

THE USE OF 3D SCANNING AND PRINTING IN THE RESTORATION PROCESS OF THE EXPOSED CERAMIC PANELS OF JORGE BARRADAS (PALÁCIO DA JUSTIÇA DE LISBOA)

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ABSTRACT

The techniques applied to restore and conserve the 16 ceramic panels which are an integral part the façade of the Palácio da Justiça's South Building, in Lisbon (authored by Jorge Barradas, Querubim Lapa and Júlio Resende), was marked by the adoption of disruptive technology as one of the main methods of approaching the pieces in need of intervention. Different materials and techniques, both digital and manual, either from physical or aesthetic perspectives, guaranteed their future preservation. Following principles of restoration ethics, photographic references of the compositions served as a goal to assimilate the original work as much as possible.

Recurring missing parts were then to be reconstructed by means of 3D scanning and current object printing technology. Such technique allows a preview and manipulation through specific computer software. Once the file has been completed with all the information necessary to produce the object, it can be sent directly to a 3D printer.

The main objective of intervening Jorge Barradas' panels with 3D printed objects, was to replace large

key pieces in a non-intrusive way and without damaging the original work. Simultaneously, in addition to the durability of such printed materials, a "life insurance" is created in case of any damage or theft, since it can be replicated quickly from the thorough scan, stored in a digital file format.

Keywords

Conservation and restoration; 3D scanning and printing; Exposed ceramic plates; Replicas.

1. INTRODUCTION

The present work focuses on the restoration and conservation methods carried out on 16 panels of ceramic slabs in relief, with an area of 12 m² each, arranged along the exterior gallery of the Palácio da Justiça's South Building, in Lisbon, built in 1970.

This intervention took place in 2020 and was carried out in partnership between the Câmara Municipal de Lisboa (CML) and 3Dlife Tridimensional Print. A multidisciplinary team

was then formed, consisting of two conservators-restorers, a technical assistant in conservation and restoration and a designer, an engineer, and an historian.

The panels which underwent said intervention, had their missing areas rebuilt. Based on fragments of the original pieces and the more recent photographic documents available from the building's construction period, several distinct methods were applied to be well succeeded.

For instances: Jorge Barradas' compositions, with large sized pieces, presented the greatest damage, even the total loss of some elements. This meant adding the option of a viable way of replacing damaged elements - which happened to be in a consistent routine of being exposed to less proper (or involuntary) accidents.

Still in our recent collective memory, one can recall the reconstruction of 28 Pompeii statues through 3D printing. Hiltrud Schinzel had already set the tone, by means of reflecting upon the need to be open to the immense possibilities of technological driven modern times (Schinzel & Huisgen, p. 27, 2003). Mentioning that restorations and conservation techniques are narrowed to the same techniques of the remote times in which they were conceived, contemporary art has presented itself with new challenges which open way to embrace the technological bursts of our century. But does this imply that digital technology is anachronical and therefore should be avoided, when used to restore pieces prior to its existence? We argue it should be embraced with all the responsibility it encompasses. Therefore, seeking to contribute and reflect upon the use of new technologies and materials, we will provide theory and evidence towards its validity as a new conserving and restoring approach to the preservation of cultural heritage.

1.1 Historical Context

Institutional functions at the Palácio da Justiça de Lisboa as a Judicial Court began on September 30,

1970. This coincided with the final cycle of the Estado Novo (New State) before Portugal's transition into representative democracy. Long-time symbolic authoritarian leader, Oliveira Salazar, had passed away earlier the same year of the building's completion.

The first negotiations for the buildings' projection date back to the late 50s, although, only in 1965 would the project be firmly taken into fruition. Going back to 1958, when Architects João de Melo Bryner Andersen and Januário Godinho were hired by the Ministry of Obras Públicas (public infrastructures development), through its Directorate-General for Edifícios e Monumentos Nacionais (national monuments and buildings), Architect Carlos Chambers Ramos, then director of the Escola de Belas Artes do Porto, was also included in the project, as a coordinator between said designers and the CML (Santana & Sucena, p. 942, 1994).

When it began being conceived, four buildings were to be built at Rua Marquês de Fronteira: Superior Courts, Civil Court, Criminal Court and Police and Penal Execution Courts. Despite this, only two buildings were seen through completion: the Civil Court and the Police and Execution Court.

