

Factors of Technical Innovation in Valencian Architecture during the Medieval and Modern Ages: Learning, Know-How and Inspiring Admiration

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From the fourteenth to sixteenth centuries the Kingdom of Valencia was to become one of the most active and innovative regions on the Iberian Peninsula in terms of building. This was largely due to the arrival of numerous architects in the city and, particularly, the endorsement, acceptance and request for these new technical methods by the Valencian society. Ever since its conquest, Valencia was considered as a land of possibilities which required the services of all manner of artisans and where these services, however demanding, were received with gratitude. These conditions allowed foreign master builders to respond to the needs of the city and, on account of the greater degree of freedom granted by the client, to seek new answers and solutions to questions such as roofing of large spaces, more open staircases or the lowering of costs. This explains the variety of building styles employed in medieval Valencia and its continuation through the modern age and captured, among other aspects, in the spherical geometry or brick vaults which were at the forefront of both Spanish and European building practice (Zaragoza 2000a; Zaragoza 2000b; Mira 2003; Berchez 1994) (**fig.1**).



Figure 1. Vault in the Royal Chapel in the Santo Domingo convent (Valencia), Francesc Baldomar, 1439- 1451.

APPRENTICESHIP AND ADMINISTRATION OF TECHNICAL KNOWLEDGE IN THE BUILDING TRADES

This sustained rise in the expertise of master builders in Valencia between the fourteenth and sixteenth centuries, backed and encouraged by promoters interested in financing important buildings and open to technical innovation, was largely due to the spreading of new skills through apprenticeship and the administration of professional knowledge. One aspect worthy of particular attention is the origin and training of the more outstanding tradesmen. As it is difficult to reconstruct the professional path of a worker of this nature from their very beginnings, it is perhaps more suitable, in accordance with available information, to speak of an administration of knowledge by those capable of passing this down. Documents reveal these factors in a disjointed fashion and while it may be taken that there was a chain through which this knowledge was passed, we are only aware of some of the links.

The transfer of knowledge and its documented tracks: apprenticeship contracts and guild regulations.

Over long periods technical building knowledge was passed on by word of mouth. The teaching of craftsmen to read and write has, paradoxically, received far more attention than the methods of apprenticeship and the passing of knowledge prior to the first written codes of these skills (these codes being fairly rare currency until the sixteenth century when accepting the theoretical division between building and architecture reigning in historic-artistic thinking of the modern age). The confrontation between tacit knowledge and literacy has, subsequently, formed an artificial dialectic which has frequently prevented reflection on the matter by defining the first term as a knowledge difficult to articulate, communicate and describe and one found in groups, consensual values, suppositions and beliefs (and, subsequently, difficult to identify, locate, quantify, classify and appraise: Long 2001, p. 245). In short it is taken that prior to the writing of codes, the apprenticeship of any trade was based on “knowing-how” and systematically ignoring the “knowing-that”. This question has been tackled by other disciplines with better degrees of success and bridging the gap imposed between tacit knowledge and literacy. In literature (Rubin 1995) and in the history of music (Treitler 1981) the first written examples of tales and musical notation have been explained as specific testimony of practice, rather than a proposal to lay down one version or another of texts and scores. With regards to the value of tacit knowledge, a specific and eloquent example may be quoted which is pertinent to Medieval building in Valencia: the Godella and Mislata quarry workings, the main sources of stone for the city, frequently relied on the association between master builders and Muslims from one town or another who were well aware of the quality of the deposits and their possible use in architecture (ARV, *Protocolos*, 1898).

The transfer of knowledge underwent partial standardization in the form of apprentice contracts registered at notarial sources. A review of documents of this type concerning the building trades in Valencia (Sanchis 1925, and a further five unpublished cases dated between 1385 and 1438) reveals a fairly clear profile of the modes of transfer of knowledge between stone cutters and masons. The overwhelming precision employed to record certain types of information allows an analysis of these

