penters to builders because their work in wood brought them close to the Cross. See Ricardo da Costa, 'Las definiciones de las siete artes liberales y mecánicas en la obra de Ramón Llull', *Anales del Seminario de Historia de la Filosofía* 23 (2006): p. 140.

85. Vich, *Documenta,* pp. 71-4.

86. The bishop and canons agreed in 1386 to continue the original and magnificent building design: 'et sicut alia construantur in altum, et iuxta formam magno decore conceptam et inceptam fieri in ipsius primario fundamento'. Sagristà, 'La catedral de Mallorca. El enigma', p. 17n2.

4

Architectural Practices in Spain, 1370-1450: Documents and Drawings

ENCARNA MONTERO
UNIVERSITAT DE VALÈNCIA

Although the current volume follows directly in the illustrious tradition forged by Llaguno, Ceán Bermúdez and George Edmund Street, the issues tackled in this essay have as much to do with social history as with architecture.[1] Numerous published and unpublished documents shed light on the practice of late Gothic architecture. Sometimes these documents confirm what scholars have long suspected, but often they also challenge long-held assumptions. This is the subject of the current essay, which focuses on material in Valencia's archives, but will also widen the horizons to consider other material too.

The essay's first part will focus on apprenticeship in building trades. The second will deal with architectural drawings. But first it is helpful to say something about place and time. Previously under Muslim control, the Kingdom of Valencia was located in the eastern part of the Iberian Peninsula conquered by King James I of Aragon between 1232 and 1245. For this, James was praised highly by Matthew Paris in his *Chronica Maiora*, and across Europe his campaigns were perceived as a Crusade that strengthened Christendom and pushed Islam to the borders of the continent.[2] From the very beginning, James, who was named the Conqueror, provided his southern territory with its own laws and institutions, thus creating a kingdom in its own right, politically and institutionally different from the other territories of the Crown of Aragon. Valencia was a land of many opportunities that consolidated and replaced Catalonia as the flagship of the Aragonese Crown in the fifteenth century, despite the Jewish pogroms of 1391, conflicts between urban factions, epidemics, famines, plunder, and closed borders with Castile.

The period 1370–1450 was not an easy time, but it can be said that there was a long period of economic growth, altered episodically by local or regional problems. This period coincides with a blossoming of the arts that is recorded in notarial documentation from those same years. Building projects grew in quantity and price, and the epicentre of this architectural activity was the capital, where newly arrived stonemasons from other peninsular kingdoms or beyond the Pyrenees engaged closely with a local work force and with customers who paid willingly for innovative structures.

Like several other Mediterranean territories, Valencia preserves a great quantity of documentation from the fourteenth century onwards. In the research conducted into the transmission of knowledge in artistic trades, the main source of information has been private records, such as last wills, inventories and apprenticeship contracts. In particular, the notarial archive of the colegio del Corpus Christi, Valencia, is a treasure trove that has provided almost all the evidence described in the first part of this text. Taking into account that architectural projects were often collective enterprises promoted by civil or religious authorities, it has been necessary to consult other holdings, such as the municipal and cathedral archives in Valencia. Both of these archives hold detailed accounts of the building processes and maintenance works of impressive structures, such as city gates or the lantern tower of the metropolitan cathedral.

The career path of the figures constructing these buildings always started in the same way: an apprenticeship in late childhood and early youth with an experienced professional.[3] This process was based on the master-apprentice relationship, on the early involvement of the adolescent in labour activities (not practice tasks, but real acts that had an impact on construction), and on the progressive supply of knowledge, depending on the capability and skills of the apprentice. In fact, this kind of training has all the conditions of significant learning, in modern pedagogical terms. In Herbert Kessler's words, 'Craft traditions themselves helped to perpetuate both forms and styles, sometimes over long periods. The apprenticeship system was fundamentally conservative. The training of artists reflected the attitude: *Nihil innovetur, nisi quod traditum*'.[4]

How then could innovation emerge out of this seemingly fixed process of intergenerational transmission? First, although the training method remained stable precisely because it was so effective, the syllabus was mutable. In other words: different forms and styles were taught in the same way, certainly between 1370 and 1450, and

Fig. 4.1
Pinnacle (ca. 1440). Polychrome wood, 150 cm high. Museo de la Ciudad, Ayuntamiento de Valencia.

probably long before and after. The documents that most clearly describe this kind of training are apprenticeship contracts. Unfortunately, there are few extant examples from Valencia, perhaps because it was only after 1514 that such arrangements had to be signed before a notary. In Castile and other European territories this kind of record is even scarcer. This accords with what we know about other artistic professions: painters' apprentices could be bound to their masters by a document (called a *carta*), but also by means of an oral agreement. This makes it difficult to say anything very definite, and before briefly analysing those apprenticeship contracts that do survive from Valencia, it is necessary to elucidate two ideas. The first concerns these documents' exasperating silence about the specific skills that were the real object of the economic transaction. The second regards the proper definition of an apprenticeship contract.

Starting with the first question, the arrangements were not explicit about skills because it was not necessary or required; it was not possible to efficiently codify technical training in a treatise for teaching purposes. Certainly, nobody learnt a trade by reading a book. As Cennini put it, 'you can read this book night and day, but if you do not follow a good master, you will not learn anything'.[5] Of course, there were technical texts about artistic trades, but they summarised a tradition that was vanishing (such as the *Libro dell'Arte* itself, regarding post-Giottesque painting, or the northern masons' books of the late fifteenth century), were not intended to be canonical treatises, or even were not

Fig. 4.2
Convent of San Francisco de Teruel, model of window tracery (unknown date). Clay, 18.5 x 8 cm. Museo Casa Benlliure, Valencia.

written by an artist, being understood as such only later (Villard is the obvious example here). The documents that were nearest to workshop practice were, in fact, compilations of colour recipes such as the French Jehan Le Bègue's.[6] Regarding the proper definition of an apprenticeship contract: in Catalan, the verb *afermar* (to bind two people by mutual agreement) is always used in these registers, but it does not automatically imply a didactic act.[7] Sometimes this also involves teaching a profession, and sometimes not. All apprenticeship contracts include the verb *afermar*, but not all *afermament* contracts are related to apprenticeship. This leads to the differentiation of two documentary types: apprenticeship agreements and job agreements. These categories were sometimes fluid, however, as we will see below.

In Valencia, published apprenticeship contracts concerned with building trades are few in comparison with those related to painting. If we turn to hiring, there is almost no evidence. This is because, for more than a century, local scholars have focused principally on painters and altarpieces. We can, however, take advantage of this by comparing new data about architecture to the reasonably solid history of painting in Valencia between 1370 and 1450. There are several extant apprenticeship contracts in this period that involve builders or stonemasons (although the terminology in late medieval documents is extremely variable, with the same worker named as 'master stonemason', 'mason', 'builder' or 'sculptor').[8]

All present similar characteristics, quite different from other artistic trades. The ages of apprentices are remarkably high, the training period is short, and the reward at the end surpasses the usual maintenance and clothing, consisting instead of masons' tools. For instance, on 12 April 1385, Joan Franch, stonemason, agreed with Jaume Bonet that he would instruct Bonet's son Joan, for three years. At the end of the training period, besides some clothes, the master would give the apprentice two axes, a set-square, a chisel and a mallet.[9] On 25 November 1390, Joan Lobet the Elder, a master stonemason, agreed with Vicent Cubells, a stonemason, that he would teach Cubells' son Antoni for nine years (perhaps the longest period known for such agreements).[10] On 29 August 1415, Pere Riera, son of a Catalan stonemason, agreed with the stonemason Julià Martinez that

he would serve Martinez for three and a half years. At the end, Riera would be given several tools.[11] On 16 August 1423, the builder Miquel Roda agreed with Pere Punyet, guardian of Pere Sanchez de Favavuig, to teach his art to Pere for four years. At the end of the training period, Roda would give Sanchez the usual tools given to novices at the end of their apprenticeship.[12] On 16 June 1434, the builder Antoni Ferrer agreed with carpenter Domènec Eiximeno that he would instruct Eiximeno's fourteen years old son Joan, for three years.[13] On 12 June 1438, Martí Lobet, 'picapedrerio et magistro operis sedis Valencie', agreed with Guillem Dezplà, stonemason, that he would teach his art to Dezplà's fourteen year old son Jaume for four years from 1 April 1439. At the end of the training period, the master would give the apprentice the usual tools.[14]

It seems that we are dealing with a stage of advanced learning in which the enrolled boy had already mastered some building skills. The expertise acquired during those three or four years distinguished him from lower paid and less skilled craftsmen. Suspiciously often, the youth was the son of a builder, which leads to the idea of a professional custom—perhaps established more firmly than normally presumed—that compelled the youngest members of the clan to seek innovations outside the family workshop.

Among the cases listed above, we have two paradigmatic examples referring to the educational trajectory of well-known professionals: Joan Franch and Martí Lobet, both masters of Valencia Cathedral. Joan Franch directed works there from 1388 to 1399, Lobet between 1428 and 1439 (although he was considered a skilful builder well before that). It was Lobet who oversaw construction of the highest level of the bell tower, raised the lantern tower to its definitive height, and built the so-called new library, introducing a significant new element derived from works by the famous Majorcan architect Guillem Sagrera: spiral columns. Lobet had, in fact, a very interesting professional trajectory, and had already mastered a very wide range of graphic skills when hired to oversee the bell tower project. He was also able to negotiate with a Muslim stone supplier, and himself owned at least four quarries near the city.[15]

Other masters of Valencia Cathedral, such as Antoni Dalmau and Francesc Baldomar, are named in *afermament* contracts, but in these cases the agreements seem to imply service, not learning. For one, there are no verbs referring specifically to pedagogy such as *addiscere* or *docere*. Furthermore, those bound to the masters are adults and are described as stonemasons. In this type of contract, the final reward is money, not tools. On 19 June 1449, Antoni Dalmau hired Pere Gironés and Martí Pi, both Catalan stonemasons, for two years. At the end of the period, Dalmau would pay 20 florins to each.[16] In 1463, Baldomar, who is considered the principal innovator in mid-fifteenth-century Valencian masonry, hired one Juan de León, described as 'moço del mestre' (the master's assistant) in a document in the cathedral archive from the same year.[17] Can we deduce that these *afermaments* with no specific didactic component were the next step in the career of a young mason who had finished his training? To work alongside the best masters in the early stages of a professional life is a good beginning. We cannot say anything more in this case, but it is probable that further evidence is to be found in the archives of many different towns, as the second part of the training seems inextricably bound with travel. Be it as it may, apprentices and assistants were differentiated groups in work forces undertaking construction. These young men were in the first and second stages of a journey towards professional independence and the financial rewards that went with it.

