



Proportion and Disproportion in the Late Gothic Layout of the Charterhouse of Jerez (Cádiz, Spain)

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Abstract

The construction of a large and complex monastery such as the Charterhouse of Jerez required a precise geometric plan, the layout, which once deployed on the ground becomes the shape control system of the construction process. The basic geometric figure that supports the layout is the square and the variations derived from the ratio between its side and its diagonal. This paper presents the graphic definition of this geometric layout and analyses its persistence over more than three centuries of architectural evolution (fifteenth through eighteenth centuries). During this lengthy process, it has been possible to characterise how the rigour of geometric abstraction, the natural conditions of the ground on which the monastery was founded, and the functional and symbolic demands of the Carthusian order have been balanced. Likewise, there has been an analysis of the situations in which disproportion is imposed: the alteration or abandonment of the geometric plan. These undesirable situations reveal the imposition of existing conditions and the evolution of artistic concepts.

Keywords Charterhouse of Jerez · Geometric analysis · Proportion theory

Introduction

The conception and production of architecture are closely related to its geometric control. Throughout history, the evolution of scientific knowledge and the conception of architectural space have produced different ways of demonstrating this relationship (Padovan 1999). The production of Gothic architecture is based

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on the application of precise geometric processes, without which its significant achievements would not have been possible (Bucher 1968; Bork 2011).

In the cultural context of the end of the fifteenth century in Spain, at a time of transition between the Gothic language and the Renaissance language that has been called late Gothic, geometry applied to architecture is focused on the control and execution of works, which has been suggested by the term *geometria fabrorum* (Ruiz de la Rosa 1987). In this final stage of the Middle Ages, the master builders kept the knowledge of these geometric resources based on basic ratios and proportions but with great potential to generate forms: from a pinnacle to a cathedral through the establishment of the dimensions of the structural elements (Huerta 2006).

In this architecture, a basic geometric concept is the *traça* (*traza* in modern Spanish), which would translate literally to “trace” (or possibly “tracing”), but “layout” conveys the right meaning in English. The layout is a drawing, not necessarily very complex, that contains the key guidelines of the building. These general lines were laid out on the ground with the help of stakes and ropes to establish the connection between the drawing and the construction of the work. The layout should not be understood as a definitive plan of the building, but as general guidelines for rationally ordering the whole and its parts. Therefore, it is a living document that evolves as the building develops, especially as the construction project lasts decades (Jiménez Martín 2021; García Ortega 2012; Pinto Puerto 2009).

In this paper, these geometric resources for the definition of the layout are studied in a large-scale built complex. It is the Charterhouse of Nuestra Señora de la Defensión or Charterhouse of Jerez, located five kilometres from the urban centre of Jerez de la Frontera (Cádiz, Spain), which occupies a confined area between the road from this city to Medina Sidonia and the Guadalete river (Fig. 1).

Its architectural configuration is articulated around the monastic core, which is surrounded by diverse structures of different origins and functions, resulting from its extensive historical process. The foundation took place in the fifteenth century and its construction developed during the sixteenth, seventeenth and up to the end of the eighteenth century. The author of the layout of the Charterhouse of Jerez is not known and no drawings have been found that can be identified as such. However, it is possible to approximate its geometric foundations by taking as a reference the space-time context in which it occurred. The start of work on the Charterhouse of Jerez is documented in 1478 (Mayo Escudero 2001). The Gothic forms built in the first decades gradually incorporated Renaissance elements, giving rise to an example of the architectural style known as late Gothic. The façade of the main entrance, built in 1571, is the first fully Renaissance element of the monastery. This context is dominated by the construction of a singular work: the Cathedral of Seville, whose influence will be transcendental throughout the geographical scope of its Archbishopric, which includes the town of Jerez (Rodríguez Estévez 2007).

Thus, the main objective of this research has been to determine the geometric foundations of the original fifteenth century layout of the Charterhouse of Jerez. Second, to analyse how the layout persists as a regulatory drawing throughout the centuries of construction evolution, from the fifteenth to the eighteenth, even though the physical conditions of the building and the cultural context changed

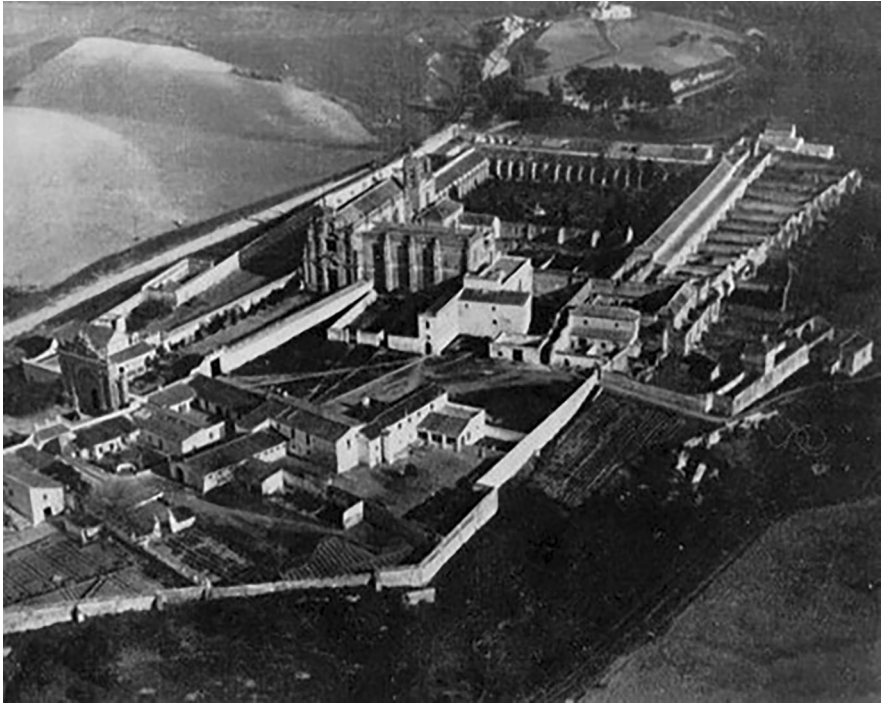


Fig. 1 Charterhouse of Jerez. Photograph from the southwest taken from an airplane in the mid-twentieth century. Archive of the Charterhouse of Nuestra Señora de la Defensión

significantly. Third, to recognise in the architectural structure of the monastery those elements that respect the layout and those that do not, that is, those that fit the proportion and those that show disproportion. The focus has been placed on the latter, since it is assumed that this disrespect for the geometric plan would reveal very significant information about the physical and cultural conditions of each historical moment. These objectives can be summed up in one: to advance the knowledge of the relationship between geometry and architecture in the case of the Charterhouse of Jerez and of late Gothic architecture in general.

