PRESERVING THE ARCHITECTURAL HERITAGE BY INCREASING THE KNOWLEDGE OF THE COMMUNITY: THE CASE OF THE ANCIENT CHURCH OF SAN PIETRO DI CONSAVIA IN ASTI.

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KEY WORDS: 3D, CAD, Model, Representation, Survey

ABSTRACT

"The first level of safeguard is, obviously, knowledge; to know means […] to document.
[…] In architecture this problem was conceptually overcome by survey, a composite operation […]"
(Cundari, Carnevali, 2000)
The safeguard of the Cultural Heritage, as stated in the above mentioned document, involves social and educational aspects.
As researchers of survey and representation methods, I think that we can propose methodologies that can actively contribute to widen the knowledge and the understanding of the Cultural Heritage and support its sharing, in the conviction that the safeguard and fruition should go together.
The experience that I want to present consists of the case of a historical building that has reached its present condition as a result of a series of factors of aggregation, reshaping, demolition which happened over the life of the building. It is the ancient church of San Pietro di Consavia in Asti, called the "rotunda", a building of Medieval origin, which was subject to a particular modification and transformation.
For the reconstruction of this process of transformation, 3D modelling techniques were applied, to generate digital geometric models of the changes that the monument underwent over time. The visualisation within the 3D model of the internal and external changes and transformations, permits the user to experience visualisation in 3D virtual space, for the various periods during the evolution of the monument.
The model has been prepared on the basis of historical, bibliographical and archival analyses integrated with the pre-existent archaeological survey as well as direct and photographic surveys.
The results of this work are visible on permanent displays in the building, which is now a museum open to the public, and on the Asti City web site.

1. INTEGRATED METHODOLOGIES OF RESEARCH FOR THE SAFEGUARD OF ARCHITECTURAL HERITAGE: FROM DATA GATHERING AND REASEARCH TO ITS DIFFUSION WITHIN THE COMMUNITY.

The monumental compound of "San Pietro di Consavia" nowadays appears to the visitor as a composition of pure volumes forming a U-shaped court open along the eastern side and featuring identical materials (bricks, tiles and sandstone) and an apparently homogeneous style.
The original religious function of the buildings is evident from their external shape: a sixteen-sided body with an octagonal cupola and an evidently truncated tower and connected with a quadrangular hall are the core of the religious function of the compound, while the two-storied sleeves with portico arranged in an L shape to form a cloister had a residential function.
The compound is now open to the public. The buildings around the cloister house the local Archaeological Museum, established in the 1930s by Niccola Gabiani, while temporary and permanent exhibitions are held in the two buildings formerly dedicated to worship.
The seemingly simple aspect of the building compound belies a complex history of evolution and transformation that affected, since the beginning, first the number of buildings, and then their geometry and functions.
The present aspect is largely the result of the last, substantial and questionable restoration carried out by Gabiani himself. He wanted to isolate the two buildings dedicated to worship "through the elimination of 'later additions' […] and the 'restoration' of the portico of the southern court and the arrangement of the open spaces as a *parterre*" (Longhi, 2000).
This event was investigated and reconstructed through a combination of historical, architectural and archaeological studies that through the specific methodologies of each discipline have clarified several obscure aspects.
The opening of the compound to a public of wide-ranging age and education (including school children) made it necessary to research and develop suitable educational communication and presentation systems. These systems were to facilitate the understanding of the main evolution phases that led to the present configuration and simulate dynamic virtual visits of the building through different ages (figure 1).
These studies were first published as a book (Bordone, Crosetto, Tosco, 2000). They were later used for the preparation of the exhibition "San Pietro in Consavia: a priory of the Order of

Figure 1. Frames of the virtual visit in the XV century

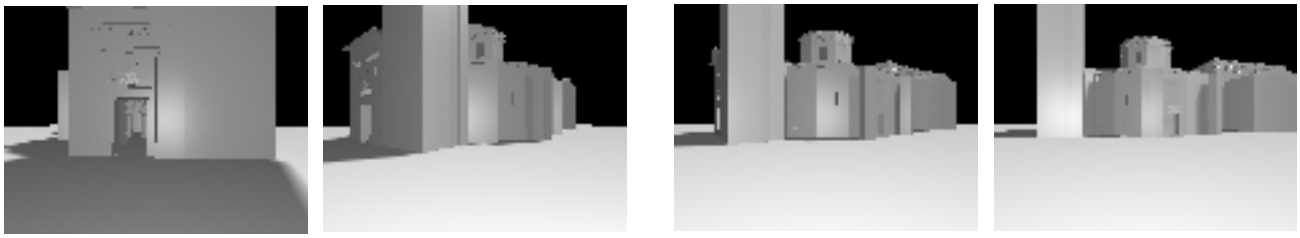


Figure 2. The first phase of construction (1110-1130)

