

DOCUMENTAL STUDIO AND 3D RECREATION OF THE SAN ILDEFONSO'S SCHOOL FACADE, ALCALA DE HENARES.

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ABSTRACT:

In order to make the last important restoration of the University of Alcalá's facade, an important documentation work and 3D recreation has been done, under three premises: historical documental study, study of the materials and, finally, 3D recreation of the facade. Part of these competences have been assumed by our research group under the safety net of the project that we come to tell in this communication.

1. INTRODUCTION

1.1 The site

Many authors (Echeverría, 2005, 2010, and 2013) have permitted to follow the creation and evolution of University of Alcalá, and the *San Ildefonso's* University College (*Colegio Mayor de San Ildefonso*) current Rector's office of the University of Alcalá, whose main facade (object of this article) is in San Diego's square.

The facade of the San Ildefonso College is the main imagen of the University of Alcalá. This monument is visited each year for thousands of tourists.

The name of the square comes from an old convent (Figure 1) situated in the oriental side of this square, which was demolished in 1859 (figure 2) and replaced by the Prince's headquarters, currently Learn and Research Center of the University of Alcalá.

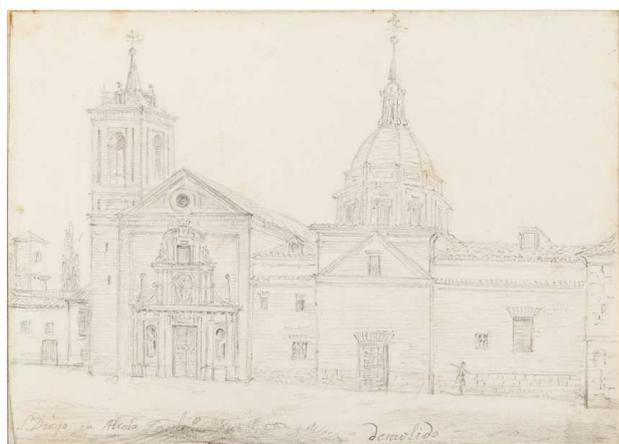


Figure 1: Facade of the demolished convent of San Diego. Valentín Cardera. Between 1820 and 1859.

1.2 Historical review

The first stone of the building was placed by the Cardinal Cisneros in Mars 14th 1499 and it was opened to the University use in 1509. Pedro Gumiel was in charge of the construction. This first building was built with humble materials, like clay and wood.



Figure 2: San Diego's square during the demolition of the San Diego's convent in 1859 for the new headquarters construction. Picture by J. Laurent, from the collection of J. F. Huerta.

Afterwards, a new facade is built (over the original made of clay) by Rodrigo Gil de Hontañón between 1537 and 1553. It was always said that the stone came from Tamajón (Guadalajara), but recent researches (García, 2013), place the quarry in the Vellón village (Madrid), in some estates whose previous owner was the Cardinal Cisneros.

The facade consists in one central module with three parts of height of which the upper part is set up by a gallery with

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semicircular arches, and two lateral wings, with only two parts with different height as those of the central one. The central module is also formed by three vertical modules, being the second one the fanciest.

The building has experienced multiple and varied interventions (Quintana, 2014) all over its long history due to the wear of the passing of time and its change of use. As an example, we have the tender proposed to restore the whole building due to the poor conservation status in which finally the architect Ventura Rodríguez (Figure 4) took charge to build a new chapel in the market square's place, but it was never built.

Regarding to the facade, the most important intervention was made by Anibal Alvarez between 1916 and 1927. Many sculptural and ornamental ensembles were completed and almost the 40% of the plinth of granite was substituted because of its damage of the capillarity.