Methodology

To achieve the proposed objectives, a methodology consisting of three processes aimed at understanding the constructive evolution of the monastery and the role of the geometric layout as a guide to this evolution has been followed. These three processes are: the collection and study of historical documents, the architectural analysis, and the generation of a digital graphic model of information.

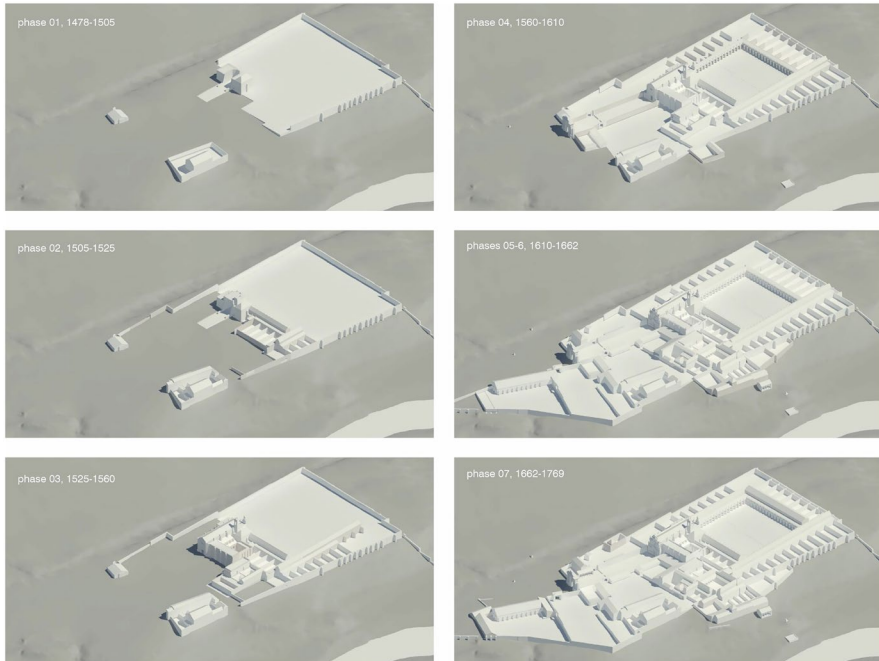


Fig. 2 3D rendered views of the construction phases of the Charterhouse of Jerez, from its HBIM model

Generation of a Digital Graphic Information Model

The methodological core of the research is the generation of the digital graphic model of the monastery, according to the methodological procedures of the Heritage Building Information Modelling, HBIM. The construction of the graphic model is inseparable from the process of knowledge of the asset that is modelled. One of the key concepts of HBIM is the Level of Knowledge (LOK), a measure of both the level of graphical detail and the reliability of the information in the model (Castellano-Román and Pinto-Puerto 2019). In this case, the construction of the model is not based on a digital capture using photogrammetry or digital scanning of the entire monastery. That is precisely one of the singularities of this case study: the model is based on the information available at the beginning of the research without the need for initial investment in extensive metric capture, which can be delayed to future developments.

The model does not represent the current configuration of the monastery, but rather its construction evolution, from the approach to the topographic surface prior to the beginning of construction at the end of the fifteenth century to its maximum development in the eighteenth century. Therefore, the model shows the sequence of construction phases that have been established from architectural analysis and historical documents (Fig. 2).

Collection and Study of Historical Documents

Knowledge of the Charterhouse of Jerez revolves around two main documentary sources: the Primitive Protocol and Foundation of the Charterhouse of Santa María de la Defensión and the document known as Manuscript 18259 of the National Library of Spain, composed by Father Gaspar del Castillo. For simplicity, this text will refer to the Protocol and the Manuscript, respectively.

The Protocol is only the first of several volumes composed for the different areas of activity of the monastery. It records the period from the foundation in the fifteenth century to the beginning of 1669, informing about the construction process and other relevant issues of the functioning of the monastery such as appointments and dismissals of Priors, acquisitions, and litigations. It is not a work of linear development but rather a set of documents arranged with different sections capable of accepting new insertions at any point (Mayo Escudero 2001). The Manuscript is a heterogeneous document composed of several sections, dating back to the second half of the seventeenth century, as it is attested by the dates of Del Castillo's profession as a Carthusian in 1645 and his death in 1696 (Mayo Escudero 2007).

Analysis of the Protocol and the Manuscript are also used to write other fundamental studies in the bibliography of the Charterhouse of Jerez, whose authorship is not revealed, since it is signed simply as a 'Cartujo de la Defensión' or 'Cartujo' (Cartujo de la Defensión 1995; Cartujo 1995). The publications present a similar structure of chronological follow-up of the works in three different areas of the monastery: the Large Cloister, the Small Cloister, and the Lay Brothers Cloister.

In addition to these textual documents, graphic documents have been central to this methodological strategy. Since no drawing of the original layout has been found, the fundamental reference is the first known floor plan, drawn by Father Juan Antonio de la Peña in 1769 (Fig. 3). It is a floor plan that frames the monumental area of the monastery and does not draw other buildings around it, which are related to the economic activities needed to ensure its functioning. The drawing was made just three decades before the beginning of the successive expulsions of the monks during the nineteenth century, which marked the decline and abandonment of the monastery, and therefore shows us the monastery at a time of full development.

