Virtual Technologies for Archaeological Studies of Nolla's Ceramic Mosaics

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Along with the success of the second Spanish Industrial Revolution, it was established one of the most important ceramics factories in Europe specialized in high resistance and quality floor tile. The great Royal Families of the moment such as Amadeo de Saboya (king of Spain), Imperial Hohenzollern family, Romanov (Imperial Russian family) and general Prim, came around to its installations for decorating their palaces, as well for composing part of some emblematic buildings such as Moscow's underground or Gaudi's Casa Batlló. They even stayed at the house that the proprietor owned into the industrial complex: the Palauet Nolla.

This house could be considered as the ancestor of the current "showroom", since like a sampler, all the floors, skirt boards and façades of the building were decorated with the most bold and striking compositions that this ceramic tiles (tesseras) permitted. The most brilliant creativity is shown through the design of these amazing compositions whose image is unmistakable.

During the last 2010, there has been elaborated a wide and complex study of the above mentioned building, warning that it was long ago an ancient convent of the XVI century, to achieve his initiation to protect it from the abandon suffered during the last 50 years. The great patrimonial value of the house rests on his ceramic decorations, very damaged and pillaged compositions with the passage of time, but possible of recovering and restoring.

This paper proposes the presentation of the methodology applied to get a trustworthy metric elevation of the building container as well as the ceramic compositions.

Documentation and detailed study of the tesseras (tesellas) have helped ensuring a high quality 3D with application of techniques and materials low cost. The result is a return to the golden period for the recognized Palauet Nolla.

Ceramic tiles. Industrial heritage. Virtual restoration. Low cost. Nolla.

1. INTRODUCTION

By the mid-nineteenth century, a floor tiles factory, which will have a key role in the Spanish Industrial History, is set at the small town of Meliana. It was built over some arable lands from *Valencian huerta* (fields), where an old seventeenth century *alquería* was placed. Since then, the building will become the emblem on this industry, and will be known as the *Palauet Nolla*.

In 1860, Miguel Nolla Bruixet begins the construction of a factory complex devoted to the production of a sort of ceramics inspired by the English models of Mintons, but above all by Maw's ones. From the latter, the businessman would import the production process, but also its designs, artistic influences and catalogues, getting inspiration even from its architecture.

This factory in Meliana has a fundamental historical significance, since it is one of the first and most important industries to promote the Second Industrial Revolution in Valencia and in Spain. In spite of the change in ownership and production in the early twentieth century, the original installation will remain in use until today.

Figure 1: *General view in 1920*

In order to start the commercialization of its products, Miguel Nolla weaves a customer network among the highest society of the time. King Amadeo I and King Alfonso XII, the Romanov and Hohenzollern families (from Russia and Deutschland respectively), the General Prim, the tenor Gayarre, the poet Querol and many others visit the factory in Meliana, and enjoy staying at Palauet Nolla, which had become a full-scale sampler of the unique possibilities offered by ceramic tiles. The building showed the finest compositions made possible by the product on all its floors, skirting boards and even façades.

The passage of time, and the carelessness of the building since 1968, has led Palauet to its current advanced state of deterioration, what seriously endangers its preservation in the short term. This would mean the passing of a top notch artistic and historical legacy, as well as losing a part of the identity of Meliana and its inhabitants, as there isn't a family without a link with this factory.

With the aim to undertake the renovation of Palauet Nolla, Meliana Town Council commissioned a thorough study of the building. The aim of this work is to know the extension of the ceramic tile decoration that the property houses, but also its historical and physical reality, and its state of conservation, always looking at the eventual restoration of the monument.

2. PALAUET NOLLA AND ITS HISTORY

The current building is the result of a constructive sequence whose origin goes back to early seventeenth century, when a huge alquería was risen at northern Valencian Huerta. This construction, of outstanding quality, will be purchased by the Sagrera family in 1844, as a consequence of the seizure, and it was intermediately transformed into a country house. For such purpose, the inner volume was modified, dividing the wide warehousing room at the first floor in two storeys, and altering façade openings in turn. During the same action the existing tower was extended.

Miguel Nolla, who married Juana Sagrera in 1939, made use of this family property in 1860, in order to develop his business project and turned the existing building into a showroom.