The South Building remains an imposing modernist construction of judicial-driven architecture, with a rectangular layout and straight, heavy lines (a characteristic of the Estado Novo's architecture). It consists of four bodies, separated by transverse joints, and structured by a grid, framed in reinforced concrete.

The responsible architects who participated in the project were: Januário Godinho de Almeida (1962); João Henrique de Melo Breyner Andresen (1962); Raul Lino (artistic coordinator) and José Luís da Cruz Amorim (furniture).

In 1967, Architect Raul Lino became responsible for coordinating the artistic commission of the project. The vision was to incorporate artwork into the building. Such task was distributed among three ceramic Artists: Jorge Barradas (1894-1971), Querubim Lapa (1925-2016) and Júlio Resende (1917-2011).

1.2 The Ceramic Panels

At the invitation of Architect Raul Lino (responsible for the artistic program at the Palácio da Justiça, three of the most important Portuguese ceramic Artists designed and produced 16 large-scale panels to decorate the gallery of the mentioned south building. The commissioned works were as follows: Querubim Lapa contributed six panels, entitled "Adão e Eva expulsos do Paraíso", "O Direito que possibilita a Paz entre os Homens e a suas glórias", "Criação de um Código", "A prática da Justiça apoiada no Direito", "Espírito da Ordem" and "Temperança"; to Júlio Resende, six panels were also commissioned, entitled "Sapiência", "Verdade", "Fortaleza", "Serenidade", "Temperança" and "Prudência"; lastly, Jorge Barradas completed, in 1969, four panels, entitled "A Justiça", "O Juíz de Fora", "O Código" and "A Balança".

Concerning the relief tile panels, researcher José Meco refers, in his book "Azulejaria Portuguesa" (José Meco, 1992, p. 87), that Jorge Barradas began a more serious shift into the ceramic art tile medium in 1944. Meco considers his early work to be too ambiguous and inconsistent in his attempt to merge modern traits with a more traditional approach to the *Azulejo* (Portuguese art tiles). Later, although, the Palácio de Justiça de Ovar (with its altar patterns), the relief panels from the Church of Parede, or the panels from the Palácio da Justiça de Lisboa, saw a more mature Artist emerge in respect to his chosen ceramic medium, albeit perhaps, not being as influential, through the years, as his more direct peers.

2. ADOPTED METHODS & PRACTICES FOR THE CONSERVATION AND RESTORATION PROCESS

Following Buys & Oakley's statement - "Science can help conservators to understand the properties of materials and possible ways to modify them, but only conservators can invent recipes for combinations of



Figure 1 – “O Juíz de Fora” (before and after): the main missing elements were the spike at the top left of the composition, and the judge's scepter.

materials adapted for specific treatment problems. new application methods are often required as well” (Buys & Oakley, 2007, p. 333-334) - the referred 16 compositions were intervened through various conservation and restoration techniques - manual and digital - with various materials serving as resource. The aim was to reconstruct missing areas and elements, based on original fragments and available photographic documents to be used as a reliable source. Therefore, from Appelbaum - “A fundamental issue facing conservators is whether to use treatment materials that are the same as original materials or different. The decision is often made *a priori* rather than on a case-by-case basis and seems, in fact, to be characteristic of certain schools or styles of conservation” (Appelbaum, 2010, p. 329-330) – our team consensually opted for the adoption of recent disruptive technologies to aid a more traditional methodology, based on the scenario that was put before us. Further below, we will address possible ethical concerns.

In the essence of our choice, the Jorge Barradas panels presented greater damage when compared to the other ones. This reason, above all, is the centre of our decision to embrace newer methods of restoration. Barradas’ compositions, due to unfortunate and unpredictable events, were more exposed to either involuntary risk, negligent actions or even acts of vandalism. We then settled that speculating on potential causes of distinct damages would have no productive outcome. On the other hand, the recurrence of such damaging events gave us only one certainty: the total loss of some major elements in the Artists’ original work.

While, for the reproduction of the Judge's Scepter, handcrafted pine with fire finishing, along with Jewish putty and glossy spray varnish were used; to produce the remaining elements, a consensual option favoured the use of 3D printing technology.

