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“Construction History in Spain”

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Construction History
Research Perspectives in Europe

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This is vol. IV in the book series “Between Architecture and Mathematics”. The Associazione Benvenuto for research in the Science and Art of Building in their historical development assigned to a few international “observers” the task of styling a map of Construction History in their various countries. Obviously, we are not dealing here with an exhaustive map, but rather with a first attempt to identify some of the significant lines of research and to put into contact the individual scholars. A small step towards the constitution of an international scientific community that is interested in architecture as well as mechanics; in construction as well as its history. A community which, up to the present, has not known how to find the essential points of contact and dialogue, and which has avoided the onus of long-term initiatives. The present volume is an aid for establishing solid collaborative research projects, knowing that this can happen only if the studies are so rigorous and detailed that those emphatic recall to arms of interdisciplinarity, sure signs of problems set forth badly, are rendered superfluous.


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Construction History began to be considered an independent discipline in Spain in the 1990s. In what follows we are concerned with the works establishing Construction History as a discipline, and not with particular studies within this field. A short history of the development of the interest in Construction History will help to explain the current situation.

**Present situation: The first Congresses and the founding of the Spanish Society for Construction History**

In 1993 the Instituto Juan de Herrera supported a new series of books specifically devoted to studies in Construction History. The proposal was made by the author and accepted by Professor RICARDO AROCA, President of the Instituto. The title of the series is “Textos sobre Teoría e Historia de las Construcciones” (Texts on the Theory and History of Constructions), edited by S. Huerta. The series received the support of the Centro de Estudios Históricos sobre Obras Públicas y Urbanismo, Centre of Historical Studies of Public Works and Urbanism (CEHOPU), a division of the Ministry of Public Works, due to the interest of then-President ANTONIO DE LAS CASAS. The first books published in the series [HEYMAN 1995; VIOLLET-LE-DUC 1996; CHOISY 1997; CHOISY 1999; and HEYMAN 1999] received a warm reception by Spanish architects and engineers. It was evident that there was a diffuse but intense interest in Construction History.

A first seminar on Construction History, Historia de la Construcción. Las fábricas de piedra hasta el Renacimiento (Construction History. Stone masonry building up to the Renaissance), chaired by A. DE LAS CASAS and S. Huerta, was held at the CEDEX (Centro de Estudios y Experimentación de Obras Públicas), Madrid, 4-6 April 1995 and attracted architects, engineers, and scholars from all over Spain, confirming previous beliefs about the interest in Construction History. It was thought then that the time was ripe for a Congress, and the Primer Congreso Nacional de Historia de la Construcción (First National Congress on Construction History) was held in Madrid from 19-21 September 1996, supported by the Instituto Juan de Herrera, the CEHOPU and the School of Architecture of Madrid. More than ninety authors contributed to
the congress and the proceedings were published as a book [Casas, Huerta, and Rabasa 1996]. The book was distributed after the congress and some hundred copies were sold.

The success of the series, the seminar and the first national congress encouraged the organizers to establish the Sociedad Española de Historia de la Construcción (SEHC) (Spanish Society of Construction History) in 1997 (president R. AROCA; vice-president A. DE LAS CASAS; Secretary S. HUERTA). The main objective of the Society was to create a link between the different professionals and scholars working in Construction History in Spain, to promote and diffuse studies and research on the topic and to begin a discussion on the definition of the discipline itself. To achieve this some concrete objectives were defined: 1) the publication of books; 2) the organization of biennial national congresses; 3) the promotion of the study of Construction History through seminars and exhibitions; 4) the publication of a newsletter and a journal, and 5) the support of the study of the discipline at a university level. A description of the main activities is given below.

The books on Construction History continued to be published in the above mentioned Series. Two more books by HEYMAN [2001 and 2004] were added and additional books by PERRONET, CHOISY (Spanish editions of L’art de bâtir chez les egyptiennes and of L’Histoire de l’architecture), TRUÑÓ and GUASTAVINO (on the building of timbrel vaults), etc., were under preparation.