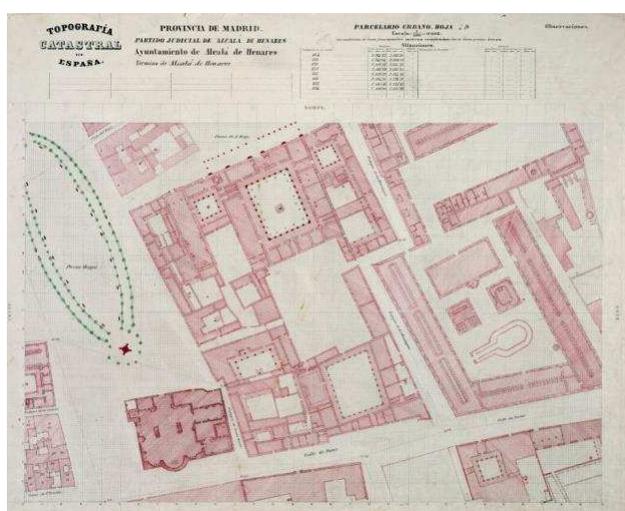


Figure 3: Kilometric sheets. 1/500 from Servicio Geográfico Nacional. 1870. Sheets D4.

1.3 Graphic database

In the research on heritage, an important studio tool to evaluate the temporal evolution of the Monument is the analysis of graphic documents (Echeverria, 2015), which allows us to add information to other studies. In the case of the University of Alcalá, this information is not very abundant and has a testimonial nature given the low precision of it.

Antoine Babuty Desgodetz (Celis, 2006) began the technique of the correct lifting of ancient monuments and the enhancement of these buildings from the appearance of the publication in 1682 "*les edifices antiques de Rome, dessinés et mesurés tres exactament*".

The first document, concerning the construction of the College of San Ildefonso, dates from 1511 (figure 5) describes in plant of the block where the current rectorate of the University of Alcalá is located. It can be seen that there is no square, there was a street ahead.

The following image is an anonymous picture (figure 6), from the middle of the seventeenth century. It is about the Cardinal Cisneros riding a horse, between the University of Alcalá facade and the Oran Castle (Rivera, 2016).

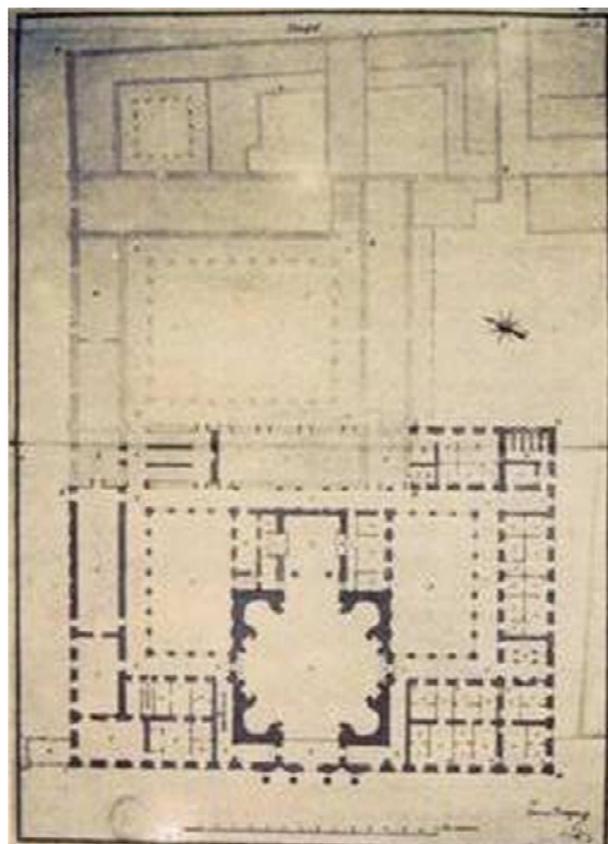


Figure 4: Principal floor plan and main facade of the San Ildefonso's residence hall and temple, from Ventura Rodríguez, year 1764 (Funds of the Superior Technical School of Architecture of Madrid)

One of the first pictures (figure 2) of the facade is from 1859, where it can be appreciated all over the square the dispersed demolition material of the San Diego's convent, which had the previous mentioned facade to the square.

We have other drawings, like the engraving of Valentín Carderera from 1846, where one can appreciate the west end of the facade, close to the San Ildefonso's chapel (figure 7).

