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Abstract. The research that is presented here was developed to understand the impact of a new building in a very delicate context, such as the venetian one. The case study was a very important project for the history of architecture, because it is the only design by Frank L. Wright for an Italian customer. The Masieri Memorial was projected by the author on Canal Grande and near the Rialto bridge. The very detailed drawings and notes helped us to reconstruct in digital form the architecture, to study the representation of it in Venice and to verify the effect with the other ancient venetian palaces, such as Palazzo Balbi. The simulation was taken to the photorealistic perception, applying all the textures and materials as found in the sketches and reserved notes of the architect. The final step was the realization of a video to simulate the perception from a boat and the materialization of a maquette using the Rapid Prototyping techniques, in nylon powder.

Keywords. Digital reconstruction; simulation; rendering; video animation; Rapid Prototyping.

INTRODUCTION
The aim of this research is to study a contemporary architecture as a single case study, insert in a context of historical buildings, to verify what kind of difficulties could generate it on the area. The site is Venice, and the area is placed in the middle of the town, on a side of the Canal Grande, near to Palazzo Balbi and Cà Foscari, after Rialto Bridge and exactly where the canal turn to go in the direction of Accademia Bridge and Piazza San Marco.

The research was developed partially at the Faculty of Architecture of the IUAV University of Venice, then at the Faculty of Architecture of the University of Trieste, and at Protoservice Laboratories for the final creation of the Rapid Prototyping model. Some parts were developed by Fabio Cuzzuol during his graduation thesis at the IUAV University of Venice.

The case study is a very important architecture of the XX Century, not only because of the prestige of the author, Frank Lloyd Wright, who is without any doubt one of the relevant architects of the 1900. But also because this project was the only he made for an Italian customer, and also because of the characteristics of the design, very detailed by him, although it was never built.

The objectives were to analyze the project, starting from all the original information on that architecture, to understand the geometry of it, to reconstruct the digital model and to render it in the venetian context as if it was built, in order to compare
the impact of this morphology on the area. The realization of a short video animation could help to comprehend the relevant aspects of the single elements, but also of the whole form and structure of it. A final verification was planned in the field of physical realization using the Rapid Prototyping techniques for generating a scale model of the façade.

The procedures we used were based on CAD software and photorealistic algorithm to simulate the real visualization of the model. Extrusion patches and Boolean geometries were integrated to define every single part of this architecture; the model was post-processed with texture mapping technology, environmental and illumination simulation, to generate single frames of interior and exterior views for comparing with the traditional watercolors by the architect. Then all the frames were mounted to realize a video animation to present the work.

The expected results were essentially in the field of graphic representation and communication, not only to show the images and the animation during presentations and public exhibitions, but above all to offer to historians and specialists some further information to add to the traditional ones taken from the Wright’s archive, to understand better the real impact of it on this fragile context.

In particular the method we used in this case is based on some experiences developed before for some architectures, but it serves as a test for some others that could be designed in the difficult area of Venice. The monographic approach of the problem is intended to describe the complexity of the single case, due to the richness of this design, as the whole elements were considered during the phase of study.

VENICE, THE CONTEMPORARY ARCHITECTURES AND FRANK L. WRIGHT
The town of Venice has a bad relation with contemporary architecture. A lot of works, designed in XX Century by relevant architects were never built due, mainly, to the very problematic aspects of the context. We would like to remember only some of them, that it is possible to find in a catalogue of an exhibition which took place in Venice in 1985, called “Le Venezie Possibili” (Puppi, Romanelli, 1985). We can remember the Hospital designed by Le Corbusier in 1964, the Congress Building for the Giardini and Arsenale areas by Louis I. Kahn, designed between 1968 and 1974, and recently the competition winner project for Piazzale Roma by Jeremy Dixon and Edward Jones, in 1992, or the Frank Gehry solution for the Marco Polo Airport, proposed in 1998.

