every proposed reconstruction should thus be accompanied by a “correspondence model” – a graph showing the reconstruction’s reliability percentage. This would make the representation honest, help remove misunderstandings, and above all allow scholars to refine their research on those elements that are still unclear. FG

The philological reconstruction of the ceiling

Everyone knows the importance of the loss of treasures belonging to Italy’s historic and artistic heritage. This can of course take place for reasons connected with natural wear and tear, to damage caused by natural events, or forms of damage resulting from voluntary or involuntary actions caused by people. The more the loss of these treasures of human activity is connected with unique and non-replicable forms of expression – because they were created by the hand of an artist, or because they are linked to historical events, or because they themselves constitute non-replicable historical testimony – the more serious it is. These considerations give rise to awareness that, at least theoretically, it is impossible to be able to reconstruct what was destroyed. To close discussion of the matter, one need merely cite respect for history and aesthetics, a cornerstone of modern restoration. However, the need, felt more than ever in the post-War period, arises to philologically reconstruct those works that were only partially destroyed, or those that have a significance that goes beyond the material shaped by the artist, and are placed in the groove of an emotional, cultural, and psychological bond. In years past, many reconstructions were done precisely in response to this demand: the campanile in Venice, the Santa Trinità bridge, the Bari’s Teatro Petruzzelli, to cite just a few experiences. And yet, the work we are presenting in these pages arises precisely from a very simple assumption, resulting from these premises: is it possible to reconstruct a definitively destroyed architectural or decorative element of which documents are conserved that describe its details, shape, and materials? An important limit in the past was the availability of technologies, materials, and workers capable of replicating this object down to the minutest details – technologies that could
**FIGURE 6**
3D MODEL OF WOODEN CEILING AFTER TEXTURING PROCESS

**FIGURE 7**
ON THE LEFT: THE FINAL RECONSTRUCTION OF THE RAMAGE ON THE RIGHT: ORIGINALE IMAGE BEFORE THE DESTRUCTION FIRE
THE FINALE RECONSTRUCTION OF THE RAMAGE WITHIN VILLINO FLORIO
guarantee a philological reconstruction both on the formal level, which is to say linked to the pure exterior appearance, and in terms of material and finishings.

This case study refers to a reconstructive experience arising from the attempt to respond to these needs, but in order to recreate elements originally built by artisans using modern-day instruments and technologies, using non-traditional methods but assisted by numerical control. This experience is set within the broader context of the restoration of Villino Florio in Palermo, which was partially destroyed by fire in 1962. Built at the order of the wealthy Florio family by the architect Ernesto Basile and constructed between 1899 and 1902, it is one of Italy’s first architectural works in Art Nouveau, and is considered a masterwork of that style on the European level as well. It was a period when creative ingenuity could be tangibly transformed into a manifestation at a high level of craftsmanship, thanks to the experience of the artisan workshops where expert wood carvers transferred age-old know-how into unique works, extremely rich in decorative terms and well conceived, also with respect to their structural complexity. Conducted by the Palermo Superintendency to restore life and form to fabrics, wood, and metal, the restoration also affected the monumental staircase, with the complex floral motif ("ramage") decorating its ceiling. The 3D model of the ramage is the information base needed for the subsequent realization of the actual object, done in 2016 with the aid of numerical control machines on oak modules, assembled and finished just as they appeared in contemporary photographs. The numerical approach allowed the entire working process to be controlled, and adequate structural reinforcement works, capable of supporting the ceiling’s considerable weight, to be prepared. FG

One of the most obvious problems in the ramage reconstruction design was certainly the difficulty of finding, in our present time, woodworking experts capable of replicating the techniques from the beginning of the last century, who could make the entire reconstruction project sustainable. In this case, the experience, manual skill, and concept of space of the operator in the 3D environment replace that of the workshop master, with the great advantage of being able to try out and adopt those methodological solutions in IT that are held to be best suited for the purpose, thereby in the end obtaining a three-dimensional model fully ready at any time for modifications of any extent, and from which a countless number of copies may be produced. In specifically dealing with the description of the production pipeline, the first and essential step was to carefully view the archival documentation available today, and to reconnoitre the building in situ: it was thus crucial to obtain for ourselves the metrics data of the environment where the wood ramage will was to be put back in place. The need to build a 3D model as faithful as possible to the original clashed with the scarce documentation available, which consisted only of two contemporary black-and-white photographs and a site plan drawn to scale. It was thus essential to assess what type of modelling could resolve the problems connected with the particular and complex shape of the element in question, along with the need to supply a three-dimensional document with a balanced polygon/bit ratio, capable on the one hand of being easily managed and reproduced by CNC machines, and on the other of guaranteeing a final product, in 1:1 scale, with the right level of detail. The subdivision surfaces technique was the modelling technique that best lent itself to this purpose. The first element of the ramage to be done was the central branch, which, with no variation in section except for the terminal portions, curved from one side of the ceiling to the other. It was thus necessary to analyze the planimetric material along with the photographic material, bringing to the digital version of the latter appropriate modifications in the image’s brightness and contrast, so as to better enhance the profile. Verified in its shape, the section of branch was then vectorized, finalizing it for the creation of NURBS surfaces: these, in fact, are particularly suited in organic modelling, since they are extremely effective in the creation of irregularly shaped curved surfaces. Using these NURBS made it possible to outline the curve of the entire branch with barely four portions, leaving practically unaltered the possibility for its additional and subsequent modifications simply by shifting the splines. The side branches were