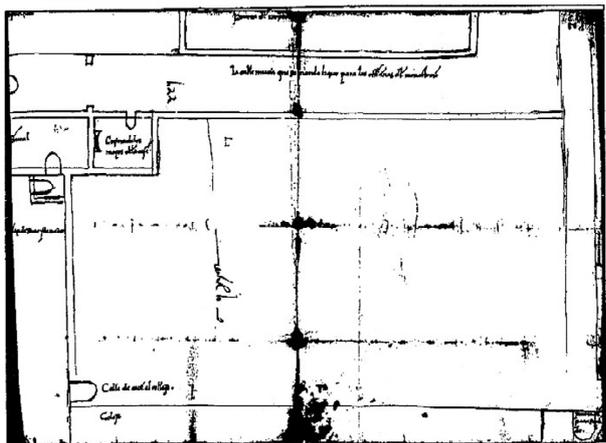


Figure 5: Sketch of Pedro de Gumiel. 1511 (AHN)

In the 19th century, the first cartographic planes appeared with some precision. The first was that of Pedro Ortiz de Pinedo, dated at Alcalá on July 20, 1837 (*Archivo General Militar de Madrid, symbol SH-M-I / 12*). Subsequently, we have the kilometers sheets (*hojas kilométricas*) of the National Geographic Service of the Ministry of Finance of 1870 (figure 3).



Figure 6: The Cardinal Cisneros riding a horse, between the University of Alcalá facade and the Oran Castle. Parish Church, Cardeñosa, Avila. (Rivera, 2016, 27)

2. METHODOLOGY

In this article, we will proceed to explain all the process followed in the research. The facade is, in this moment, being in the process of rebuilding, so the results will be modified in real time. As Porcuna indicates (2016, 279).



Figure 7: Partial view of the San Ildefonso's residence hall. Engraving 1846. Carderera.

The digital modelling in 3D constitutes one of the more powerful tools in the documentation, researching, divulgation and put in value of the cultural patrimony.

The appearance of 3D scanners for the measurement of three-dimensional real objects has long revolutionized data collection systems (Navarro, 2007). During this time several generations of 3D scanners have been increasingly effective, accurate and of smaller size and weight. In spite of this, architects continue to use traditional techniques as the basis of work, but taking advantage of the speed and precision of the new techniques (Mesa, 2007 and 2009) (Goitia, 2010).



Figure 8: Picture of the laser scanner FARO FOCUS 120 and the San Ildefonso College Facade.

The principal 3D recreation was done during the summer of 2016 and now a scaffold is built covering the whole facade. This scaffold permits to review and specify all the data. The finalization of the work is expected to the summer 2017 so that, new data will be impossible to add before the congress take place. As a proof of the communication development the equipment used for the data collection is: a laser FARO Focus 3D and the SCENE program (FARO's contribution).

For the photogrammetric studio we have used Agisoft Photoscan, and the pictures have been taken by a camera Canon 6000.

During the work, using the scaffold, we pretend to proceed in the detailed documentation of different sculptures mixing the photogrammetric and optic scan techniques (Molero, 2016). First of all, a qualitative studio was done beginning from the perception and designs of the research group. It allowed to establish a guideline to set up the positioning places. After this first step, we considered to lift the acquisition points of the image in order to collect the data in perpendicular to the facade in the highest points. To do it, a lifting platform was used (figure 9).



Figure 9: Location of the platform in one of the scan and photographed position.

Using the lifting platform, it has been possible to divide the surface of the facade into a 5 x 5 grid in order to avoid blind areas to the laser beam of the scanner due to the large amount of relief on the façade (figure 10). Subsequently 2 new measurements were made from both ends at street level to complete some detected blind zone.

The presence of tourists near the façade at all hours was one of the main difficulties, being necessary to close the pedestrian crossing area temporarily. A particularly complicated position to execute was the main door, which must be done outside the opening hours of the building, due to the interference of visitors to the building. Thanks to the platform it could be possible to take

pictures for the photogrammetry and the scan lectures with the proceeding parameters.