The main historical picture of the Charterhouse of Jerez is provided by the Cartusia de Xeritio painting, an anonymous work from the late seventeenth century (Fig. 4). The painting belongs to a collection called the 'Galerie des Cartes', made at the request of Rev. Father General Dom Innocent le Masson (1675–1703), which represented monasteries of the order, originally located in the Hall of the General Chapters of the Grande Chartreuse. They are currently housed at the Correrie Museum in Grande Chartreuse. Its main value lies in offering a representation of the entire monastery in aerial perspective, made with a descriptive intention of its parts and the articulation between them reinforced by the incorporation of a legend to name each of the represented spaces.

Finally, the most valuable graphic document for the analysis of the dimensions and proportions of the Charterhouse of Jerez is the digital drawing made by the Department of Urban Planning of the Jerez City Council (Fig. 5). This drawing has been made with topographic means, completing the details with direct metric

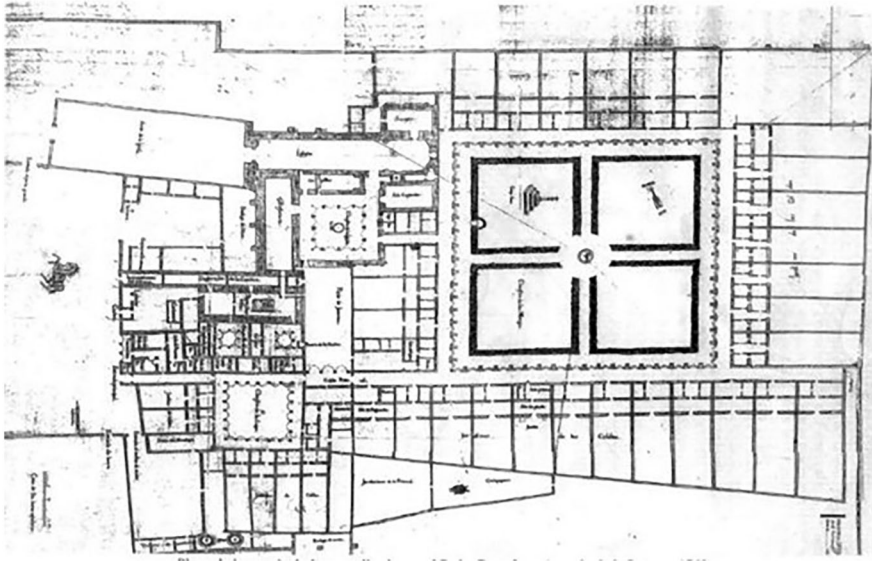


Fig. 3 Floor plan of the Charteuse of Jerez by Father Juan Antonio de la Peña (1769) (Mayo Escudero 2002)

capture using analogue means. The main value of this planimetry is its precision and thoroughness, which has made it the basis of the three-dimensional graphical model and geometric analysis.

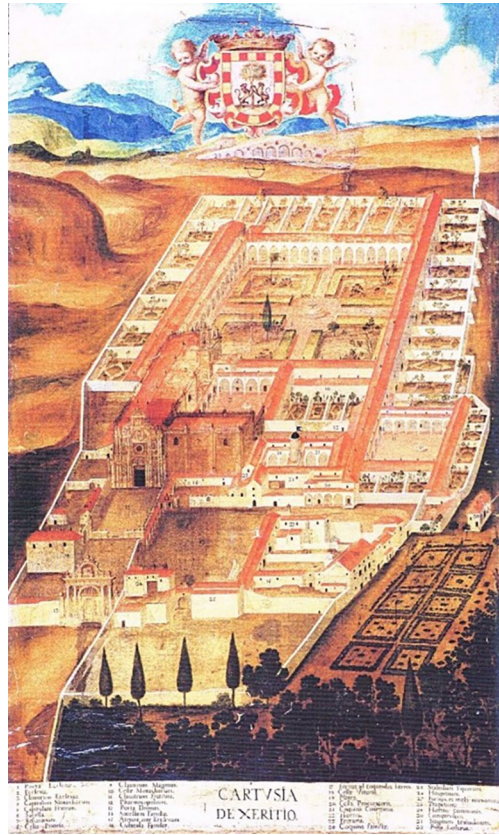
Architectural Analysis

Knowledge acquired through the study of historical documents has been complemented by architectural analysis. This analysis has focused on three basic architectural concepts: the spatial-functional programme, the construction systems, and the architectural typology.

The spatial-functional programme is a key concept in a Carthusian monastery. It is structured around two cores, the cenobitic and the eremitic, which serve as the architectural framework for the different routines of a Carthusian monk: community life and solitude, respectively. Thus, solitary life requires living and working units, cells, that allow maximum possible isolation. For this purpose, the cells are arranged in a cloister that occupies a large area and, consequently, is called the Large Cloister. However, the Carthusian monks combined this isolation with certain community activities that required specific architectural spaces: church, refectory, kitchens, and chapterhouses, all of which were arranged around a smaller cloister than the Large Cloister and, therefore, known as the Small Cloister (Fig. 6).

Another singular consideration about the life of the Carthusians that has an impact on the spatial and functional structure is the distinction of the monks between the Fathers and the Lay Brothers. While the Fathers were ordained

Fig. 4 Cartusia de Xeritio, seventeenth century, anonymous. Collection Monastery of the Grande Chartreuse



priests and focused on contemplative life, the Lay Brothers were not ordained priests and engaged in manual labour. Therefore, the Lay Brothers had different spaces from the Fathers and a specific area called *Conreria*. The word *Conreria*, typical of the Carthusian lexicon, comes from the French word for the Father Procurator, *Courrier*. The *Conreria* housed the cells of the Father Procurator and the Lay Brothers, the chapel, the workshops, and other rooms connected with the material life of the monastery. In the older Carthusian monasteries, the *Conreria*, or “lower house”, was a separate building from the monastery, or “upper house”, as an additional guarantee for the solitary and silent life of the monks. However, this separation became less and less advantageous, which made the merging of the “upper” and “lower” houses more and more common, and at the General Chapter of 1679 it was finally abolished (Aniel 1983; Barlés Báguena 2010).