One of the key skills of a successful master was the ability to draw. Most of the few architectural drawings that have come down to us are demonstrations of constructive geometry derived from procedures acquired during the learning process. These resources formed part of a wider, structured body of knowledge which, needless to say, was transmitted by channels other than treatises: words, graphic puzzles (presumably on perishable media) and early entry into the world of work (in the stonemason's yard). Such unwritten transmission of knowledge has often been identified as hermeticism.

In the particular case of architecture, this supposition of professional secrecy has taken root especially in the collective imagination, not only since the eighteenth century when British masons' lodges adopted much of the imagery associated with the stonemason's craft, but also as a result of inaccurate information in popular historical novels. People seek out drawings associated with medieval architectural practice in the hope of finding traces of this encrypted knowledge, the most common example being mason's marks. Independently of this, scholars have also sometimes puzzled over the interpretation of these drawings, mainly for two reasons: first, in this type of document it is the graphic element that contains the fundamental information; and second, there is usually no written text to help with the interpretation of the imagery, and any notes which are supplied are very brief. The explanation lies, of course, in geometry, a tool with which most historians are relatively unfamiliar. Architectural drawings are not undecipherable hieroglyphics; in most cases, when basic precepts of geometry are applied, these drawings can be interpreted without too many problems. Without these, they remain unintelligible because they are taken out of context and without the formulas that help us understand how the forms are developed.[18]

First, we should make a preliminary distinction between drawings made for the patron (in the examples that have come down to us, almost always a *fabrica ecclesiae*, or religious building fund), and those intended to solve a specific problem in construction, usually in 1:1 scale, close to the work being carried out and connected to the practice of architecture. Within the group of drawings which were held by the commissioning body, we can also differentiate between so-called 'presentation' drawings and what would now be called architectural projects, namely floor plans and sections (although sometimes floor plans and sections could be included in the documents used to explain the work to the patrons). A paradigmatic example of the first sub-group would be drawings of façades, worked in extraordinary detail and including sculptures. Here it should be clarified that although the artistic element was just as important as the technical drawing in presentation models, the main working instrument was still geometry. Everything was ultimately governed by geometry and measurement, and we can find this even in the most decorative designs. With façade drawings, architects called on another skill learned in the stonemason's yard: ornament, which they could also draw skilfully and later transfer to sculpture. Thus, we can find both measurement (the guarantee of *firmitas*) and beauty (*venustas*) in late medieval architectural drawings.

Within the second group of drawings—those intended to solve a specific construction problem, usually on a 1:1 scale)—there is a wide variety which will be reviewed in detail below, although not many examples have survived due to their function. They are ephemeral by nature, being directly connected to work at the building site: designs scratched into walls or other parts of a building, measurements relating to perimeters (as recorded in contemporary documentation), templates for use in carving mouldings (typically described in medieval sources as 'patrons', 'moles', or 'gabarits'), or pieces that were difficult to define stereotomically. All such drawings were necessary and indeed essential for construction to continue.[19]

In short, the idea proposed here is that drawings on parchment or paper, usually kept in the archives of chapter houses and dioceses, were not designs to be used on site, but rather explanatory documents *ad alienos*: an illustration and a guarantee for the patrons, and also a general guideline for the future master builder who would eventually take over the work.[20] This is obvious from the drawings' state and place of conservation and must always be borne in mind when analysing these drawings. They formed part of the *fabrica ecclesiae* and were not connected to the work on site, although they could not be fully understood without architectural knowledge, and non-experts needed the explanations of the draughtsman to make sense of them (then as now).[21] Meanwhile, any master builder taking over the leadership of the project could easily read these documents, and would be able to project his knowledge onto the plan, deducing from it with perfect clarity how to resume work.[22] Important examples in the Castilian area of influence include the plan for Seville Cathedral (ca. 1481, a copy of another drawing of ca. 1433); the designs for the Velasco tomb in Guadalupe (ca. 1464); and the drawing of the capilla mayor of San Juan de los Reyes (ca. 1484). In Catalan-Aragonese territory they include the floor plan of the bell tower of Sant Feliu in Gerona (ca. 1368); a design for Tortosa Cathedral (ca. 1379–1382); the elevation of a pinnacle in the archives of Lérida Cathedral (ca. 1400); the design for the façade of Barcelona Cathedral (1408); and perhaps the project to enlarge the parish church of San Bartolomé in Jávea (ca. 1513).[23]

The list of 1:1 scale drawings on building walls and floors is longer than one would expect. In Castile, there is a scale drawing for a rose window incised into a flat stone, dating from the late thirteenth century (León Cathedral Museum).[24] Traces have also been found, for instance, in Cuenca (also late thirteenth century, on the inner wall of the lantern), and in Seville (ca. 1450–1475, in different parts of the cathedral).[25] In Aragon there is a graffito in the church tower of Santa María la Mayor in Alcañiz, which is a design for the east end of the church, and a sketch for the construction of window tracery in an inner passage of the apse of La Seo in Zaragoza.[26] A recently discovered room on the ground floor of Benisanó Castle, Valencia, is also full of *mostres* on plaster, which are still being studied (researchers have identified various designs for vaults with curved ribs, which seem to have been produced as part of a discussion, and for a gatehouse).[27] There are documents indicating that there was a *casa de la traça* in Seville, in El Escorial and in Granada Cathedral.[28] The designs in these locations are closely related to the on-site drawings mentioned above, although the latter were also often institutional, becoming almost a piece of architectural performance art (for example, the setting out of the dimensions of the bell tower of Valencia Cathedral by Andreu Julià and two assistants on 3 July 1380, before a magistrate, the city's jurymen and the chapter).[29]

Occasionally this demonstration would be accompanied by the delivery and explanation of a drawing of the finished project, like today's models and projections, meaning that the on-site design and the presentation drawing formed a dual entity. Perhaps we could regard this as the combination of two complementary modes of graphic expression to defend a given architectural idea (for example, returning to the events of 3 July 1380 in Valencia Cathedral, a parchment was bought for the master to draw the bell tower).[30] Following this line of reasoning, the extant drawings could be supposed to form part of a more extensive set of representations (some ephemeral, others not) in the initial phase of a stonemason's workshop, or in another decisive moment in its history. This would be another argument in favour of the theory that sees medieval architectural drawings as graphic documents that must be placed in context, not easily understood in isolation.

In addition to the example from Valencia Cathedral, we can add a reference from the *Sotsobreria de Murs i Valls* to building work on the bridge of la Trinidad in Valencia, begun in the mid-fourteenth century. On 3 November 1401, three and a half *cahíces* of plaster were bought to make a *mostra* (model). Given that this was a large amount of plaster (2103 litres), it has been surmised that the material was not intended for making a scale model, but would be used to plaster a large wall in one or more layers for a 1:1 working drawing of one of the great arches of the bridge.[31] In other words, sometimes a temporary drawing surface might be created, to be used in the same way as a tracing floor was used in the tracing house of cathedral projects. This is the case, for example, of the Capilla Real of the former convent of Santo Domingo in Valencia, where an even larger amount of plaster was paid for on 10 July 1451 (four and a half *cahíces*, the equivalent of about 2704.5 litres). This, together with payments for red ochre, suggests a surface was plastered so the chapel vault could be drawn at 1:1 scale.[32] However, the use of plaster for tracing designs could include also the consideration of variant shapes in order to make a

final decision.

Templates, like 1:1 scale drawings on the building site, were graphic expressions which were not meant to last. There are many records of this practice in the archives, as well as material evidence of their use. The ability to produce these was vitally important, as it made the work of the stonemasons more efficient and, above all, could speed up the construction process.[33] References to templates, although somewhat dispersed, are frequent in specialist literature, and it is difficult to gather a significant number of monographic publications on the subject.[34]

Many materials were used to make templates: canvas, wooden boards, or ideally, a sheet of metal.[35] A review of the documentation published in the Catalan-Aragonese sphere provides some specific examples. The inventory of the assets of Pere Mates, a businessman and stonemason of Mallorca (20 November 1358) includes 'quandam quantitatem de moyles de ferro' and 'unum caxonum cum VIII mollos stagni et plumbi'.[36] Zaragozá and Gómez-Ferrer also mention several cases in Valencia which show the use of templates.[37] Records show the use of wooden *molles* (shapes made of glued paper), like those used by Dalmau in the retrochoir of the cathedral and Baldomar in the capilla real in the convent of Santo Domingo, and metal patterns, as used by Compte in the Lonja.[38] The working method was simple:

> It consisted of drawing on the block the profiles given by the patterns made to full scale by the masters, roughing them out with the help of the scantillons (*galgues*), the sliding T bevel (*sentenella*) and the curved bevel (*sentenell*), to obtain ashlars (*carreus*) and other pieces … The *galga* was a small wooden bar with a grove which indicated a given measurement, used to adjust the size and shape of the piece.[39]

Obviously, this was usually not a simple stone block, but rather a standard moulding of the sort required in bulk: friezes, cornices, blind arches, bases, capitals, some elements of the vaults, triforia, tracery, piers and so forth.[40] The importance of these templates should not be underestimated, because they required a preliminary design which in some cases has also been linked with the emergence of exact and scaled architectural drawing.[41] This task of designing templates has also been shown to relate to the gradual separation of the master craftsman from the building site.[42]

In the crown of Aragon, there are well-documented cases of mass production of marble capitals in Roussillon dating from the twelfth century, and shafts and capitals in Gerona. There are also records of various orders for the Royal Chancellery of Valencia during the reigns of Peter IV and Alfonso V of Aragon.[43] The use of templates furthermore explains certain architectural forms by Guillem Sagrera that predate any similar examples in the European context by more than a century. The *tas-de-charge* which emerge cleanly from the wall and spiral fluted columns in Palma's Lonja required preliminary stereotomic definition; Sagrera must have created templates for the keys of the rib vaults and for the column bases, as this was the only way such complex volumes could be translated into stone.[44] In the case of Valencia, the series of documents relating to the Trinidad bridge again provide significant information. A note from 17 November 1401 specifies spending on paper, starch and glue to make *mostres*.[45] Zaragozá and Codoñer suggest that these samples could actually be templates for the stonemasons. Similarly, in 1415 Jaume Esteve was to be paid 2000 sueldos 'per raho de tallar motles e haver menestrals' (for cutting shapes and hiring workers) in the project for the choir entrance in the cathedral.[46]

Three-dimensional models, which were rarely preserved before the sixteenth century, are less ambiguous as objects intended for the patron. These scale models were not intended to solve structural problems, but to persuade a patron of the excellence of a given project, explaining just how the future building would look. Their use appears to increase from the fourteenth century onwards, and is most often documented in Italy.[48] In August 1345, Bernat Dalguaire worked for seven days on a structure of this type, to be shown to the bishop and chapter of Tortosa Cathedral for approval.[49] The model for the spire of the bell tower of Valencia Cathedral, made by Antoni Dalmau in 1442, may bear some relation to the painted wood pinnacle from a guildhall, now conserved in the Valencia's Museo Municipal (Fig. 4.1).[50] The structure, on an octagonal plan, is 1.5 metres tall. Another example of three-dimensional models made for the patron may be a clay model of a window tracery in the Museo Casa Benlliure in Valencia, which according to the note on the back came from the church of San Francisco in Teruel (Fig. 4.2).[51] The piece is an irregular shape, approximately eighty millimetres wide and 185 millimetres tall. Its thickness ranges from thirteen millimetres at the base to eight millimetres at the top. It is thought to be a terracotta tile with a layer of plaster on top which was used to model the window. The date of the relief has not yet been determined. It could be possible that it was part of the church's late nineteenth-century restoration, although there are no obvious similarities with windows there.

