Building Techniques in Architectural Treatises: Construction Practices versus Technical Writings - Introduction

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BUILDING TECHNIQUES IN ARCHITECTURAL TREATISES: CONSTRUCTION PRACTICES *VERSUS* TECHNICAL WRITINGS

Thematic collection edited
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INTRODUCTION

The articles collected in this volume are in part the result of a conference on *Les techniques constructives dans les écrits d'architecture entre Italie, France et anciens Pays-Bas (XVI^e – début XVIII^e siècle)*, held in Brussels and Namur in February 2015.[1] The conference addressed the complex relationship between construction practices and architectural theory in the early modern period. The paper presentations and roundtable discussions were organised along three main themes. The first theme examined potential connections between technical passages in architectural treatises on the one hand and actual building practices on the other. To properly understand the contents of a technical text, however, one must also take into consideration its literary aspects, and these were dealt with in the other two themes, which concentrated on the rhetoric that is inherent in technical writings, and on issues raised by the international circulation, translation and adaptation of treatises on construction techniques. The present collection of articles is dedicated to the first theme, the thorny and often elusive connection between writing and building. The literary aspects of the texts will form the subject of a second group of articles in a later issue of this journal.

The aim of the conference was not to attempt a systematic survey of the countless modes of contact between technical writings and building traditions, but rather, through selected case studies, to raise a number of historiographical questions and suggest a few directions for future research. In accordance with this aim, three contributions first presented at the conference (Pier Nicola Pagliara, Francesco Benelli, Hubertus Günther) have here been complemented with two newly commissioned essays on related topics (Gianluca Belli, Sara Galletti), so as to bring out the complexity of the subject and the manifold ways in which it can be

1 For more information on this conference, see: http://gemca.fltr.ucl.ac.be/php/evenements/20150227.php.

approached, situated as it is at the crossroads of several disciplines – not just architectural history and construction history, but also philology and history of science.

The scholarly literature on the architectural treatises of the Renaissance is admittedly vast already.[2] It offers thorough analyses of the cultural, political and epistemological aspects of this literary genre, addressing crucial issues such as the relationship with antique texts; the novelty of a theory-based approach in comparison with medieval practice; the impact of the printing revolution on the circulation of architectural forms and theories; the education of their authors, their communication strategies and readership; and the self-representation of their princely patrons.[3] Furthermore, in recent years, construction history, too, has developed into a flourishing field of study – witness, among other initiatives,[4] the recent foundation of this journal.

Even so, the potential connections between architectural theory and construction history remain comparatively under-researched.[5] One reason for this relative neglect is that the current state of research does

2 This is not the place for an exhaustive bibliography on the subject. Two essential works in the francophone literature are Jean Guillaume, ed., *Les traités d'architecture de la Renaissance. Actes du colloque tenu à Tours du 1 au 11 Juillet 1981*, Paris, Picard, 1988; Yves Pauwels, Frédérique Lemerle, *Architectures de papier. La France et l'Europe (XVI^e^-XVII^e^ siècles)*, Turnhout, Brepols, 2013.

3 See, among many others: Pier Nicola Pagliara, "Vitruvio da testo a canone," in Salvatore Settis, ed., *Memoria dell'antico nell'arte italiana. 3: Dalla tradizione all'archeologia*, Torino, Einaudi, 1986, p. 5-85; Mario Carpo, *L'architettura dell'età della stampa. Oralità, scrittura, libro stampato e riproduzione meccanica dell'immagine nella storia delle teorie architettoniche*, Milano, Jaca Book, 1998; Joseph Rykwert, "On the Oral transmission of Architectural Theory," in Jean Guillaume, op. cit., p. 31-48; Berthold Hub, "Persuasive Wort-Bild-Strategien in den Architekturtraktaten der italienischen Frührenaissance," in Franz X. Eder et al., eds., *Bilder in historischen Diskursen, Interdisziplinäre Diskursforschung*, Wiesbaden, Springer, 2014, p. 111-144.