Figure 3. The second phase of construction (end of the XII century - XIII century)

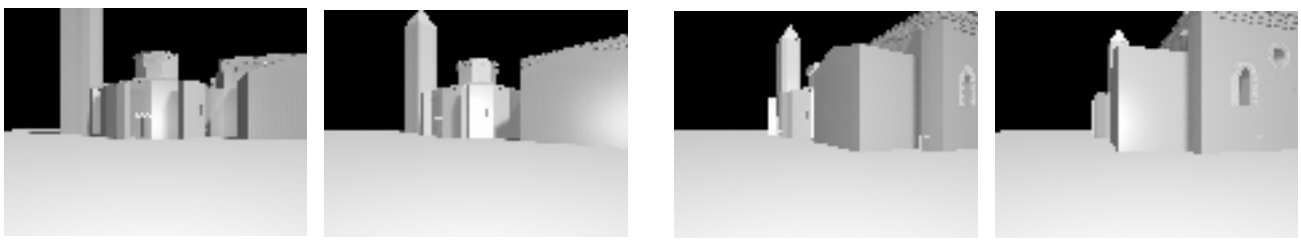
Malta on the *Via Francigena*" (end 2002), to make the monumental compound known to the general public and to promote the comprehension of the buildings. On the same occasion, a presentation was prepared for the web site of the city of Asti. For both events, the author of this paper prepared the 3D digital processing.

2. 3D DIGITAL MODELLING AS A METHOD FOR CHECKING THE HISTORICAL RECONSTRUCTION.

The reconstruction of the historical evolution of a building allows viewing through its present aspect the different looks it had in the past, and recognizing their traces.
Francesca Cataliotti wonders about the purpose of such studies, and suggests possible answers. "Why reconstruct? Perhaps is it possible to restore the identity, the sense of *unicum*, by adding up fragments and appearances?
We reconstruct because of a sort of intellectual pleasure which the architect cannot do without, because of the necessity to satisfy that romantic taste of reviving, if only on the drawing board, the original shape of the ancient monument, in order to understand what has disappeared, in part or whole,… or, perhaps, is it the architecture itself that asks to be represented in order to be understood and enjoyed at a distance, in time and space?
The reconstructive representation is, first of all, a way to understand the object and could become an important tool of historic and iconographic research, because it allows reviving a building, whether it is partly or totally lost, or hiding in the body of a stratified building". (Cataliotti, 2001)
3D digital modelling offers in this respect a powerful method of checking hypotheses. Notes Gabriele Rossi: "in a 3D digital model, the complexity of the representation gives way to an illustrative schematization which has, in any case, better spatial control of the object and far exceeds the traditional static axonometric and perspective forms of representation.
The model thus becomes an essential tool to check and control the validity of reconstructive hypotheses". (Rossi, 2000)

3. 3D AND KINETIC DIGITAL MODELLING AS A TOOL FOR UNDERSTANDING AND FOR EDUCATION AND COMMUNICATION.