Finally, there is a series of documents relating to Valencia Cathedral from September 1424.[52] On 18 September 1424, a settlement was reached between the Valencian chapter

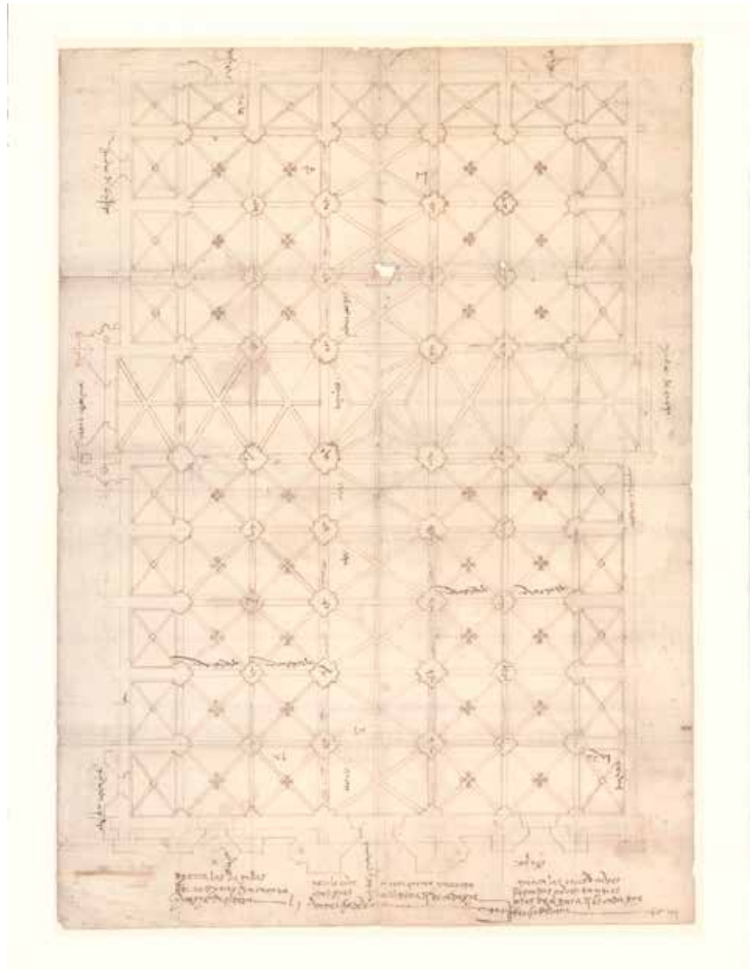

Fig. 4.3
After Maestre Ysambarte (?), plan of Seville Cathedral (ca. 1481, copy of an earlier project of ca. 1433). Ink on paper, 57 x 41.1 cm. Convent of Santa Clara de Bidaurreta, Oñate (Guipúzcoa).

Fig. 4.4
Egas Cueman, project for the Velasco Tomb in the chapel of Santa Ana (ca. 1464). Ink on paper, 45 x 21 cm. Monastery of Guadalupe, Guadalupe (Cáceres).

and Martí Lobet to build the terrace and parapet of the cathedral's bell tower. The clauses refer to a *mostra* of tracery in the possession of the chapter, drawn by Lobet in a patch of land belonging to Pere Daries. Three days before the contract was signed, the master was paid for drawing several samples of the tracery, spire and altarpiece of the cathedral.[53] It is worth noting the relationship between this graphic series and an imminent but still unsigned contract: the type of commissions a master builder could get depended on his drawing skills. These details of the completion of the Campanar Nou of Valencia Cathedral repeat those from the start of work in 1381 under Andreu Julià, when its preliminary designs were set out for the authorities, the dimensions of its foundations calculated in a plot in Ruzafa, and a drawing on parchment produced.[54]

This raises the controversial question of the use of scale in architectural drawings in the late Middle Ages. A lack of a linear scale has often been taken to mean there was no scale in a drawing, but the fact that no notation explicitly states the proportion used does not mean there is no system of reference. Franklin Toker, in his study of the contract for the Sansedoni house in Siena, clearly explains this misunderstanding:

> Preserved together, the Sansedoni elevation, the contract, and the palace seem to constitute a unicum in Gothic architecture, but there is no evidence that the drawing itself was unique. Many more surviving architectural graphics should qualify as 'working drawings' once their specific Gothic contexts are explored. The question of scale is a good case in point. It is widely reported that medieval architectural drawings were not drawn to scale. What is meant is simply that scales rarely appear on such plans. The 1:48 scale of the Sansedoni elevation can rapidly calculated from the measurements on the drawing. Had there been no measurements, traditional formulas governing the widths of doors, piers, and windows would have given the scale. When such 'hidden' scales are decoded it becomes apparent that it was not the scaled drawing but the un-scaled drawing that was a rarity in the Middle Ages.[55]

In this way, after a specific study of the context in which each drawing was created, Toker proposes restoring their status as working documents, not because they were used on site, but because they contained information which could be used to construct a specific building. Alfonso Jiménez Martín concludes that, in fact, just a few scales were used, 'no more than six', depending most of all on the size of the construction.[56] Thus, plans of the largest buildings, such as churches with three naves, would be at drawn at a scale of 1:144; reasonably large single-naved churches and courtyards would be at 1:108; and smaller buildings at 1:96 or 1:48. Larger scales would be used for detailed designs. It is not so surprising, then, that the plan of the bell tower of Sant Feliu in Gerona fits a 1:100 scale reasonably well, or that the plan by Antoni Guarc for Tortosa is at 1:75 [57] (both examples do not correspond exactly to the scales described by Jiménez Martín, but at least are not far from them.)

The custody of architectural designs linked to projects that were never completed in the archives of chapter houses and similar collections of documents prompts some reflections on the concepts of authorship and intellectual property in the late Middle Ages. Acceptance of a specific architectural proposal after it was properly presented usually involved execution by the author of the drawing, if available. If for any reason the project did not go ahead, the documents linked to its presentation remained in the possession of the patron who paid for it. This did not imply a lack of appreciation for the specific skills of a given master builder. For example, in 1392 Joan Franch drew the entrance to the retrochoir for Valencia Cathedral 'per tal quel ves lo senyor cardenal' (in order to be shown to Lord Cardinal), although he is not thought to have directed the construction.[58]

It is now time to consider the most significant Spanish architectural drawings dating from 1370 to 1450, starting with Castilian examples. The plan for Seville Cathedral was discovered in June 2008 in the archive of Bidaurreta's Clarissan convent, and it has since been transferred to the Archivo Histórico Provincial de Guipúzcoa (Fig. 4.3). It is drawn on paper and dated circa 1481, and is thought to be a copy of an earlier project, drawn on parchment in 1433. The plan is quite complex, with three parts: the ground level (a five-aisle church with chapels along the perimeter), the vaults, and the plan of a pinnacle placed in the western edge of the northern part of the transept. According to Begoña Alonso and Alfonso Jiménez, who undertook a thorough study of the drawing, it was not drawn to scale, but is very carefully proportioned on the basis of a rigid modular scheme.[59] It seems thus to be something like a working drawing, because 'the author left all the necessary measures; using them, the modular scheme, the style conventions and the master's experience, it should be possible to build the plan with exactitude'.[60]

Alonso and Jiménez attribute the 1433 original design on parchment to 'Maestre Ysambarte', a French architect documented in Seville Cathedral in 1433 and 1434 who worked previously in Lérida, Daroca, Zaragoza, and Palencia.[61] In the spring of 1435, his successor was 'Mestre Carlí', another northern mason who had already worked in

the cathedrals of Barcelona (1408), Lérida (1410–1427) and Valencia (1428). At this point, it is interesting to remember that Antoni Dalmau—the Valencian architect we have already encountered—was summoned by the canons of Seville between 1446 and 1449. He went to work in the *Magna Hispalensis* but imposed several conditions: he would be the sole master, could choose any assistants he wanted, and would receive 6000 maravedis a year, a certain amount of wheat, and a house. His duty was to supervise masonry works and to make *muestras*.[62] The presence in Seville of at least two masters from Aragonese territories can be understood as a symptom of the dynamism of the building centres of northeastern Iberian Peninsula in the first half of the fifteenth century. Barcelona, Gerona, Lérida and Valencia attracted foreign professionals who then moved on to other cities. In this context, the Bidaurreta plan is quite significant: it is a copy of the first general plan of the cathedral, one presumably used by Carlí, Dalmau and others. More than forty years after its completion, the 1433 project was still substantially valid.

The second Castilian example is quite different. Here, we are dealing with a sequence of three designs for the tomb that the Velasco family built in the chapel of Santa Ana, in Guadalupe (Fig. 4.4).[64] The drawings are linked to a contract dated 12 September 1467. All are signed by the sculptor Egas Cueman and the notary before whom the agreement was arranged. Retaining their documentary context, the drawings clearly demonstrate the legal validity of these kind of sketches. Even a first-rate artist such as Cueman was obliged to work according to this kind of binding preliminary project. The first of the three designs shows the plan for a rib vault. The second is an elevation of the Velasco tomb with the recumbent figure leaning towards the observer to make visible as many details as possible; the third depicts an angel to be set in the nearest pier to the entrance. In short, the three drawings provide all the information needed to imagine how the commission would be materialised.

Fig. 4.5
Juan Guas (?), presbytery of San Juan de los Reyes (1485–1490). Ink on parchment, 194 x 96 cm. Museo del Prado (inv. D05526), Madrid.