3. METRIC SURVEY

The first stage in the study of an existing building is the metric survey, what provides a two-dimensional representation. For such purpose, our company uses a system developed by Professor Jacques Rosier, from Egleton Institute (in France). This system allows generate high accuracy drawings very fast and at low cost. This technique is based in a simple concept, although its correct use requires certain practice. Despite its simplicity and flexibility, it is extremely effective and precise, since it uses a device – exclusively made for it- which incorporates a laser distance meter, in our case we used DISTOTM D5 model from Leica®. The said device consists of four basic parts: a fully adjustable tripod, a board where the sheet of paper is placed, the rotary base that holds the distance meter and a ruler, and finally the laser itself.

The use of this device provides a plan to scale of any element being surveyed, as floor plans as sections. It is a very economic method, since it only needs a start-up capital for the acquisition of the distance meter and the assembling of the base. Afterwards, it provides a lot of flexibility since it is possible to use it anywhere and for any sort of

surveys, as electricity is not required and the small size and lightness of all its elements make it easily transportable. Furthermore, the system allows that just one person makes any kind of metric surveys, without needing any other technicians and in quite a short time.

Once the whole surveys are done, the process of digital conversion starts separately. First the drawings are scanned and vectorized using CAD software, later they are merged and definitely adjusted.

In the course of the years using this system, the degree of accuracy observed is lower than a centimetre, considering a maximum margin of error that ranges between 2 and 5 centimetres in cases where the element surveyed is of high complexity and size. This technique permits even to detect small amplitude movements, for instance in vertical faces, without needing a 3D laser scanner.

In the issue at hand, the Palauet Nolla in Meliana, this system has been used with very satisfactory results. It confirmed the verticality of the tower and the perimeter walls, and noticed the deformations in each part of the two slabs of the building. It is essential to count on this kind of information in order to define the actual deterioration of the structures and, consequently, suggest the actions to be done for undertaking the restoration of the building. In this case, the maximum level of error was lower than 2cm for distances over 20m.

Apart from the survey of the main body of the building, all particular elements, constructive and decorative one, have been documented. That includes paints, mouldings, carpentries, wallpapers and ceilings. This task has a double objective. The first one is to have exhaustive knowledge of every element that makes up the monument, as from a researching approach as for having the necessary information when developing the restoration project. The second objective is making a 3D model of the building that includes all the characteristic elements, with the purpose of getting a real and complete image of its original state.

Figure 2: *Current state of mosaic composition*

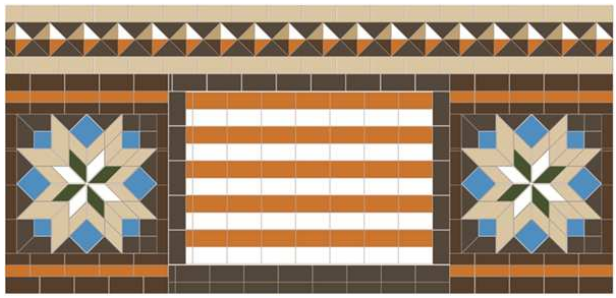

Figure 3: *Restitution in CAD*

4. PHOTOGRAMMETRY

One of the tasks that should be done during the study of a historical building is the photogrammetric correction of external and internal vertical faces. The resulting image constitutes a fundamental grounding, since it is used to both to trace the elevations and to draw any particular and decorative element. But above all, it is useful for reflecting the pathologies that the building is bearing in corresponding sheets.

In the case of the photogrammetric correction for the Palauet Nolla it was resorted to a “handicraft” technique. These works were done without specific software or devices, as they were too expensive for the promoter to afford. The photogrammetry applied in the issue at hand is based on two stages: data collection in situ and its later processing at the office.

The first phase is, therefore, collecting data. To that end, all faces to be rectified were photographed. Each plane that composes a face is taken independently picture because the following computer processing doesn't regard volumes, as we will explain below. At the same time, some reference points are gathered on the façades, using a complete laser station. They will be used to introduce the coordinates of the reference points

for the correction of the images. They are transcribed on a photograph or a schematic drawing. For this reason it is important always choosing easily identifiable points. It is necessary taking at least four reference points per photography.

The second step is the computer processing of the images. The coordinates of the reference points are introduced into the digital image rectifier – in this case ASRix 2.0® – and then the image correction starts, getting the image of the face in real extent, It should be taken into account from the beginning if it is necessary to join some pictures for recomposing the image and take some reference points corresponding between the images to be joined.

This simple system is more laborious than using specific techniques and instruments, but it makes possible that the works could be made not necessarily by specialist technicians, what means an important economical saving.

5. REALIZATION OF THE VIRTUAL RESTORATION OF THE BUILDING

To carry out the virtual restoration of the building was used three computing applications Autocad® (CAD), 3dStudio® (3DS) and Photoshop®, optimizing the resources that each one offers.