The identification of the different construction systems has been carried out by direct inspection of the building and analysis of available archaeological reports. Different types of materials and fixtures have been verified against historical information to make graphical modelling decisions. The synthesis of spatial, functional, and constructive concepts observed in a Carthusian monastery can be

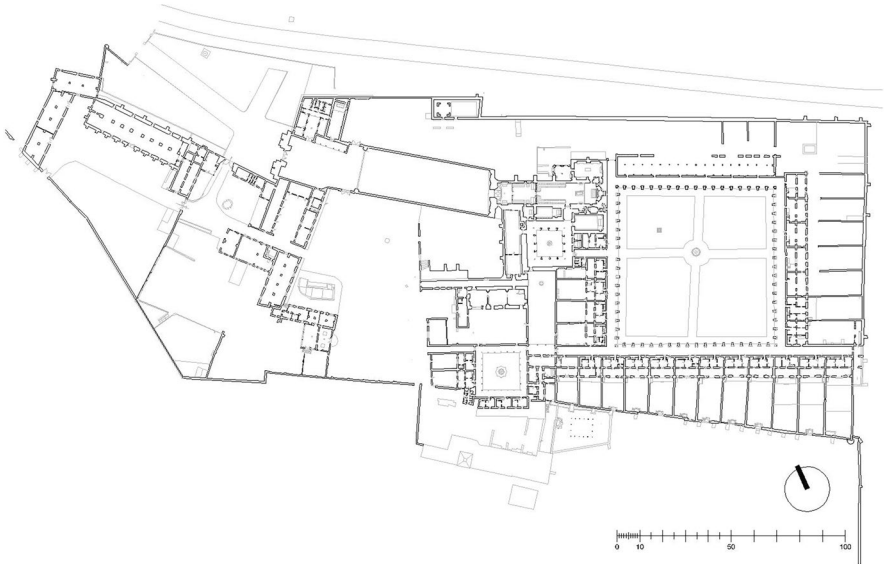


Fig. 5 Floor plan of the Charterhouse of Jerez. City Council of Jerez, 2005

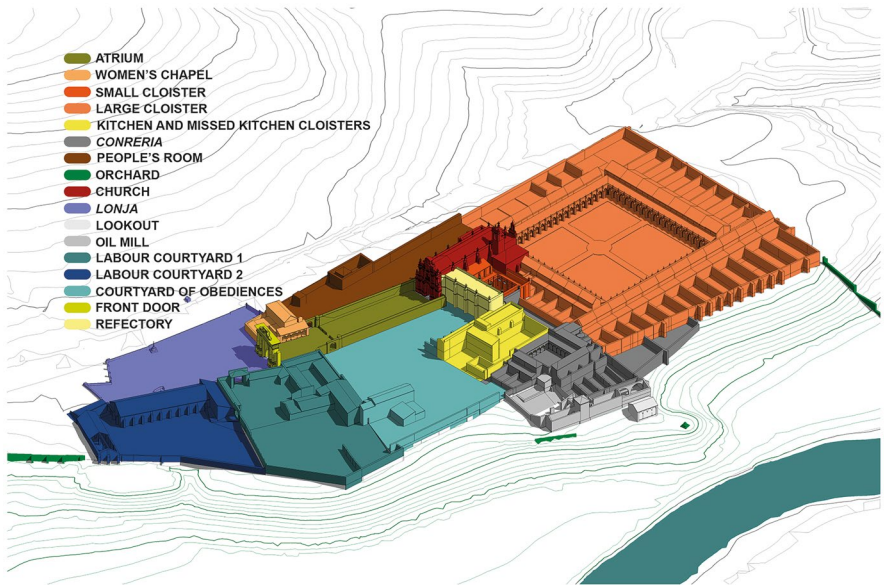


Fig. 6 Location of the main areas of the monastery

expressed in terms of architectural typology. For the architectural characterization of the monastery from a typological point of view, the reference text by Carlos Martí Arís is used, in which the Carthusian foundations are identified as “a

Table 1 Construction phases

Phase	Name	Years
Phase 00	Pre-existence	...–1478
Phase 01	Foundation	1478–1505
Phase 02	Large Cloister W-S	1505–1525
Phase 03	Cenobitic Core	1525–1560
Phase 04	Large Cloister E-N	1560–1610
Phase 05	<i>Conreria</i>	1610–1662
Phase 06	Baroque Completion	1662–1769
Phase 07	Monastery	1769–1835

perfect example of reconciliation between the individuality of the building and the identity of the type” (Martí Arís 1993).

Results

The Charterhouse of Jerez is a monumental complex of great surface area that includes both the buildings destined for monastic life and the activities that allowed the economic support of it. To the complexity of this functional structure must be added a lengthy three-century construction process in which the organization of the spaces had to reconcile geometry, the rules of the order known as *Consuetudines Cartusiae*, the physical conditions on the site of the foundation, and the cultural circumstances of each historical period. This constructive evolution has been organised in a sequence of eight phases, the time limits of which correspond to the relevant events of this evolution (Table 1).

In any case, the result of the historical process recognizable today reflects the remarkable existence of an architectural project that, although it did not address the whole complex in its entirety, had to remain as a layout/guide for the most significant parts of the complex: the eremitic area that occupies the Large Cloister and the community outbuildings of the cenobitic core.

Given the Gothic shapes of its stonework and the dates recorded in the documents, it is possible to characterise the Charterhouse as an important late Gothic work begun in the late seventies of the fifteenth century. The scale of the undertaking developed by the Carthusians over a century, and the maintenance of a unitary late Gothic language, place us in the context of the construction of the Cathedral of Seville and its production centre, with which it shared many masters, stonemasons, material resources, and shapes, especially during the first three decades of the sixteenth century. Likewise, the Charterhouse shared not only the influence of the Cathedral of Seville but also the blossoming of a focus of local production infused by it and external influences (Romero Medina and Romero Bejarano 2017).