The design of the presbytery of San Juan de los Reyes in Toledo is the third and last of the extant examples of Castilian works (Fig. 4.5).[65] It is an ink on parchment drawing of considerable size, kept in the Prado since 1872. Traditionally, it has been attributed to Juan Guas, thought to have come from Brittany, although this assignment is not unanimous. The design shows an interior view of the presbytery, a cavalier projection that has been outlined with extraordinary accuracy. Prolix sculpted ornamentation spreads across piers, friezes, spandrels, cantilevered vaults, and arches. The draughtsman also included a sketch of the main altarpiece of the church. This particularly sumptuous project was, however, never built. Teresa Pérez Higuera has attempted to determine the drawing's chronology and attribution on the basis of the known building process. In 1484, Queen Isabella spent Easter in Toledo.

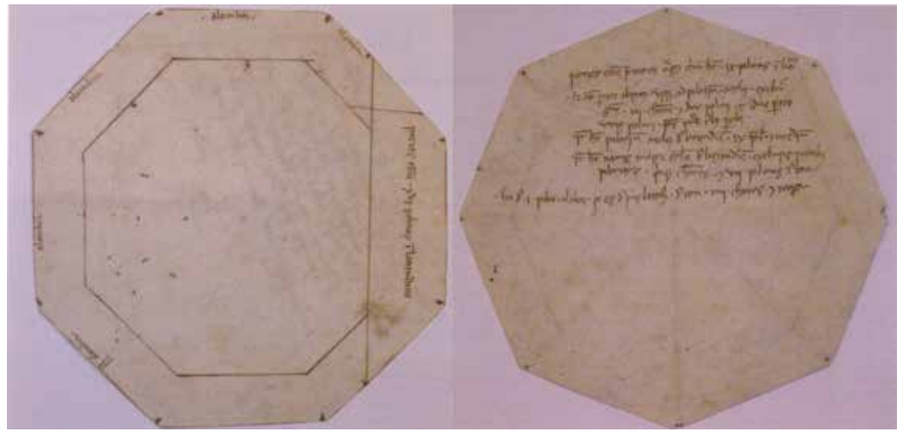

Fig. 4.6
Pere Sacoma (?), plan of the bell tower of Sant Feliu de Gerona (ca. 1368). Ink on paper, 16 x 16 cm. Arxiu Diocesà de Girona, Gerona.

This sojourn has been connected with the new conception of the presbytery as a royal funerary chapel, becoming a virtually independent space.[66] The drawing must predate 1492, for the shield of Granada is not included in the heraldry. From 1494 to1496 the project was partly abandoned because Ferdinand and Isabella decided to be buried in Granada instead.[67] On this basis, Pérez Higuera concludes that the Prado drawing must have been drafted between 1485 and 1490, when Guas and Egas Cueman conducted the work on San Juan. Sergio Sanabria, on the other hand, dated the drawing to 1479–1480, in the very first years of the building process.[68] According to this idea, this cavalier projection was a presentation device which, given the extraordinary ornamental programme, must have required the participation of someone acquainted with heraldry and court customs. When Guas died in 1496, Enrique and Antón Egas assumed responsibility for San Juan, agreeing to follow the changes specified in a drawing that was made and signed by 'maestre Simón'.[69] This has been considered an argument for attributing the Prado projection to Simón de Colonia, who also worked in this Franciscan church at that time, although this possibility seems rather unlikely, as Pérez Higuera suggests. Despite its fame, this extraordinary document still awaits a thorough study.[70]

Let us now look at the eastern part of the Iberian Peninsula. Four extant drawings dating between 1368 and 1408 have remained in Aragonese territories. The first example of this series is a plan for the bell tower of Sant Feliu church in Gerona (Fig. 4.6). This design on paper was discovered by Josep Maria Marquès and has since been analysed by Miguel Ángel Chamorro Trenado and Arturo Zaragozá Catalán.[71] The plan was kept as a loose paper among the libros de obra of Gerona Cathedral dated between 1365 and 1391, and first exhibited in 2002. It can be stated with confidence that the design was drawn around 1368, when Master Pere Sacoma began work on a new bell tower for Sant Feliu. In fact, at the beginning of the summer of that year, Sacoma traced the plan of the tower on site, prior to signing a contract that September.[72] The plan is a regular octagon, generated from a square with sides of sixteen centimetres. On the recto, there is a slightly irregular polygon with several ink manuscript notes including alambor (slope) and 'paries omnes XVI palmos latitudine'. On the verso is an account of the dimensions of that part of the church adjacent to the bell tower, written in Latin and Catalan. It is clear that this plan was attached to the contract of September 1368. Its purpose was to resolve the junction of the western wall of the church and the bell tower.[73] When comparing the dimensions of the drawing with the actual size of the church, the correspondence is specific: 1:100. Finally, the peculiar format of the drawing suggests that it may have been fixed to a plan of the entire church, measuring approximately eighty-five by thirty-five centimetres.[74]

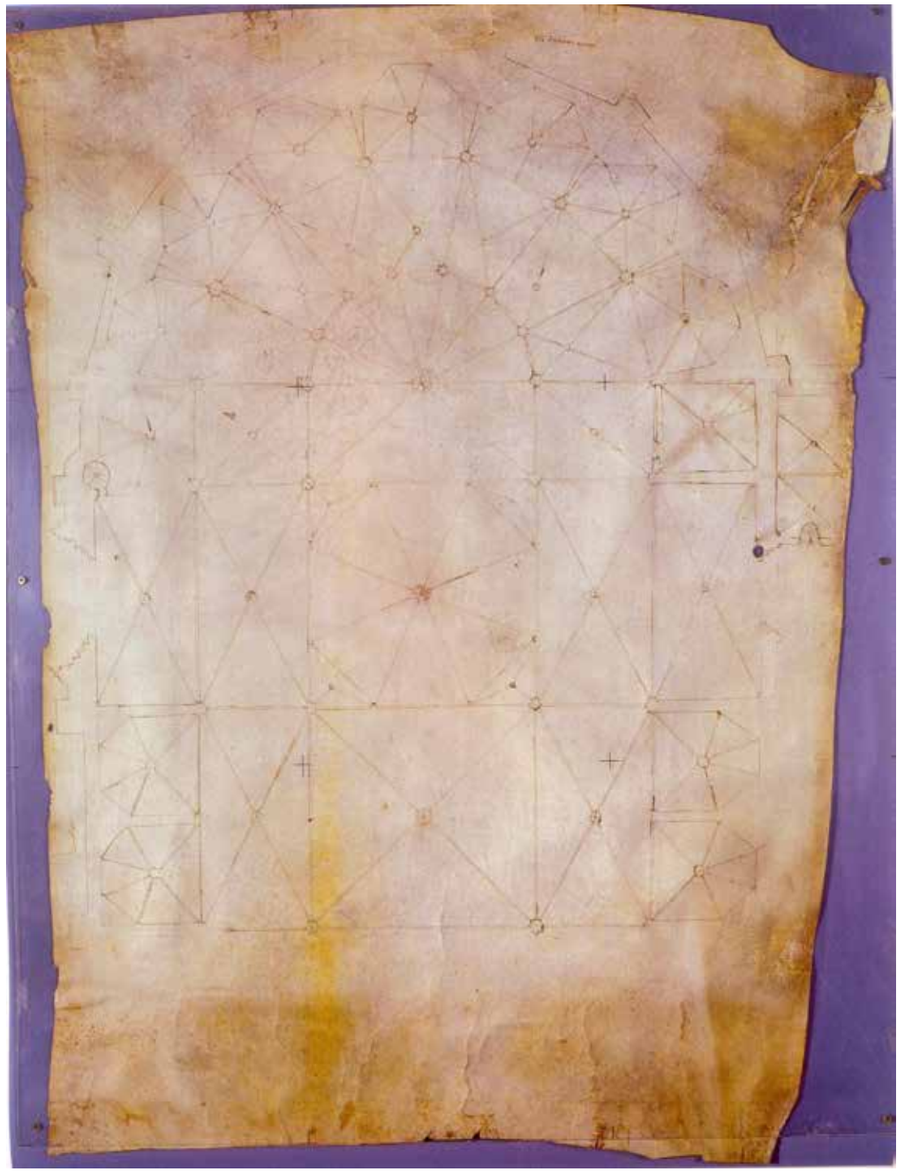

Fig. 4.7
Antoni Guarc or Andreu Julià, plan of Tortosa Cathedral (ca. 1379–1382). Ink on parchment, 89.3 x 62 cm. Archivo Capitular de Tortosa, Tortosa.

The second Catalan drawing is related to Tortosa. It is an ink on parchment plan of Tortosa Cathedral, dated between 1379 and 1382 (Fig. 4.7).[75] Another drawing of the cathedral, which disappeared at the beginning of the twentieth century, showed the elevation of one of the radiating chapels, and was signed by Benet Basques de Montblanc and drawn in 1345–47 or 1375.[76] The plan includes traces of scratches produced by the use of styluses and compasses. The reference measures were the span and its multiple, the cane. Comparing the drawing to the actual size of the cathedral, we can again deduce the scale, 1:75, although this is not definite because the project was never built.[77] However, this has not prevented architects from recreating the volume of the virtual building using the information provided by the sketch, which clearly shows the potential of many medieval architectural drawings to serve as working tools. Perhaps the most intriguing elements of the plan are two manuscript notes: on the recto can be read 'Antoni Guarc', and on the verso 'mostra a portar' (design to be taken). The attribution to Master Guarc seems clear. The meaning of the verso text is less certain and may imply the involvement of another prominent mason. On one hand, it has been suggested that the plan was made for discussion elsewhere, possibly in Valencia, where the former master of Tortosa Cathedral, Andreu Julià, was working.[78] On the other hand, some think that the parchment was a copy of the original project for Tortosa, probably designed by Julià, who lived there until 1380 when, as we have seen, he was required by the canons in Valencia to design the plan of the bell tower.[79] In any case, the plan's non-local origin seems likely, for Julià may have been Guarc's advisor or even master. It would be very interesting if Andreu Julià had provided designs for Tortosa Cathedral from afar. In that case, Antoni Guarc would be the recipient of this *mostra a portar*, and both manuscript notes would make sense. Unfortunately, there is no document to confirm this, although Guarc appears as *magister imaginum* in Valencia Cathedral in 1385, and he was extraordinarily well paid for his work in the Santa Ana Chapel.[80] Guarc could thus have been a mason trained under Julià, who remained in Tortosa conducting the building process according to his master's guidelines.

The third example of a Catalan architectural drawing is also kept in a cathedral archive. It is a design in ink on paper of circa 1400 showing a pinnacle in elevation, apparently drafted as part of the project to complete the bell tower of the old cathedral of Lérida (Fig. 4.8).[81] It has been attributed to Guillem Solivella, who directed building works there from 1396. It certainly seems to be much simpler other examples, but it offers a good sample of a sketch aimed at showing the minutiae of a project.

