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MULTIDISCIPLINARY INTEGRATED STUDY OF SAINT ILDEPHONSE'S COLLEGE, UNIVERSITY OF ALCALÁ (MADRID, SPAIN)

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ABSTRACT

This paper presents a multidisciplinary study of the Saint Ildephonse's College, the first building of the University of Alcalá, founded in 1495 and declared World Heritage Site by the UNESCO in 1998. During the last restoration of the building, carried out in 2011-2012, all the walls' coatings were removed and the historical materials came out to light.

The aims of the study were: to identify the different stages of the building's history, supported by direct measuring and sampling; to understand the changes suffered by the building in the last five centuries; to formulate a feasible hypothesis of its initial configuration. The study integrated a stratigraphic study based on a photogrammetric survey, a morphological analysis of the masonry patterns, materials characterization, a metric analysis of the original remaining parts and an architectural assessment of the construction chronology. Material samples were taken from the walls of the College and the characterization results were put in discussion with published data, reviewing the historiography of the building.

Four historical stages were identified, corresponding to: the original 15th century building and the 16th century stone façade; the construction of a clock tower and a granite cloister inside the central courtyard during the 17th century; the refurbishment works and change of use into a religious school in the 19th century; the return of the University in the 20th century. The analysis of the original building's remaining parts allowed to propose a hypothesis of the original two-storey building constructed with rammed-earth and brick masonry, which was previously unknown. The same constructive pattern and metrics were also identified in the side wall of the University Chapel, which was built simultaneously to the College. The original walls did not have any brick-row between the rammed-earth boxes, which was commonly used in the area of Toledo. Instead, this constructive technique is related to the rammed earth constructions used in the area of Spanish-Islamic kingdom of Granada. The biography of Cardinal Cisneros could explain the use of this technique in the centre of Spain.

INTRODUCTION

The construction of the College began in 1501. The College was built with rammed earth and brick masonry, a cheap and fast technique common at that time, and was organized around a two-story courtyard. The works lasted only seven years and the College was ready for lecturing in 1509.

Since then, the College has suffered many transformations due to changes of use and restorations. Only 30 years after the original building was finished, the main façade was replaced by a new one built with stone and designed by Gil de Hontañón. In 1599, Juan de Ballesteros designed a clock tower which was to be built in the south side of the central courtyard, although a new and smaller tower was finally built in 1615. The outstanding granite cloister, which can be seen nowadays, was designed by José de Sopeña and built between 1656 and 1670.

In 1836, the University Complutense moved to Madrid and the existing buildings were abandoned. The College was occupied in 1850 by the army and later transformed into a religious school that ran until 1931. At last, the university returned to Alcalá de Henares in 1977 and the building was completely refurbished according to the contemporary necessities.

METHODOLOGY

The study combined bibliographic and graphic historical documentation of the building, a planimetric survey of the walls, a morphological analysis of the masonry patterns and other building techniques, a materials characterization of samples extracted from the walls, a classification of the materials and building techniques and a metric analysis of the remains of the original building [1]. The results of materials characterization were crossed with the masonry patterns identified in the walls [2] and the combined results were cross referenced with the historical data and drawings, allowing an identification of the constructive techniques and materials used in the building [3].

The aim of this multiple approach was to obtain results which can support feasible hypothesis on the original College and to identify a temporal sequence of the main events occurred during the last 500 years.

1.1 Initial Works: historical documentation and planimetric survey of the walls.

The first stage of the study was a search in historic archives to collect of the historical documents, drawings and photographs. From this study, several detailed facts and dates of the main elements of the College could be defined.

To obtain accurate drawings of the existing walls, a photogrammetry survey was carried out. A complete set of photographs were taken and corrected using the computer program ASRix, developed by Steve Nickerson, member of ICDC (International Committee for Documentation and Cultural Heritage, ICOMOS UNESCO). This program modifies the photographs according to (x, y) coordinates of, at least, four points. Using a laser-distance-meter, the real measurements of the four segments can be determined, defining a real size rectangle. Then, the photographs can be corrected, obtaining a set of orthographies which can be drawn at real scale and size with a CAD computer program [4].