Among these, the project thought by Frank L. Wright was the most careful to the environment. Not only because it was the smallest one, but also because - in the beginning - it should have been a private house for a young couple, and not a public building for institutions, such as those listed before. Then there are some other differences among the preceding ones and the Wright one: for example, it was designed before them - in 1953-54 - on a small triangular area, between two historical palaces. Moreover Wright himself was conscious of the particular opportunity it was offered to him and decided

Figure 1
The waterfront of the area for the Masieri Memorial in Venice.
to propose a design that consider the environment, with all the natural and artificial effects (from the water of the canal, to the multi-windows system of the venetian façades). In fact the project had some different levels of study, with small changes, especially in the configuration of the front elevation on the water canal.

THE EVOLUTION OF THE IDEA OF THE PROJECT

The history of the project was known. In 1951 Angelo Masieri asked Frank L. Wright to project his house on the Canal Grande, instead of an unfinished house, during a meeting in Venice in which the University of Venice gave the Honoris Causa Degree to the famous architect. Wright accepted the proposal and they were in agreement to see again for defining the details of the program. But when Angelo and his wife Savina went to the United States to speak directly to Wright in his studio, a road-accident modified the plan of the trip. Angelo died and Savina decided to change the program of the project. His wife decided to transform the initial idea for a private house in a hostel for students of the Faculty of Architecture. Wright agreed with the new proposal and started working to define different hypothesis, starting from 1953. In fact in a letter to Savina the architect wrote some general ideas of the project: “...the building affords views up and down the canal where no one in Venice ever looked out before - two corners of the room. This is modern; so are all the techniques. Alongside these corner features, a glass lighting feature rises - lighting outside and inside by way of neon tubes (low candlepower) when appropriate. [...] The material I’ve selected for your approval is a thin marble slab with edges each way. [...] The floors are concrete suspended from the roof beams by iron rods concealed in the partitions. The roof is a garden” (AAVV 1988). In these words are concentrated all the main thoughts of the author, to interpret the site of Venice with this house. It is interesting to note that these considerations remained the same in all the variations he did. We have identified three particular solutions to develop the research on the digital representation. In detail these are: the one produced in January 1953, the second one in February 1953 and the third one in March 1954. Some elements changed - such as the position of a small tower or the quantity of windows in the front elevation. But, as we said before, the most important concept remained. As he wrote in a letter of presentation of the project “in the small building that I designed thin marble sticks firmly fixed on concrete pillars from the canal rise from the water such as canes, or stems of rice, or water plants. These marble pilasters rise to support the floor and the slabs of the balcony floor overhanging the water. How much more Venetian! Not imitation, but interpretation of Venice.” (AAVV 1988). These parts are shown very well in the first perspective, in which some details are expressed.

Figure 2
The triangular area for the project in Venice.
with notes and sketches near the drawing. Although it is not clearly defined in all the particular components of the block, the scheme of the final project is well configured, with some plants and flowers that enrich the balconies.

The second solution has some differences from the preceding one, such as the position of the tower that is moved from left to right in the façade. The structure of the plan was not changed a lot, having both of them a squared grid of 1.9 m for side. The drawings are well defined and a very beautiful perspective was drawn to show the impact of the building in the area. But this perspective presents a mistake in the composition. In fact, as you can see from the comparison between it and the digital reconstruction (see figure 8), the height of the building is figured as the same of Palazzo Balbi. On the contrary, thanks to the digital simulation, we could verify that they are very different in height, and the Masieri Memorial is much lower than the Venetian Palace. This representation mistake was fatal for the lucky of the project, because when it was presented publicly it generated a refusal by the Venetian people, who thought that Wright wanted to build a skyscraper in Venice.

In the third solution the tower remains in the same position as the preceding one, but the grid is smaller. In fact the plans are divided in a series of squares of 1.2 m of side. So it is possible to have a much bigger space for the structural elements. We can notice that Wright, as in other projects, works with regular geometries based on simple figures. In this case the area is triangular and the grid is squared.

