Digital reconstruction and analysis of the Nari's Monument in Florence.

A Bartolomeo Ammannati's Statue.

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Abstract: Around 1540, Bartolomeo Ammannati designed the tomb of Mario Nari that was placed in a side chapel of the church of SS. Annunziata, Florence.
Because of political reasons, the tomb was almost entirely destroyed in the 16th century. The only two sections that survived the demolition were the statue of Mario Nari and the statue representing an allegory of Victory.
In 1945, these two statues were housed in the National Museum of the Bargello, in Florence. In occasion of the celebrations of five centuries from the birth of Bartolomeo Ammannati, the two surviving statues became part of a virtual reconstruction aimed at investigating the original set up of the Nari's Monument.
3D digital survey and further photogrammetric survey have created the right documentation and model to start hypothesizing the original composition. The chapel, original location of the sepulchre, was also surveyed using 3D digital equipment, allowing us to verify a match between our reconstructed model and the original space in which it once stood. Digital 3D models developed within a CAD program were the perfect tools to test different hypothesis and to contrast the gathered information with archival documentation related to the original set up of the monumental tomb.
Our paper will summarize the protocols used to complete the survey and to develop our hypothesis as well as presenting the results so far achieved.

Keywords: 3D Laser Scanner, Florence, Bartolomeo Ammannati, Statue, Mario Nari's Monument, Sepulchre.

Introduction

Between 1540 and 1542, Bartolomeo Ammannati (architect and sculptor, 1511-1592) designed and sculpted the tomb of Mario Nari that was placed in a side chapel of the church of the SS. Annunziata in Florence.
The Monument was demolished in the 16th century and only two surviving sections remained intact: the statue of Mario Nari, personified as a laying warrior, and a statue representing an allegory of Victory dominating a fallen prisoner. After the Second World War, these two statues were housed in the National Museum of the Bargello, in Florence; in occasion of the celebrations of five centuries from the birth of Bartolomeo Ammannati, the two statues became part of a virtual reconstruction aimed at investigating the original set up of the Nari's Monument (PIRAZZOLI, 2011).
The paper shows the phases of survey and virtual reconstruction of the Mario Nari's sepulchral Monument, which follow three stages:

1. Analysis of the funeral architecture and sculpture and the Ammannati's work;
2. Survey of the statues, of the San Nicola chapel and of a portion of the church of the SS. Annunziata;
3. Reconstructions and models.

The history of the monument

Mario Nari was a Roman noble, died in 1539 in a duel against Francesco Musi in Florence (CHERUBINI, 2011). Despite the chronicles describe quite well the facts about the fight, the history of the monument commission remains foggy. Sources claim that Mario was probably close to the Ammannati's circle of friends, and that Montorsoli, Bartolomeo's master, played the role of mediator between the aristocratic family and the Servite Oder, and the family and the artist. We know that the sculptor was not famous at that time and was working at Sansovino's workshop between Urbino and Veneto. In 1540 the Nari family commissioned the monument to Ammannati and in 1542 they obtained the approval to build the funeral monument in the San Nicola chapel by the friars, the duke Cosimo I and the Palagio family (owner of the chapel). Notwithstanding his noble origin, common people, and later Cosimo I, did not accept that a man deceased in duel was buried in a religious space since it was considered immoral. Afterward, the monument was immediately covered and then, in 1565, dismantled and scattered (LOFFREDO, 2011). Until the beginning of the 19 the century no piece of information regarding the Mario's sculpture (demi-gisant) or the locus where it was placed was available. The first documentation refers to villa of Poggio Imperiale. Subsequently, it was moved to the Spedale degli Innocenti and reached the Bargello in 1865 (CISERI-STROZZI, 2011).

The Victory had different fate. After the demolition, it was transformed in the allegory of the faith and placed in the second cloister of the SS. Annunziata. It was probably at the beginning of 19th century, that it was cleaned and transferred to the Giardino dei Semplici, where it stayed until the end of the Second World War. After that date it was relocated to the courtyard of the Bargello.

Just in 1975, thanks to the new exhibition design of the Sala di Michelangelo made by the architect Carlo Cresti and the curator Luciano Berti, the two statues were sited together, but the Nari's setting up did not follow the Ammannati's pattern: they were placed on a big low basement and leant at the same level. Both statues suffered partials mutilations and deterioration due to the changing of collocations and meaning (when the Victory became faith it has been put a chalice in its right hand, destroying part of the marble), and traumas (both statues were damaged during the flood of 1966). They have been cleaned two times by the Opificio delle Pietre Dure of Florence before 1975 and restored in 1998.

In 2011, in occasion of the exhibition "L'acqua, la pietra, il fuoco - Bartolomeo Ammannati scultore", curated by Beatrice Paolozzi Strozzi and Dimitri Zikos and designed by Giacomo Pirazzoli, it started a new study on the monument that led up to a reasoned disposition (PIRAZZOLI, 2011).

The Monument is acknowledged by scholars as particular important due to two main reasons: (i) it was the first relevant work of Ammannati's career, and (ii) it is considered the figurative connection between the two schools that influenced the sculptor; the Bandinelli's teaching and the study of Michelangelo (DE TOLNAY, 1954) in the Florentine period on one side, and the reception of the Venetian manner, in particular the Sansovino's one, on the other (PIZZORUSSO, 2008). It has been written that with those statues

Ammannati demonstrates to be a mature artist: the figures have specificities (calm grace, simplicity and intensity) that will characterize his future sculptural activity

(LOFFREDO, 2011).

[Ammannati] *trasferitosi ad Urbino, diede principio a una sepoltura e lavorò molte istorie di stucco ma in questo tempo morendo il Duca, egli se ne tornò a Firenze e fece quella sepoltura di marmo, che doveva andare nella Nunziata, di Mario Nari, romano che combatté con Francesco Musi, in cui egli aveva fatto la Vittoria che aveva sotto un prigione, due fanciulli e la statua di Mario sopra la cassa; ma quest'opera (perchè fu stimata incerta da qual parte fosse la vittoria e perchè non fu l'Ammannato in ciò molto favorito dal Bandinello) non si scoperse altramente, e le statue furon trasportate in vari luoghi, et i due fanciulli di marmo sono oggi, rapresentando due agnoli, dinanzi all'altar maggiore nella chiesa de' Servi. Per questa cagione, rimanendo mal soddisfatto l'Ammannato, se ne andò a Vinegia* [Venezia]

(BORGHINI, 1954).