constants and the establishment of document founded hypotheses. The short-medium length of apprenticeship (around three years), the unusually advanced age of the apprentice (from fourteen to sixteen years old), their geographical origin (Valencia or neighbouring towns), their working background (craftsmen) and the handing over of tools at the end of the apprenticeship, leads one to surmise that the training undertaken was similar to a type of “higher level training course” and one following on from previous contact with the trade. It is worthy of note, and contrary to what one would initially expect, that members from one family dedicated to the building trade frequently received training from outside sources: in Valencia there are at least two documented cases where the sons of stonemasons learnt their trades from other building professionals (APPV, *Lluís Despuig*, 1439; Sanchis 1925, p. 38). One may then ask what these parents saw in the masters entrusted with the training of their children. When leaving commercial interests aside (such as the establishment of collaborating relationship and contacts with a professional in order to gain access to different types of work, etc.), it is then necessary to ask whether the selection implied an implicit acknowledgement of the knowledge of the masters approached. At the outset there appears to be a clear relation between apprenticeship and the mobility of the trainee over the first years of their working lives. It is somewhat more complicated to extend this type of movement to the later working periods of the majority of building workers though, in this regard, it is necessary to consider the vague differences which seemed to appear between the apprentice and the skilled worker - with both being fully employed - within the broad idea of service which characterised the majority of the working population in pre-industrial societies (Buchbinder 1991).

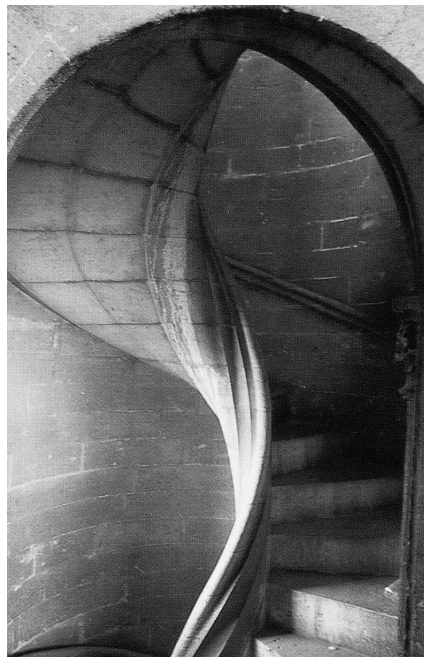


Figure 2. Spiral staircase of the Valencia Lonja, Pere Compte, 1490-92.

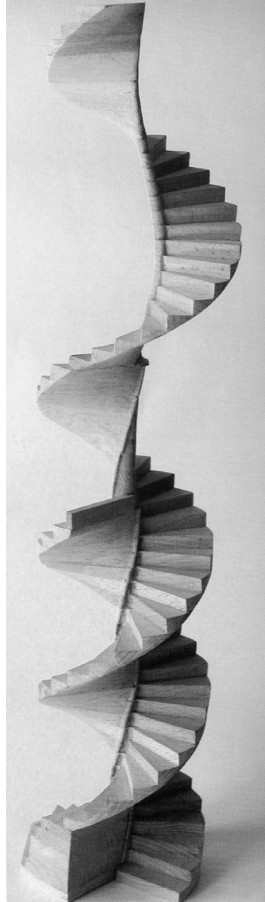


Figure 3. Actual scale model of the double spiral staircase of the Royal Chapel at Santo Domingo convent, Valencia.

From another perspective, attempts have been made to trace the on-site training of stonemasons and masons outside apprenticeships, and to discover how contact was established between builders and mainstream lettered thought (Shelby 1970). Research tends to be focused on the relationship between technology, science and architecture (Davis 1995). In Valencia, a privileged field observation area in these matters lays on the competence normally recognised for masters builders in water works and surveyors (Glick 1996).

In 1404 an inventory was made of the equipment supplied to Joan Lobet as master builder of the Cathedral of Valencia (Sanchis, 1925, p. 34). The listed objects include basic tools, measuring instruments and hoisting machinery which are presumed to be relatively manageable in size. Even when considering the fact that Lobet would have his own resources in addition to those mentioned,