3D digital modelling, a technique of representation by now widely consolidated in the various design phases, is presently stirring a renewed interest for the survey of existing structures.
This is, on the one hand, due to the natural connection with the most innovative methodologies of instrumental survey. On the other, it is a consequence of the wide-ranging potential applications in the fields of critical thematic analyses and of spatial and temporal simulation: "*digital mock-ups* […] allow a richer and more controlled interaction between user and model […] *digital mock-ups* are able to cover, within a unique representation system, the entire range of possible modelling". (Maldonado, 1992).
The quick evolution of digital technologies, hardware and software, makes it ever easier to build 3D models of considerable geometrical complexity.
A critical selection of data, first of all in respect of the relationship between scale and contents of the representation, is absolutely essential to avoid, in the modelling phase, very complex procedures adding insignificant detail which uselessly increases the size of the digital file. In this respect it should be considered that the most suitable support for the visualization of the model in its space-time dimensions usually is the monitor of a personal computer.
While 2D digital drawings now usually implement a level of detail that is greater than the level achieved, for the same scale of reduction, in a traditional drawing, it is most appropriate to simplify 3D digital modelling by implementing primitive solids, by analogy with material plastic modelling.
3D digital modelling complements drawing as an information and communication tool, while adding, as a specific prerogative, the possibility to enter the fourth dimension.
This important aspect is underlined by Claudio Moriconi, who observes that "with the digital support the drawing simulates the hypothetical reality, overcomes static limitations and allows interacting with any kind of sign.
By creating virtual images, digital graphics is probably the most suitable tool to interpret the complexity of reality […]".



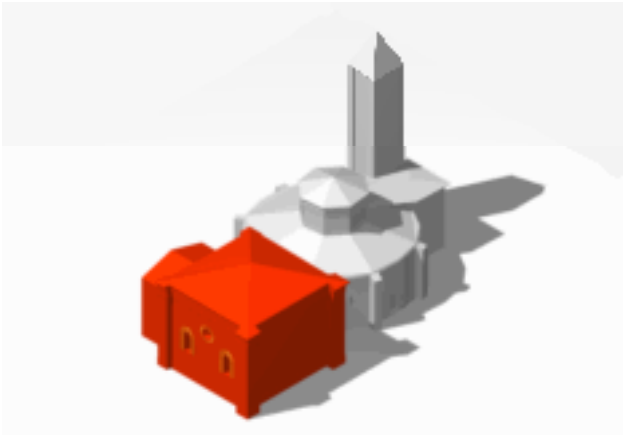


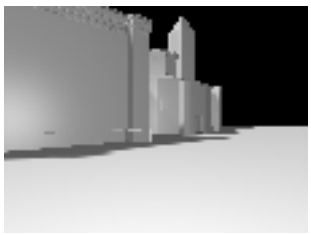
Figure 4. The third phase of construction (XV century)

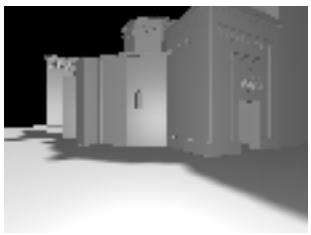
Figure 5. The fourth phase of construction (XVI century)

(Moriconi, 2001)
The creation of a 3D digital model offers, as a result, infinite possibilities of observation: from the objective visualization of a cylindrical projection, to the subjective visualization of a conical projection. In this respect Mario Docci and Riccardo Migliari state that: "modelling is not only a creative strategy, but also a cognitive one. Digital models allow 3D simulations… Computerized models are conceived as 3D systems, real *maquettes* that live in a virtual space perfectly corresponding to a real space, so much so that they encompass all four dimensions. They are visible through a screen, a window (which reminds the window of Alberti's *perspectiva artificialis*). This window visualizes the models in a 2D space that can be perceptive (in a central projection) or measurable (in a parallel projection), with the capability to vary the point of view so as to simulate the mobility and the transformability in time and appearance". (Docci, Migliari, 2000)
The meanings of the introduction of the time dimension, and the relationship of the latter with the history of the representation techniques, are sharply investigated by Giorgio Garzino: "the possible kinetic representations are closely related, even in the intent of their author, to the views shown in ancient architectural drawings. In fact, from the standpoint of the history of representation they take a place of extraordinary interest. The all-encompassing representation intent of synthetic images, which centres the same extents on the human viewer, is inherently in contrast with the graphic technicality and the supposed rigor of objectivity. Additionally, the introduction of the time factor to a certain extent introduces a dynamic element in the representation and in the knowledge of its subject. While the representation that followed the 'paper path' refers to a precise moment in history, the representation that unfolds as a succession of images on the screen emerges as a becoming, a process". (Garzino, 1996)
The monumental compound, and in particular the core buildings with a religious function, was a test case both of the potential of 3D digital modeling for the historical reconstruction of the monument and of the perceptive quality of the virtual visit in space and time. The communication clearness and immediacy could be verified in both respects.
Thanks to digital modelling, the 3D visualization of the morphological transformations of the urban fabric as well as of buildings or complexes in various historical periods makes it possible to share this information and diffuse it in a readily understandable form to a wide-ranging spectrum of public.
"The digital techniques of representation make it possible to create a picture of the situation before and after the intervention, and to rebuild, if necessary, the stratification too.
The era of graphic papers that only the specialists can decipher is over. Now the very users of a building or of an urban complex can appreciate spaces […] before during and after its irreversible transformation". (Moriconi, 2000)