4 Most notably the International Congress on Construction History, held in Madrid (2003), Cambridge (2006), Cottbus (2009), Paris (2012) and Chicago (2015); the Congrès francophone d'Histoire de la Construction, held in Paris (2008), Lyon (2014) and Nantes (2017); and the resulting publications.

5 Seminal studies on these connections are Roberto Gargiani, *Princìpi e costruzione nell'architettura italiana del quattrocento*, Roma, Laterza, 2003; Hans W. Hubert, "In der Werkstatt Filaretes: Bemerkungen zur Praxis des Architekturzeichnens in der Renaissance," *Mitteilungen des Kunsthistorisches Institutes in Florenz*, 47 (2003), 2004, p. 311-344; Pier Nicola Pagliara, "Costruzione e strutture nel *De re aedificatoria*," in Massimo Bulgarelli, Arturo Calzona, eds., *Leon Battista Alberti e l'architettura*, Milano, Silvana editoriale, 2006, p. 170-177.

not permit a systematic confrontation of written information, which is often scarce, with built architecture – not even in the case of individual authors or specific techniques.[6] Evidence from building archaeology (*Bauforschung*) is still too scattered to enable comparative surveys of different building traditions. Moreover, systematic studies of the technical contents of architectural treatises are also sparse. Meanwhile, a more general approach to the subject, albeit from a different perspective, is available within the domain of the history of science,[7] and more recently also within the field of *Wissensgeschichte der Architektur*, which is "dedicated to investigating the knowledge involved in architectural achievements."[8]

This historiographical situation seems to be due in large part to a dichotomy inherent in the subject. Scholars of communication theory and media studies know that the characteristics of a medium of communication have an important influence on the dissemination of knowledge over space and time. Harold Innis's distinction between space-biased and time-biased media seems particularly relevant here.[9]

6 Studies of specific techniques (such as stereotomy) or specific aspects (such as the knowledge of mechanics underlying construction) are currently flourishing, but in other cases general conclusions are difficult to make because both written sources and systematic archaeological surveys are scarce. In the case of Andrea Palladio, for example, the link between his technical writings and his built works has been accurately studied only for particular architectural elements; see Mario Piana, "Il motivo costruttivo dell'architrave tripartito in Andrea Palladio: fonti e modelli," in Franco Barbieri, Donata Battilotti, eds., *Palladio 1508-2008. Il simposio del quadricentenario*, Venezia, Marsilio, 2008, p. 175-181.

7 See, for example: Pamela O. Long: *Openness, Secrecy, Authorship. Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*, Baltimore, The John Hopkins University Press, 2001; Id., *Artisan / Practitioners and the Rise of the New Sciences, 1400-1600*, Corvallis, Oregon State University Press, 2011; and, specifically for northern Europe: Pamela H. Smith, *The Body of the Artisan. Art and Experience in the Scientific Revolution*, Chicago, University of Chicago Press, 2004.

8 Claudia Bühring, Elisabeth Kieven, Jürgen Renn, Hermann Schlimme, "Towards an Epistemic History of Architecture," in Hermann Schlimme, ed., *Practice and Science in Early Modern Italian Buildings. Towards an Epistemic History of Architecture*, Milano, Electa, 2006, p. 7. Also Hermann Schlimme, "Bauwissen im Italien der frühen Neuzeit," in Dagmar Holste, Jens Niebaum, Hermann Schlimme, eds., *Wissensgeschichte der Architektur. 3. Vom Mittelalter bis zur Frühen Neuzeit*, Max Planck research library for the history and development of knowledge, Edition Open Access, 2014, p. 90-367.

9 Harold A. Innis, *The Bias of Communication*, Toronto, University of Toronto Press, 1951. We owe this reference to Charles van den Heuvel, Bernhard Roosens, "Administration, engineers and communication under Charles V. The transformation of fortification in the Low Countries in the first half of the 16th century," in Angela Marino, ed., *Fortezze d'Europa. Forme, professioni e mestieri dell'architettura difensiva in Europa e nel Mediterraneo spagnolo*, Roma, Gangemi, 2003, p. 411.