A paradigmatic case of this kind of presentation object is the drawing for the west façade of Barcelona Cathedral (Fig. 4.9).[82] Like other façade drawings, it is very large, accurately executed, and includes rich ornamentation. It has been attributed to Master 'Carlí' or 'Carlín' and dated to 1408. It was formerly an ensemble of twelve parchment pieces, of which only eight remain. The left side is entirely lost.[83] The drawing now measures 311 centimetres (six Catalan spans) by 140 centimetres, and the scale used is 10:1, remarkably large compared to other examples.[84] This was probably because of the specific nature of façade projects, but we can also consider the special significance of this work for Master Carlí. The Norman stonemason had just arrived in the city, perhaps from Perpignan, where his brother Rotllí was registered in 1410.[85] Carlí spent fifty-two days drafting the design, and Barcelona's canons paid him six *sueldos* for each day's work.[86] He also provided a model for the cloister chapel of San Felipe and Santiago el Menor.[87] It seems that Carlí was determined to become master architect of Barcelona Cathedral, a prestigious position. We know that six years earlier Arnau Bargués had delivered a design for the façade that was rejected. In Carlí's proposal, the debts to Rouen Cathedral in the tracery patterns, the gable, and the pinnacles are easily identifiable, hardly surprising given his probable origin.[88] The door is profusely decorated. Yet this marvellous elevation was never built. Carlí appears in the account books of Lérida Cathedral between 1410 and 1427, in those of Valencia Cathedral in 1428, and in those of Seville in 1439, where he stayed till 1454.[89] The drawing lay neglected in the cathedral archive until 1843, when it was published in a Parisian journal.[90] It was later engraved, and was key to the project to complete the façade that was presented circa 1860. Moreover, Oriol Mestres, the architect of Barcelona Cathedral, found at the end of the nineteenth century the foundations of several buttresses that were laid according to Carli's designs.[91]

The designs of Seville, Guadalupe, Toledo, Gerona, Tortosa, Lérida and Barcelona offer a consistent image of architectural practice in Spain between 1370 and 1450 that concurs with what is known from documentary evidence. In late medieval Iberia, as in other European territories, geometry was the principal working tool, even in façade elevation designs with their heavy ornament: all was ruled by proportion. It is thus possible, as suggested above, to find measure (a guarantee of *firmitas* in the Vitruvian sense) and beauty (*venustas*) in medieval architectural drawings.

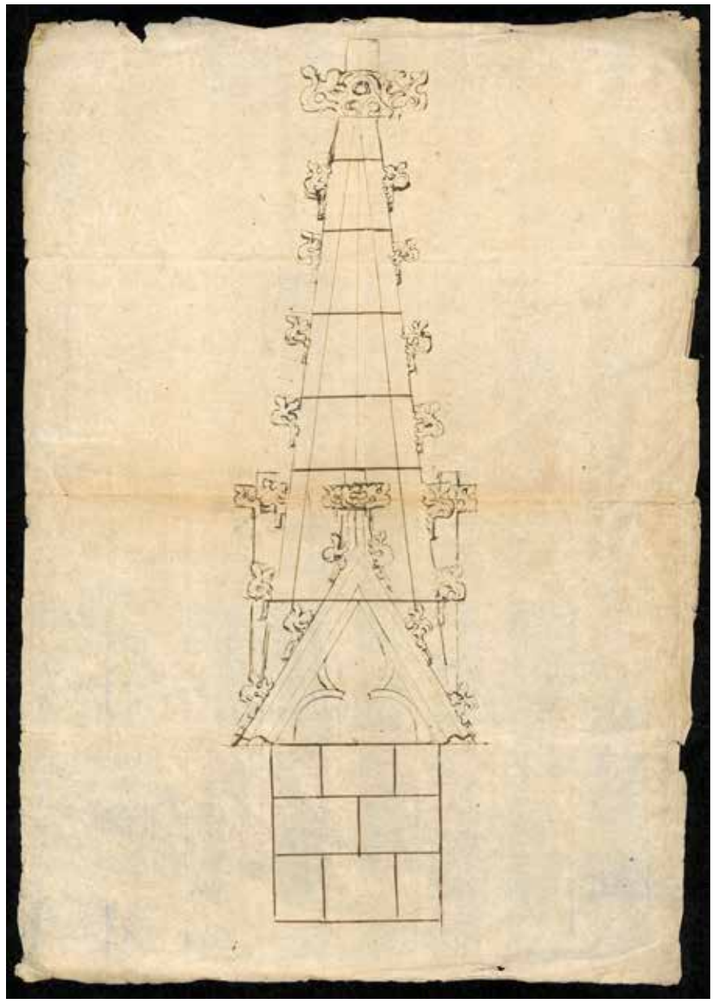

Fig. 4.8
Guillem Solivella (?), elevation of a pinnacle (ca. 1400). Ink on paper. Arxiu Capitular de Lleida (inv. P0148), Lérida.

Having briefly inventoried and contextualised the extant physical objects relating to architectural practice, we should consider the function of drawings in the communication of knowledge. To start with, all the examples we have seen refer to large-scale projects, with all that implies in terms of planning, financing and hiring renowned professionals. The average project did not require such a high-powered graphic production.[92] Even so, when designs are provided, they begin from the same empirical basis: the manipulation of simple shapes that give way to increasingly complex developments: to what has been called 'practical geometry' or 'constructive geometry'.[93] This is geometry based on proportional measurements but not on arithmetical calculation, a working method which was already defined by the early fourteenth century.[94] In the words of Shelby, it is a prescriptive geometry, but not rigidly restrictive, that is, the steps to follow are well-established but they can be changed according to the master stonemason, limited only by his skills, his inventiveness, and his desire for innovation.[95] It is not, therefore, the Euclidian geometry that was taught in the quadrivium, but rather, knowledge linked to specific problem solving, mainly transmitted through spoken instructions and ephemeral drawings.[96]

Ownership of geometry books in the fifteenth century would not have been restricted to universities or court libraries such as that of Martin I of Aragon. The 1461 inventory of Francisco de la Barcerola, a carpenter, mentions 'hun llibre appellat de Jeumetria ab cubertes vermelles' and 'hun llibre appellat de Jeumetria ab cubertes de pergami' (a book entitled *About Geometry* with red covers, and a book entitled *About Geometry* with parchment covers).[97] Even so, not all builders could master the art of drawing. The ability to measure 'a raho del compas' (using the compass) and geometrically define a building, ensuring it was both well-built and beautiful, was a specialisation beyond many apprentice builders. It would compensate the hard-working student with contracts for building projects in which he would have to revalidate the skills acquired together with his master.

Finally, we must review the subject of travel as an opportunity for the transfer of constructive knowledge, and, with this in mind, note the possibility of directing a project remotely with the help of drawings.[98] The journeys of architects to see buildings and structures which could serve as models for a current project are well-documented in the kingdom of Aragon. In the spring of 1346 Bernat Dalguaire travelled with an assistant to Avignon and other places 'per cerquar e veure obres' (to seek and to see works) that could be useful in the construction of Tortosa Cathedral.[99] He also brought samples from his travels. Pere Balaguer travelled to Catalonia twice, on the orders of two different patrons. In 1392 the Valencian municipal authorities sent him to look at portals which could serve as reference for the construction of the Serranos Gate, and in 1414—with Valencia's own bell tower waiting to be finished—the Valencian chapter paid for a trip to see bell towers.[100] Travelling in the opposite direction shortly afterwards, Bertomeu Gual and the carpenter Joan Anyugues left Barcelona to see 'lo simbori' (the lantern) of Valencia Cathedral in April–May 1418.[101]

Like architects, drawings could also move. A drawing depicting one of Gerona's bridges over the River Ter, for example, was brought to Valencia in 1446 for consultation.[102] Two years earlier, in Valencia, the stonemason Miquel Sánchez de Cuenca demanded that Jacquet de Vilanes, formerly living in Orihuela, return a 'mostram unius tabernacle ab son legiment in pergameno' (the model of a tabernacle with its explanation on parchment).[103] There was a fairly clear limit on the distance travelled, which mostly coincided with the territories of the kingdom of Aragon, Catalonia and the South of France. Craftsmen of other types were rarely required to travel so far. Painters, for example, did not travel to see artworks but instead to train in more active and innovative centres; the presence of foreign painters and their works in Iberia in turn provided useful insights into innovations in other centres. Of course, the *afermaments* of foreign apprentices also took place in the stonemason's yard, and workers had to follow the work: there are frequent mentions in Valencian documentation of stonemasons from Castile, Biscay, or France.[104]

There was, however, another type of professional travel, specific to stonemasons who wanted to increase their knowledge by viewing and studying other buildings. This would require some type of notes or sketches to record the main characteristics or details of constructions for future reference. It is noteworthy that as well as finished buildings, the travellers would also learn new technologies. Dalguaire and his assistant brought 'treeslats i mostres' (copies and drawings) to Tortosa in 1346.[105] This is an invaluable reference because it proves that graphic documentation was created on these journeys, which would then pass to the *fabrica ecclesiae*. The value of these models is made clear in the clauses of contracts specifying that the designs must be kept by the patrons, as is the case of the samples which Guillem Sagrera provided for the building work in Mallorca's Lonja.[106] Sometimes the buildings themselves offer the only evidence for the circulation of such drawings: the tower finials of Burgos Cathedral, for example, seem to be inspired by the spires of Cologne Cathedral, still unfinished when Juan de Colonia (or Johannes von Köln) arrived in Castile.[107] This suggests that the foreign masters not only visited works under construction, but also had access to their drawings if the process was still ongoing.

The question of travel finally leads to the problem of remote control of the building project. The master stonemason was often required to be physically present. This

Fig. 4.9
Maestre Carlí (?), drawing for the main façade of Barcelona Cathedral, detail (ca. 1408). Ink on parchment, 311 (6 Catalan spans) x 140 cm. Arxiu Capitular de Barcelona, Barcelona.

is attested, for example, by the contract for the bell tower of Sant Feliu, Gerona (1368), which specifies that Pere Sacoma could not leave the site unless he was working on the bridge over the Ter. Even in these circumstances he was required to devote an hour to supervising the project, and always leave a second-in-command in charge.[108] We can also consider the case of Andreu Julià, resident in Tortosa when he began work on the Campanar Nou of Valencia Cathedral (1380). He was in charge of the construction and moved to the city to direct work on site. We have already seen Julià's design skills three times in relation to this commission: setting out the building on the building site with ropes, pegs and canes; producing a drawing on parchment, with costs defrayed by the chapter; and calculating the measurements of the tower's foundations in a plot in Ruzafa. The presence of the master builder elsewhere (as in this case) could result in another of project lacking leadership: indeed, the fact that the design for Tortosa Cathedral, dated to between 1379 and 1382 by Lluís i Guinovart, has been assigned to Antoni Guarc, then working in Tortosa, may be a result of Julià's absence. If so, this case would be a perfect example of the transmission of an architectural design, although Guarc would only be providing a few drawings, not directing the project.

