Historical-virtual reconstruction of an Italian garden
Imagining the past of Villa lo Zerbino

Anna Toth
Politecnico di Milano
Design Department.
E-mail: anna.da.toth@gmail.com

Davide Spallazzo
Politecnico di Milano
Design Department.
E-mail: davide.spallazzo@polimi.it

This paper discusses a model for the virtual reconstruction of the historic garden of Villa lo Zerbino in Genoa. We describe the process that starts from a specific knowledge (based on documents, drawings and maps) and leads to a 3d model focusing on the vegetation elements. This representation allows addressing issues peculiar to the reconstruction of historic gardens, such as the analysis of their evolution over time and the complexity associated with modeling the vegetation. In so doing, this paper contributes to academic research on historic heritage and proposes 3D modeling as a basis for the restoration project, as well as a means to reveal architectural patrimony to the public. Also, by providing a 3D representation of the changes witnessed by the villa over centuries, this paper aims to stimulate further contributions on the co-evolution of historic heritage and urban landscape.

Keywords: virtual reconstruction, historic garden

1. Introduction

Realistic virtualizations of architectural heritage allow the audience to feel the sensation of a time travel, which collects the memories of a site in one digital product. This result requires a vast research work in the historic documentation, later confronted with the surveys of the present situation, together with modeling abilities in order to provide a highly realistic digital model. A blurry image is indeed what the virtual reconstruction has to clarify.

Dealing with historic gardens further increases the complexity of the task, since vegetation is ephemeral by nature and usually poorly documented, and its organic shapes require a great effort in the modeling phase. Furthermore, very few examples of virtual reconstruction of historic gardens are available in the literature (Ceconello M., Spallazzo D., 2010) and often focus on the virtualization of architectural elements within

the gardens (Huang Y., Liu Y., and Wang Y., 2009) or on very large areas such as landscapes (Niederoest J., 2002).

It is therefore valuable to deepen the research in the field of virtual reconstruction of historic gardens, and their vegetation in particular, in order to study their evolution over time and analyze their relationship with the surrounding landscape.

The project we discuss in this paper fits into this strand, describing the virtual reconstruction of Villa lo Zerbino in Genoa.

The aim of the project is ambitious: to reconstruct the villa, the garden and the surrounding areas as they were in different ages, in particular in the 16th and 19th centuries, in order to analyze their evolution over time. The project is still ongoing and, to date, the virtual reconstruction of three sample areas at the 19th century condition is completed.

Thanks to the virtual reconstruction of the three areas of Villa lo Zerbino, it's now possible to study the evolution of the garden from the 19th century and today, and recreate also the views of the surrounding landscape from the villa complex. This allows us to enter the garden and have a complete sense of how the landscape was part of the villa.

One of the most important characteristics of Alessian villas is indeed their position. The main axis of the villa is always perpendicular to the mountainside, offering a beautiful panorama from the villa complex. The building itself has a cubical form defined by a transparent construction, which allows seeing through the villa from both the entrances, letting the garden inside the villa, recreating a perfect harmony in which the main character is no longer the building but the garden, whose surrounding landscape is a close extension.

Confronting the historical maps of the 16th century, the 19th century model and maps and photos of the present situation we can also note how the urban development of a city becomes an essential factor from the point of view of a single villa. By virtue of the representation of the presumed panorama of the city from Villa lo Zerbino we can also study the relationship between the villa complex and its surrounding landscape.

On this experience, we focus our paper that contextualizes historically the villa and its evolution, describes the methodology adopted and presents and discusses the results achieved.

2. Villa lo Zerbino

The case study identified for the project of historical-virtual reconstruction is Villa Balbi Durazzo Gropallo allo Zerbino (Figure 1), one of the most important examples of an Alessian villa built in the city of Genoa, in a suburban position, between 1599 and 1604.

The choice of the position of the villa describes its main typology: a suburban complex far from the city centre in a dominating position. The distance from the urban settlement guaranteed a strong detach from the ordinary lifestyle giving a commanding sensation to its owner.

Over the centuries, Villa lo Zerbino witnessed various changes. Along with the expansion of the city, which slowly reached and incorporated the villa, the layout of its garden was modified following the English landscape garden trends of the late 17th century.

Villa lo Zerbino has been chosen not only for its cultural importance, but also because of the rather rich documentation (such as maps, images, surveys, descriptions) that facilitates a historic representation of its appearance over time. Moreover, the preservation of the 19th century layout allows recognizing the original project of the garden created by the renowned architect, Andrea Tagliafichi.