Two more national congresses were held in A Coruña (1998) and Seville (2000). Again the reception was very good, the proceedings were published [BORES et al. 1998; GRACIANI et al. 2000] and, again, some hundred copies were sold in Spain. These successes seemed to demonstrate that the perceived interest on Construction History was not ephemeral. Then, in the general meeting of the SEHC in 1998 it was formally decided to organize the First International Congress on Construction History. The matter was discussed again at the general meeting of 2000 in Sevilla, where Prof. MASSIMO CORRADI attended on behalf of the ASSOCIAZIONE EDOARDO BENVENUTO. Eventually, the First International Congress on Construction History was held 20-24 January 2003 in Madrid, organized by the SEHC, the Instituto Juan de Herrera, the School of Architecture of Madrid, the Associazione Edoardo Benvenuto, the Colegio Oficial de Arquitectos de Madrid (Association of Architects of Madrid), and the Fundación Dragados. More than 200 authors from twenty-five different countries participated in the congress, and the proceedings were published [Huerta 2003]. The fourth Spanish National Congress on Construction History will take place 27-29 January 2005 in Cádiz and some 150 contributions have been already been accepted.
Some other seminars were organized within the frame of Construction History. The interest on vaulted construction led to a seminar on *Grandes bóvedas hispanas* in 1998 (Madrid, CEDEX, 19-23 May) and the contributions presented were published in a volume edited by S. Tarragó [1998]. The same interest led to research on timbrel vaulted constructions and particularly of the work of the Spanish architect Rafael Guastavino in America. Under the initiative of R. Aroca, A. de Las Casas and the author of this present report an exhibition was organized in Madrid and a book was published [Huerta 2001].

The newsletter of the SEHC, the *Boletín de la Sociedad Española de Historia de la Construcción*, has been published since 1997, though irregularly. From 1997–1998 the editor was A. Castro; since 1998 G. López Manzanares has been the editor. The journal is in the course of publication, with the intention being to publish every year.

In the School of Architecture of Madrid an attempt has been made to include Construction History as an academic discipline. Since 1997, two new optional syllabi have been introduced at the graduate level: *Construction History I: From Antiquity to the Middle Ages* and *Construction History II: From the Renaissance to the XXth century*. Each of them consists of some twenty lectures with their respective seminars. At the postgraduate level, a new program was established in 1998 entitled “Mecánica de las estructuras antiguas: historia, teoría y práctica” (Mechanics of historical building constructions: history, theory and practice), directed by R. Aroca, J. M. Ávila and S. Huerta.

**Possible grounds for the interest on Construction History in Spain**

The detailed description given above was intended to show that the current situation of Construction History in Spain is the result of a deliberate effort. However, it must be said that success is not usually a direct consequence of effort. The work done would have been impossible without the support of the institutions cited above and the warm reception of the books and Congresses, mainly on the part of Spanish architects and engineers, and their respective professional associations (the Colegios de Arquitectos and Ingenieros). To those institutions, and to the people in charge of them, the subject of Construction History seemed “interesting” from the outset. A scholarly topic is rarely considered of interest by professionals and professional associations, and perhaps even more rarely are they willing to spend money on books, seminars, exhibits, and congresses. The question, then, is very concrete: Why do Spanish architects and engineers consider Construction History to be an interesting topic?

To answer this, it is first necessary to define more precisely what is Construction History, i.e., what was the idea of the discipline which was communicated and which stimulated so much interest on the part Spanish
scholars and professionals. Construction History is a “technical” approach to the understanding of the “building universe”, to the works of architecture or civil engineering. This is, of course, a “hard” approach [Hall 2000] which may not be shared by all. The whole matter of the definition of this discipline is now subject to debate. Since the first contribution of Summerson [1985], for example, Dunkeld [1987] has contributed to the topic and Louw [2003] presented recently a contribution in Madrid. No doubt, the question will be discussed in more detail in the coming years.