1.2 Morphological analysis.

A morphological analysis on the four walls of the central courtyard was carried out, on the basis of the drawings and considering the different brickworks and materials that could be identified. The size and shape of the existing voids (windows and doors) were also analysed. The different materials and masonry works were classified, establishing a first set of masonry patterns and rammed earth stratigraphy and morphology (Figure 1).

1.3 Materials characterization and classification of constructive techniques.

In order to identify the materials used in the building, several samples were extracted from the masonry types previously identified: bricks, mortars and rammed earth (Figure 1). The samples were characterized using conventional physic-chemical techniques [2]. As a result, some samples could be clearly distinguished based on microstructure and chemical composition

According to the materials characterization and the morphology analysis, the constructive techniques were identified and a classification of the brickwork and masonry could be done [3]. The result was a complete set of drawings of the four walls of the central courtyard, where all the stratigraphic units were related to the historic works carried out in the building. These unreleased documents are one of the most important results of the work because they integrate all the current knowledge available concerning to the history and evolution of the building.

1.4 Metric analysis and hypothesis of the original building

The metric analysis aimed to identify the original dimensions of the building elements of the original College according to the 16th century metric units and the stratigraphic units which corresponded to that period. The basic units used in this analysis were the Castilian foot and vara, according to those used in the XV century in the centre of Spain (3 Castilian feet = 1 Castilian vara = 83.59 cm).

RESULTS

Four main stages were identified in the building chronology, which are summarised in Figure 2.

Stage 1: Foundation of the University (1499) and construction of the main Façade by Gil de Hontañón (1553)

The original College was two stories high and was built with rammed earth (tapial boxes) placed between brick-work piles. The new façade, three stories high, was built 50 years later and the north side of the building was elevated one story more, as it can be observed in Figure 2. The constructive techniques and materials identified which correspond to the original College were: 3 feet limestone baseboard, tapial boxes (rammed earth) of 3 by 9 feet, with 3 to 4 putlog holes horizontally distributed, placed between brick-work piles of 3 to 6 feet width. The brick-work used bricks of 4 x 16-18 x 8-10 cm and limestone mortar. The walls were covered with a thin layer of limestone mortar which hid the putlog holes. The dimensions of the original voids (windows) were 4 ½ x 12 feet.

Figure 3 shows the stratigraphic units which correspond to the original building discovered on the four sides of the main courtyard (called Saint Thomas' Patio). The remaining parts of the east wall, which corresponded to a theatre originally [5], were used to identify the materials and stratigraphic units and to propose a hypothesis of the initial configuration. It can be observed that the same constructive technique and materials, along with the constructive metrics, can be identified in all the four walls. Furthermore, this constructive technique and metrics have been also discovered in the side wall of the St. Ildephonse's Chapel (Figure 4). It must be highlighted that the Chapel, located next to the College, was designed by the same architect and was built simultaneously with the main College.

The lack of horizontal rows of bricks between the rammed earth boxes was not a usual tapial solution in the area of Madrid [6]. However, this type of construction can be found in the south of Spain, as it has been described in the literature [7-10]. In fact, the walls of rammed-earth boxes between brick-work piles and without horizontal brick rows between the boxes were typical from the Spanish-Muslim architecture (Pavón 1999). The use of this technique in the original main building of the University of Alcalá can be explained based on the active involvement of Cardinal Cisneros in the conquest of the kingdom of Granada, which took place in 1492 and the subsequent baptism of the converse Muslims [12, 13]. It can be highlighted the presence of his right-hand man in the placement of the first stone of the university, whom was a formerly noble Nasrid [14].