The historical reconstruction of the Villa regards mainly two periods, the 16th and the 19th century (Figure 2).
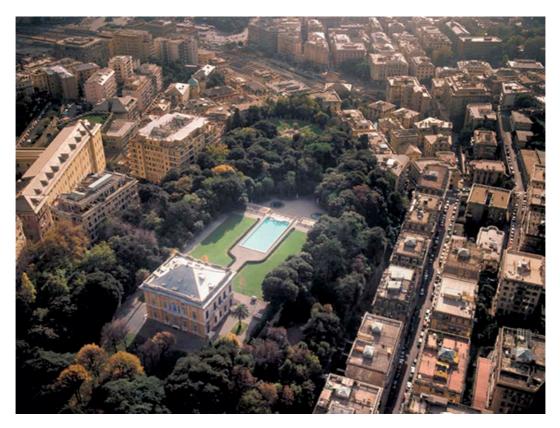
Figure 1. *Villa Balbi Durazzo Gropallo allo Zerbino*
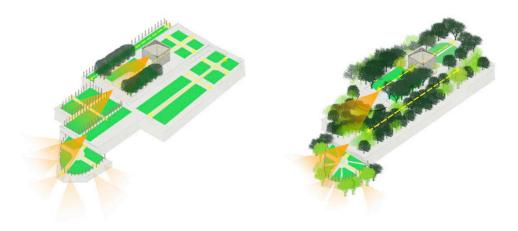*(source: http://villalozerbino.it/)*

Figure 2. *Simplified layout of the villa in the 16th century (left) and in the 19th century (right)*

The sixteenth century villa, built out of the city walls and far away from the center of the medieval Genoa, had a regular layout featured with straight, perpendicular avenues followed by pergolas and flowerbeds. It was Martin Pierre Gauthier, in the 18th century, who presented the reliefs of Villa lo Zerbino in his book (Gauthier M. P., 1830). Although the author of the collection never saw the villa in its 16th century form, his drawings present what may have been the plan of the garden until the changes of the 19th century.

In a letter[1], in 1804, Ippolito Durazzo, the villa's owner at that time, writes about his intention to modify the structure of the garden of villa lo Zerbino. The architect of the new plan is Andrea Tagliafichi, who gives the garden a completely different style, following the English landscape trends of the era. He conserves several parts of the original garden plan but radically transforms the others, creating a perfect harmony between old and new elements. Even in the absence of any plan left by the architect, the present conditions of the villa allowed us to understand the original forms of the 19th century project. A map (Poggi M., 1898) supports our historic reconstruction of the original project, although it does not provide additional information.

Regarding the growing urban landscape of the 19th century, among the several accurate maps available, we used that provided by Barbieri (Barbieri P., 1938).

3. Sample areas

In order to provide an impression of the full appearance of the garden, we focused on three areas in three different terraces (Figure 3), virtually reconstructing at their 19th century condition. We choose these areas so as to study three types of transformations from the point of view of the layout of the garden. In so doing, we also show how the relationship between the landscape and the garden of the villa has changed over the decades.
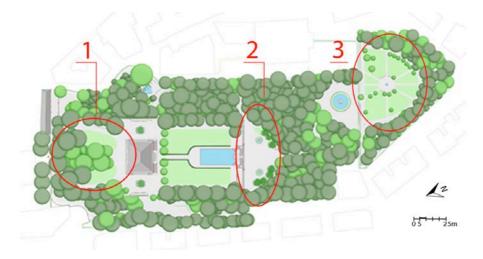

Figure 3. *Sample areas chosen for the virtual reconstruction*

The first sample area is the first terrace (Figure 4), behind the main entrance of the villa. It comprises a large avenue followed by symmetrical flowerbeds. The original plan of Andrea Tagliafichi maintained the straight avenue of the 16th century garden in order to organize an optically ideal entrance in the garden: the building is in the center of the composition of this area. The recent installation of the double row of *tiglia cordata* covers completely the villa, destroying the garden composition.

The 19th century layout provided also rows of evergreens on its lateral parts, closing the visuals from and towards the villa. These green structures revealed to be fundamental during the development of the close urban zones, but the lack of conservation of the area damaged the protection of the villa complex.

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[1] Castelbarco A. C., Lo Zerbino a Genova, Le dimore storiche

Figure 4. *Current picture of the front of the villa taken from the first area*

The second area is located in the second terrace (Figure 5). With the changes implemented by Andrea Tagliafichi, the character of the second terrace was completely modified.