There are some reasons for the emphasis on the technical aspect. The first is, that if we are founding a new discipline, this discipline must have an easily recognized identity. It is the technical aspect which forms the core of Construction History. A more general approach will mingle Construction History with other disciplines: history of architecture, archaeology, restoration of historical buildings, history of sociology and economics, etc. Of course, all of these disciplines are relevant to Construction History, but if the global emphasis shifts in any of these directions, this young discipline is going to be subsumed, no doubt, by the corresponding established discipline.

In Spain, from the beginning, we have been conscious of this problem, and we have tried consistently to draw a line, to identify, and to separate. The case of restoration may be a good example: this activity involves a lot of people and money, and many books and journals are devoted to it. The shared central issue is historical buildings, but the point of view is different. Consider, for example, a Gothic spire. From the point of view of restoration the matters under consideration will be the type of stone, the cracks and damages, the possible ways of strengthening, its structural analysis and consolidation, etc. The same spire will be considered by the construction historian in another way: he will be interested in its Gothic design, in the stonecutting, on the possible scaffolding used during construction, on its structural behavior, as clues to understand medieval design. The two views are complementary (a study of the cracks may disclose important information about the internal structure; a knowledge of the stereotomy will be necessary to substitute some stones), but they are essentially different.

This approach may seem too simple, even naïve or incorrect, but it has demonstrated its functionality and its appeal, at least in Spain (and, perhaps also, in the First International Congress of Madrid, which was organized following the same ideas). The approach has its origins in a genuine interest in the technical processes of building. This interest is a consequence of curiosity: we are curious, we enquire, we want to know how the Gothic cathedrals were built. Let us consider another example, the case of an Egyptian obelisks: how is it possible to remove a slender block of stone weighing 400 tons from the quarries of Aswan
and transport it hundreds of kilometers, by earth and water, without breaking it? Without this kind of curiosity it is not possible to build any science or discipline.

But, intelligent enquiries require some previous knowledge; in this case, the knowledge required is technical. Without this, it is impossible to ask pertinent questions. This is a great difficulty for regular historians [Maas 1969]: they lack the technical background to understand some kind of problems. Some particular technical details may be learned: a basic understanding of medieval stonecutting requires only some basic knowledge of practical geometry. But it is the point of view of the builder which is needed, a feeling of the whole process involved, if we want to understand complex matters such as the construction of a Roman or Gothic vault.

Important parts of the classical treatises on architecture are devoted to highly technical matters (the fabrication of mortars, stonecutting, the design of pendentives, the construction of wooden frames). Architectural historians have usually skipped these parts. The more technical treatises were simply ignored, and there are no critical editions of the books which shaped the science of construction of the last centuries, such as Fray Lorenzo de San Nicolás [1639], Bélidor [1729], Rondelet [1802–1810], etc. The situation is even worse with the specific topics such as stereotomy, carpentry, structural theory or building materials. Only recently, say, in the last thirty to forty years, a systematic interest in such specialized topics has grown. But reference works are still lacking and, for specialized aspects, annotated editions are a necessity. Therefore, we need people with a technical background who interested in history, as well as historians ready to grapple with difficult technical matters—in other words, people who are eager to bridge the gap between building technology and the humanities (art, history, architecture, etc.). We need also a specific methodology.

Spanish architects and engineers are well prepared for the task. Spanish civil engineers have had a humanistic preparation, and architects receive both an artistic and technical education. In particular, the situation of Spanish architects merits some comments due to their singularity. From the beginning, Spanish architects have been a mixture of architect and building engineer (Bauingenieur). For example, nowadays in the School of Architecture of Madrid, from a total of eight departments, four may be called scientific or technical: Building Structures; Building Construction and Technology; Applied Mathematics and Physics; and Building Installations. The technical syllabi may reach 42% of the total of 455 credits (or 4,550 hours) in five years.

The objective is to reach an almost “Vitruvian” ideal: the architect should control every aspect of the design of the building, including all of the technical aspects. A good background in mathematics and geometry, mechanics, applied
physics, structural theory, urbanism, etc., has been considered necessary for the architects during the last two centuries.