With regard to the original building shape and size, the results point out that the four sides of the College were not of the same height originally, even before the new façade was built up. The original north side of the building reached 43 feet, while the other three sides barely reached 31 ½ feet of height (Figure 3). Furthermore, the first floor of the north side was, at least, 1 Castilian vara (3 feet) above the others (20 feet above the ground). This different position of the floors suggests that the original corridor which faced the courtyard did not run uniformly along the four sides of the building. Actually, it is very probably that there was no gallery on the north side of the courtyard, because the first floor was quite probably the main Library of the College and the access was through a staircase inside the building.

According to the plot plan of Alcalá de Henares of 1870 [15] and considering the uses of the different parts of the College, it can be deduced that, originally, the main movements inside the building corresponded to an east-west axis, instead of the north-south axis defined later in the main building by the symmetric façade, the clock tower and the pavement of the XVII-century granite cloister. This affirmation is supported by the location of the path between the main courtyard and other two, located east (College of Saint Peter and Saint Paul) and west (known as the "theatre's courtyard" and located between San Ildephonse's Chapel and the College's theatre).

Stage 2: Improvements in the XVII century: New Clock tower (1599) and building of the new granite cloister (1670)

During the 17 century, two main elements were constructed in the building: a tower and a stone cloister. The clock tower was constructed on the south side of the College. The materials used largely differ from the ones previously used in the building. It has been observed that, although

the size and shape of the brickwork match with the former (4 x 16-18 x 8-10 cm and limestone mortar), the composition of both the bricks and the mortar was different [3]. The manufacturing temperature has been measured to be clearly higher than on the other bricks and the type of sand of the mortar had a different chemical composition. This fact could be explained considering the troubles reported to occur during the tower construction. According to the historic documents, the tower was planned to be very high (133 feet) and during the construction important structural problems emerged. As a consequence, the architect was dismissed, the tower design was changed (96 feet) and the brick-work was demolished and reconstructed, probably with another contractor. This fact can be observed in Figure 3, where the profile of the unbuilt tower is drawn on the south wall elevation.

To raise the walls of the College due to the construction of the granite cloister, a different type of bricks and brick-work were used in the XVI century. The dimensions of the bricks were larger than before (4 x 26 x 14 cm) and the thickness of the mortar layers also increase, reaching 4 cm. However, the composition of both, the bricks and the mortar were very similar to the former of the XVI century. The cloister reached the height of the side walls of the main façade and the other three sides of the College were elevated to three stories.

These improvements dramatically changed the appearance of the building. The clock tower emphasized the north-south axis and the cloister provided an internal façade and a centre to the central courtyard. It can be highlighted that the centre (originally occupied by a small temple) was slightly displaced backwards in order to enlarge the perspective, using the pavement composition which has reached our days.

Stage 3: Rehabilitation works in the XIX century

In 1850 the army located the College of Cavalry and many new voids (doors and windows) were opened in the four walls of the central courtyard, accordingly to the new uses of the spaces (bedrooms, classrooms, canteen, kitchens, stores and stables) [16]. Afterwards, the building is occupied by a Piarist Fathers' School (1861-1931).

The brickwork used thicker bricks 5 x 24 x 12 cm and mortar layers of 1.5 cm. The chemical composition and heating temperature greatly differ from the previous [3]. The works are located mainly on the sides of the voids and new timber lintels were used to raise the doors in order to reach the high of the former windows. The same brickwork can be found closing several former voids and strengthen the east wall. The preserved voids and the new ones followed the rhythm of the granite cloister's archery, unifying the architectural composition.

Stage 4: Restoration and refurbishment works in the XX century

Several interventions of restoration and refurbishment were accomplished, directed by Aníbal Álvarez (1914 -1927), Santiago Climenty and Eduardo Martín-Sonseca (1959 y 1960), Carlos Clemente (after 1987). The height of the voids was drastically reduced, some voids were closed and a new granite band is placed as a skirting board and framing the voids. During this period, the Clock tower was demolished. Some reinforced concrete elements were constructed in the walls in specific points, as it can be observed in the east wall (Figure 3) and the remaining rammed-earth walls were covered with hollow brick masonry in order to provide a support for a continuous rendering. The voids' height was reduced including first a false arch and, afterwards, lowering the lintels. The voids were widened except the two main entrances to the central courtyard, located on the north and south walls.