Objects that are light, portable and easily transported over large distances (such as architectural treatises) are better suited to dissemination over space than over time. It therefore makes sense to study them "horizontally"; that is, to look at their dissemination across space, at a given period (synchronic). Conversely, things that are heavy, durable and difficult to move (such as buildings or construction practices) are better suited to dissemination over time than over space. These are therefore best studied "vertically"; that is, to look at their evolution through time, at a fixed place (diachronic). To some degree, this dichotomy applies also to the historiographies of architectural treatises and construction techniques. While architectural treatises are often studied horizontally (discussing their creation, circulation, translation, adaptation and impact), construction techniques are typically studied vertically, in a *longue durée* perspective. There are few horizontal studies that compare different construction practices in different regions at a given time. In this regard, the topic of this volume – the connection between writings on architecture and construction techniques – involves confronting the horizontal circulation, across space, of written knowledge with the vertical continuity, through time, of local building practices.

The general historiographical view is that the link between architectural writing and technical tradition is very weak, if not absent altogether. Although in some fields writing serves as an instrument to record technical data when these become too complex to memorize,[10] it is commonly accepted that in the field of architecture, as a rule, technical knowledge is not transmitted through writing,[11] and that technical skills circulate primarily through other channels, especially through direct experience on construction sites – as seems to be confirmed also, in the second half of the fifteenth century, by the scepticism about technical writing that is expressed in certain texts, such as the treatises of Filarete and Francesco di Giorgio.[12] Direct observation is indeed regarded as

10 See Mario Carpo, op. cit., p. 30; and Pamela O. Long, *Openess*, op. cit., p. 117-119, for the example of artillery manuals.

11 Compare with the comment of Mario Carpo (op. cit., p. 17) that "il libro stampato non è manifestamente né un materiale né una tecnica di costruzione, e neppure uno strumento di cantiere. Ma il cantiere non è il solo luogo in cui architettura e tecnica si incrociano".

12 For Filarete and Francesco di Giorgio, see the contributions of Sophie E. Wolf, "Bilder der Architektur im Traktat," and Caterina Cardamone, "'*Ancora nel fare si adatteranno meglio che con parole non si può dire*'. Sulle molteplici considerazioni epistemologiche nel Libro architettonico di Filarete," presented at the conference *Wege des Wissens in Kunst,*

indispensable for the acquisition and transmission of technical skills.[13] It seems self-evident, moreover, that know-how in matters of construction, being tied to local materials and long-term traditions, does not travel as easily as treatises. While we subscribe to the general outline of this view, we also believe that its core idea – that architectural forms and theoretical concepts circulate extensively through writing and printing, while technical skills are transmitted only via direct experience on building sites – should not be interpreted too strictly, because such a neat dichotomy would severely limit the study of the treatises' technical contents.[14]

Since in this historiography writing is not regarded as an appropriate vehicle for sharing technical information, technical treatises are discussed above all in terms of the rhetoric of the text and within the context of princely patronage, where they illuminate the mutual dependence between patron and technical expert.[15] But what are the authors writing about, then, when they write about construction techniques? Which technical subjects are suitable to delivering another message, to conveying the author's rhetorical intentions? Which topics enable an author to advertise his reliability, strengthen his authority and elevate his status? Which arguments are easier to transmit through writing then through drawing? What degree of detail is desirable in a technical exposition? How much generalisation is acceptable? How much attention did these technical passages receive from contemporaries? How were they read?

Architektur und scienza *des Humanismus*, Innsbruck, 14-15 April 2016; both will be included in the forthcoming second part of this publication.