LASER SCAN PARAMETER	FARO FOCUS 3D
CHOSEN OUTLINE	Outside from 20m
RESOLUTION AND QUALITY	Resolution: 1/6 Quality: 4x
SCAN RANGE	Vertical range: from -60° to 90° Horizontal range: from 90° to 270°
SENSORS	Use clinometer: activated Use compass: activated Use altimeter: activated
COLOR PARAMETERS	Weighted measuring to the center
ADVANCED CONFIGURATION	Clear contour: activated Clear sky: activated

Table 1. Laser scan parameter

Different positions were proposed for each part of the outside of the facade. Positions with the most seen surface of the building were searched, so that, the vertical scan range was always the maximum, from -60° to 90°, but the horizontal range was reduced, from 90° to 270°, due to the fact that the new angle didn't need to be as much larger as the first one because it was only one plan.

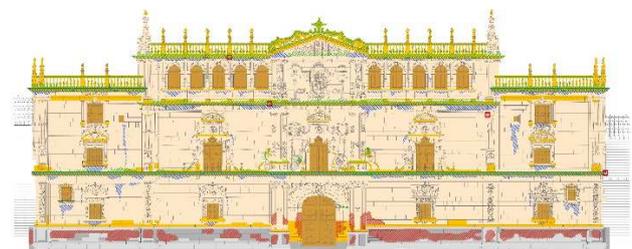
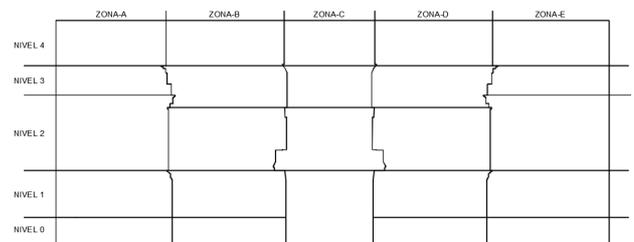


Figure 10: Location of scanner position and view of facade plan.

With these position combinations the record of almost all the space of the facade's outside was possible with around 50 million of points with coordinate X-Y-Z, including the detailed photographic record in each position. After this step, the different

scans were put together to reach the complete point cloud of the building's facade.

3. PROSPECTIVE

From this initial work carried out with the known image of the University, it is intended to continue with a modeling of the public spaces of the rest of the College of San Ildefonso in order to participate in models of augmented reality.



Figure 11: Model detail of the entrance zone during the work

On the other hand, it is intended to put the data obtained within the INSPIRE standards. They are two main data specifications inside INSPIRE where cultural heritage data are site: Data Specification on Protected Sites, and the Data Specification on Area management / restriction / regulation zones and reporting units (Chias and Abad, 2015).

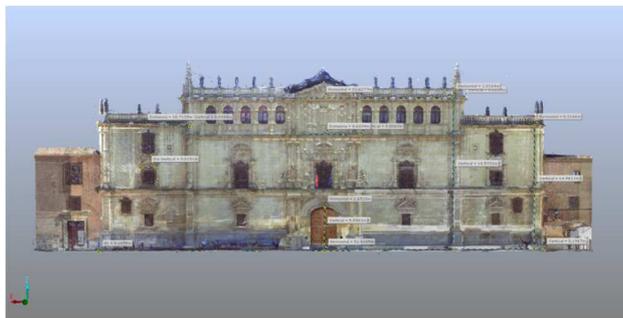


Figure 12: Work process image (orthophoto model)

4. CONCLUSIONS

As we have seen, the facade of the College of San Ildefonso is the most well-known image of the University of Alcalá. There are several historical images of this facade, but for the first time has been obtained a representation almost real of its current state, not only flat, but in 3D to be used by researchers, conservators, and communicators. From the 3D model you can get plans, sections, orthophotos, or partial details.

From the data obtained, a 3D recreation has been done and is now being used as a base for the restoration work and it will be used to compare it with the final result. A new data base will be created with the new technologies (photogrammetry, CAD, digital photography, laser scan) in order to facilitate the approach and better knowledge of our patrimony. This facade's data map (HGIS) will be the building's DNA with the record of all the significant variables: form, history, materials, color, conservation and maintenance during the monument's life. Thanks to this map, a new project of augmented reality can be developed in order to visualize the University's buildings in an interactive way.

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