A thorough study of this matter has yet to be undertaken, but some historical hints may be mentioned. It is interesting to note that no official difference existed in the eighteenth century between architects and engineers (with the exception of military engineers): both projects of architecture and civil engineering had to be approved between 1744 and ca. 1800 by the Real Academia de Bellas Artes (Royal Academy of Fine Arts). In this period, the second half of the eighteenth century there were many complaints for the lack of technical and scientific instruction of architects [Navascués 1996]. The result was a heavy emphasis on scientific material in the syllabi offered by the First School of Architecture, established in 1844 in Madrid. Since then, there has been a constant emphasis in the teaching of mathematics, building construction and structural design.

The first specific interest in Construction History appeared at the beginning of the twentieth century. But to place this in context, a brief outline of the beginnings of this type of studies in Europe should be made.

**Brief outline of the origin of Construction History studies**

The interest in the building techniques of previous epochs can be traced back at least to Vitruvius, who cites Greek building manuals. Of course, Vitruvius was not undertaking any kind of scholarly research, but he did study manuals that pertained to the older, Greek, building tradition. The systematic study of Roman ruins began during the Renaissance with studies by Brunelleschi, Donatello, and others. Perhaps the main emphasis was on the language of the classical orders and the laws of composition, but Vasari is explicit about Brunelleschi’s interest in Roman structures [Murray 1972]. It might also be that the contemplation of the heavy concrete masses had some influence on the idea of what can be built and on the right proportions for the different structural elements. The Pantheon served as the model for the dome of Saint Peter’s designed by Bramante. The description of wall construction by Alberti is reminiscent of Roman building, with courses of brick or stone embedded in the concrete. Roman bridges have been a model for builders for centuries.

The interpretation of Vitruvius required some kind of analysis and interpretation of the Roman ruins. This is evident in the drawings of some editions, for example Rusconi [1660] (Fig. 1). The drawing itself is not a copy of the actual structure and presupposes a conscientious analytical effort; here, perhaps for the first time, the stratified structure of Roman concrete is made visible.
Fig. 1. Drawings of Roman construction made by Rusconi for his edition of Vitruvius.

Fig. 2. Piranesi’s interpretation of some details of Roman construction [1756, 1790]. Left, wall construction. Right, the dome of the Roman Pantheon.

It appears that the first technical studies of Roman building and materials originated in the eighteenth century. Ziegler, for example, published a book in 1776 with the expressive title *Reasons for the strength of ancient mortars* (cited in [Giedion 1971]). The interest in the technical aspects of the architecture of antiquity is also evident in the writings of Winckelmann [1762]. Some drawings of Piranesi attempt to analyze Roman construction graphically (Fig. 2). Here is a
mixture of documentation and invention: the drawing of the wall is quite correct, but the Pantheon dome has no brick ribs. But “invention” is a part of the process of formulating new theories, in this case about how the Romans built.

At the beginning of the nineteenth century, the monumental treatise of Rondelet [1802–1810] included many monographic studies of the most important buildings of the past: the Pantheon in Rome, San Vitale in Ravenna, Santa Maria del Fiore in Florence, etc. The first systematic studies were made within the context of the analysis and interpretation of Gothic architecture: Robert Willis in England and Viollet-le-Duc in France were followed by Ungewitter in Germany. However, these studies were particular to Gothic construction; there was no attempt to build a new discipline.

It was August Choisy who first tried to define a new approach. In the introduction to his Art de bâtir chez les romains (The art of building in Rome) [1873], he is explicit about the objectives and methods to be followed. He begins by saying: “Though the buildings of antiquity have been studied many times from the point of view of architecture, we have a vague idea of the constructive processes involved” (my translation). The book was followed by L’art de bâtir chez les byzantins (The art of building in Byzantium) [1883] and L’art de bâtir chez les égyptiennes (The art of building in Egypt) [1904].
His monumental *Histoire de l’architecture* [1899] treats the whole problem of architecture, but the emphasis on technical aspects is evident. Finally, in 1909 his *Vitruve* was published posthumously, in which he arranged the content of the treatise following a logical order, again with special consideration given to the technical aspects. Choisy can be considered the father of Construction History. He was the first to present the approach in a consistent way and contributed decisively to it (Choisy’s analysis of vaulted construction in Rome and Byzantium, though with some historical errors, has not been surpassed in its description of the technical problems and processes). His analytical drawings were copied once and again in subsequent studies (Fig. 3).