Given the scope of work, it has addressed the virtualization of the building from three scales with three different levels of definition.

- Complete building.
  Both from the point of view of the complete virtual restoration of the building to the performance of simple schemes to observe all the various proceedings to which the property has been subjected.
- Singular elements.
  Virtual restitution high level of characteristic's detail of the building elements such as porches, stairs and observation tower.
- Decorative details.
  Definition in 3d of complex decorative elements such as mouldings and pilasters.

The process followed for the implementation of the virtual image is similar in all cases.

(i) Based on the survey conducted by 2D photogrammetry have been drawn using CAD 3D geometries that form the basic parts (structural elements) and more complex geometry elements (cornices, arches, woodwork, mouldings, ...)

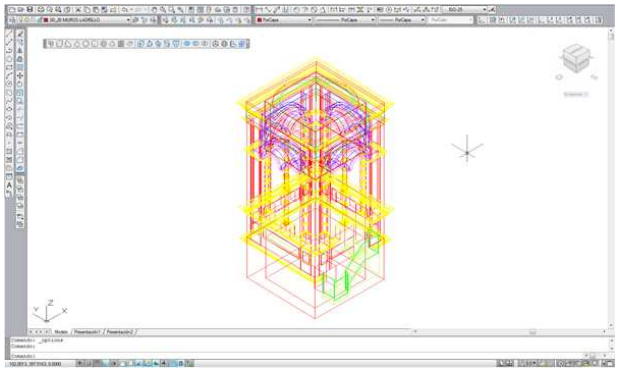

Figure 4: *CAD capture*

(ii) Subsequently made this drawing in Autocad® is imported into 3DS where it fits the geometry of some of the elements to achieve greater degree of reality and similarity to the original model. Other minor elements of easier volume, as pinnacles or geometric decorative details are drawn directly from 3DS, as if run CAD, the amount had been converted into a faceted surface, while we get to do it in more smoothing 3DS on their faces and a spherical appearance.

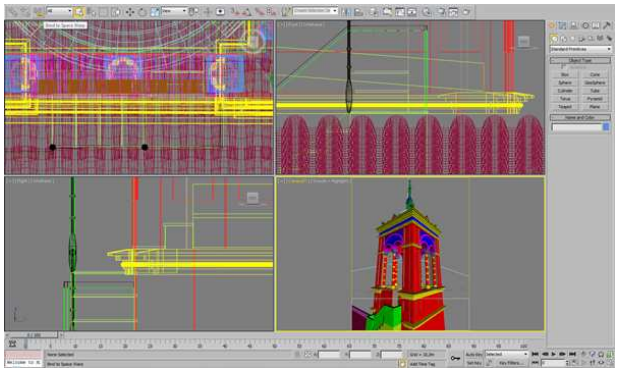

Figure 5: *3DS capture*

(iii) For the allocation of material, have been isolated from the faces of the elements in terms of mapping to be applied in each in order to adjust it and give it realism.

Meanwhile for the decorative details with a highest degree of geometric complexity has opted for a simple volumetric interpretation of them to subsequently apply a mapping where the image is used a photograph of the item and corrected and as bump map an image retouched by Photoshop to get part of the relief of the piece.

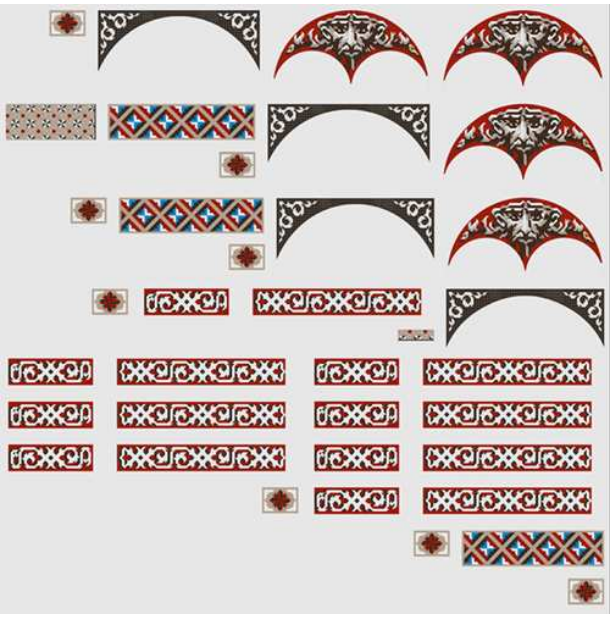

Figure 6: *Mosaic compositions map for 3DS*

After that it is explained in detail the process for conducting the observation tower (miramar), it is useful to understand the general process used and the resolution of problems encountered when building the 3D model of the building.