Artistic and Architectural References

We don't know which were the architectonical configuration of the chapel as well as the reciprocal position of the statues. Historical sources affirm that the Victory was arranged into a niche, the *demi-gisant* on a sarcophagus, and probably there were also two little angels that completed the Monument (DAVIS,1977; LOFFREDO, 2011).

In order to hypothesize the original setting of the shrine, considering that documenting sources about the Ammannati's project are not existing, we conducted the study in a comparative and deductive way. Through bibliographical sources and both direct and indirect analysis of the references, we established the iconographical, formal, stylistic, and compositional elements that constitute the Memorial.

We started investigating the theme of the funeral monuments and the book *Tomb sculpture,* written by Erwin Panofsky in 1964, represents our fundamental point and a theoretical base. Panofsky divides the burial culture in two categories: the *Magic* part, linked to the Egyptian and Christian cultures, and the *retrospective* (and *representative*) one, that differentiates the classical culture and the Renaissance. Despite Panofsky describes also a combination of the two types, the Ammannati's example is near to the second grouping. Besides, in order to understand the architecture and the sculpture of the case study, we considered the artist's education and studies: the training at Baccio Bandinelli, Sansovino and Montorsoli's atelier, the study of Michelangelo's work, and the classical influences.

Then, we took in account some specific references that are compatible with the possible setting of the Monument, such as:

- A detail of the gisant represented in a drawing of the *Second project of the Tomb of Giulio II by Michelangelo (1513)* by anonymous, stored in the Gabinetto Disegni e Stampe, Galleria degli Uffizi, Florence.
- The Sarcophagus of Larthia Seianti, 150-130 B.C., Museo Archeologico Nazionale, Florence
- A detail (central part) of the Tomb of Giulio II by Michelangelo in the Church of San Pietro in Vincoli in Rome.

- The *Finestra Inginocchiata* of Pitti Palace in Florence by Bartolomeo Ammannati (1550 -1570).
- Tombs of Antonio and Fabiano Del Monte hosted in the Church of San Pietro in Montorio in Rome by Bartolomeo Ammannati and Giorgio Vasari (1550).

Among the listed examples, the Cappella Del Monte represents the main compositional reference (Tombs of Antonio and Fabiano Del Monte). In order to make a comparison, as a first step we did the digital recording of the Tomb of Fabiano del Monte by image modelling (Photoshop) and the post-processing with Rhinoceros. Then the model of the Tombs has been scaled and proportionated on the base of the supposed sarcophagus of Mario Nari, and finally we studied the two cases together.
As matter of fact, we know that the two statues were placed on two different levels that the Victory was hosted in a niche, as well as the cited example, but none of the known sources explains which shape it would have had. Before the last survey of the chapel of San Nicola was completed, the thickness of the wall that hosted the Victory represented a further question mark; the acquisition of this data helped us to clarify other points, such as the position between the two statues, the total high of the monument and the relation among each part.

Survey Campaigns and 3D models

In order to complete the architectonical arrangement so as to follow the Ammannati's project, we did the survey of both statues and of the chapel.

The Sculptures

To accomplish an accurate survey of the statues in a short time, we used a series of different survey methodologies, linked to the reverse engineering. The 3D model, done with Agisoft Photoscan 1.0.4, was elaborated with the strategy of the structure for motion and then integrated with a precedent 3D laser scanner survey (2010), done in the occasion of the exhibition on Bartolomeo Ammannati scultore, that represented a first study on this theme (PIRAZZOLI, 2011).
In 2012 the photogrammetric campaign in the National Museum of Bargello was completed (Verdiani-Corsini); for this purpose it has been used a digital reflex high definition Olympus E500 8 megapixel SRL with a superwide angle 9-18mm Zuiko zoom, fixed on a stable tripod. Thanks to the use of the tripod, we constantly maintained the setting on ISO 100; the light low sensitivity sensor allowed us to obtain pure images with the least possible noise. We set the camera on total depth of field so to have all the elements in focus and readable, moreover the short focal length of the lenses permitted a close-up shooting and, to obtain the best pictures, we worked in diaphragm priority mode. Finally, we set the white balance according to the colour temperature of the Sala Michelangelo (between 2800k and 3200k). Because of the new setting up, in the last survey it was not possible to take pictures of the back of the statues. We proceeded with convergent shooting method, considering the marble group as it was inscribed in a box with three main planes.

The software

In order to determine which software returns the best 3D model, we tried both *Autodesk 123D Catch* and *Agisoft Photoscan 1.0.4*.

123D Catch, released by Autodesk, is a free app that allows creating 3D scans of virtually any object.

For the Mario Nari's sculpture, this software used 84 pictures and elaborated the mesh. We proceeded sharpening the mesh, saving in .obj format and importing the file in *Rhinoceros*.

For the Victory's sculpture, *Autodesk 123D Catch* did not aligned all the selected sculpture's images; therefore, to complete this part some references points have been necessary. Lastly, we finished the model ensuing the same procedure, as we did for Mario.

Agisoft Photoscan 1.0.4 is useful to generate high-resolution orthophotos and detailed Digital Elevation Model (DEM). Synthetically, the main phases were the following: pictures uploading, high precise alignment and mask picture, ultra-light build geometry, mesh elaboration, texture processing, model export (.obj and .tiff). To obtain good results, different parameters have been inserted in the elaboration of:

a. The two statues together, model1
b. The two statues together, model2
c. The Victory
d. Mario's legs

We achieved a good model with 40-50 pictures per each, and we noticed that, despite the long time of data processing, the ultra-light option does not assure a better model.

Although the result done by the two software is comparable, we exploited *Agisoft Photoscan 1.0.4* for the realization of the ultimate model. The final step was the integration of the data coming from the last campaign with those of the 3D laser scanner campaign of 2010, where the laser scanner 3D Cam2 Faro Photon 80 has been used.

The Chapel

The 3D laser scanner survey of the chapel of S. Nicola represented the second phase of the task.

We used a time-of-flight 3D laser scanner (*Riegl VZ-400*) with a digital camera reflex (*Nikon D700*) directly integrated with it. Then, in order to have the 2D and 3D results, we imported the elaborated point cloud (PTX file) into *Leica Cyclone software*.