13 On the value of experience in the early modern period, see Katharine Park, Lorraine Daston, eds., *The Cambridge History of Science. 3. Early Modern Science*, New York, Cambridge University Press, 2006, in particular Peter Dear, "The meaning of Experience," in Ibid., p. 106-131, and R.W. Serjeantson, "Proof and Persuasion," in Ibid., p. 132-175. For a recent case study of the transmission of knowledge, see Howard Burns, "The Lesson of Lorenzo: 'Kitchen Cabinets' and inter-class Friendships as Workshops for Innovation in Cinquecento Venice," lecture at the conference *Wege des Wissens…*, cit.

14 On the different modes of the circulation of knowledge, see Claudia Bühring, Elisabeth Kieven, Jürgen Renn, Hermann Schlimme, op. cit., p. 7; Pieter Martens, Dirk Van de Vijver, "Engineers and the Circulation of Knowledge in the Spanish Netherlands," in Sven Dupré, Bert de Munck, Werner Thomas, Geert Vanpaemel, eds., *Embattled Territory: The Circulation of Knowledge in the Spanish Netherlands*, Gent, Academia Press, p. 73-106; Krista De Jonge, Maarten Delbeke, "Across Borders: Architecture and Knowledge in the Seventeenth-Century Southern Low Countries," Ibid., p. 299-332.

15 Pamela O. Long, *Openess*, op. cit., p. 5, 103, 106.

When considering technical passages and their possible connections with actual construction practices, it might be useful to bear in mind that the relationship between writing and building can essentially occur in two ways: either the building comes first, or the writing comes first. When the writing postdates the building, it is descriptive. The text describes and codifies an existing practice; it says how something has been built in the past – in the recent past (for example, by the author himself), or in a more distant past (for example, in antiquity). When the writing predates the building, it is, *de facto*, prescriptive. The text says how something can be done in the future. Now, one way to look at an architectural treatise is as a device that turns description into prescription. In most architectural writings the technical passages are descriptive rather than prescriptive. But when a certain construction practice is put into words (and, *a fortiori*, when put into print), then this textual description has almost automatically, by virtue of its mere existence on paper, the tendency to become interpreted as a prescription, an *exemplum* or recipe for future use – and that regardless of its initial purpose. Therefore, when examining the contents of technical writings and their relationship with practice, it will be useful to distinguish the initial purpose of the text from its actual use or effect.

One complication is that the purpose of a text is difficult to evaluate without understanding its use of literary conventions and rhetorical schemes – aspects that will be addressed in our second group of articles. Another complication is that to understand the purpose of a technical passage its content must be situated within the context of current building practices – if only to assess the *absence* of information, which can be just as instructive as the content that *is* transmitted. Technical knowledge that is intentionally omitted or left unsaid gives an idea of what was taken as self-evident and thus provides crucial insights for an architectural *Wissensgeschichte*. Besides written descriptions, missing descriptions also shed light on the links between writing and construction practice.

As said, this collection of articles does not offer a systematic approach to the problem; nor does it intend to argue that there was a linear connection between technical writings and construction practices – it merely wants to explore possible modes of contact between the two. To do so, the case studies that follow investigate, as concretely as possible,

the relationship between writing and building by confronting selected texts with the material evidence of extant buildings.

Pier Nicola Pagliara continues an established research tradition by focussing on the technical arguments of a single treatise. He shows that Alberti's *De re aedificatoria* evinces a profound technical culture and thorough knowledge of construction practices. He also relates the use in different architectural contexts of certain techniques – *opus quadratum*, concrete vaults (*volte di getto*), polished bricks – to the circulation of the treatise, in which close observation of ancient techniques, experience from the building site and discussion with experts are brought into conversation with literary sources.

Gianluca Belli's study of Giuliano de Sangallo's vaults combines careful *Bauforschung* with an attentive reading of the available textual sources. His analysis illustrates Giuliano's sustained thinking about different techniques for constructing vaults with stucco decoration. Although concrete vaults (*volte di getto*) were common in Florence from the 1470s, this construction method was not discussed in treatises, with the exception of Alberti's *De re aedificatoria* (which however stems from a different context) and Vasari's *Vite* (1550). Yet this absence from the texts does not necessarily imply that their authors were disconnected from actual building practice. Their silence was possibly a deliberate choice motivated by the technical problems caused by this short-lived construction method.