Producing the left spike meant having a 360° scan of the similar opposite element, undamaged, and still part of the composition. Such was obtained by a hand-held 3D scanner. Later rendering the data through the *Solidworks* software, the three-dimensional reconstruction was calibrated further with parameters such as dimensions, thickness, density, and execution speed. Once these parameters were defined, the information was converted into an



Figure 2 – “A Balança” (before and after): the missing elements were the third lock of both chains holding the Justice scale. The three-dimensional reconstructions were designed from original fragments that had been collected, and from photographic sources featured on the book "Palácio da Justiça, Civil Court and Courts of Police and Execution of Sentences" from 1970.



Figure 3 – Detail of the original “chains” holding the scales.

executable file, sent directly to the 3D printer. The object was then printed in monocolour PLA-N, a composite of plastic with nylon, in a construction process led by the successive addition of layers, which form a three-dimensional object. The interior body of the 3D printed objects consisted of a cross structure of light trusses, which gave them the desired lightness and strength, while the external wall was denser.

After printing, the object is completed by means of handcrafting texture and paint, thus faithfully replicating the original piece. The handcraft process is meticulous once the piece completes its 3D printing phase. A designer artist manually obtains the desired texture, through the addition of acrylic resins, whilst polishing it with sandpaper. After this “modelling” development, painting ensued. The monochromatic object (the replica) underwent the application of oil paint, used in conjunction with acrylic paint. Afterwards, they are bonded with acrylic resin to

obtain the desired texture. The process is then finished with a UV protective film.

Due to the nature and frequent use of such public space, it was decided (with unanimous approval within the restoration team) that the main goal was to serve the unknown majority: the common bystanders of the area, potential untrained observers. Through an imperceptible use of restorative techniques, it was opted to favour a broader sense of cohesion between all parts of the set. Yet, for the specialist’s clinical eye, a clear distinction between the restored part and the original work is evident, therefore elevating, primarily, the Artist & Author.

These small yet striking details which are seen in the replicas, were also made by the designer artist’s mimetic painting. Such technique, precise and extremely meticulous, consisted of chromatic reintegration, aiming to re-establish an approximation to the original pieces’ traces, singular to the Artist. A full manual reconstruction of the missing parts was seen through after the 3D printed raw object was obtained. As a non-destructive manual technique, reversible materials were used to perform the much-needed rigorous task. It brought the result closer to the artist’s pictorial and stylistic techniques. This thought-out option was provided within similar thought patterns as observed on several Jorge Barradas’ pieces. Such minute technique had as end goal to not only identify the watermark of his style, but to authentically preserve it.

Therefore, adapted from tested and established theory (Bailão, 2015, p. 261), we opted for the mimetic method, which should follow clear guidelines, such as: preserving any existing formal and chromatic reference of the original work; resorting to photographic or graphic documentation as possible; gathering as many technical studies as possible of the materials before they are applied. Information obtained should provide the hues to be reproduced, the location of shadows, lights, and volumes, as well as the type of perspective (or anatomy, when applied). Studying rigorously the materials, will then allow for the best use of pigments, binders, solvents, and varnishes – as suitable for each singular Artists’ work.

When carefully observed, a constant trait emerges from the ceramic production of Jorge Barradas

(Oliveira, 2016, p. 38-39; p. 5-9 from *Annex II*). On certain pieces from the Artist, the top surface of his tile work is filled with small circles, made on a “dirty” white background which overlaps the glaze with another “cleaner” white. Such convolutions are present in almost all tiles and cover the entire bottom of panels. Yet, the white background is not obtained directly from semi-industrial enamel, although it may appear so, but with a white sprinkled with a dark pigment using a sieve. By circling the rounded and blunt end of a brush handle (in this case with a diameter of 2 mm), this dirty white, from afar, gives a cloudy and smoky background. Such are some examples of source validation, through which minute details underwent, to achieve results that were rigorously faithful to what had been identified on the original pieces.

2.1 Replicas: Scanning & Printing

The production of replicas in 3D printing derives from the previous mapping of the specific part (through a 3D scanner). Depending on the nature of this specific object, mapping is carried out in a laboratory/studio environment, or, in alternative, by a handheld scanner.

Our intervention benefited from the fact that the pieces which needed reproduction, had a direct match with the intact opposite pair - the left spike of the “O Juíz de Fora” panel - and the remaining damaged fragments of the scale’s chains (from the panel “Balança”). In both situations, a handheld scanner was used to map these objects, allowing the data to shape virtual objects worthy of correspondence to the authentic parts.