From digital reconstruction to the actual mode

The lack of design references regarding the ramage section, of which only black-and-white documentation exists, necessitated studying the problem of its reconstruction in greater depth, following new and advanced scientific methods. Thus, thanks to the specialist contribution of Laboratorio di Informatica Applicata (Applied IT Laboratory) of Istituto per i Beni Archeologici e Monumentali (IBAM ITlab) of Lecce’s CNR, it was possible to reconstruct, in three dimensions, the ceiling’s complex morphology, starting only from the available photographic documentation.
then studied, in particular those charged with supporting the drop ceiling's light points. In the middle portion, their section is regular but deviates from that of the central branch which, as the it spirals off to the sides, gradually reduces. Further special characteristics are found both at the extremities, the start and the end, that appear enveloped onto themselves with a profile that tends to become irregular, and in the branching typical of an Art Nouveau decoration; in this regard, the choice was made to make the various side elements as objects independent of the central branch, deciding to connect them together only during the final phase of the modelling work. Starting in this case as well from the section, the profile was extruded and the NURBSs were used to better reproduce the various spirals: the subdivision surfaces technique applied to the extremity and in the branching points was essential to guarantee a good final result. Of the difficulties found most frequently, mention should certainly be made of that connected with the large number of polygons of which the final model, due to its complex shape, was formed: this partially compromised the file’s very manageability: in fact, as long as it was composed of distinct levels – one for each modelled branch – it lent itself to additional modifications, something difficult to do after all the side branches were connected to the central one. This obstacle was overcome by proceeding with a complete remesh of the model, which led to eliminating all the redundant polygons and to the fusion of others. The polygonal “optimization” phase thus ensured a good ratio between model quality and heaviness in terms of its bits, so as to fully resolve the problems connected with manageability.

However, for a proper aesthetic and stylistic analysis of the final result, the element in its original setting was placed back into the virtual. The setting was thus reproduced in three dimensions and in scale, and the entire remaining decorative wood apparatus, consisting mostly of elements with a uniform

◆ FIGURE 9
AN ASSEMBLY STEP
profile, was modelled. Lofting was used to
develop the moulded frame running around the
ceiling’s perimeter, the slats passing in parallel
on the side, and, perpendicularly to them, the
moulded dividers: a modelling technique that,
starting from splines extruded along a path,
offers both great precision and minimum file
heaviness, while leaving unaltered the possibility
of new and additional modifications both in the
profile and in the trajectory of extrusion. An
essential phase that preceded the calculation
of synthesis images was that of texturing: in
fact, the simulation of the visual impact of the
ramage, complete with its original material
placed back in the ceiling, is fundamental. The
need to adapt the timber’s veining to the model’s
curved surfaces thus led to the adoption of a
UVW mapping, unlike the remaining elements
of the drop ceiling, where a simple cubic
mapping was sufficient. In the model’s mapping,
use was made not of procedural textures, but
of raster images appropriately processed by
image editing programs, in order both to avoid
pattern defects and to guarantee optimization of
the chromatic aspect. The calculation of images
with rendering engines capable of simulating
a photorealistic illumination of the environment
made it possible to obtain an initial, immediate
visual comparison between the period images
taken as a reference and the model produced
in the phase immediately prior to its realization
in real scale, fundamental for ascertaining
whether or not there were any plastic deviations
in the polygonal mesh with the lost original,
and thus to assess the corrective intervention,
even minimal, in the portions deemed critical.
The export of the model with an extension
suitable for the transmission of the numerical
data to CNC machines contributed towards its
ex novo development and to its return to its
original placement. A work of this importance
and difficulty, both for the monument for which
it was designed and for the very nature of the
article in question, is energetically ready for
considerations on what skilled IT operators, also
definable as “digital craftspeople,” might do in
equipped “IT workshops,” in settings similar to
that of Villino Florio. The clearest advantages
in this sense are the considerable savings of
time, and significantly reduced development
expenses, which certainly do not compromise
the quality and the final performance in the
process leading to the philological reconstruction
of the individual articles. IF

Acknowledgements

We extend our sincere thanks to Mariù Miranda
of the Region of Sicily, who with so much
professionalism followed and encouraged the
development of the work presented on these
pages, and to Roberto Scopigno (CNR ISTI) for
the trust shown in us.

BIBLIOGRAPHY

• A. SPEZIALI, Italian Liberty. Una nuova stagione dell’Arte Nouveau, Cartacanta, 2015
• E. Sessa, Ernesto Basile: dall’eclettismo classicista al modernismo, Novecento, 2002
• F. Pirrone, E. Mauro, E. Stessa, Palermo, una capitale: dal Settecento al Liberty, Electa, 1989
• E. MAURO, Il Villino Florio di Ernesto Basile, Graft, 2000
• F. GABELLONE, Ancient contexts and Virtual Reality: From reconstructive study to the construction of knowledge
• F. GABELLONE, Digital technologies and communication: prospects and expectations, Open Archaeology. Volume
1, Issue 1, ISSN (Online) 2300-6560, DOI: 10.1515/opar-2015-0005, April 2015
• F. GABELLONE, La trasparenza scientifica in archeologia virtuale. Una lettura critica al Principio N.7 della Carta di
Siviglia, CASPUR CIBER Publishing SCIRE-S-IT, SCientific REsearch and Information Technology, (2012), ISSN 2239-4303,
DOI Code: 10.2423/i22394303v2n2p99

AUTHOR PROFILE

Francesco Gabellone
Architect, researcher at IBAM-CNR (office of Lecce, Italy). He is founder and scientific responsible of the
ITLab laboratory of IBAM-CNR, in the framework of which he does research activity finalized to the knowledge,
valorization and enjoyment of the cultural heritage by means of virtual 3D technologies. He is professor in
Digital restoration at the Academy of Arts of Lecce.

Ivan Ferrari
Ph.D. in ancient topography, currently he is CTER at IBAM-CNR. He does research activities aimed to the
knowledge, valorization and enjoyment of the cultural heritage, with particular emphasis on technologies for
3D modelling, rendering and animation.