In conclusion, it is worth reconciling the intense graphic activity which can be intuited for some projects with the terse clauses which governed the final moments in the lives of well-known master builders, such as the provisions of their wills. This is the case for Francesc Canals, 'mestre d'obra de vila' (master mason), and even more for Martí Lobet.[109] The wills of these two masters specify the form of their tombs, their funeral rites and the distribution of their goods, without any mention of their professional tools. The artistic commissions, epitaphs, and last wills of Francesc Canals, Martí Lobet, Antoni Dalmau and Juan Guas were certainly consistent with their professional role and their

works at the service of distinguished patrons such as kings, canons, and noblemen.[110] The most outstanding builders reached prominent social position by means of carefully selected apprenticeship contracts, travels, development of drawings skills, and an absolute mastery of geometry. These are the virtues and merits that should symbolically ornament their tombs, rather than any other coat of arms.

1. Architecture formed only one part of my PhD research into the transmission of knowledge in artistic trades in Valencia between 1370 and 1450, research that also required me to investigate practice in other peninsular territories, especially the crown of Aragon. See Encarna Montero, 'La transmisión del conocimiento en los oficios artísticos' (PhD diss., University of Valencia, 2013; published as *La transmisión del conocimiento en los oficios artísticos* [Valencia, Institució Alfons el Magnànim, 2015]).

2. Matthew Paris, *Chronica majora* (London: Roll Series, 1872-1883), 3: p. 517.

3. About apprenticeship of artistic trades in the crown of Aragon, see Montero, *La transmisión del conocimiento*, pp. 17-75.

4. Herbert L. Kessler, 'On the State of Medieval Art History', *The Art Bulletin* 70:2 (1988): pp. 182-3.

5. 'ché molti son che dichono che senza esser stati con maestri ànno imparato l'arte. No'l credere, che io ti do l'essempro: di questo libro, studiandolo di dì e notte e ttu non ne veggia qualche pratica con qualche maestro, no ne verrai mai da niente; né cche mai possi chon buon volto stare tra i maestri.' Cennino Cennini, *Libro dell'Arte*, ed. Fabio Frezzato (Vicenza: Neri Pozza Editore, 2012), p.137.

6. For this issue in Valencia, see Encarna Montero Tortajada, 'Recetarios y *papers de pintura* en la documentación bajomedieval. Valencia, 1452: el ejemplo de Andreu Garcia', in *Libros con arte, arte con libros* (Extremadura: Universidad de Extremadura-Consejería de Cultura y Turismo, 2007), pp. 507-517.

7. 'Afermar: 5. Unir una persona amb un altra per conveni mutu. a) Llogar un fadrí amb un mestre per apendre un ofici. Molts fadrins o macips qui se affermen e estan ab lurs maestres per appendre lur offici, doc. a. 1393 (Col. Bof. XLI). Si algun hom s'afermarà ab altre per estar ab ell... per soldada, Cost. Tort., II, 4.' Antoni M. Alcover, Francesc de Borja Moll and Manuel Sanchis Guarner, *Diccionari català-valencià-balear* (Palma de Mallorca: Moll, 1993), 1: pp. 241-242.

8. For the full list, and an accurate analysis, see Amadeo Serra Desfilis, 'Diventare maestro nei mestieri della costruzione a Valencia, secoli XIV-XV. Apprendistato, pratica e mobilità', *Lexicon* 22-23 (2016): pp. 13-23.

9. Bertomeu Martí, no. 76, 12 April 1385, Archivo de Protocolos del Corpus Christi de Valencia.

10. Protocolos notariales, Garcia Sancho, no. 2058, 25 November 1390, Archivo del Reino de Valencia, cited in Ximo Company et al. (eds.), *Documents de la pintura valenciana medieval i moderna I (1238–1400)* (Valencia: Universitat de València, 2005), p. 343.

11. Protocolos notariales, Andreu Julià, no. 1264, 29 August 1415, Archivo del Reino de Valencia, cited in José Sanchis Sivera, 'Maestros de obras y lapicidas valencianos en la Edad Media', *Archivo de Arte Valenciano* 11 (1925): p. 38.

12. Joan Çaposa, nº24713, 16 August 1423, Archivo de Protocolos del Corpus Christi de Valencia.

13. Ambrosi Alegret, nº20702, 16 June 1434, Archivo de Protocolos del Corpus Christi de Valencia.

14. Lluís Despuig, nº22028, 12 June 1438, Archivo de Protocolos del Corpus Christi de Valencia.

15. For the Muslim stone supplier, see Encarna Montero Tortajada, 'Moro Petit: los trabajos de un picapedrero musulmán en una ciudad militantemente cristiana (Valencia, 1407-1440)', *Saitabi* 66 (2016): pp. 27-39.

16. Vicent Camarasa, no. 20916, 19 June 1449, Archivo de Protocolos del Corpus Christi de Valencia, cited in Mercedes Gómez-Ferrer, 'La cantería valenciana en la primera mitad del siglo XV: el maestro Antoni Dalmau y sus vinculaciones con el área mediterránea', *Anuario del Departamento de Historia y Teoría del Arte. Universidad Autónoma de Madrid IX-X* (1997-1998): pp. 100-3. Begoña Alonso points out that the master of a cathedral typically hired two youths to serve him. See Begoña Alonso Ruiz, 'El maestro de obras catedralicio en Castilla a finales del siglo XV', *Anales de Historia del Arte* 22 (2012): p. 236.

17. Zaragozá and Gómez-Ferrer, *Pere Compte*, p. 253.

18. All the references to architectural design can be read in Spanish, at greater length, in Montero, *La transmisión del conocimiento*, pp. 287-322.

19. See, in general, James S. Ackerman, 'Architectural Practice in the Italian Renaissance', *Journal of the Society of Architectural Historians,* 13:3 (1955), pp. 3-11; Valerio Ascani, *Il Trecento disegnato: le basi progettuali dell'architettura gotica in Italia* (Roma: Viella, 1997); Malvina Borgherini, *Disegno e progetto nel cantiere medievale. Esempi toscani del XIV secolo* (Venise: Marsilio Editori, 2001); Francis Bucher, *Architector. The Lodge Books and Sketchbooks of Medieval Architects* (New York: Abaris Books, 1979), vol. 1; Michael T. Davis. 'Science, Technology, and Gothic Architecture', *Avista Forum* 8:2 (1995): pp. 3-6; Alfonso Jiménez Martín, 'El arquitecto tardogótico a través de sus dibujos', in Begoña Alonso Ruiz (ed.), *La arquitectura tardogótica castellana entre Europa y América* (Madrid: Sílex, 2011), pp. 389-416; Arnold Pacey, *Medieval Architectural Drawing. English Craftsmen's Methods and Their Later Persistence (c.1200-1700)* (Stroud: Tempus, 2007), especially chapters 2 and 3; Enrique Rabasa Díaz, *Forma y construcción en piedra. De la cantería medieval a la estereotomía del siglo XIX* (Madrid: Akal, 2000); Roland Recht, *Le Dessin d'architecture* (Paris: Adam Biro, 1995); Helen Rosenau, *Design and Medieval Architecture* (London: Batsford, 1934); Jesús Miguel Rubio Samper, 'La figura del arquitecto en el período Gótico. Relaciones entre España y el resto de Europa', *Boletín del Museo e Instituto 'Camón Aznar'* 22 (1985): pp. 101-15; Lon R. Shelby, 'The Education of Medieval English Master Masons', *Medieval Studies* 32 (1970): pp. 1-26; Lon R. Shelby, 'The Geometrical Knowledge of Mediaeval Master Masons', *Speculum* 47 (1972): pp. 395-421.

20. About the collective nature of architectural projects, see Castellani, 'Il cantiere medievale', p. 20.

21. 'Because of the technical inadequacy of architectural drawings, the master mason and the patron could not have completely agreed upon the details of the building, or in some instances even the overall design, before construction got underway. Frequent—sometimes daily—consultations between the master mason and the patron or his representative were the normal routine in medieval building.' Shelby, 'The Education', p.17.

22. For a definition of architectural drawing, see Franklin Toker, 'Gothic Architecture by Remote Control: An Illustrated Building Contract of 1340', *The Art Bulletin* 67:1 (1985), p. 88.

23. An updated census of Gothic drawings can be found in Jiménez, 'El arquitecto tardogótico', pp. 407-11. See also Begoña Alonso Ruiz and Alfonso Jiménez Martín, *La traça de la iglesia de Sevilla* (Seville: Dereçeo, 2008), pp. 103-17.

24. Alonso and Jiménez, *La traça de la iglesia de Sevilla*, pp. 96-7.

25. José Antonio Ruiz de la Rosa, 'Dibujos de ejecución. Valor documental y vía de conocimientos de la Catedral de Sevilla', in Alonso Jiménez Martín et al. (eds.), *La catedral gótica de Sevilla: fundación y fábrica de la 'obra nueva'* (Seville: Secretariado de Publicaciones de la Universidad, 2006), pp. 300-47.

26. M. Siurana Roglán, 'Un grafito, posible cabecera de la iglesia de Alcañiz', *Teruel* 68 (1982): pp. 163-74; T. Thomson Listerri, *Iglesia de Santa María la Mayor de Alcañiz* (Alcañiz: Centro de Estudios Bajoaragoneses, 2006), pp. 16-19; Arturo Zaragozá Catalán and Javier Ibáñez Fernández, 'Materiales, técnicas y significados en torno a la arquitectura de la Corona de Aragón en tiempos del Compromiso de Caspe (1410-1412)', *Artigrama* 26 (2011): pp. 40-1 (Fig. 1.6) and 52-3 (Figs. 4.4 and 4.7).

27. Arturo Zaragozá Catalán and Mercedes Gómez-Ferrer Lozando, *Pere Compte: arquitecto* (Valencia: Generalitat Valenciana-Ajuntament de València-Centro UNESCO Valencia, 2007), p. 222.

28. José Calvo López and Marcos Ros Sempere, 'Los instrumentos de los canteros en la transición del Gótico al Renacimiento', in Alonso, *La arquitectura tardogótica castellana*, p. 418. The authors link this practice to the controversial definition of *ichnographia* by Vitruvius.