4. THE FIGURATIVE RECONSTRUCTION OF THE EVOLUTIONARY STAGES OF THE CHURCH OF SAN PIETRO OF CONSAVIA IN ASTI.

The complex history of the evolution of the core buildings formerly dedicated to worship was the subject of a volumetric representation, of the interior as well as the exterior, divided for simplicity in six main phases, illustrating the studies mentioned above.
The first phase (figure 2) addresses the construction, from 1110 to 1130, of the most ancient kernel, the Romanesque church of Santo Sepolcro, a rotunda. The church includes an "ambulatory with eight columns inscribed within a circular perimetrical wall inside and a polygonal one outside" (Tosco, 2000). Both the ambulatory and the cupola have no vault.
The second phase (figure 3) is characterised by the changes carried out between the end of the XII century and the XIII century by the Knights of San Giovanni, consisting of the addition of the central vault, the buttresses, the hall and the tower.
During the third phase (figure 4), in the XV century, the Valperga hall was built, a square structure probably serving funerary functions, covered by a cross vault.
The fourth phase (figure 5) is characterised by the building of the barrel vaults, with lunettes, of the ambulatory, in the XVI century.
The fifth phase (figure 6) includes the elaborate transformation of the Valperga hall into a parish church having a longitudinal





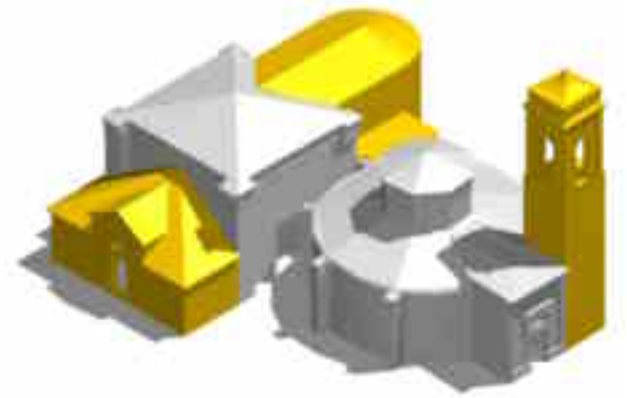


Figure 6. The fifth phase of construction (XIX century)

Figure 7. The sixth phase of construction (after 1930)

plan, during the nineteenth century. The Valperga hall became the hall of the new church placed between the entrance body and the presbytery. The tower was reshaped and the rotunda was transformed in baptistery. Mario Tamagno documented this change in his survey (Tamagno, 1897). “Actually the survey was still carried out in accordance with the 19th century custom of adjusting reality to an ideal model, and searching for "original" conditions, with an eye to a possible stylistic restoration”. (Longhi, 2000).

The sixth phase (figure 7) is characterised by the complex restoration, dating back to the early 1930s, carried out by Niccola Gabiani.

An official of the municipal Arts Department, he wanted to free the church and the baptistery from the additions made to the original constructions. He thus operated as a restorer with the ‘naivety’ of a neophyte that finally joins the select circle of restorers of d’Andrade's school” (Longhi, 2000), returning the building to us in its present conditions.

5. 3D DIGITAL MODELLING FOR THE REPRESENTATION OF MORPHOLOGICAL TRANSFORMATIONS: METHODOLOGIES AND PROCEDURAL ASPECTS.

The reconstruction of the evolution of the buildings required the geometric modelling of the interior and exterior. This was based on the recent archaeological and planimetrical survey by Elisabetta Genta (Crosetto, 2000), and on the survey of the fronts prepared by the author and by Marco Vitali, integrated with data drawn from historical-archival and bibliographical sources and additional measurements directly taken in a survey of the interior.