The survey campaign was conducted in April 2013, during which eight scans have been effected: two in the nave, two inside the chapel, one on the doorstep close to our chapel and three outside, into the Chiostro dei Voti. Without targets, we realized the alignment between the scans through three common points, applying the proceeding to each scan. The result was the digital model of the object that we accomplished using *RiScan Pro* (Riegl). To extract the data suitable for Cad and modelling software, we utilized the software released by *Leica Geosystems*, hence we uploaded the point cloud in *Cyclone* with .ptx format and we used the reference plane method to extract plans and cross-sections.

Because of these scans, we reconstruct the geometry of the chapel and part of the church. As explained above, this survey was really essential for knowing the thick of the wall in which the monument was placed. The survey campaign showed that the wall hosting the Tomb measures one and half Braccia Fiorentine (87 centimetres). Therefore, presuming that the Ammannati's choices have been made taking into consideration

the thick of the wall, our reconstruction followed the Roman models where the thickness of the partitions were thicker than Florentine examples.

Final results: rendering, photo simulation and 3D print

Finally we arrived at the most probable configuration of the sepulchral.
We used the *Braccio Fiorentino*, to hypothesize the reference grid and then find the proportional relationship between the statues, between the statues and the niche and between the monument and the chapel. The *Braccio Fiorentino* (B.F.), equivalent to 58,36 centimetres, was the unit of measure of the half of the 16th century in Florence. For example, the evidence shows that the base of the Victory is inscribed in a semi-circular area of radius 1 B.F, confirming the hypothesis that the niche had a semi-circular plan and a basin-shaped at the top part.
Again, the survey was useful to define the most probable position of the Victory with respect to the wall: the wall thickness (1 and half B.F.) could host completing the statue (1 B.F.). Therefore, the Tomb Del Monte in San Pietro in Montorio in Rome represents the main reference model of this configuration.
From this achievement, we can deduct the distances and the position between the two statues, the shape and the measures of the niche, the dimension of the lower parts, and the dimension of the sarcophagus.
Pursuant to our hypothesis, the whole monument was high 9 and half B.F. That means that the highest part of the tympanum of the tomb and the cornice of the chapel were at the same high, and that the sarcophagus together with the Mario's statues, proportioned according to the whole dimension of the monument, were a third of it (3 B.F).
In order to give a full illustration of the research, the most complete one, the results are showed through 2D representations, renderings 3D, photo simulations and 3D print.
To realize the 3D print it has been necessary optimizing the mesh of the sculptures through the software *Geomagic,* so that to obtain solid exportable models necessary for the 3D print (.stp and .stl formats). The *watertight model* of a portion of the monument has been realized with *Rhinoceros,* and it has been used in part also to realize the rendering 3D. We elaborated a model done by six closed poly-surfaces, joint lately with the Boolean command in one single closed poly-surface. Lastly, The 3D model has been printed in ABS (Acrylonitrile butadiene styrene) with *printer Dimension 1200es Series* at CDR – engineer's society, Florence.

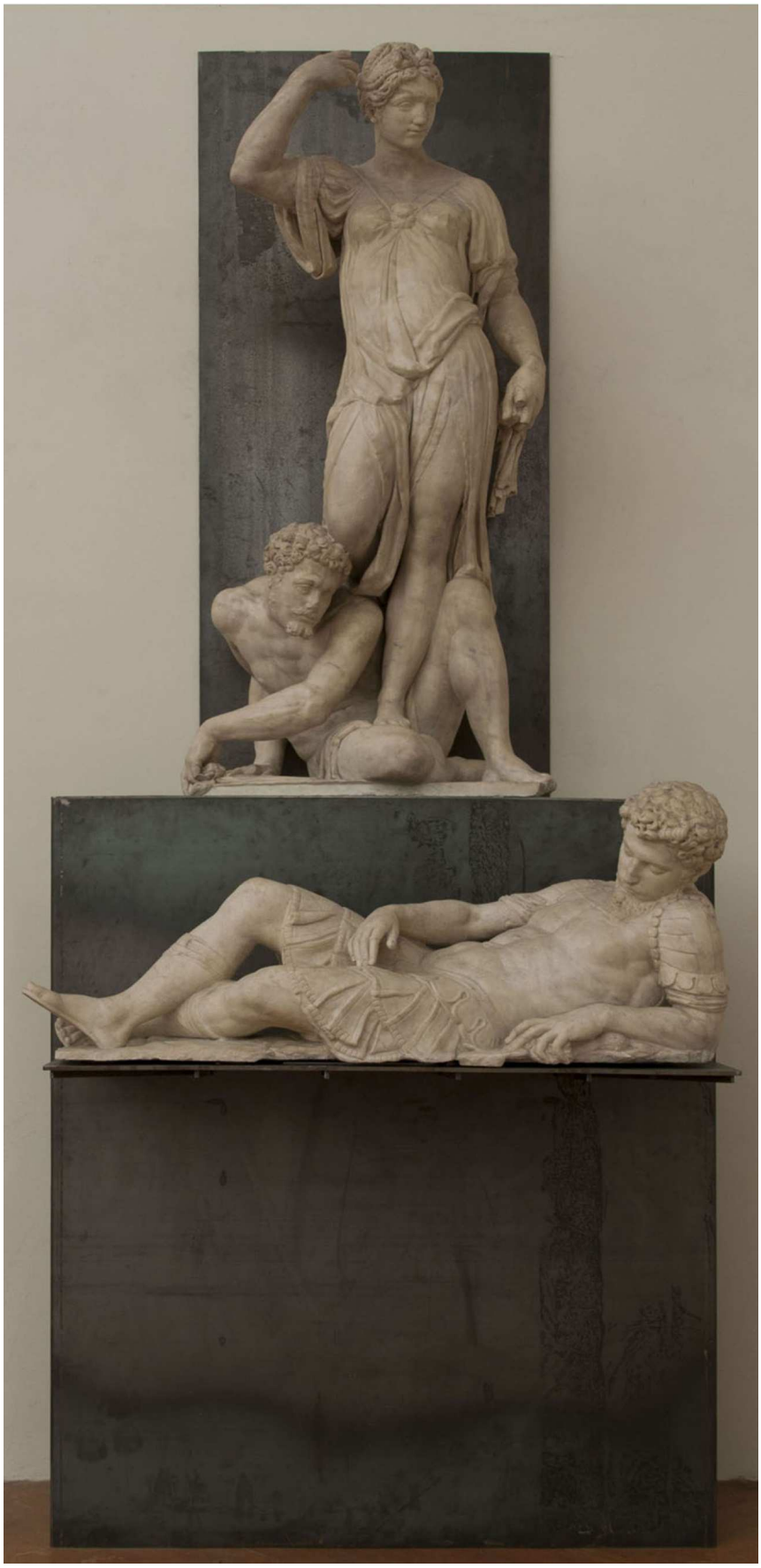

Fig. 1 – Mario Nari's Monument at the National Museum of Bargello, Florence (Exhibit design by G. Pirazzoli, 2011).