the inventory still provided a fair indication of the specific skills of a renowned master builder in Valencia at the beginning of the fifteenth century. Consideration should be given to the relative scarcity of material resources revealed by the documentation. The factors distinguishing a master builder do not, at the outset, appear to be related to his skill with any particular instrument (the plumb, trowel, measurement of rubble and lime) but, instead, the knowledge enabling him to handle these instruments in order to design, administer and supervise a construction of any scale. It is necessary to review the popular belief based on the paradox “poor of means, rich in skill” and take that which may be valid with regards to tacit knowledge. However, it has been possible to re-establish the value of some of these objects as architectural instruments (Wu 1998-1999, based on the headstone of Hugues Libergier, writes a brief dissertation on the value of tools represented in the figurative arts as a basis for the reconstruction of architectural calculations; Bechmann 1991). The inventory of Joan de Villalba, a mason from Jerica who died in 1447 (Aparici 1997, p. 262) underlines the precariousness of materials as reported in the document of 1404. However, the by-laws for the Valencia guild of masons dated 1695 (Baixauli 2001) expressly prohibit apprentices from using the work tools of masters (trowel, rule, plumb and others) and this seems to indicate that it was the prerogative of these latter to use certain tools. In all events it is necessary to clarify that this rule was immediately modified to adapt to the prevailing market conditions with a shortage of skilled workforce.

In order to compare historiographic building with standardized building (and establish what might be the historic truth) it is necessary to make a systematic analysis of the coding of building trades over the period in question. After an initial review it has been possible to ascertain that the length of apprenticeship varied little from 1350 to 1700 and entailed around three to four years work under a master builder (Epstein 1998). This then maintaining the hypothesis of a relatively short training following on from some type of contact with the trade.

Administration of knowledge and specialized workforce

Between 1350 and 1500 (perhaps earlier and definitely after) it is possible to observe a progressive restructuring of building organization in Valencia which may be referred to as the professional hierarchy on site. The master builder appears to take on increasing responsibility, relying on a small gang of experienced masons who are delegated specific work functions and who are subsequently consulted on the same. The reason behind this change appears to lie in the progressive specialization of the master builder who, on account of his specific knowledge, is apparently allowed to take on a broader range of building related activities which are denied to the other workers. A further explanation for this process could well be the presence of a well-organised public works administration group which allowed the master to disassociate himself somewhat from work organization aspects and market strategies.

Knowledge was a precious tool for any specialised or skilled worker and one well worth administering in a capable fashion in fourteenth to sixteenth century Valencia.



Figure 4. Monastery of San Miguel de los Reyes, Valencia, sixteenth-seventeenth centuries.

CIRCULATION OF KNOWLEDGE: MOBILITY AND COLLABORATION WITH OTHER TRADES

The mobility of master builders very much influenced changes in technique and architectural expression. From the fourteenth to sixteenth century Valencia witnessed the arrival of a large number of foreign, or presumably foreign, master builders who were conversant with innovative processes. These specialists were well received and readily employed by organizations and individuals in different construction undertakings. Valencia appears to have been a city only too ready to accept highly qualified artisans and it has been recorded that at the end of the fourteenth century there was a shortage of skilled building workers which made it necessary to call for master builders from other geographical areas in order to undertake projects of any scale (Serra 2005). In the fifteenth century, reference may be made to the case of Charles Gauter, known as Master Carli, who originated from Rouen and who was responsible for the façade of Barcelona Cathedral in 1404. He was the master builder on the Lerida Cathedral between 1410 and 1432, was present in Valencia in 1429, and responsible for works at the Seville Cathedral between 1439 and 1449, though previous reference to this master is already made in local documentation in 1435. The sixteenth century saw the incorporation of a large number of French stonecutters working on buildings such as the monastery of San Miguel de los Reyes after having worked on coastal fortification in the Kingdom of Valencia (Arciniega 2001) (**fig.4**). In the area of military architecture, the strategic defence interests of the Habsburg Empire and the advanced military engineering knowledge

acquired in Italy all favoured the arrival of skilled technicians from the transalpine country in the times of Carlos V and Felipe II (Vigano 1994; Camara 1998). The ready acceptance to incorporate foreigners contrasted with the small involvement of Muslims in building works in spite of their proximity and notable presence in other economic activities. As opposed to that occurring in other cities of the Court of Aragon such as Saragossa, Daroca and Segorbe (Borras 1999; Aparici 1998), references to Valencian Muslims purely tend to refer to suppliers of materials or those convicted to slave labour.