3D digital modelling required a critical selection of the data with the goal of simplifying the representation of the geometrical shape, internal and external, of the buildings. This included everything, from the vertical load-bearing structures to the vaults and roofing, the openings and the decorative apparatus.

For the reconstruction of the demolished parts, based on the hypotheses of Tosco and Longhi, volumes were used which only represent the outer shapes. When historical-iconographical documentation is available, on the contrary, as was the case for Mario Tamagno's survey which was supported by a series of historical photographs, it was possible to implement the same level of definition that characterizes the modelling of current structures.

The MicroStationV8 CAD software package was used for the preparation of the 3D digital model. To highlight each of the new construction phases with respect to the previous ones, the identification of the changes that the monument underwent through the ages.

The model was used to produce a set of axonometric views of the exterior, for presentation and educational purposes. The views highlight the extent of the interventions by following an ideal path around the compound. Axonometric cutaway views where the roofing is not shown display the underlying vaults, which were built in several subsequent phases after the original construction.

The images produced were included in the city of Asti web site pages dedicated to the church. They are also visible through the information system supporting the permanent exhibition located inside the “rotunda”.

The model also demonstrated its value in conducting virtual visits at various times in history.

Via the “Fly-through” procedure supported by the MicroStationV8 software package, an ideal path was built outside and inside the monument. A large set of virtual cameras was uniformly scattered along the path, so that a very large number of frames is available.

The editing of the individual frame, which MicroStationV8 can do automatically, was instead performed through the Premiere software package, which ensures a better control of the fluency of the sequence and allows saving the file in compressed formats compatible with standard applications (i.e. Windows Media Player) normally installed even on entry-level personal computers.



REFERENCES

Bordone, R., Crosetto, A., Tosco, C., 2000. L'antico San Pietro in Asti. Storia, architettura, archeologia, Umberto Allemandi & C., Torino-London.

Cataliotti, F., 2001. "Simulare" l'architettura. In Soletti, A., Belardi, P., Cataliotti, F. Claudio Moriconi professione infografico, Università degli Studi di Perugia, pp. 119-130.

Crosetto, A., 2000. «Ecclesia et hospitale». Indagini archeologiche al Santo Sepolcro d'Asti. In Bordone, R., Crosetto, A., Tosco, C. L'antico San Pietro in Asti. Storia, architettura, archeologia, Umberto Allemandi & C., Torino-London, pp. 219-242.

Cundari, C., Carnevali, L., 2000. Verso la "Carta del rilievo architettonico". In Il rilievo dei beni architettonici per la conservazione, Atti del Convegno, Napoli, 15-17 aprile 1999. Kappa, Roma, pp. 33-37.

Docci, M., Migliari, R., 2000. La modellazione come strategia creativa e conoscitiva. Il rilevamento dell'Amphytheatrum Flavium. In Baculo, A. Architettura e informatica, Electa, Napoli, pp. 37-52.

Garzino, G., 1996. Il disegno calcolato, Levrotto & Bella, Torino, ch. VIII.

Longhi, A, 2000. Erudizione, tutela e restauro: Niccola Gabiani e l'architettura del San Pietro. In Bordone, R., Crosetto, A., Tosco, C. L'antico San Pietro in Asti. Storia, architettura, archeologia, Umberto Allemandi & C., Torino-London, pp. 203-216.

Maldonado, T., 1992. Reale e virtuale, Feltrinelli, Milano.

Moriconi, C., 2001. Il modello virtuale. In Soletti, A., Belardi, P., Cataliotti, F. Claudio Moriconi professione infografico, Università degli Studi di Perugia, pp. 20-30.

Rossi, G., 2000. Ricostruzione grafica e modello solido. Carl Weichardt a Pompei. In Baculo, A. Architettura e informatica, Electa, Napoli, pp. 121-123.

Tamagno, M., 1897. Chiesa di S. Pietro di Conzavia in Asti. Rilievo di Mario Tamagno. Memorie di un architetto, VII: section V table 4, section VII tables III-IV.

Tosco, C., 2000. Le dinamiche architettoniche: dal Santo Sepolcro all'ospedale. In Bordone, R., Crosetto, A., Tosco, C. L'antico San Pietro in Asti. Storia, architettura, archeologia, Umberto Allemandi & C., Torino-London, pp. 127-149.