The 16th century layout was replaced by an area characterized by two ponds and four couples of *phoenix dactylifera*. The rest of the terrace is composed by a forest, an important element of the English landscape gardens.

These changes resulted in alterations in the relationship between the landscape and the garden as well. The urban center, which in the 19th century became an important element of the panorama, was less visible due to the vegetation of the second terrace.

Figure 5. *Current picture of the second area*

From the third terrace, the last sample area, the panorama is visible in a wide angle of view, dominated by the sea and by the silhouette of the Cathedral of Santa Maria Assunta. In the 19th century this sight was

characterized by the columns of the pergola that surrounds the area and divided the panorama creating different viewpoints.

With the evolution of the urban landscape, the vegetation around the third terrace (Figure 6) started to have a protecting role, but conserved the open character of the layout. The present situation of this area has a completely closed aspect, since a spontaneous green structure covers the panorama.

Figure 6: *Current picture of the third area*

4. Methodology

The virtualization project of Villa lo Zerbino entails a high level of complexity due mainly to its extremely varied nature and to the incompleteness of documentation that obviously increase for more distant epochs.

Looking at the reconstruction from the only point of view of the modeller, the difficulty regards the very varied nature of the complex that encompasses architectonical elements, vegetation (both formal and natural growth components) and the surroundings. Each element brings with it different needs, different levels of detail and diverse modelling approach which result in a necessarily hybrid methodology.

Furthermore various and often incomplete sources aroused the question of the reliability of the resulting model and invite to reflect on how to disclose diverse degrees of trustworthiness in the model itself.

As already stated the aim of the project here discussed is to provide a highly realistic virtual reconstruction of the complex at different epochs, intended as a means to raise awareness of the historical importance of Villa lo Zerbino and of its transformations over time.

For this reason a very high level of dimensional accuracy of the model is not required and very expensive and time consuming survey technics such as photogrammetry and laser scanning has been avoided.

An accurate architectural and botanical survey of the garden has been indeed carried out to verify the completeness and reliability of the available sources and used as a basis for the modelling phase.

Survey, modelling and texturing are the essential steps followed for the project that faced the complexity described above with a hybrid modelling approach.

Concerning the architectural part, the process followed the methodology elaborated and tested in previous projects (Ceconello M., Spallazzo D., 2010); Ceconello M., Paquet E., 2007)that implies the definition of different levels of geometric simplification for the architectural elements based on their formal complexity and importance in the overall scene.

Texture mapping and bump maps increase the level of realism keeping the total amount of polygons under control.

By virtue of a consolidated methodology and of the experience gained in previous projects, we were able to create a model with high level of realism in its architectural parts, in short time and with a good control on the number of polygons.

The vegetation elements are divided in two groups, basically separated by the differences of the garden trends. On the one hand, the formal vegetation has a dominating presence in the layout of the 16th century. Shrubs and trees are shaped by *ars topiaria*, which consists in pruning the elements to give them a geometric form.

On the other hand, the project realized by Andrea Tagliafichi follows the rules of the English landscape garden and results in less visibility of the human work on the vegetation.

The aforementioned reasons indicated the necessity to divide the vegetation in two groups in the modelling process.

On one side, the formal garden elements have been modelled on the basis of procedures elaborated in a previous project (Ceconello M., Spallazzo D., 2010) that met the same issue. In respect to that project we had to face a much wider amount of formal vegetation and necessarily to improve the procedure in order to preserve a high level of realism without weighing down the model.

Thanks to a well-balanced employment of polygons, photographic textures and technics, such as the scattering, we managed to obtain realistic models of formal vegetation with a relatively small amount of polygons.

The other group of the vegetation is comprised by existing polygonal models, which have been chosen after accurately studying the botanical species in the garden. These models' dimensions and colours were modified according to the necessities of the garden.

The visualization of the lawn was another part of the modelling that demanded several tests balancing between highly realistic polygonal models that imply an excessive number of polygons and faster techniques such as displacement and texture mapping that keep the polygons under control but don't achieve the same realistic results.

Modelling the grass implies also adjusting the creation of unwanted patterns that unveil the use of repeated modules, solved in the resulting model with the superimposition of photographic textures and polygonal models at different scale.