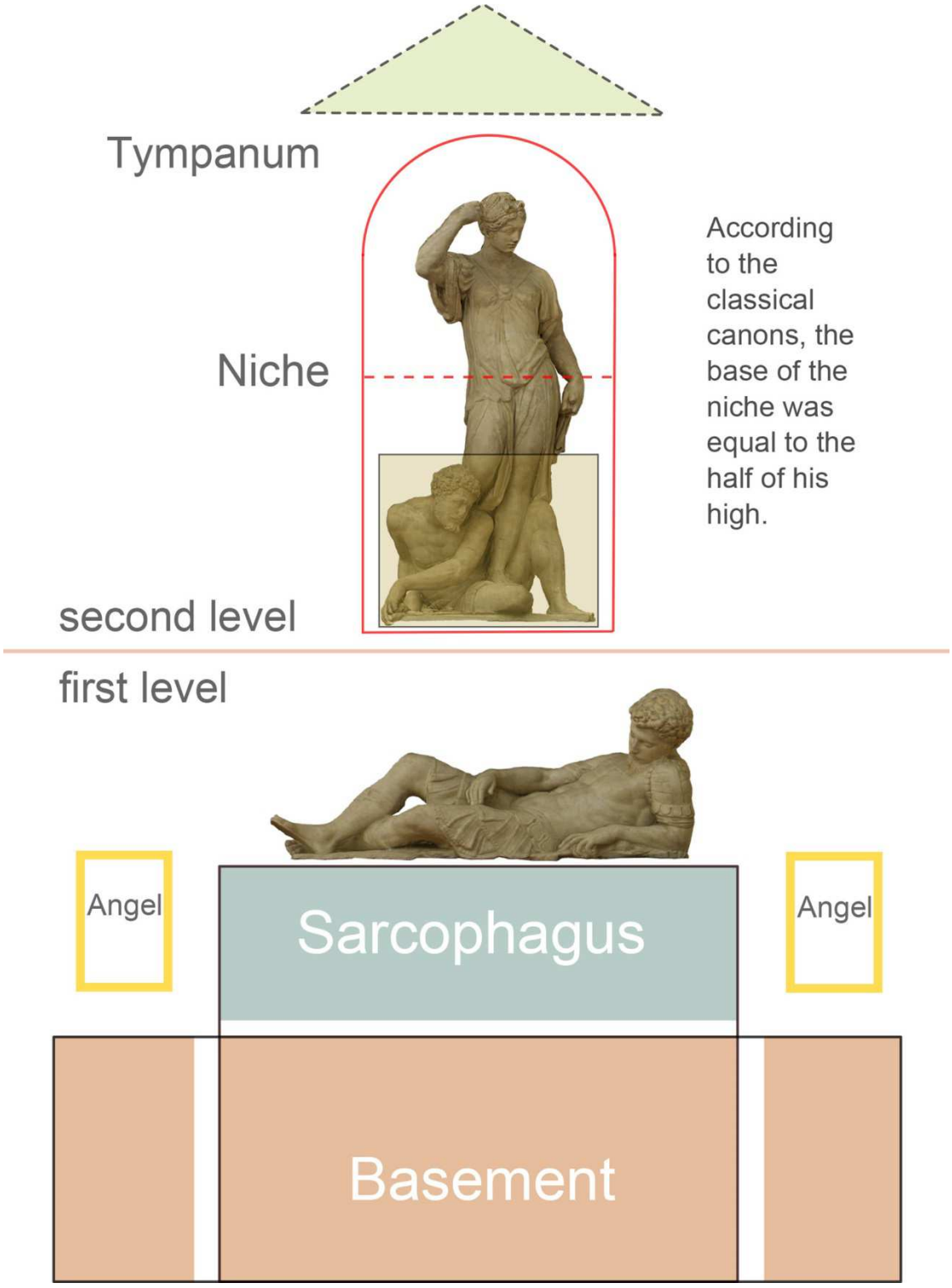

Fig. 2 – Hypothesis on the compositional scheme.

Fig. 3 – 3-B. Ammannati, G. Vasari, Chapel Del Monte (1550), San Pietro in Montorio, Roma.