CONCLUSIONS

A multidisciplinary study combining historical data, stratigraphic analysis and materials characterization of the St. Ildephonse's College of the University of Alcalá was carried out. The study analysed the remains of the original 16th century construction and the subsequent transformations of the building, identifying the constructive materials and techniques used along 500 years.

The integrated analysis was based on a cross-referencing methodology: direct measurements and materials characterization results were crossed and the combined results were analysed according to the historical data.

Four historical stages were identified and the main changes suffered by the building were fully documented. The new information obtained concerning the constructive technique used in the original building, which was unknown, was related to the Spanish-Islamic rammed-earth techniques used in the south of Spain, especially in the Spanish-Islamic kingdom of Granada. This hypothesis is supported on the results presented in this study, the published works on rammed-earth construction in Spain and the biography of Cardinal Cisneros

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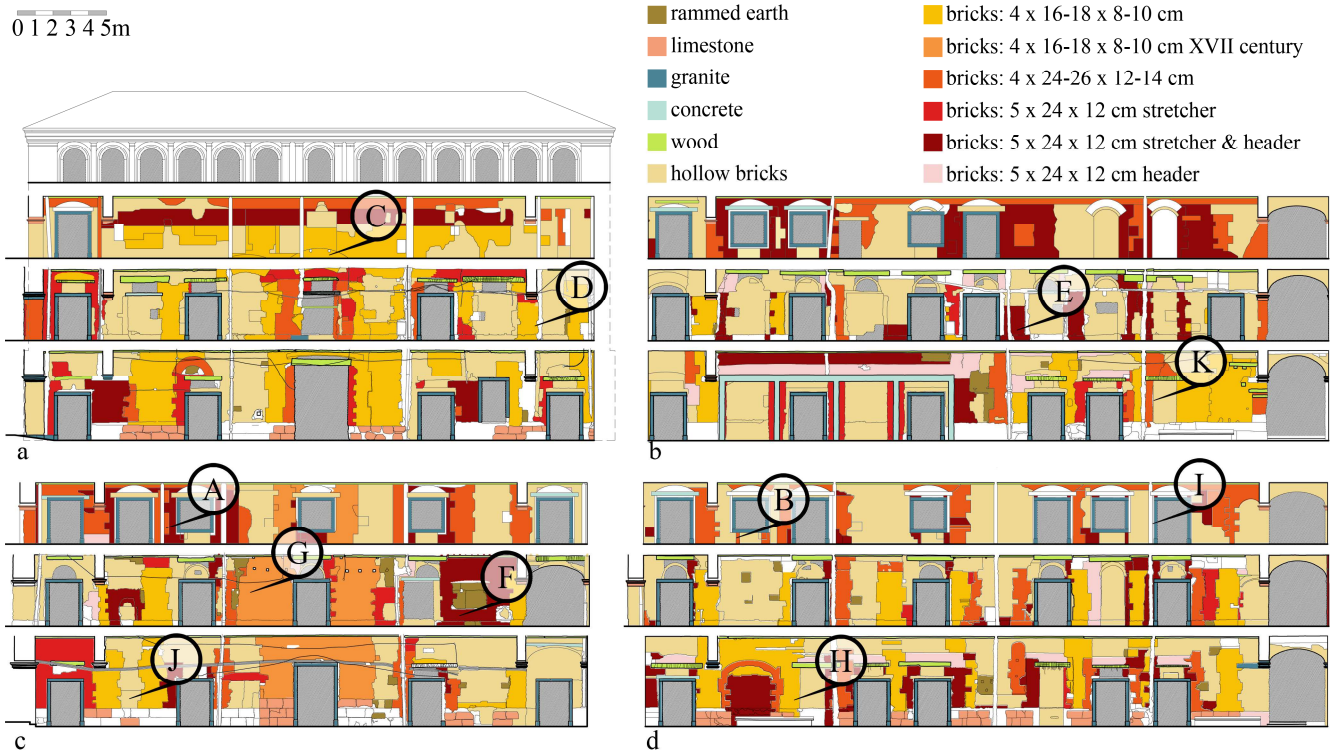
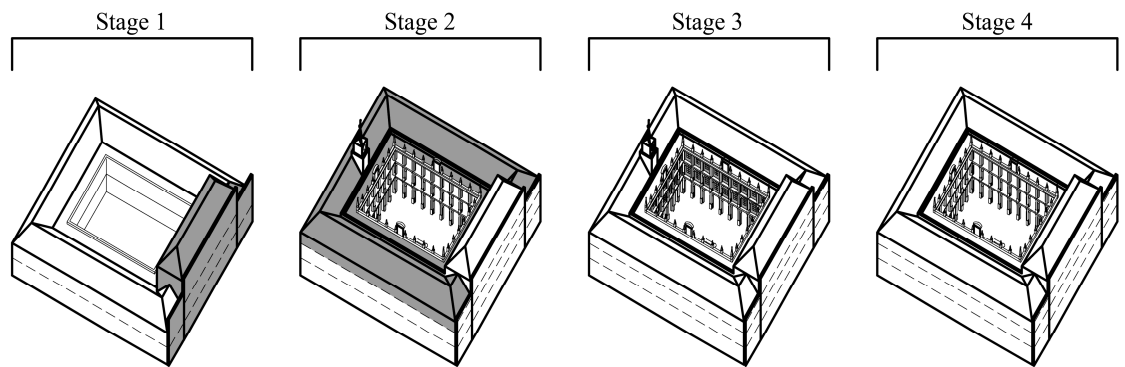