Valencia was also ready to receive young workers who wished to train with established masters in the capital, such as those serving their apprenticeship under Antoni Dalmau (Gomez-Ferrer 1997-8) and the well-recorded case of Pere Compte, born in Gerona, who trained in Valencia under Francesc Baldomar and which culminated in innovative processes in the art of stone cutting and vault systems and eventually led to a well-defined circle of stonemasons by the start of the sixteenth century (Zaragoza 2000b). In this way Valencia served as a focus point for expert master builders and those who wished to complete their apprenticeship alongside expert Valencian builders. While the authorities readily took credit for the works carried out by others, there does not appear to be any degree of civic pride related to these masters in spite of all the generosity and titles bestowed upon them.



Figure 5. Skew door and carpentry decoration of the Royal Chapel, Santo Domingo convent, Valencia.

Historiography has given particular consideration in recent years to technical innovation in stonemasonry. However, the other building trades do not appear to have lagged behind in terms of progress and improved operation and it is of some note that several of the great renovators in Valencian building between the fifteenth and sixteenth centuries came from other professional areas and were known under their corresponding titles rather than architects or master builders. Renowned figures such as Joan del Poyo or Gaspar Gregori (**fig.5**) trained and worked in carpentry throughout their careers. While wood was evidently important in the construction processes of the day in the form of scaffolding, shoring, roofing, auxiliary machinery and other architectonic elements, it is also necessary to underline the standing that the guild of carpenters held in the social-professional structure of Valencia. In the area of masonry, or rather the architecture built in mortar, plaster, wood and brick, the list of illustrious craftsmen is by no means short and the best of these were paid on a par with the most highly considered stonemasons (**fig.6**). The names of Jaume Gallen, Pere Vinia and particularly Francesc Marti alias Biulaygua undoubtedly rivalled in social esteem with their contemporaries Francesc Baldomar or Pere Compte and their work was never considered as a mere adaptation of building solutions previously established in stonemasonry. Indeed, masonry frequently proved to be an area ripe for innovation and witnessed new and highly significant techniques in the form of the brick panelled vault, plasterwork and the Valencian partition wall, this latter being a technique described by Friar Lorenzo de San Nicolas in his treatise (San Nicolas 1639; Galarza 1996).

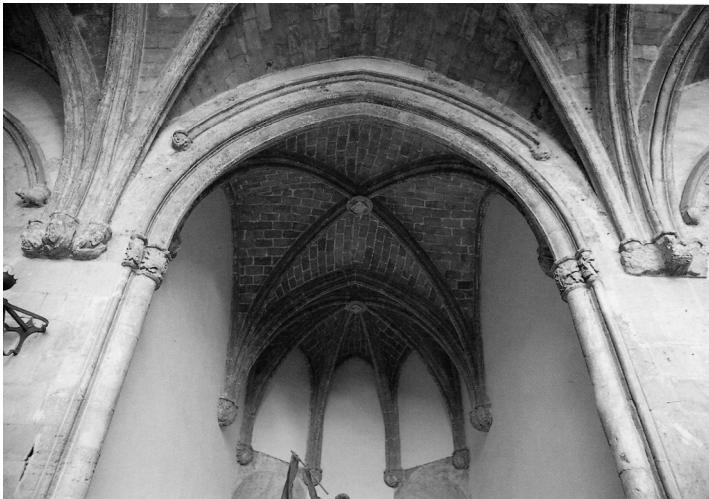


Figure 6. Brick vault, Holy Cross Chapel at the cloister of the Santo Domingo convent, Valencia.

The experience accumulated by practice and the ongoing transfer between masters and trainees through drawing and the assimilation of instruments for the description and modification of a three-dimensional reality through geometry are behind the two courses of technical renovation in Valencian architecture between the late Middle Ages and the Renaissance. In the fourteenth and

fifteenth centuries the application of geometric knowledge to the enlargement and improvement of Valencian irrigable land was led by surveyors who worked shoulder to shoulder with master builders in the construction and maintenance of irrigation channels, dams and waterwheels and on projects for transfers between water courses (Glick 1970, 1996). The Valencian levellers were specialised in the design and construction of all types of water channels and had the capacity to act as surveyors, water technicians and builders, but were largely recruited from among the master builders (Serra 2002). In the sixteenth century the predominance of artillery in attacks on fortifications, the appearance of the bastionary front and experience on the battlefield all combined in the form of a new type of military engineer who drew plans, designed models and arranged the defences of cities and forts, and gangs of stonemasons and masons were entrusted with the materialization of these drawings, calculations and tactical operations (Camara 1998; Arciniega 1999). The need to provide new and complex forms to arches, vaults and escarpments was a specific duty of the master builders – stonemasons and masons - in accordance with the fortification guidelines ordered by military engineers and commanders to hold back revolts by the Moors, assaults by pirates and the feared attack by a Turkish contingent off the Valencian coast during the sixteenth century. On gaining military experience, the more talented master builders could then aspire to the title of engineer though the most common situation was that they worked on site and remained tied to a specific work, often for very long periods.