As in the Cathedral of Seville, in the Charterhouse of Jerez can be noticed the existence of a layout that directed, with considerable determination, the course of such a lengthy work. This layout has not been preserved, nor is its authorship

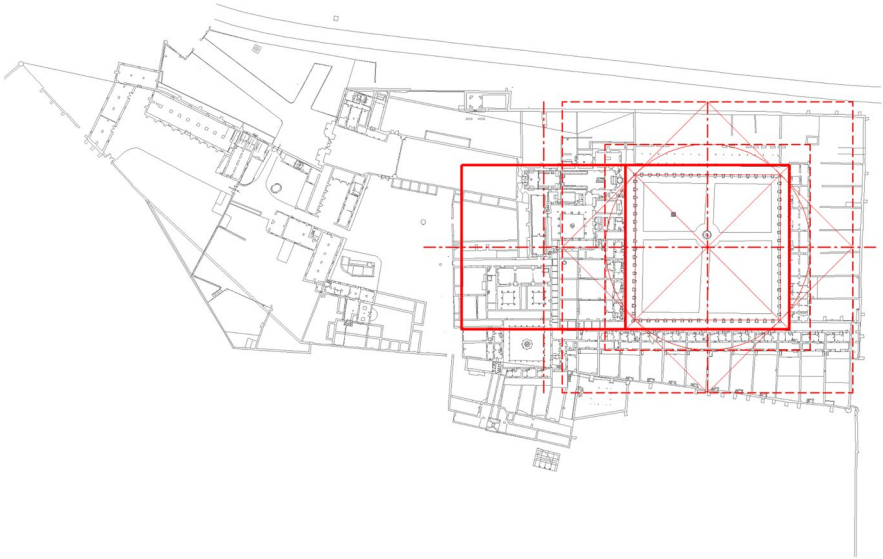


Fig. 7 First-order layouts of the Charterhouse of Jerez

known, although due to the estimated dates, between 1467 and 1478, they could be attributed to one of the major masters of the Cathedral. Both the Cathedral of Seville and the Charterhouse of Jerez belong to the Archbishop of Seville, and the major masters in the service of the Archbishopric controlled the works in its territorial area. Despite these references, it seems daring to propose the name of the master builder, remaining in the surroundings of the production centres of Seville and Jerez, and the influence of the territorial implantation of the Carthusian order itself.

Knowing the layout of the Cathedral of Seville, which is taken as the most immediate reference, and following the basic guidelines of the structuring of these great buildings according to a hierarchical process that links the whole and the parts, a geometric approach has been proposed to the foundational layout, which has established relationships that are perpetuated over time.

Proportion

The initial approach to the layout, which we are calling first-order layouts, is based on the geometry of the square (Fig. 7). The first square defines the Large Cloister, which is the most difficult piece to fit together in the whole complex because of its large surface area. It corresponds to the walls that separate the cells from the cloister galleries. This same square, when duplicated according to its diagonal, determines the dimension of the extension of the Large Cloister up to the orchards, with the adjustments required by the presence of the road to the north and the orography to the south, which will be described when developing the mismatches or disproportions of the layout.

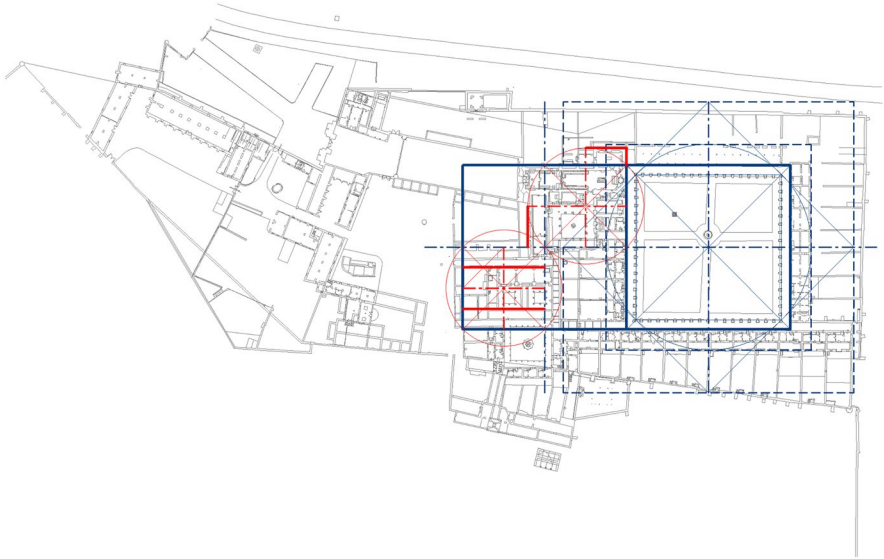


Fig. 8 Second-order layouts of the Charterhouse of Jerez

If this first square is associated with the eremitic core, a second square of the same dimension is arranged to organise the spaces of the cenobitic core, complementary to the previous one, providing space for the Church, Refectory, Chapter Rooms, Small Cloister, and offices. In the case of Jerez, the available surface area was constrained in the north–south direction by the Medina road and by the floodable area of the Guadalete river, so the second square is arranged juxtaposed to the first in a direction parallel to the road, east–west.

The arrangement of the spatial complexity of the cenobitic core gives rise to what we are calling second-order layouts (Fig. 8). The axes of this square delimit four quadrants that organise differentiated functional structures. In the northeast quadrant are the most significant parts, such as the Church, the Refectory, and the Small Cloister. In the southwest quadrant are the Kitchens and their annexed rooms around the cloisters. The northwest and southeast quadrants are available for offices and a more flexible link with the Large Cloister.

In the northeast quadrant, the church is aligned with the two corresponding sides of the square. The outline of a circumference with a radius of the diagonal of the square determines the space for the Sacristy, to the north, and the Refectory, to the west. In the southwest quadrant, there is a division into four horizontal bands. The upper and lower ones are characterised by their occupation with longitudinal corridors that functionally articulate such a compactly occupied space. The central bands are occupied by the kitchen spaces and their auxiliary cloisters.