29. Arturo Zaragozá Catalán and Ángela García Codoñer, 'El dibujo de proyecto en época medieval según la documentación archivística: el episodio gótico valenciano', in Michela Cigola and Tiziana Fiorucci (eds.), *Il disegno di progetto dalle origini al XVIII secolo* (Rome: Gagemi Editore, 1997), p. 42.

30. Zaragozá Catalán and García Codoñer, 'El dibujo de proyecto', p.42.

31. *Sotsobreria de Murs i Valls*, 1401-1402, f. 139v, Archivo Histórico Municipal de Valencia, cited in Zaragozá and Codoñer, 'El dibujo de proyecto', p. 44.

32. See Amadeo Serra Desfilis' essay in this collection, as well as Arturo Zaragozá Catalán, 'La Capilla Real del antiguo Monasterio de Predicadores de Valencia', in *La Capella Reial d'Alfons el Magnànim de l'antic Monestir de Predicadors de València* (Valencia: Generalitat Valenciana, 1997), 1: p. 33. See the transcription of the document in 2: p. 82: 'Item, donà a·N Gregori Castellà, algebçer, per IIII caffichos e mig de algebs que de aquell foren comprats per ops de fer mostres de la volta de la capella en la dita obra, que muntà XVIIIss'.

33. Dieter Kimpel notes the importance of separating the cutting of the stones from their placement. 'Le développement de la taille en série dans l'architecture médiévale et son rôle dans l'histoire économique', *Bulletin Monumental* 135 (1977): pp. 195-222. See also Castellani, 'Il cantiere medievale', p. 27.

34. Although there are a number of references to templates in specialist literature, they are dispersed and difficult to locate. Francesca Espanyol Bertran, 'Los materiales prefabricados gerundenses de aplicación arquitectónica (S. XIII-XV)', in Joaquín Yarza and Francesc Fité (eds.), *L'artista-artesà medieval a la Corona d'Aragó* (Lérida: Universitat de Lleida, Institut d'Estudis Ilerdencs, 1999), pp. 77-127; Víctor Iñurria, 'Las herramientas de la construcción en el siglo XV', *Loggia* 7 (1999): pp. 76-91, esp. p. 87; Joaquín Yarza Luaces and Francesca Español Bertran, 'Diseño, modelo y producción industrial en la Edad Media', in *El Diseño en España: antecedentes históricos y realidad actual* (Madrid: Ministerio de Industria y Energía, 1985), pp. 29-30; Francesca Español, 'Las manufacturas arquitectónicas en piedra de Girona durante la Baja Edad Media y su comercialización', *Anuario de Estudios Medievales* 39:2 (2009): pp. 963-1001.

35. Coldstream, *Medieval Architecture*, p. 80; Bessac, 'Outils et techniques spécifiques', p. 176. In an email to the author on 18 December 2004, the stonemason Rodrigo de la Torre expressed his reservations about the use of wooden templates, being more inclined to believe that metal scantillons were employed.

36. Gabriel Llompart, 'Pere Mates, un constructor y escultor trecentista en la "Ciutat de Mallorques"', *Boletín de la Sociedad Arqueológica Luliana* 34 (1973): p. 105.

37. Zaragozá and Gómez-Ferrer, *Pere Compte*, p. 221.

38. See Luisa Tolosa Robledo and Mª del Carmen Vedreño Alba, 'Cronologia de la construcció de la Capella Reial', in *La Capella Reial d'Alfons el Magnànim*, 1: pp. 85-110, especially the years 1439, 1446, 1447 and 1450-1453. Also see Zaragozá Catalán, 'La Capilla Real del antiguo Monasterio de Predicadores', p. 33. Baldomar designed templates on many occasions, both for the building site in Valencia and for the quarries at Sagunto.

39. Iñurria, 'Las herramientas de la construcción', p. 87.

40. Kimpel, 'Le développement de la taille en série', p. 199.

41. Kimpel, 'Le développement de la taille en série', p. 217.

42. Davis, 'Science, Technology, and Gothic Architecture', p. 3; Toker, 'Gothic Architecture by Remote Control', p. 89.

43. Yarza and Español, 'Diseño, modelo y producción industrial', pp. 29-30; Español, 'Las manufacturas arquitectónicas', pp. 977 and 980. This last page refers to some interesting full-scale drawings of the section needed for the gadrooned column shafts ordered by Alfonso V in 1446. The designs have been preserved in the corresponding records of the Cancillería Real (reproduced in Fig. 13 of the article). The Chancellery record is 2269, f. 217.

44. Enrique Rabasa Díaz, 'Plantillas y maclas', in Alonso, *La arquitectura tardogótica castellana*, pp. 439-40.

45. *Sotsobreria de Murs i Valls, años* 1401-1402, f. 140v, Archivo Histórico Municipal de Valencia, cited in Zaragozá Catalán and García Codoñer, 'El dibujo de proyecto', p. 44.

46. José Sanchis Sivera, 'La escultura valenciana en la Edad Media. Notas para su historia', *Archivo de Arte Valenciano* 10 (1924): p. 6; 'Arquitectos y escultores de la Catedral de Valencia', *Archivo de Arte Valenciano* 19 (1933): p. 18.

47. Coldstream, *Medieval Architecture*, p. 79; Alonso and Jiménez, *La traça de la iglesia de Sevilla*, p. 83. Ackerman proposes instead that 'drawings were not the chief means of communication between architects and builders. The enormous expense and effort devoted to the construction of models for the larger projects suggests that much of the designing went on in plastic form at this stage. Builders, rather than work with detailed specifications, got the gist of the design from the model, and when they encountered problems, they simply got the answer from the architect or supervisor by word of mouth.' Ackerman, *Origins, imitation, conventions*, p. 8.

48. Rubio Samper, 'La figura del arquitecto en el periodo Gótico', p.110. Also see Bruno Klein, 'Simili ma diversi: perché esistevano a nord delle Alpi riproduzioni gotiche di architettura, ma non modelli gotici per l'architettura', in Tassin and Frommel (eds.), *Les maquettes d'architecture: fonction et évolution d'un instrument de conception et de réalisation* (Paris: Picard, 2015), pp. 37-46.

49. Josep Lluís i Guinovart and Victòria Almuni Balada, 'La traça de la catedral de Tortosa. Els models d'Antoni Guarc i Bernat Dalguaire', *Lambard* 9 (1996): p. 23. Alonso and Jiménez note that this would not be anything important, merely a sketch of the volumes of the building, as ten or fifteen days' work was normal, with a few exceptions. Alonso and Jiménez, *La traça de la iglesia de Sevilla*, p. 83.

50. Zaragozá Catalán and García Codoñer, 'El dibujo de proyecto', p. 43. See also Zaragozá and Gómez-Ferrer, *Pere Compte*, p. 223 (illustration on p. 221).

51. Zaragozá Catalán and Ibáñez Fernández, 'Materiales, técnicas y significados', pp. 52, 53 (Fig. 4.6) and 54.

52. Zaragozá Catalán and García Codoñer, 'El dibujo de proyecto', pp. 42-43.

53. Sanchis Sivera, 'Maestros de obras y lapicidas', p. 40.

54. Sanchis Sivera, 'Maestros de obras y lapicidas', p. 44.

55. Toker, 'Gothic Architecture by Remote Control', p. 89.

56. Jiménez, 'El arquitecto tardogótico', pp. 402-3.

57. Miguel Ángel Chamorro Trenado and Arturo Zaragozá Catalán, 'La traza de la torre campanario de la iglesia de San Félix de Gerona', *Goya* 338 (2012): p. 8; Lluís i Guinovart and Almuni i Balada, 'La traça de la catedral de Tortosa', p. 28.

58. José Sanchis Sivera, *La Catedral de Valencia* (Valencia: Imprenta de Francisco Vives Mora, 1909), p. 214, footnote 3.

59. Alonso and Jiménez, *La traça de la iglesia de Sevilla*, p. 25.

60. Alonso and Jiménez, *La traça de la iglesia de Sevilla*, p. 26.

61. See Antonio García Flores and Juan Carlos Ruiz Souza, 'Ysambart y la renovación del gótico final en Castilla: Palencia, la Capilla del Contador Saldaña en Tordesillas y Sevilla. Propuesta de trabajo', *Anales de Historia del Arte* 19 (2009): pp. 43-76; Javier Ibáñez Fernández and Jesús Criado Mainar, 'El maestro Isambart en Aragón: la Capilla de los Corporales de Daroca y sus intervenciones en la Catedral de la Seo de Zaragoza', in A. Jiménez Martín (ed.), *La piedra postrera. V Centenario de la conclusión de la Catedral de Sevilla, Simposium internacional sobre la Catedral de Sevilla en el contexto del gótico final* (Seville: Cabildo Metropolitano, 2007), 2: pp. 75-114; J. Ibáñez Fernández, 'Con el correr del sol: Isambart, Pedro Jalopa y la renovación del Gótico final en la Península Ibérica durante la primera mitad del siglo XV', *Biblioteca* 26 (2011), pp. 201-226.

62. Mercedes Gómez-Ferrer, 'La Cantería Valenciana en la primera mitad del siglo XV: El Maestro Antoni Dalmau y sus vinculaciones con el área mediterránea', *Anuario del Departamento de Historia y Teoría del Arte de la Universidad Autónoma de Madrid IX-X* (1997-1998): p. 101.

63. See, here again, Ibáñez Fernández, 'Con el correr del sol'. Also see Javier Ibáñez and Zaragozá Catalán, 'Materiales, técnicas y significados'; Javier Ibáñez Fernández and Marco Nobile,, 'Unidad y diversidad en la arquitectura de la Corona de Aragón durante los siglos XIV y XV / Unità e diversità nell'architettura della Corona d'Aragona tra il XIV e il XV secolo', in L. Agustín, A. Vallespín and R. Santonja, *Un alma común. Arquitectura sículo-aragonesa / Un'anima comune. Architettura sículo-aragonese* (Zaragoza: Universidad de Zaragoza, 2014), pp. 12-22; J. Ibáñez Fernández, 'The Northern Roots of Late Gothic Renovation in the Iberian Peninsula', in K. Ottenheym (ed.), *Architects without Borders. Migration of Architects and Architectural ideas in Europe 1400-1700* (Florence: Istituto Universitario Olandese di Storia dell'Arte 2014), pp. 15-27.

64. See Diego Angulo and Alfonso E. Pérez Sánchez, *Spanish Drawings, 1400-1600* (London: Harvey Miller, 1975), pp. 17 and 18, Plate 4, Figs. 1, 2 and 3; Alfonso E. Pérez Sánchez, *Historia del dibujo en España de la Edad Media a Goya* (Madrid: Cátedra, 1986), pp. 112-14; Ángel Fuentes Ortiz, 'La Capilla de Gonzalo de Illescas en el Monasterio de Guadalupe: un proyecto de Egas Cueman recuperado', *Archivo Español de Arte* 90: 358 (2017): pp. 107-124.