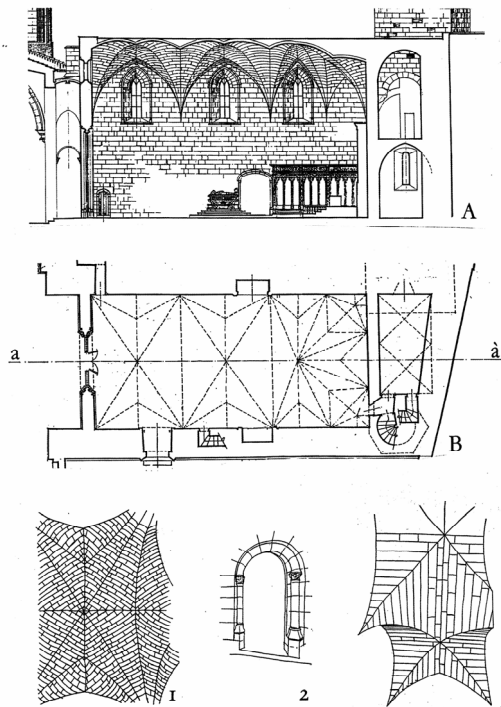


Figure 7. Royal Chapel at Santo Domingo convent (Valencia), according to Zaragoza (1996).

In another direction, the design, assembly and preparation of building machinery was an experimental area and here the applied knowledge of mechanics of certain master builders served as an aid to construction processes and granted the builders recognition as versatile technicians. This was the case of Pere Balaguer when he devised a system to hoist weights in the works to the Serranos Gate (1392-1400) or Joan del Poyo (active between 1402-39) on taking over the maintenance of the city's public clock (Serra 1994). Collaboration with seamen is also documented with regards to operations with derricks and other mechanisms to hoist large loads which would prove to be extremely useful for the construction of free-standing vaults such as the Royal Chapel in the Santo Domingo Convent (Tolosa, Vedreño and Zaragoza, 1996) (**figs.1 and 7**).

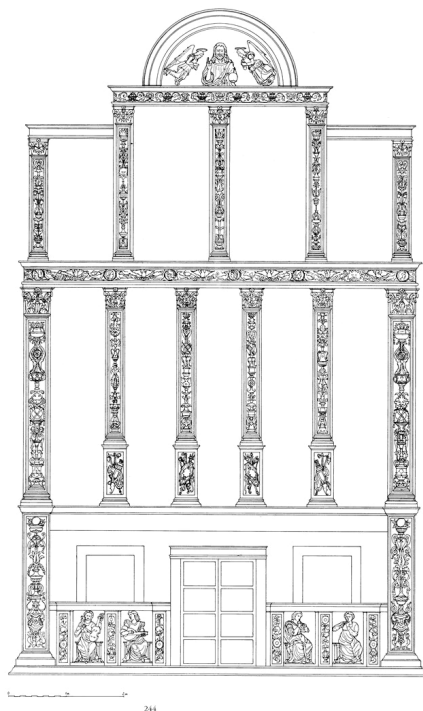


Figure 8. Reconstruction of the organ of Valencia Cathedral, Lluís Munyoc and Yanez de la Almedina, 1510-1515, according to Gomez Lozano.

The contact and understanding with figurative artists perhaps served more for the renovation of architectonic expression rather than technical change in spite of the difficulty frequently encountered in separating these aspects. The convergence of motifs and forms employed in applied arts such as silversmithing or the joinery of altarpieces throughout the international Gothic period (Zaragoza 1999; Miquel and Serra 2005) gave rise to a new *Roman* language by sculptors and painters in the Valencian architecture at the start of the sixteenth century. This is demonstrated by the case of Lluís Munyoc, a joiner and sculptor who associated with the painters Yanez de la Almedina and Hernando Llanos (Gomez Ferrer 1998) (**fig.8**). There is no obvious answer to the

question concerning the degree of influence of innovative processes in decoration and compositional form on technical change in construction, but it is possible to discern the different paths followed by both processes. Around 1500 the advanced and modern stereotomy of the most noted stonemasons followed its own course, independent from the new form of expression inspired by Roman architecture and one which was to serve as the main patrimony of figurative artists (Marias 2000).