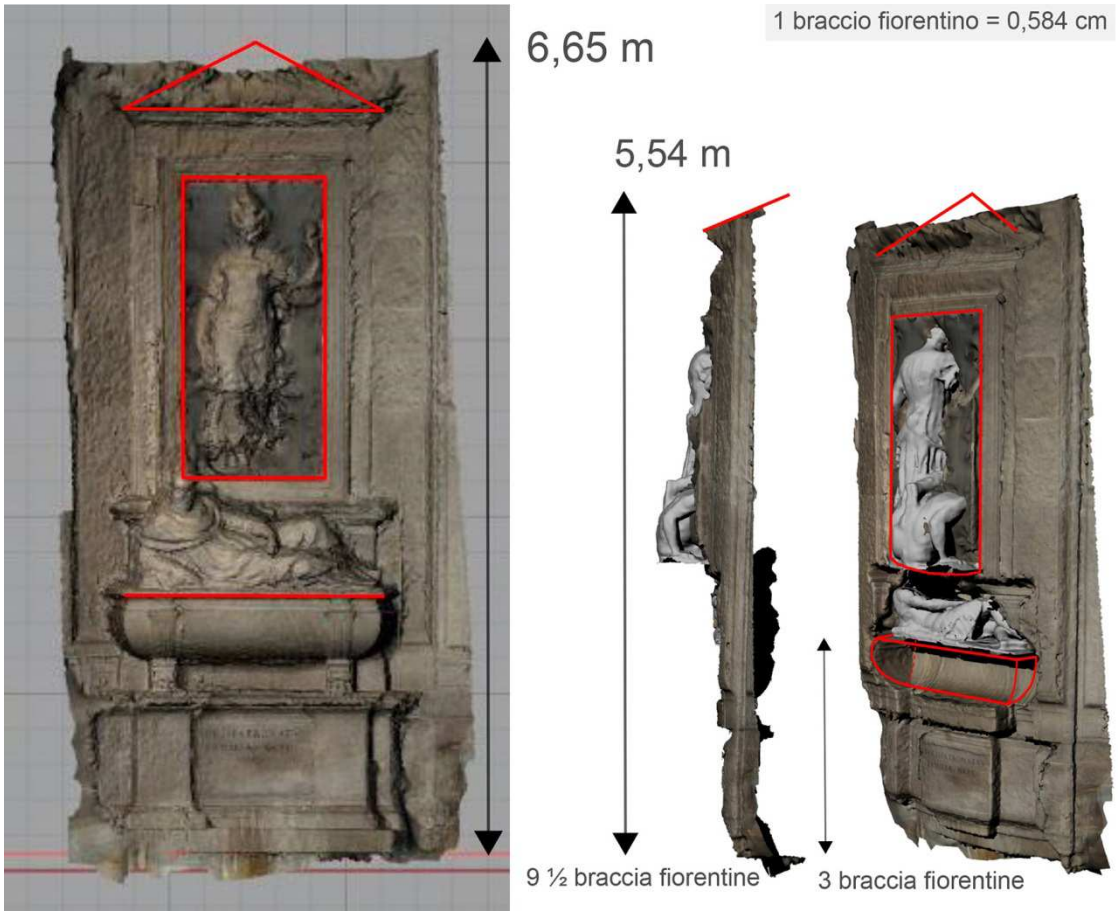

Fig. 4 – Digital recording of the Tomb of Fabiano del Monte by Image Modelling and post-processing with Rhinoceros