**THE DIGITAL RECONSTRUCTION**

Starting from the sketches, drawings, notes and above all the geometrical analysis of the three solutions, we decided to generate three digital models of them in order to verify the different hypothesis and compare them. We use a CAD system with extrude primitives and Boolean modeling. Every part of the architectures are constructed in detail at the scale of 1:1, to define in the best way the singularity of all the elements. At the same time we started from the plan and the elevation, trying to combine the two sections (horizontal and vertical one) in a 3D form.

Some problems were found in the construction of the staircase, because we didn’t have all the information we need. The logic of the construction itself helped us to resolve some questions as if we were at Wright Studio, thinking about the possible solutions he would have preferred. Every detail was taken from the archive of architect’s drawings of this project, and, if it was not possible to find one, we tried to take it from the general Wright Archive, considering that he
used a lot of typical elements in some of his designs. The result was a three-dimensional model for every solutions, rich of the architectural details required.

The further step was to model the main buildings of the area, to verify the visualization impact on the Canal Grande. In this case we used a double strategy: in the case of Palazzo Balbi we reconstruct in 3D the palace because of its proximity to the Masieri Memorial. Then it was possible to verify the natural illumination in a photographic manner, thanks to rendering techniques offered by the simulation algorithm of sun exposition.

For other buildings we decide to generate only a simple stereometric volume and apply the texture of the picture taken from a camera on it. This method has two benefits: to simplify the construction of the building itself, and to speed the operations of rendering and above all of generating the single frame for the final video.

The comparison between models allow us to understand better the evolution of the idea of the project, where the high tower to the left is moved to the right for having a better contact with the Palazzo Balbi. A rendering without color help us to comprehend better the articulation of the volume of the project, so we decided to concentrate to the most interesting solution, that is the second one, to generate the video animation.

After the construction phase we passed to the materials simulation. Thanks to the information from the Wright Foundations and from some other institutions we had a very specific information about the materials Wright intended to use. For the façade the main one is the white marble with black streaks. So we applied the texture to the whole façade, while for the windows frames we used a brown color to simulate the wood. Then we decided to exclude from the rendering all the vegetation, to reduce time computing.

The final rendering could be compared to the watercolor by Frank L. Wright, and, as we said before, the differences between them are very impressive. The mistake we talked about comes with great relevance.

As there aren't a lot of information about interior furnitures, we let the space empty. Only the white marble was used for the floor and for pilasters. The other part of the walls are in Venetian white marble plaster.

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Figure 6
Digital reconstruction of the model (elab. F. Cuzzuol).

Figure 7
Comparison between the three solutions (elab. F. Cuzzuol).
The final step of the visual reconstruction was the realization of a video animation. In this case we used the second solution of the project (February 1953) because of the richness of the details. The idea was to view this architecture staying on a boat on the Canal Grande, approaching slowly to the building in order to perceive the impact of it.

Using the technology of post-processing software, we utilized sequences fading to see it from different points of view, from the Accademia Bridge, from the Rio Novo, from the street.

Then we entered the foyer to see Venice from the windows, where we made also the verification of the sun illumination inside this space.

THE RAPID PROTOTYPING MODEL
After the visual communication phase, we wanted to verify the physical aspect of the project. But, instead of having the whole repetition of it, we decided to analyze only the most interesting part, that is the façade. The technology used was based on the solidification of nylon powder, thanks to a laser radiation, called SLS (Selective Laser Sintering), that works taking information from a 3D digital model, section by section. The accuracy of the machine is one tenth of a millimeter, and the scale of the model was 1:100. So we obtained a very exhaustive reproduction that could help us to understand better the configuration of the architecture itself.

CONCLUSION
This research shows the advantages in using digital technology to verify the impact of a building on a problematic area such as the town of Venice. Although the project will never built, the procedure could be used also in some other cases, such as...
during the verification of a design before its construction. Then it is possible to use some procedures to realize some communication projects, such as video presentations, models for exhibitions, etc.

We want to underline that it is very important to concentrate different levels of information in a single program of research, starting from the consultation of archives and catalogues, to the analysis of drawings, from the geometrical studies to the digital modeling construction, from the photorealistic simulation, to the direction of a video.

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