DRAWINGS AS AN ELEMENT OF CONTROL AND MEASUREMENT OF INNOVATION

Documentation confirms the use of drawings for many different purposes though these may generally be divided into two groups in accordance with the person or persons to whom these were directed. The first group covers those drawings or sketches, whether painted or modelled, aimed at the apprentices and labourers of the master builder and geared to site control and management and referring both to the general plan or model of the work and the design of building elements. The second group refers to those overall sketches of the work and details which were attached to outlines, three-dimensional models of the structure and prospective works to lure undecided clients (Montero 2004). It may be difficult to discern the difference between one group and another, according to the examples, but both served as useful tools to show the structure and reveal any innovations in the work (Zaragoza and Garcia 1993).



Figure 9. Probably a model of the topping of the belltower, early fifteenth century (Ayuntamiento de Valencia).

An example of the first group among the known cases in the Kingdom of Valencia is the topping of the belltower to Valencia Cathedral made by Antoni Dalmau which interested many “craftsmen” in 1453 (Sanchis 1909) (fig. 9). While in the second category, reference may be made to the letter sent by King Martin I to the abbot of the Sant Bernat de Rascanya monastery (Valencia) requesting his assistance and expertise in the design and organization of areas by sending a plan or sketch of the monastery works which were intended to be included in the Royal Palace in Barcelona (Girona 1911-1912, p. 148). The documentation refers to many other cases and in all of these the use of drawings may be accepted as a means by which masters could reveal the technical and aesthetic innovations of a project and one which serves as a means of work control and client acceptance.



Figure 10. Skew door of the kitchen at the cloister in Trinity convent, Valencia.

The features which were most highly considered by patrons and artisans in new buildings and reform work were possibly the windows and doors as their positioning in very visible places, the capacity of innovation allowed by their designs and the technical prowess involved all reflected the expertise of the master builder and the prestige and standing of the client (**figs.10, 11 and 12**). The sources make frequent reference to drawings of windows and doors. These features were rich in decorative elements and conceived according to the latest knowledge in the state of the art, and were often specifically ordered out to renowned master builders at some considerable expense. By way of example, in 1405 Joan Llobet charged 25 pounds for two windows to the house of the notary Leonardo Gomis, while Pere Capella was the master builder responsible for many of the housing works (APPV, sign. 1346). Both this example and other windows attributed to Joan Llobet in different locations show that he was a highly considered master in the design and cutting of these elements.

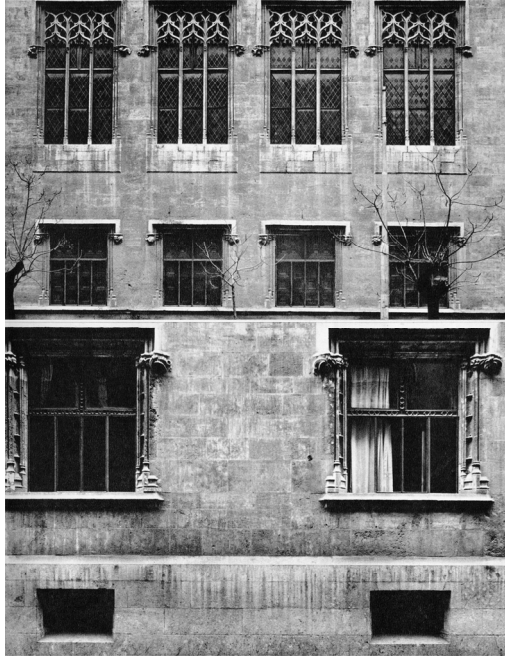


Figure 11. Façade of the Consolat del Mar, Valencia.



Figure 12. Doors of the san Jeronimo of Cotalba monastery (Alfahuir, Valencia).