To understand the deployment of the proposed layout on the site, it is significant to analyse the topography and the existing constructions at the time of the foundation of the monastery. Historical documents refer to the existence of two buildings on the site at that time: the Hermitage of Nuestra Señora de la Defensa, which gave



Fig. 9 The site of the Charterhouse before its foundation in 1478 and the development of the first-order layouts

its name to the Charterhouse, and a cottage (Fig. 9). The hermitage occupies a privileged location: the highest point of the surrounding area, close to the road from Jerez to Medina Sidonia. As this point was occupied by a previous construction, the head of the church of the new monastery, the symbolic reference of the new foundation and the starting point of the works, will be located at the next highest point in the surroundings, reinforcing its symbolic and functional preeminence (Fig. 10).

Thus, between the road and the river there was a sufficiently horizontal terrain to build a monastery. The available space was more flexible in the east–west direction and more restrictive in the north–south direction, due to the presence of the road to the north and the steep slope that defined the floodable area of the river. The deployment of the layout acts as a form of appropriation of the site and responds to its topography by deploying two squares aligned in an east–west direction, one that will generate the eremitic core associated with the Large Cloister and, juxtaposed to it, another of the same dimension that will resolve the cenobitic core. Within this, the church occupies a predominant position, associated with its symbolic value, which links its apse to the highest point of the surroundings, only behind the point already occupied by the Hermitage of Nuestra Señora de la Defensión.

Persistence of the Layout and Disproportion

The proposed layout described above dates from the end of the fifteenth century and directs the founding works of the monastery. However, the constructive evolution of the monastery lasted for decades, subject to various historical circumstances. Hereafter, the relationship of the layout with the constructive evolution is presented, showing not only those elements which conform to it, but also those which do

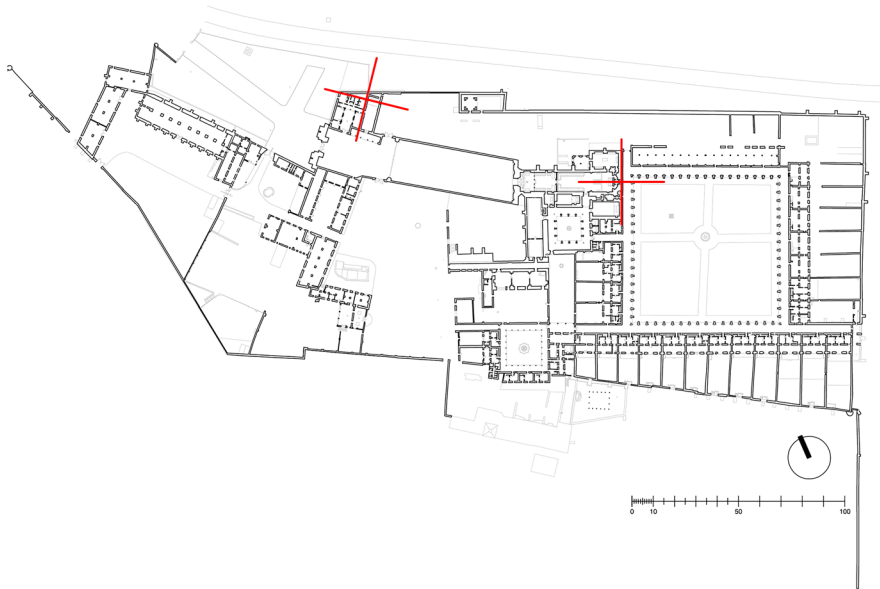


Fig. 10 Plan of the Charterhouse of Jerez, showing the highest points in relation to the Hermitage of Nuestra Señora de la Defensa and the apse of the monastery church

not, showing a disproportion. These situations do not contradict the value of the layout as an instrument of shape control of the entire late Gothic work, but rather they alert us to special situations where it has had to be altered or modified due to insurmountable circumstances, and which, for this reason, are of great value in increasing our knowledge of the monument.

The first phase of the monastery construction (1478–1505) involved, given the large surface area of the monastery and the downward slope toward the river, an important effort to level the terrain, which we can confirm through the analysis of the architectural configuration of the levels and structures of the building and the specific geotechnical work carried out on it in recent years (Vorsevi 2007). This adaptation to topography explains the obliquity of the southern wall of the Large Cloister, which reduces the available surface prior to the abrupt descent of the terrain towards the Guadalete (Fig. 11).

In the second phase (1505–1525) the construction of the Large Cloister progresses, and it can be seen how the system of proportions established in the first-order layouts is respected in the construction of the cells in the southwest corner (Fig. 12).

In the third phase (1525–1560), the main constructions of the cenobitic core are developed according to the geometric guidelines described as second-order layouts (Fig. 13). However, certain distortions in the alignments of the walls can be detected which have their origin in the imposition of a square geometry for the Small Cloister. In other Carthusian monasteries, this cloister is resolved with a rectangular geometry and could also have been planned in this way from the original layout, avoiding the

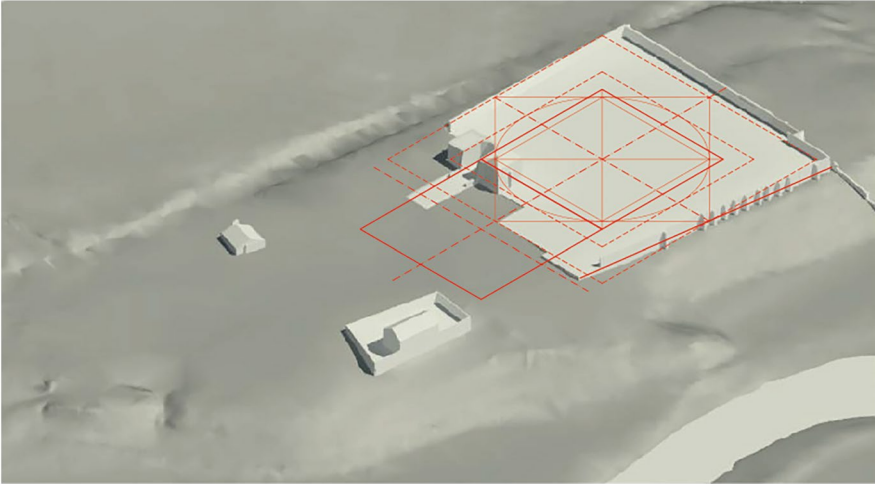


Fig. 11 Phase 01, Foundation (1478–1505)