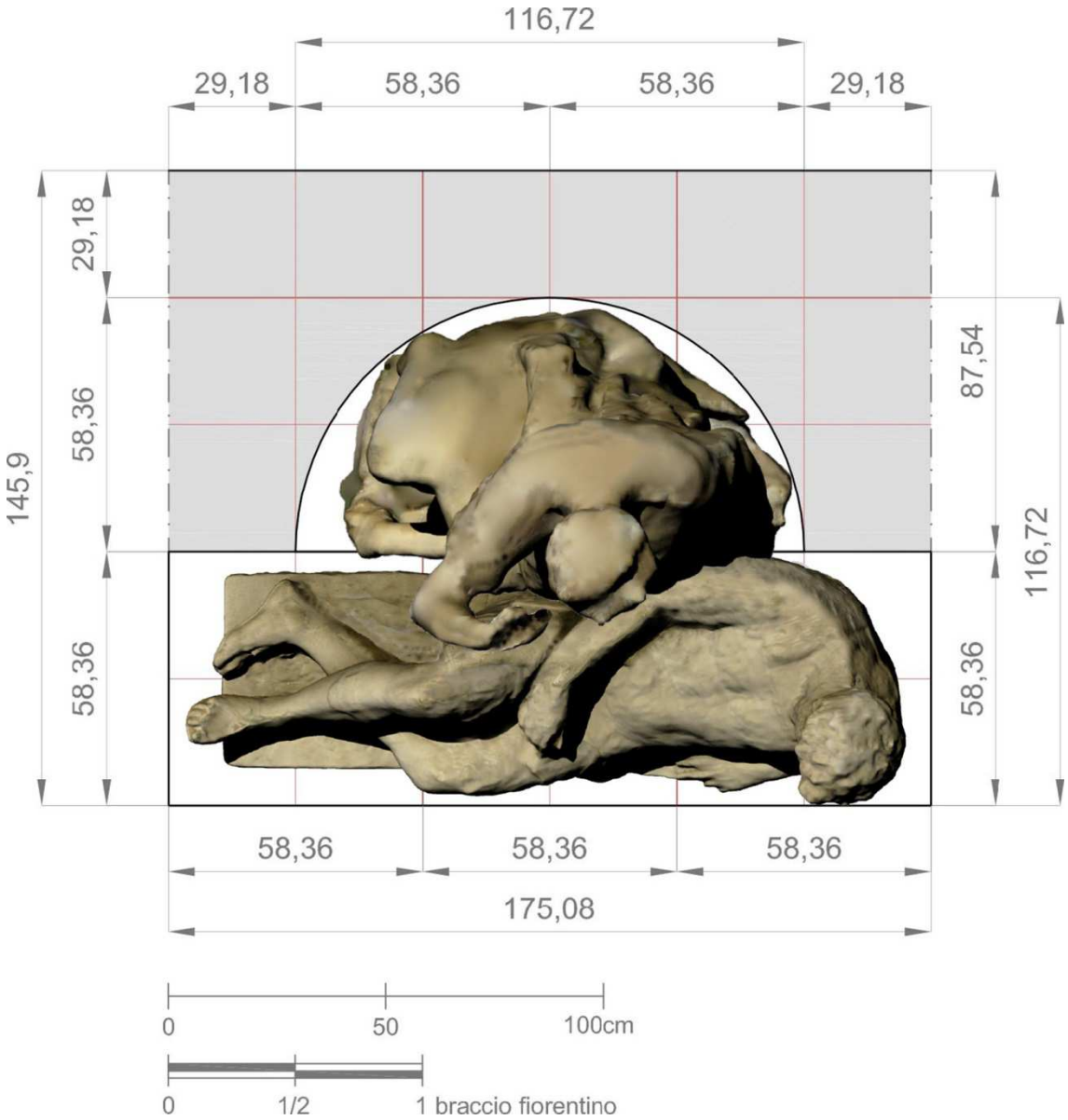

Fig. 5 – 2D restitution of the Monument, plan

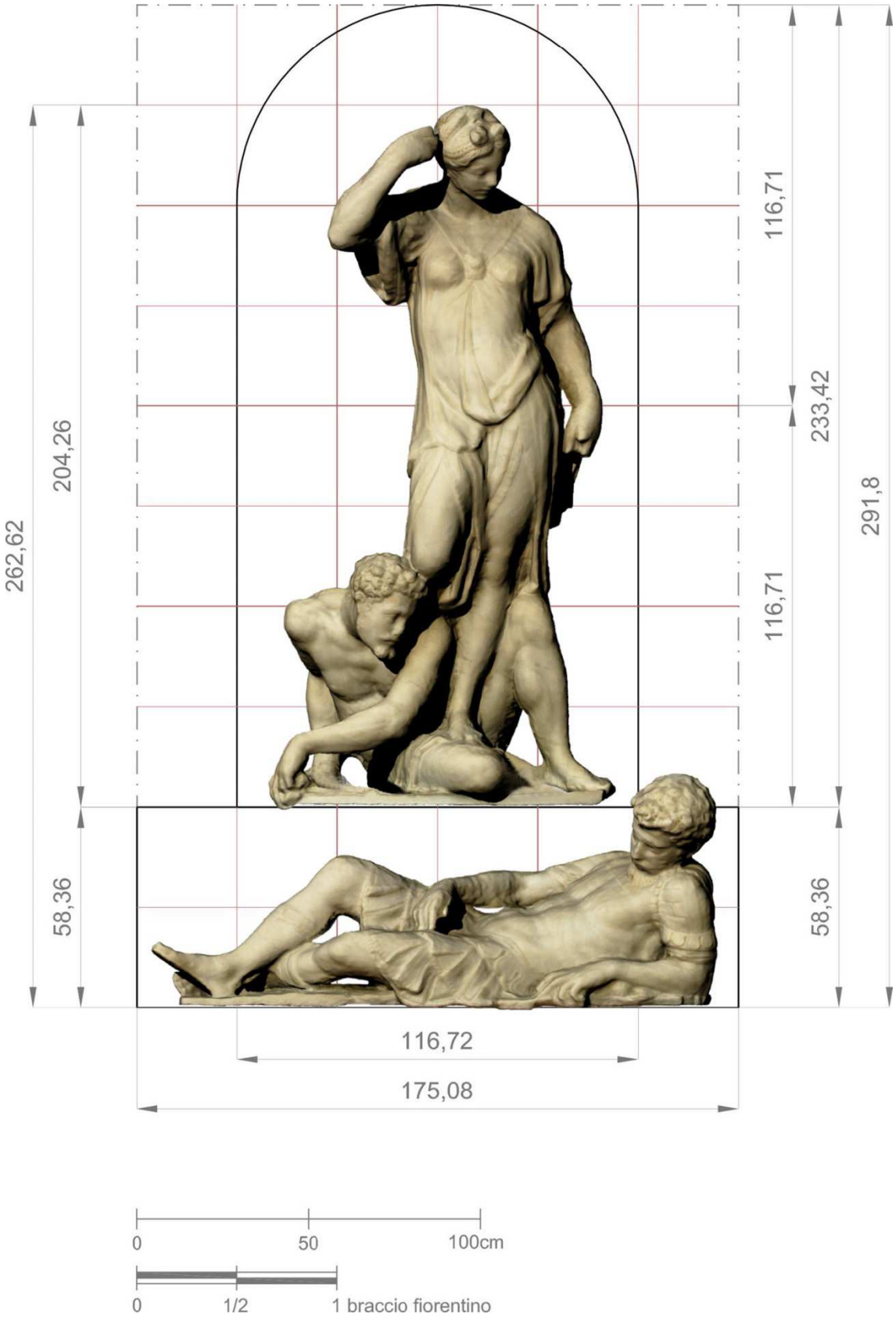

Fig. 6 – 2D restitution of the Monument: front.