PATRONS AND “PUBLIC” ATTITUDES: APPRECIATION AND PRAISE OF INNOVATION

The Valencian documentation throughout the fourteenth and fifteenth centuries reveals words of praise and admiration for the city’s master builders, in parallel with other European regions, with expressions such as “master of building works, very skilled and capable in his art” (Serra 2005) and signs of appreciation of the work carried out: “as you are aware we trust in the notable expertise of his art” (Miquel 2004), as a result of the technical changes which were applied both in the innovative outlines of vaults and in the progress in the use of stereotomy, sketches and working drawings (Zaragoza 2000a). In addition to these innovations, one of the aspects which reveal the high technical knowledge of the masters was their capacity to build stairs (**figs.2 and 3**): of single arch over horseshoe arches, of various runs over independent back arches, of various runs with back arches connected at the arris and, finally, of various runs and skew arches (**figs.13 and 14**). The known references to these stairways provide detailed information of the characteristics, measurements, materials and form, and reveal the high cost which was often entailed. The fact that the majority of these stairways were entrusted to the best master builders in the city of Valencia: Miquel Navarro, Joan Eiximeno, Francesc Baldomar, Pere Compte or Joan Corbera confirm the acknowledged capacity of these masters and their knowledge (Gomez-Ferrer 2005). One of the first documents referring to a notable and expensive stairway was perhaps that built in 1393 in the Royal Palace of Valencia by an unknown master, perhaps Joan Franch, which cost the vast sum of 500 gold florins (ACA, Mestre Racional No. 393). The development in the building technique of stairways ran parallel to the development in the art of stone cutting and reveals the capacity to transform an architectonic element which, in the words of Vandelvira (1977, p. 99), Tosca (1992, p. 243) or Gelabert (1977, p. 224), could be highly complex and which responded to the need for improvement, the demands of Valencian society and the interest of the master builder himself to enhance his professional reputation in the city.

One characteristic of architecture in the Kingdom of Valencia was the arrival of numerous foreign artisans and the good reception received by the same. This could well indicate a willingness to receive the new forms transmitted by these masters, but also reflects the intentions of the patrons to receive the fame and honour which could be bestowed by these works. Both master builder and client were the protagonists of the new work order as this reflected the latter’s wealth and highlighted his status, while the master mason had to make all attempts to respond to the desires of their promoters and reveal their capacity for innovation in each work. By way of example, the City Council indicated in reference to the work on the Lonja building that, “we want it to be very magnificent and beautiful to honour and embellish the city” so that the city traders “settle in the city in view of such a suitable and convenient place for trade which will readily meet their favour” (Aldana 1988, pp. 19 and 37). Earlier in 1418 the same council granted an extraordinary salary to Joan del Poyo on the grounds that “the city should satisfy and pay such a master and retain him at all cost” as “on account of his famed work, he was very much in demand by many wealthy people

to carry out conspicuous works” (Serra 1994). A further factor which could well play a significant role in the ordering of work was the economy: King Pedro IV ordered the transfer of two master builders from the Aljaferia Palace in Zaragoza so that they could study the brick and plaster work of the Royal Palace of Valencia in view of the savings that this could procure (Rubio 1921, p. 257). In his works the Franciscan theorist Francesc Eiximenis (ed. 1987, p. 511) makes reference to the beauty, soundness and economy of the vaults: “the work is more beautiful, stronger and safer as it does not burn and costs less than that built in good wood by a master builder, and is a more long-lasting work”. In 1407 Martin I ordered brickwork techniques to be employed in the Royal Chapel in Barcelona Cathedral, going against the recommendations of the master architect and in imitation of that built at the Chapel of Saint Martin at the Valldecrist Charterhouse, founded by the same monarch (Bassegoda 1977, pp. 88-99).



Figure 13. Stairs of Palau de la Generalitat (Valencia).

CONCLUSIONS

The authors have not attempted to offer a particular explanation or establish the scope of each process of architectonic innovation and have, instead, provided a general overview within the possibilities of a paper. However, an attempt has been made to chart the flow of technical knowledge in an area of European architecture immersed in social and cultural changes which marked the transition from the late Middle Ages to the Renaissance in Europe, and perhaps our observations may be extended to some degree to other territories and cultural contexts to provide better knowledge of the causes of change in building history.



Figure 14. Stairs of the Santo Domingo College, Orihuela (Alicante).

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