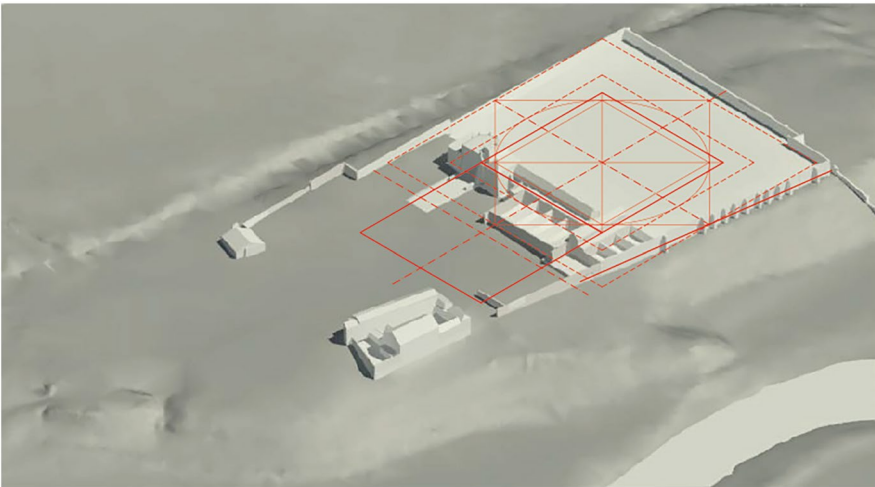


Fig. 12 Phase 02, Large Cloister W-S (1505–1525)

distortions mentioned above. However, the dates place us in the sixteenth century, with a greater implementation of Renaissance architectural concepts, which may have led the master Diego de Riaño (Romero Medina and Romero Bejarano 2017) to alter the original plan in favour of a square Small Cloister.

In the fourth phase of the construction evolution (1560–1610), one of the most significant alterations to the layout of the monastery, its most obvious disproportion, took place. It is related to the construction of the main entrance façade and the atrium between it and the church façade. The main entrance façade



Fig. 13 Phase 03, Cenobitic Core (1525–1560)

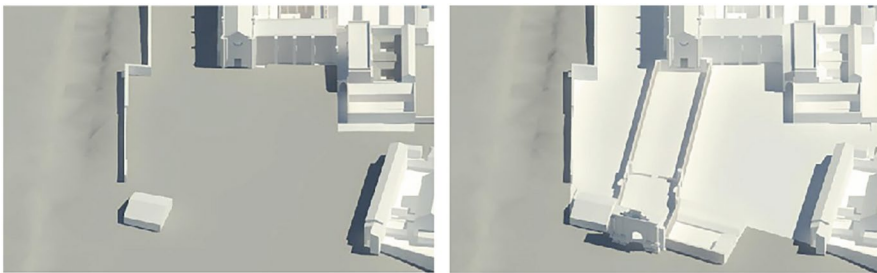


Fig. 14 The space in front of the church in phase 03 (1525–1560) and the construction of the main entrance façade and the disproportionate atrium in phase 04 (1560–1610)

was not built as a freestanding building, but as a piece that, supported by existing structures, helps to complete and configure the monastery enclosure. The need to build an atrium and the existence of the Hermitage of Nuestra Señora de la Defensión is resolved by placing the main entrance façade next to it, although this involves an obvious alteration of the general lines of the complex (Fig. 14).

The north wall of the atrium, which links the Hermitage with the church façade, is forced into an oblique alignment that breaks the geometric regularity of the general structure, producing a space of nonregular proportions. The search for a certain regularity conditioned the layout of the south wall of the atrium, which is built parallel to the north, resulting in a trapezoidal atrium (Fig. 15). This solution gave the atrium a certain perspectival regularity, minimising the perception of the oblique alignments forced by the preexisting conditions and highlighting the scenographic value of the church façade (Fig. 16).

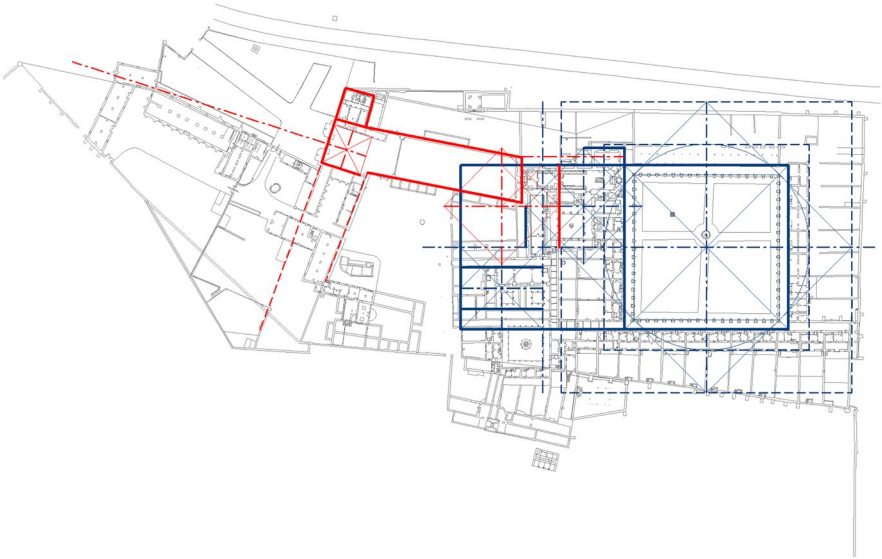


Fig. 15 Layout of the atrium



Fig. 16 Phase 04, Large Cloister E-N (1560–1610)

The fifth phase (1610–1660) and the sixth phase (1660–1769) are presented together, since the latter did not involve the construction of new buildings, but rather the superimposition of profuse Baroque decoration. Thus, in these phases, with the general configuration of the monastery already completed and consolidated as a very important part of the economic activity of its surroundings, it was considered necessary to organise the spaces related to this activity, which until then had been