The main body, made in brickwork, which extends from the top to the bottom ledge of the tower plastered, arches, columns and cornices and decorative elements have been modelled in 3D CAD based on the 2D model established by the survey. This geometric model has been imported into the program 3DS 2010, is in this application where end computing to model and apply materials to obtain the virtual image. On 3DS, the geometry that had been simplified or deformated during import was retouched and restored, as is the case of arches, which when imported from CAD, 3ds transforms and simplifies polygonal geometry. Subsequently it has drawn the inner and outer shells of the dome and decorative elements of simple geometry such as the pinnacles and the needle, made by parallelepipeds and spheres. These items are made directly in 3ds for two main reasons, firstly are simple geometric elements and rapid implementation, and secondly, the 3ds directly geometrize the program works better with them and we avoid deformation when imported from AutoCAD®, and that the process of touching up the same would be complex and costly.

Figure 7: *Tower views; 1920 – 2011 – virtual restitution*

After drawing all the elements that make up the observation tower materials applied to them. In this case, since the objective was to obtain a virtual model as a real element and since this has lots of pieces of mosaic was decided to use an unwrap UVW mapped in most of the material assignments. Using this tool allowed us to adjust in each of the polygons or faces in which the program breaks down the exact volume image accordingly. The same tool was also the one used to assign each of the cloths for the mosaic ceramic decoration.

To locate these images in the panels as well as for digital treatment and reintegration colour of the tiles was used Photoshop. This software application is assembled, based on the unwrap UVW mapped

obtained, the fingerprints of the mosaics and ground photographs of certain materials. Due to the rigorous geometric architectural elements as well as the decorative elements based on mosaic. The maps obtained from the mosaic fit perfectly with polygons or faces obtained by the UVW unwrap tool.

For the allocation of materiality in the cornices, which given its geometry is not going to assess in detail the material, the tool has been used UVW map using a specific map.

For the rosettes that up with 3 pieces of fired ceramic with extremely complex geometry, we chose to assign as a rectified image map and processed digitally using Photoshop on a discretization of the geometry that forms the piece. To give it depth and realism has applied a bump made from rectified image and treated in the original piece.

We found different difficulties in making the 3D model of the building, the most important was because of the large amount of tile that has as it adapts well to flat surfaces as curves. Along with the complication of getting the 2d survey of the actual mapped mosaic obtained with appropriate chromatic reintegration, making these fit curved surfaces has been an added difficulty.

Moreover, the decorative elements of complex geometry are treated individually. Moulded cornices, balusters of the railing, etc. are drawn in detail in 2d and 3d but these images have been used for descriptive sheets, since its incorporation in detail in the graphics would not provide quality general and dilate times rendering.

All operations were aimed at obtaining a high precision model, which reinstated the building to scale 1:1 and this allowed to know and to understand the *Palauet Nolla* and construction process.

6. APPLICATION AND USE

The simultaneous realization of 2D and 3D surveys is key to the methodology used to research the building, and allowed us to find out information or contrasting part of what was available, such as the sequencing and construction process in the implementation of certain structural or decorative elements. In the case of the dome of miralmar allowed us to learn the process of placing mosaic shell of the dome through the completion of mapping it.

Figure 8: *Palauet Nolla 1920*

Figure 9: *Palauet Nolla 2011*

Figure 10: *Palauet Nolla virtual restitution*

3D geometrization of certain objects, allows the compression of elements difficult to express in 2d and attach these images to the descriptive sheets, such as ceramic tile, which formalizes the channel

or some of the mouldings, whose geometry is particularly difficult expressed in 2D.

Cooperation of the uprising in 2D and 3D representation allows the building in its entirety in a simple, affordable and understandable to anyone who comes to his study. The virtual representation of the building, we can also get an idea of the appearance of Palauet Nolla at its greatest splendour.

7. CONCLUSION

The Palauet Nolla is a building which, despite of his relative volumetric simplicity, offers a great complexity in the way to represent it, in two or three dimensions, considering the important number of decorative elements which represent the main part of its interest.

Taken into account the magnitude of the work that means such developed studio of a very characteristic building and the limited economical and temporal possibilities of the promoting organization, it is evident that appealing to techniques that offer a high level of accuracy while reduced costs, like the case of Palauet Nolla, has been the key to make possible the viability of this initiative.

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