As mentioned, the surrounding landscape has a relevant role in the structure of the villa. It is not only a background, but a panorama, in which certain elements, such as the sea and the cathedral of Santa Maria Assunta, have particular importance. Therefore, the cathedral has been accurately modelled. By contrast, since the rest of the landscape has significance only as group of buildings, whose presence is understood in terms of the distribution of the urban structure and not as singular elements, their modelling allowed a simplified approach.

The volumes of the buildings are based on the plan of [7] and their height and colours, without textures, was hypothesized studying the conserved 16th century architecture in Genoa.

The position of trees is defined approximately and the use of billboards allowed us to obtain a good visual effect without weighing down the model.

5. Results and discussion

The virtual model of Villa lo Zerbino realistically represents three different areas of the complex at the 19th century condition: the first terrace with the villa, the second and third terrace (Figures 7, 8a and 8b, 9a and 9b respectively).

Considering the important relationship between the Villa and the landscape, we modelled also the surrounding areas of villa lo Zerbino recreating a likely view of the 19th century panorama.

The virtualization project has been realized using a commercial software (Autodesk 3Ds Max), starting from the polygonal modelling till the production of photorealistic renderings.

As an early result of the project here described we can also mention the definition of a methodology for the historical-virtual reconstruction of a villa and its garden, made of two main stages: the historical reconstruction through the research of documentation and the virtual reconstruction as a means to verify the hypotheses and to disseminate the results.

Furthermore this project allowed to consolidate a methodology for the virtualization of historic villas defined in previous works (Ceconello M., Spallazzo D., 2010), partially modified to match different needs and face problems not previously encountered.

As already stated, the project is still on-going, and the virtualization must be completed including other areas and reconstructing the 16th century condition, but the three sample areas resulted to be meaningful for the project's aims.

The photorealistic renderings allow indeed to easily compare the present condition with the 19th century project, increasing the awareness of the past of the villa for non-experts and providing scholars and experts with new means to study the villa's evolution over time and its changing relation with the landscape.

For example, confronting the renderings with the photographic materials of the present we can note that the 19th century situation of the villa was the last moment of its glorious period. Even though the 19th century layout of the garden in its early forms apparently protected the villa from the urban development, our virtual model portrays a villa that is still able to create connections between its garden and the landscape. This continuous dialog, which is one of the main foundations of the characteristics of Villa lo Zerbino, now seems to suffer. The reason is not only the unavoidable advancement of the urban centre but also the uncontrolled growth of the vegetation of the garden.

Figure 7. *Virtual reconstruction of the front view of the villa from the first area*

The comparison between the two conditions allows also to infer hypothesis for future interventions on the garden: the green structure that had in the past the function to invite the landscape into the villa, appearing to enlarge its space, could now be transformed into a system capable of protecting the villa

complex from the visual handicaps of the surroundings. At the same time, it could underline those landscape elements that have an antique role in the villa's view, such as the sea and the cathedral of Santa Maria Assunta.

Figure 8a and 8b. *two views of the virtual reconstruction of the second area*
Figure 9a and 9b. *two views of the virtual reconstruction of the third area*

6. Future works

The experience of the historical-virtual reconstruction of Villa lo Zerbino identifies several venues for future work, some defined at the beginning of our project but still not completed and others emerged during the project development.

Completing the virtualization of the entire complex at its 19th century condition, together with the aforementioned reconstruction of the 16th century state, are certainly the first aims to be accomplished in order to enlarge the timeline and describe with completeness the evolution over time of such an important historic site. These new experiences could further assess the methodology here described, and make it available and reliable for other virtualization projects regarding historical villas and heritage as well.

Our work could also be the basis for restoration projects of historical sites, which require the detailed description of past situations: the virtual reconstruction provides indeed a likely visualisation of the past and can reveal hidden concepts (e.g. visual
connections).

A polygonal model, suitably adapted, can also allow real time navigation both on the web and in large screen virtual theatre, providing users with an inspiring navigation in the past.

Finally we should not forget that creating a virtual reconstruction of a heritage, as it was, means visualizing an uncertain past: we are not sure that it was exactly as we depict it but anyway we can pursue likelihood. Furthermore the plausibility of the reconstruction can have different degrees within the same model, depending for example on the available documentation or on the accurateness of the surveys.

Assessing the level of reliability of our model and finding a way to represent it in the model itself is a challenge for the future: visualizing the uncertainty in the 3D models could indeed extend the potentials of the virtualization project, by giving a clear image of the quality of the available sources, by adopting new methods of visualization (colours, transparencies, etc.) and by providing several hypothetical images of the past.

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