Figure 1. Saint Ildephonse's College central courtyard (University of Alcalá). Stratigraphic units and location of samples. a) North wall. b) East wall. c) South wall. d) West wall. [3]



Stages	Dates	Works	Brick-work type (dimensions of bricks)
1	1499-1553	Main College – Main Façade	Rammed Earth brick piles (4x16-18x8-10cm)
2	1599-1670	Clock Tower-Cloister	Brick-work masonry (4x24-26x12-14cm)
3	19 th Cent.	Army–Priarist Fathers	Brick-work masonry (5x24x12cm)
4	20 th Cent	Restoration and refurbishment	Hollow brick and reinforced concrete

Figure 2. Constructive and chronological stages of the building. [1]

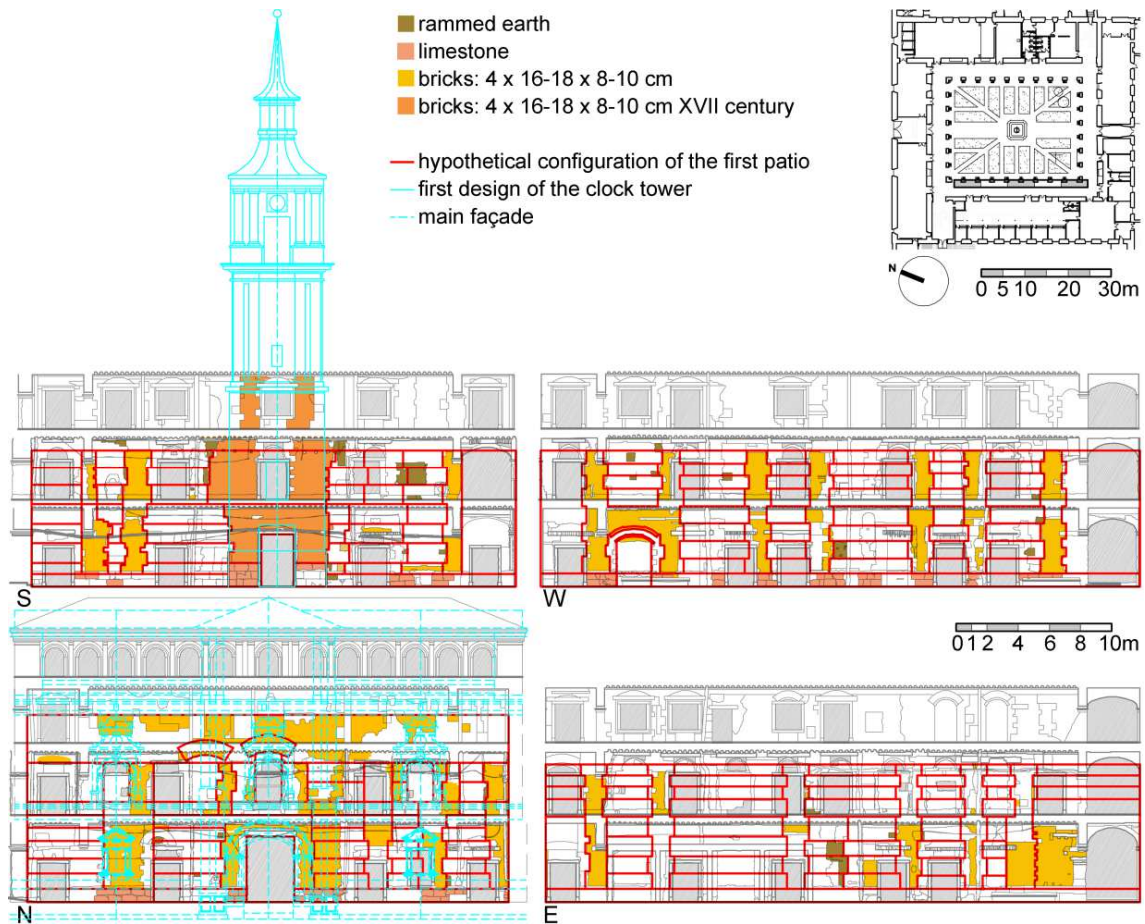


Figure 3. Ground floor plan of the main courtyard and remains of the original rammed earth-brick masonry walls of the Saint Ildephonse's College.

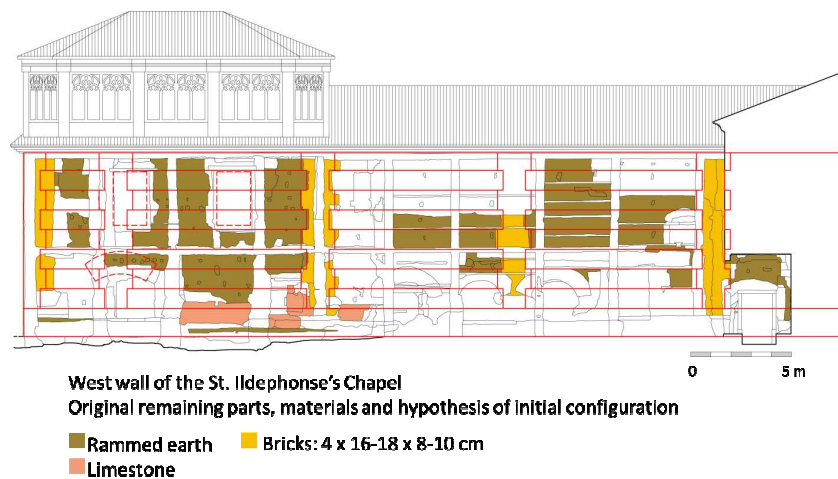


Figure 4. West wall of the St. Ildephonse's Chapel. Remains of the rammed earth-brick masonry walls and hypothesis of the original configuration.