Others followed the rational/technic al approach of Willis, Viollet-le-Duc and Choisy. In Germany, for example, the architect Josef Durm wrote excellent books on the art of building in Greece [1881], Rome [1885] and the Renaissance [1904]. Though the technical aspect was only a part, he attributed great importance to it and included many analytical constructive drawings. Mohrmann revised the manual of Ungewitter and published a new edition in 1890, where, for the first time a systematic use is made of the structural analysis to understand the mechanics of Gothic cathedrals and relate this to its architecture and construction. Many general building manuals contained a historical section with the description of buildings and procedures of the past, following the model of Rondelet and including the new analysis of Choisy, Durm, etc.; examples are [Breymann 1865], [Gottgetreu 1880–1888], and [Esselborn 1908]. The monographs on architectural styles also made evident the interest in constructive descriptions, such as [Egle1905].

Another thread for the History of Construction is to be found in the general histories of technology, in which there were always chapters or sections dedicated to building and civil engineering. The interest in the history of engineering begins already in the second half of the nineteenth century, but the naissance of the History of Technology as an independent discipline occurs at the beginning of the twentieth century [Stummvoll 1975]. Construction was considered a part of technology and received attention in correspondingly. For example, Neuburger dedicates some chapters to it in *Die Technik des Altertums* [1919], and in the *History of Technology*, edited by Charles Singer et al. [1954–58], chapters on building are found in each of the historical periods considered. The same occurs in the bibliographies of the History of Technology: [Fergusson 1968] and [Russo 1969] contained corresponding entries.

The interest in Construction History diminished abruptly with the advent of Modern Architecture in the first quarter of the twentieth century. It was not a mere change of “style”; the whole process of construction was changed. The old tradition of building with masonry and wood—wall and vault structures—which
had dominated for millennia, came suddenly to an end, as did the academic or theoretical interest in studying this kind of construction. Of course, there was some inertia: some professors in the universities continued teaching traditional methods of construction; some architects continued building in historical architectural styles; some books were published (for example, [Hess 1943] and [Thunnissen 1950] but few cared. These kinds of works were considered out of date and were simply ignored (and this may be easily appreciated by reviewing the contents of architectural journals between, say, 1900 and 1940). A renewal of the interest may be observed in the 1950s, mainly due to the archaeologists. The great works on Roman construction of Blake [1947, 1957, 1973] and Lugli [1957] constituted a turning point. But a perusal of the published literature also shows a proliferation of particular studies on Construction History.

Construction History began to be considered as an independent field in the 1980s. In England in 1985 the Construction History Society was founded, which publishes the Construction History Journal. Some interest was apparent also in the United States: in 1987 within the Society of the History of Technology the “Building Technology and Civil Engineering Interest Group” was established, which published a newsletter entitled The Flying Buttress (the group disbanded at the end of the 1990s.) However, these were isolated initiatives, and though the number of related publications grow almost exponentially, there was no feeling of working in a common field: the articles were published in journals and congresses of architecture, engineering, medieval history, Asiatic studies, archaeology, etc. Construction History has not yet reached the status of an internationally recognized discipline. There are no university courses or departments; even the keyword does not exist, making bibliographic research difficult.

The teaching of Construction from the 1900-1920s to the 1990s in Madrid

The manuals of building construction cited above formed the basis for the teaching of construction in the School of Madrid at the beginning of the twentieth century. This may be demonstrated by the presence of the books in the school library, but an unexpected source is necessary to see this influence. Luis Moya (a famous Spanish architect between the 1940s and the 1970s) was a young and diligent student in the 1920s and attended the lectures on Building Construction given by the architect Carlos Gato, professor of this discipline. The notebook with notes and drawings taken by the young Luis Moya during these lectures has survived and was published by the School of Madrid in 1993.
In Moya’s notebook, the source of almost every drawing can be traced back to the books by Viollet-le-Duc, Choisy, Ungewitter, Egle, Breymann, Esselborn, etc. Some pages of the manuscript are reproduced in Fig. 4. The drawings of Choisy [1873] are easily recognizable as is the false hypothesis of Piranesi concerning the dome of the Pantheon; the other drawings pertained also to Choisy [1883].