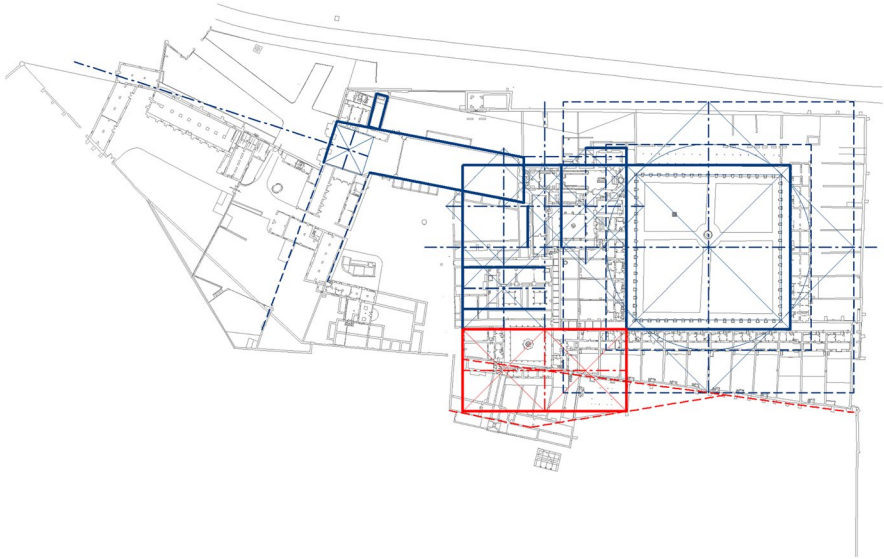


Fig. 17 Layout of the *Conreria*

occupied by reused buildings. To this end, the construction of a *Conreria* was planned, a set of spaces articulated around a cloister where the administrative offices of the monastery and the cells of the lay brothers would be located.

The chosen site is located in the southwest corner of the monastery area, bounded on its northern flank by the Kitchen Cloisters, on the west by the Courtyard of Obediences, on the eastern flank by the Large Cloister, and on the south by the retaining wall of the fill made for the leveling of the monastery, following the oblique alignment with respect to the orthogonals of the complex, which was necessary to adapt to the orographic conditions (Fig. 17).

Even though more than a century had passed since the foundation of the Charterhouse, a certain persistence of the general lines of the layout of the monastery is recognisable in the *Conreria* project. This is due to the support of the pre-existing alignments, but also to original design decisions of this time such as the location and size of the Lay Brothers Cloister (Fig. 18).

Conclusions

Based on the above results, there is substantial evidence that the fifteenth century foundational layout of the Charterhouse of Jerez is supported by a system of proportions based on the square and its diagonals, in accordance with the practical knowledge of the master builders of the time, known as the *geometria fabrorum* of the late Gothic period.



Fig. 18 Phase 05, Conreria (1610–1662) and Phase 06, Baroque Completion (1662–1769)

The layout is adapted to the topographical conditions of the site, being resolved as the juxtaposition of two squares aligned in an east–west direction. One of the squares is dedicated exclusively to the Large Cloister, the eremitic core of the monastery, which forms the gallery that connects all the cells. The diagonal of the square generates the general lines of the living spaces and orchards of these cells. The juxtaposed square is dedicated to the spaces of community life, the cenobitic core, with a more complex organisation that has been altered over time, but where relationships can also be seen based on the diagonal of the square and the division into four parts (Fig. 19).

The late Gothic layout persisted as a guide throughout the successive phases of the monastery's constructive evolution during the sixteenth, seventeenth and eighteenth centuries, despite the fact that other considerations derived from the monastery's new functional requirements and new artistic and spatial approaches were imposed. Both in the foundational phase and in the successive construction phases, the distortions with respect to the layout reveal unique circumstances related to the physical and cultural conditions of each historical moment. Therefore, it has been possible to recognise the existence of previous buildings, the adaptation to topographic conditions, and the appropriation of the atrium space at the cost of abandoning the established proportional system (Fig. 20).

To conclude, the analysis of the respect for the system of proportions of the layout and, simultaneously, of the circumstances in which some disproportion is produced has allowed an advance in the knowledge of the relationship between geometry and architecture in the case of the Charterhouse of Jerez and Late Gothic architecture in general.

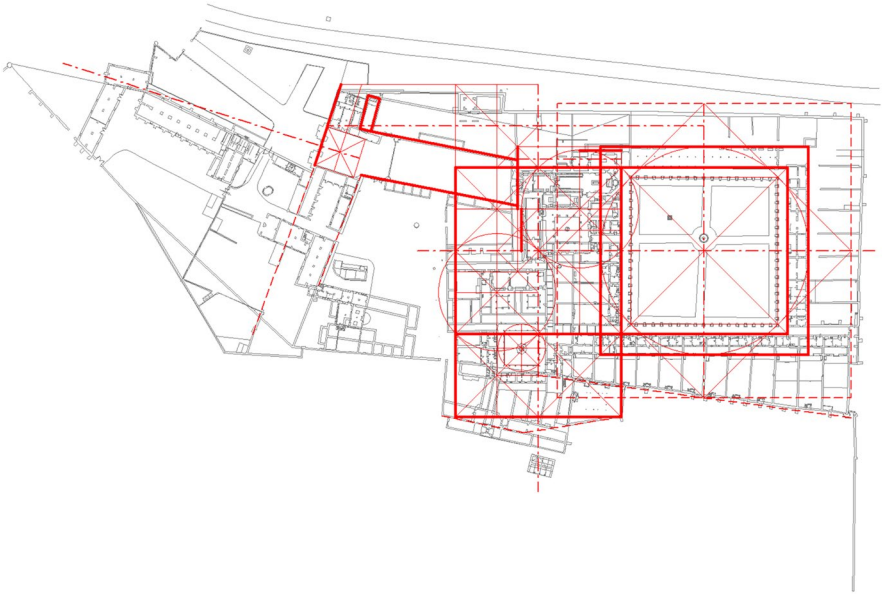


Fig. 19 General synthesis of the geometric layout on the ground plan of the Charterhouse of Jerez



Fig. 20 Phase 07, Monastery (1769–1835)

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