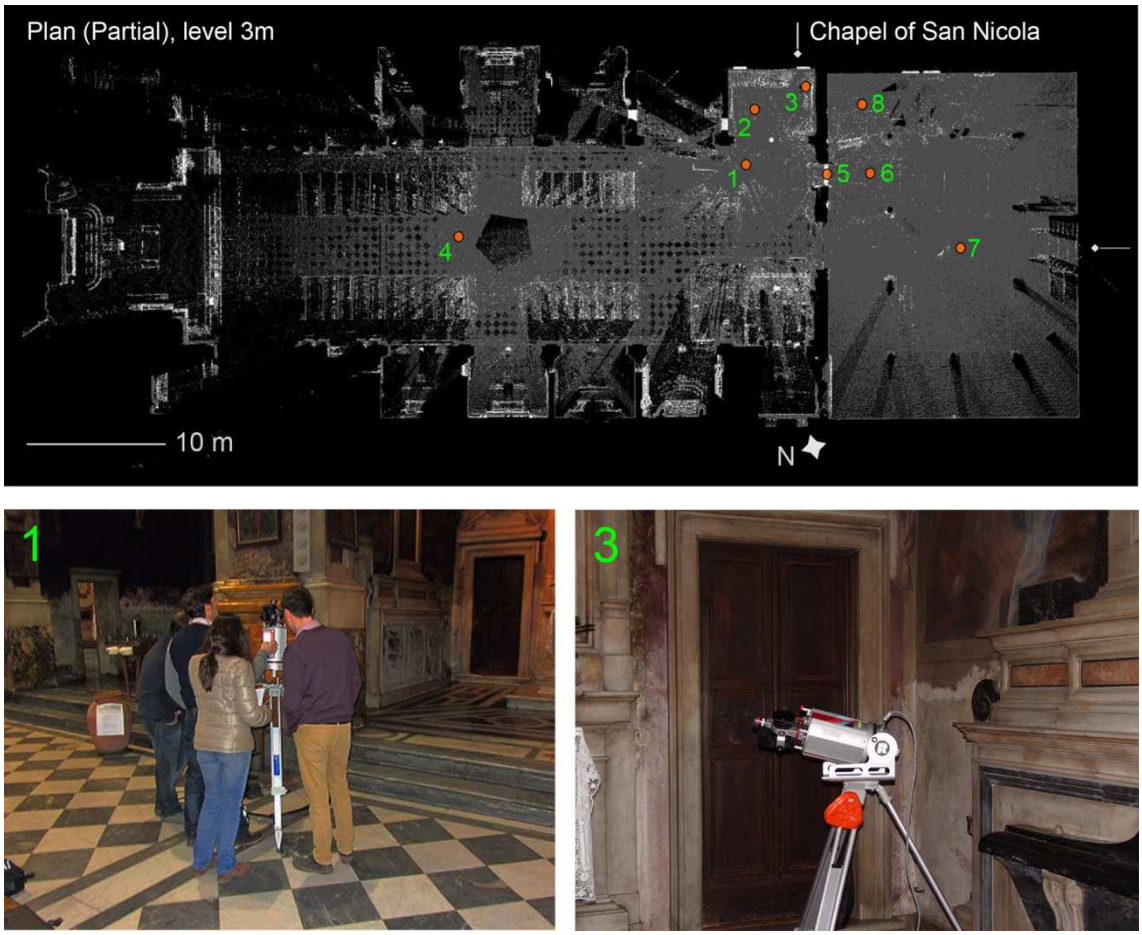

Fig. 7 – 3D laser scanner of the Chapel of San Nicola, plan of the laser stations.

Fig. 8 – Perspective of the interiors of the Basilica. Coloured point cloud (silhouette).

Fig. 9 – Cutway perspective. Reference plane (slice 2m- section C-C').

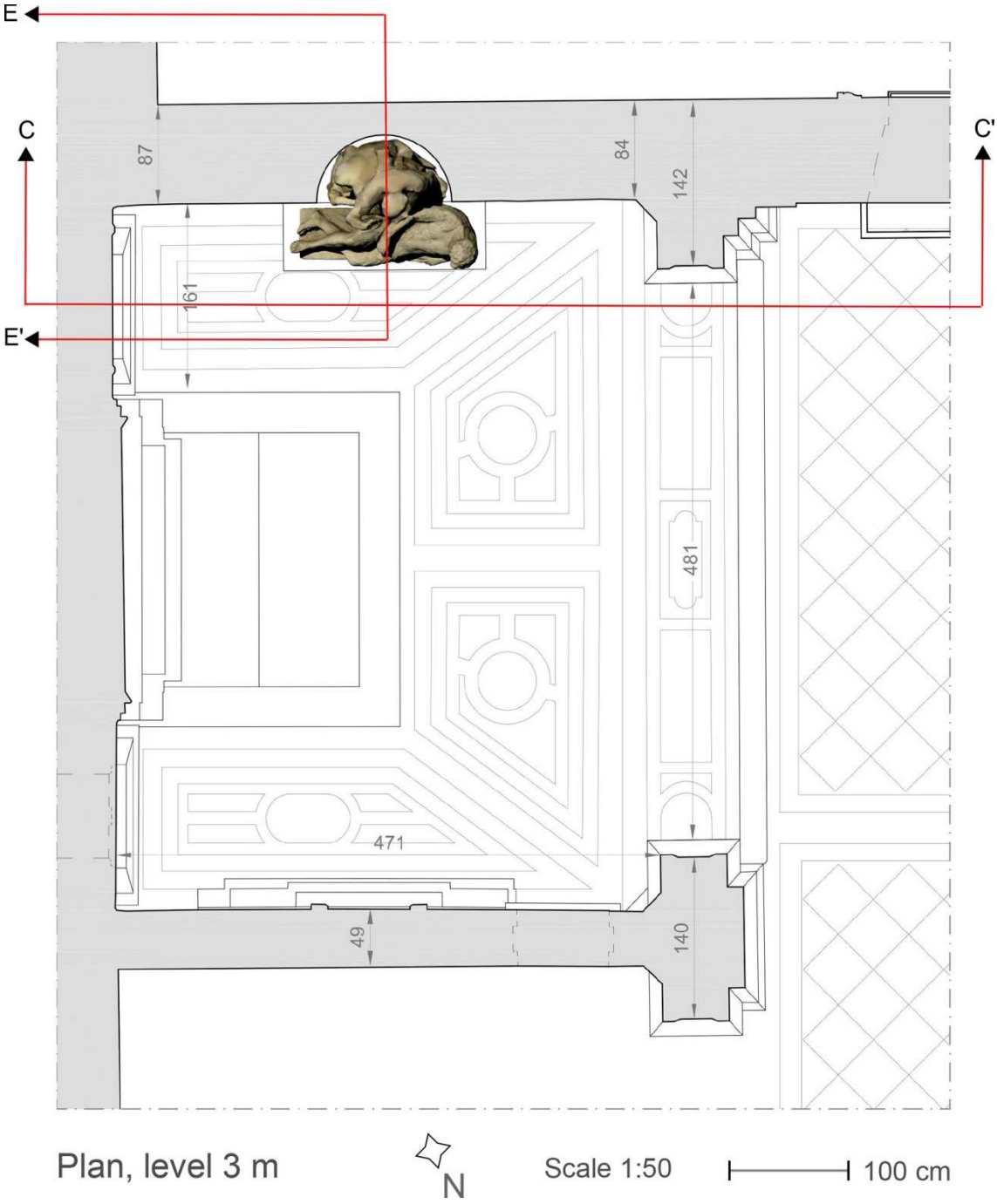

Fig. 10 – Final result: 2Drestitution, plan.