Leopoldo Torres Balbás, a young professor in the 1920s, also revived the study of the theories of Gothic construction. His first contribution, in 1920, had the interesting title “On how a theory of Construction History evolves”; this is the first time that the term Construction History (historia de la construcción) appears in Spain. Others articles by Torres Balbás followed [1935; 1939; 1945; 1946]. Torres Balbás tracked the origin of medieval ribbed vaults to Roman and Arabic architecture; he used constructive arguments to propose an alternative to
the French theories. In the 1940s the study of the traditional building methods still formed a part of the teaching in the School of Architecture of Madrid: the manuscript of the lectures of Rafael Fernández Huidobro (chair of Building Construction) showed the unmistakable influence of Viollet-le-Duc, Choisy, etc. (Fig. 5). This was perhaps logical in Spain in the 1940s: during the first decades of the dictatorship of Franco, modern architecture, as any progressive or modern idea, was regarded with suspicion. Political reasons were mingled with the sustained interest in understanding the buildings of the past.

The proof that a genuine interest existed is found in the lectures of Fernández Huidobro thirty years later, in the 1970s. By then the core of the teaching was modern building and structural types—the conventional skeletal construction in steel and concrete, but the membranes and shells, hanging roofs, geodesic domes, etc., as well. But Fernández Huidobro continued to lecture on the construction of Roman and Gothic vaults, the behavior of masonry arches, stereotomy, the
origins of the horseshoe-shaped arch and the structure of the Mosque in Córdoba.

The interest in explaining the architecture of the past by means of constructive reasoning was still alive. I was fortunate to attend some his lectures before his retirement at the end of the 1970s, and still remember the vivid impression that this approach made on me.

Fig. 6. Some pages of the lectures on Building Construction by Fernández Huidobro in the 1970. From [Fernández Huidobro 1972]

In the 1980s a diffuse interest in Construction History existed in the School of Architecture of Madrid; attention was paid to the work being done in Europe, but the old interest and the curiosity was also alive. Sometimes there was a mixture with the interest on aspects of restoration, one of the useful applications of Construction History. One example is the course organized by Mas-Guindal [1987] for the Architectural Association of Madrid with the title Mecánica y tecnología de los edificios antiguos (Mechanics and technology of historical buildings). Though the course mainly addressed the problems of restoration, some of the contributions had a marked emphasis on Construction History problems. There were other signs of a new awareness of Construction History topics: some dissertations were read [Sánchez Pro 1980]; [Pérez Arroyo 1980];
[Cervera Bravo 1982]; [Huerta 1990] (Pérez Arroyo, Cervera Bravo, and Huerta were supervised by R. Aroca) and the Associations of Architects and Technical Architects (Colegios de Arquitectos y Arquitectos Técnicos) published numerous facsimiles of the most important Spanish architectural treatises. In the first half of the 1990s, simultaneously but independently of the establishing of the SEHC, some specific books on Construction History, were also published ([González Moreno-Navarro 1993]; [Ortega Andrade 1993–1998]; [Castro Villalba 1995]).

Conclusion
In conclusion, the interest in Construction History in the School of Madrid can be traced back through the last 100 years. The situation may have been similar in other architecture and engineering schools in Spain. It was the permanence of the ideas of late nineteenth century that made the constructive approach interesting. Without this interest, it would have been impossible to obtain the support to promote and diffuse Construction History in the 1990s with success.

The first steps counted with the impulse of novelty. Now the task is to consolidate what has been done and, particularly, to promote a university status for Construction History, at the same level as the History of Architecture or the History of Science.

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