65. Alfonso E. Pérez Sánchez, *Museo del Prado. Catálogo de dibujos I. Dibujos españoles siglos XV-XVII* (Madrid: Museo del Prado, 1972), pp. 17-19, Plate 1; Angulo and Pérez, Spanish Drawings, p. 18, Plates 1-3 (Figs. 5, 5a and 5b); Pérez, *Historia del dibujo en España*, pp. 111-112; Sergio L. Sanabria, 'A Late Gothic Drawing of San Juan de los Reyes in Toledo at the Prado Museum in Madrid', *Journal of the Society of Architecture Historians* 51 (1992): pp. 161-173.

66. Teresa Pérez Higuera, 'En torno al proceso constructivo de San Juan de los Reyes en Toledo', *Anales de Historia del Arte* 7 (1997): p. 16.

67. Pérez Higuera, 'En torno al proceso', p. 19.

68. Sanabria, 'A Late Gothic Drawing', pp. 161-73.

69. Pérez Higuera, 'En torno al proceso constructivo', p. 19.

70. It will feature prominently in a forthcoming PhD dissertation on Juan Guas by Costanzi Beltrami at The Courtauld.

71. Chamorro and Zaragozá Catalán, 'La traza de la torre campanario', pp. 3-15. See also Zaragozá Catalán and Ibáñez Fernández, 'Materiales, técnicas y significados', p.60.

72. Chamorro Trenado and Zaragozá Catalán, 'La traza de la torre campanario', p.12. See also Zaragozá and Ibáñez, 'Materiales, técnicas y significados', p.60.

73. Zaragozá Catalán and Ibáñez Fernández, 'Materiales, técnicas y significados', p.60n150.

74. Chamorro and Zaragozá Catalán, 'La traza de la torre campanario', p. 8.

75. See Lluís i Guinovart and Almuni i Balada, 'La traça de la catedral de Tortosa'; Chamorro Trenado and Zaragozá Catalán, 'La traza de la torre campanario', p. 15n39 (citing Josep Lluís i Guinovart, Geometría y diseño medieval en la catedral de Tortosa. La catedral no construida (PhD diss., Escuela Técnica Superior de Arquitectura de la Universitat Internacional de Catalunya, 2002), p.115 and thereafter); Victòria Almuni Balada, *La catedral de Tortosa als segles del gòtic* (Benicarló: Onada Edicions, 2007), 1: pp. 462-65 and 2: appendix, figs. 20 and 21.

76. Almuni in Balada, *La catedral de Tortosa*, 1: p. 453

77. Chamorro Trenado and Zaragozá Catalán, 'La traza de la torre campanario', p. 10.

78. Chamorro Trenado and Zaragozá Catalán, 'La traza de la torre campanario', p. 10.

79. Almuni, *La catedral de Tortosa*, vol. 1, p. 464.

80. Bertomeu Martí, no. 76, 14 April 1385, Archivo de Protocolos del Corpus Christi de Valencia.

81. See Francesc Fité i Llevot, 'Pináculo-Dibujo de la catedral de Lérida', in Joan Ainaud et al. (eds.), *Cataluña Medieval.* Barcelona: Lunwerg, 1992, p. 310. Exhibition catalogue. See also Francesc Fité i Llevot, 'Dibuix de pinacle', *Seu Vella. L'esplendor retrobada* (Lérida: Generalitat de Catalunya-Fundació La Caixa, 2003), pp. 57-8.

82. See Elias Feliu, *La catedral de Barcelona* (Barcelona: Barcino, 1926), pp. 83-4; Juan Ainaud and José María Gudiol, *Catálogo monumental de Barcelona* (Madrid: CSIC, 1945), pp. 48 and 88; Angulo and Pérez, *Spanish Drawings*, p.17, Plate 3, Figs. la and I; Joan Bassegoda i Nonell, 'La fachada de la catedral de Barcelona', *Memorias de la Real Academia de Ciencias y Artes de Barcelona* 45 (1981): pp. 263-307; Bassegoda i Nonell, *Els treballs i les hores*, pp. 18-19 and 151-172. The drawing was exhibited in 1968 and in 1986. See, respectively, *La fachada de la catedral de Barcelona, 1887-1913* (Barcelona: Colegio de Arquitectos, 1968), and catalogue entry no. 6 in Josep M. Guix Ferreres et al (eds.), *Thesaurus. L'Art als bisbats de Catalunya (1000-1800)* (Barcelona: Fundació Caixa de Pensions, 1985). A recent image is available in Marià Carbonell Buades, 'Consuetud i canvi en l'arquitectura del Principat de Catalunya a l'entorn de 1400', in Rafael Cornudella (dir.), *Catalunya 1400. El Gòtic Internacional* (Barcelona: MNAC, 2012), p. 105.

83. Bassegoda i Nonell, *Els treballs i les hores*, pp. 18 and 151.

84. Jiménez, 'El arquitecto tardogótico', p. 403.

85. Serra Desfilis, 'La arquitectura del tardogótico en la Corona de Aragón', p. 476.

86. Bassegoda i Nonell, *Els treballs i les hores,* p. 151.

87. Bassegoda i Nonell, *Els treballs i les hores*, p.151.

88. Serra Desfilis, 'La arquitectura del tardogótico en la Corona de Aragón', p. 476.

89. Serra Desfilis, 'La arquitectura del tardogótico en la Corona de Aragón', pp. 476-77.

90. Bassegoda i Nonell, *Els treballs i les hores*, pp. 118-19.

91. Bassegoda i Nonell, *Els treballs i les hores*, pp. 151-72.

92. 'But the importance of models should not be overestimated: like the presentation drawings they rarely represent the structure that ultimately was built, and in any case they were made only for the most grandiose structures. I think that the average palace and church was built from rough plans and a batch of details.' Ackerman, *Origins, imitation, conventions*, p. 8.

93. Shelby, 'The Geometrical Knowledge', pp. 409 and 420.

94. Bucher, 'Micro-Architecture', p. 74. See also Juan Carlos Navarro Fajardo, *Bóvedas de la arquitectura gótica valenciana. Traza y montea* (Valencia: Universitat de València, 2006).

95. Shelby, 'The Geometrical Knowledge', p. 420.

96. Shelby, 'The Geometrical Knowledge', p. 420; Davis, 'On the Drawing Board: Plans of the Clermont Cathedral Terrace', in Nancy Wu (ed.), *Ad Quadratum. The practical application of geometry in medieval architecture* (Aldershot: Ashgate, 2002), p. 190; and Davis, 'Science, Technology', p. 4.

97. Zaragozá Catalán and Gómez-Ferrer, Pere Compte, pp. 219-20. Two more early sixteenth-century examples are cited, one in Tortosa and the other in Valencia.

98. See Amadeo Serra Desfilis, 'La logia abierta: transferencias y movilidad en la arquitectura tardogótica hispánica', in Begoña Alonso Ruiz and Juan Clemente Rodríguez Estévez (eds.), *1514: arquitectos tardogóticos en la encrucijada* (Seville: Universidad de Sevilla, 2016), pp. 339-52.

99. Almuni i Balada, La catedral de Tortosa, pp. 72-74; Amadeo Serra Desfilis, 'La arquitectura del tardogótico en la Corona de Aragón: intercambios y trayectorias', in Alonso, *La arquitectura tardogótica castellana*, p. 466. The trip was funded by

the bishop and chapter.

100. Serra Desfilis, 'La arquitectura del tardogótico', p.466. See also Matilde Miquel Juan, 'Entre la formación y la tradición: Martí Lobet a cargo de las obras de la catedral de Valencia', *Espacio, Tiempo y Forma* 7: 22-23 (2009-2010): pp. 13-44.

101. Bassegoda i Nonell, *Els treballs i les hores*, p. 152.

102. Chamorro Trenado and Zaragozá Catalán, 'La traza de la torre campanario', pp. 10-11. See also Zaragozá Catalán and Gómez-Ferrer, *Pere Compte*, pp. 24-8; and Javier Ibáñez Fernández and Arturo Zaragozá Catalán, *'Inter se disputando*. Las juntas de maestros de obras y la transmisión de conocimientos en la Europa medieval', in Enrique Rabasa, Ana López and Marta Alonso Rodríguez (eds.), *Obra Congrua. Estudios sobre la construcción gótica peninsular y europea* (Madrid: Instituto Juan de Herrera – ETSAM, 2018), pp. 113-29.

103. Lluís Masquefa, no. 22198, 26 March 1444, Archivo de Protocolos del Corpus Christi de Valencia (also published in Zaragozá and Gómez-Ferrer, Pere Compte, p. 219). We will inevitably wonder what 'legiment' might mean. It was not to be found in the Alcover-Moll *Diccionari Català-Valencià-Balear*, but it can be assumed that the word refers to a brief text explaining the measurements or details of the structure.

104. Vid. Joaquín Aparici Martí, 'Obra en piedra. Maestros vizcaínos en la Plana de Castelló', *Millars. Espai i història* 29 (2006): pp. 113-50.

105. Almuni i Balada, *La catedral de Tortosa*, pp. 72-74; Serra Desfilis, 'La arquitectura del tardogótico en la Corona de Aragón', p. 466.

106. Coldstream, *Medieval Architecture*, pp. 80-81. Coldstream refers to Llaguno, *Noticias de los arquitectos y arquitectura de España*, 1: p. 96 (the document is transcribed in the appendix, doc. XXIX-2, p. 277).

107. Yarza and Español, 'Diseño, modelo y producción industrial', p. 28.

108. Chamorro and Zaragozá, 'La traza de la torre campanario', p. 4.

109. Lluís Despuig, no. 22028, 20 April 1439, 15 July 1439, Archivo de Protocolos del Corpus Christi de Valencia.

110. Alonso, 'El maestro de obras catedralicio', pp. 239-40. The author lists the tombs of other master stonemasons, such as Juan de Cándamo or Guillén de Rohan. Costanza Beltrami recently presented a paper on the funerary chapel of Guas: 'Burying the builder: a case study of the funerary chapel of Juan Guas (active 1453-1496) in San Justo y Pastor, Toledo', *Loci Sepulcrales, Pantheons and Other Places of Memory and Burial in the Middle Ages* (Santa Maria da Vitória Monastery, Batalha, Portugal, 21-23 September 2017).

5

Patterns of Intention: Royal chapels in the Crown of Aragon (fourteenth and fifteenth centuries) and the Capilla de los Reyes in the Convent of Saint Dominic, Valencia[1]

AMADEO SERRA DESFILIS
UNIVERSITAT DE VALÈNCIA