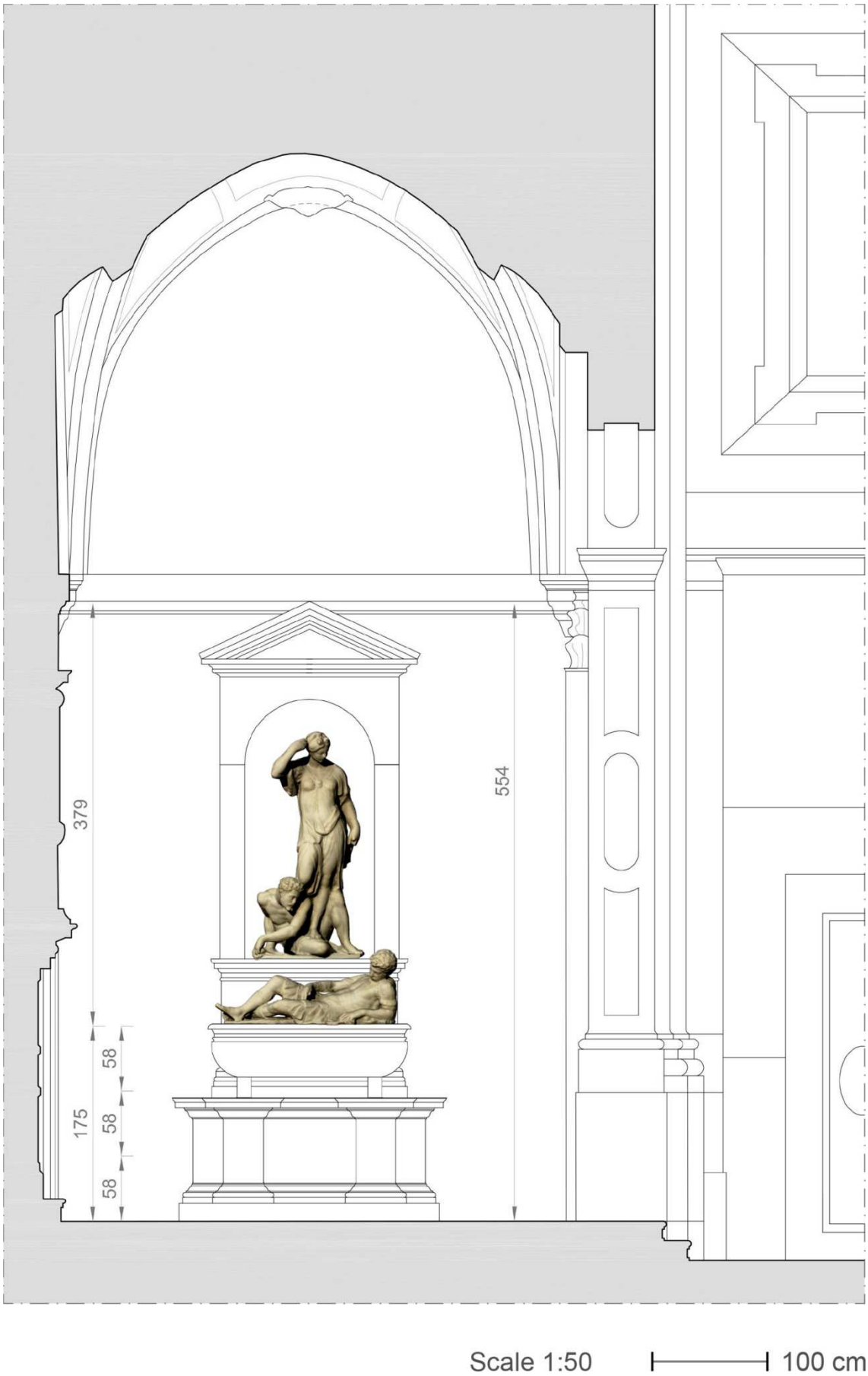

Fig. 11 – Final result: 2D restitution, section C-C'.

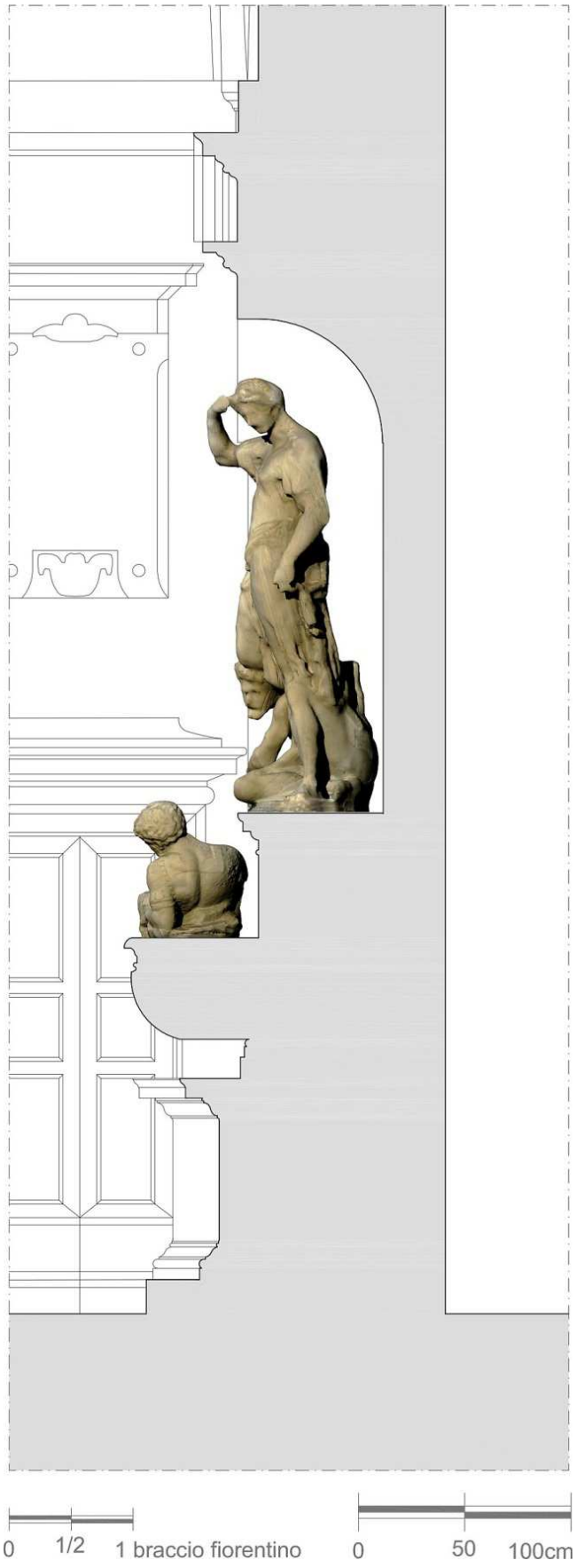

Fig. 12 – Final result: 2Drestitution, section E-E'.

Fig. 13 – Final result: Rendering and photo-simulation.

Fig. 14 – Final result: 3D print.

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Imprint:
Proceedings of the 19th International Conference on Cultural Heritage and New Technologies 2014 (CHNT 19, 2014)
Vienna 2015
http://www.chnt.at/proceedings-chnt-19/
ISBN 978-3-200-04167-7
Editor/Publisher**:** Museen der Stadt Wien – Stadtarchäologie
Editorial Team: Wolfgang Börner, Susanne Uhlirz
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