Through a sweeping action, this handheld electronic device shoots seven crosswise laser beams, capable of collecting up to 480,000 measurements per second, thus producing a detailed digital image, with a margin error of 64 microns (less than a strand of hair).

In addition to obtaining an incredibly accurate image of each component, the equipment also records the exact placement of three-dimensional parts. All this information is converted into computer files, which can be used as many times as necessary during the hopefully enduring life of the art piece.

After a specific part has been mapped and converted into a file, the digital object is processed in a through specific software. This allows for the density of the materials and the printing speed to be calculated and defined, according to the functions and objectives we set for the part. Once the file is rendered, it is sent directly to a 3D printer, and becomes a physical object.

Before the final part of this process, a prototype is produced to ensure a reliable compatibility with the intended design. Once this certainty is consensual among the team, does the final version go into production.

The new parts were assembled using neutral silicone, after insulating the contact points of the original parts with acrylic resin. We proceeded to paint, perfecting the replica to blend in the original panels. It is from this combination of technology and craftsmanship, between digital processes, 3D printing and bioplastic, which new approaches and different dynamics rise in favour of complementary objectives: not only the preservation of cultural heritage (in a lasting way), but also in a fast, sustainable, and economical way.

3. FINAL CONSIDERATIONS

As expected, conducting this project through digital fabrication, by means of 3D printing with PLA-N (nylon) as the main material, as well as combining modern technology with manual artistry, produced results in which so far, everyone involved was pleased, as would consider it a viable option in future conservation and restoration interventions were economical and undistinguishable replicas are needed.

With just one layer of printing, the possibility to manually shape a replica are endless, due to the tension and curves made possible by the material, thus becoming a structural part of the pieces’ success.

3.1 Ethical concerns: memory, ecological sustainability & cultural heritage

Before we conclude, addressing poignant concerns of ethical nature are essential.

On one hand, clearly, the use of plastic can be seen as a devaluation of the original intervened pieces. Let us say that each scenario would have a different outcome, and good sense, in this scenario, led us to believe that repairing damaged materials in the truest form of authenticity could never make stolen/damaged parts rematerialize into existence, but would also result in futile taxpayer paid costs of restoration, with no guarantees of achieving better results than our multidisciplinary teamwork. Even if the costs for a single use, now, are still higher than traditional methods, we foresee a saving on the long run.

The area in question, nearby Lisbon's Penitentiary, as well as the nature of judicial court rulings, made these works of art vulnerable and exposed to involuntary and voluntary risks. Therefore, to preserve, as Pierre Nora would say, such example of a place in our collective/national memory (Pierre Nora, 2008, p. 33), such pondering did, indeed, take place. As a team, we stand by our collective choice.

On the other hand, and rather briefly, concerning the use of plastic as counterargument. The ecological crisis of our planet centres on the elimination of single-use plastics massively consumed and discarded daily. Therefore, plastic by itself, is not the problem. When used properly, it is an affordable durable material. Such is our case in using it. We believe in preserving the intervened pieces, so they will remain intact, and, by repudiating vandalism and being unjudgmental towards accidents, reason leads us into concluding that any restoration on the Palácio da Justiça's panels won't occur daily – not even sporadically – and we are assured all institutions involved will follow the best practices available for any disposing of plastic with the minimum environment hazard.

4. CONCLUSIONS

Although the role of traditional conservation and restoration methods remain as valid as before, the use of modern 3D printing technology in interventions akin to ours, have proven to be a useful safeguard for specific cases of restoring public use cultural heritage spaces.

In favour of this approach, we present the following: the parts are easily replaceable in the event of another accident or misconduct attack, for mapping the artwork happens only once; it is possible to quickly produce a new replica for replacement; less durable and time-consuming parts to restore, can now, with 3D printing, have greater longevity; in addition to being produced more accurately, they can be produced as many times as needed, without quality loss and identical results.

As soon as production costs decrease, when the technology involved is widely adopted, the “democratization” of its use will happen, allowing its application to reach a broader spectrum in the preservation of artistic and historical heritage. There is room for plenty more innovation.

In conclusion, two short examples of its potential use: the case of sculptures in public spaces, where 3D printing can be of great use (when - and if - vandalism or theft of bronze pieces continue to rise, 3D mapping can guarantee a faithful reproduction of the original works); it may allow the replacement of original pieces, placed in gardens and other public spaces with quality replicas, while the originals are kept in museums, galleries or other safer locations.

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