Francesco Benelli's contribution, by contrast, illustrates an architect's attempt to bring literary description and construction practice closer together. His detailed analysis of Antonio da Sangallo the Younger's drawings and annotations of Vitruvius's description of ancient architecture shows how discrepancies between the ancient text and the visual evidence that was available to Antonio compelled him to make creative alterations to the antique models. However, the case of the Ionic capital shows that these slight adaptations must not be regarded as misunderstandings, but rather as deliberate efforts to bring Vitruvius's instructions and their inherent contradictions in line with the construction practices that Antonio knew so well.

Hubertus Günther discusses the French tradition of vaulting and its difference from the Italian tradition. In France vaults were usually built in carved stone, whereas in Italy they were mostly made of brick.

This helps explain why Italian theorists largely disregarded vaulting, while French writers, and especially Philibert de L'Orme[16], developed an extensive theory of vaulting, with a strong focus on the art of stereotomy. The case of the church of SS. Trinità dei Monti in Rome, which was vaulted "in the French manner", with stones imported from France, illustrates that contemporaries were well aware of these local specificities.

Sara Galletti continues this discussion and confronts the remarkable vaults designed by Philibert de L'Orme with the theory of stereotomy he expounded in his influential *Premier tome de l'architecture* (1567). By translating stone vaults into paper diagrams, de L'Orme undoubtedly codified his professional experience, but the correlation between his practice and his theory is not straightforward. De L'Orme's text is not a description of his own built œuvre, nor a set of instructions: going beyond actual practice, he attempts to theorize the construction method by deducing its underlying geometric principles.

Together these contributions make clear that there exist tangible, multifaceted connections between architectural writings on the one hand and construction practices and technical traditions on the other. Whether they concern the rapprochement of the art of building to a written culture that is far removed from the building site, the adaptation of an ancient treatise to modern praxis, or the translation of current practice into theory, these encounters operate in both directions, leaving their marks on the writings as well as the buildings. They deserve to be examined in all their complexity and offer remarkable prospects for further research.

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16 Editing a multilingual publication means making compromises between consistency and adherence to the different norms of each language. For the spelling of this name we have chosen to maintain the accepted usage in each language. Hence we adopt the form "de L'Orme" for texts in English and "De l'Orme" for texts in French.

Namur) for their help in co-organising the conference, and to Francesco Benelli (Alma Mater Studiorum, Università di Bologna), Krista De Jonge (KU Leuven) and Maarten Delbeke (ETH Zürich) for chairing the roundtable discussions. We are especially grateful to the editorial committee of *Aedificare* for their confidence in this project and in particular to Robert Carvais for his indefatigable assistance in preparing this publication. Above all, we extend our warmest thanks to the authors of the following articles, for it is they who deserve credit for having transformed our sketchy plan into solid writing.

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Construction Expertise in Leon Battista Alberti's *De re aedificatoria*

Already in the title of his treatise, *De re aedificatoria*, Alberti favours the art of building, which in Vitruvius's work was one of the *res* of architecture, its main material part. In fact, in Alberti's text, construction assumes a more important place than in Vitruvius's *De architectura*, or than in most of the new treatises of the fifteenth and sixteenth century. In short, Alberti proposes, above all, a structural system based on the innovative idea of the *ossatura*, or "skeleton," providing the necessary indications for how to achieve this, but he also gives detailed descriptions of technical processes, which testify to a full understanding of actual building practices.

When drafting his own text, Alberti relies upon the texts of countless Latin and Greek authors, particularly on the subject of all sorts of materials, from wood to stone, comparing these writings with his own deductions based on his careful examination of ancient and medieval artefacts and of the constructions of his time that had surpassed the ancients. He also consulted experts of all levels. His ideas on the construction and functioning of cupolas, and his astute understanding of the structure of the Pantheon, must in fact derive from Brunelleschi. Unknown craftsmen, on the other hand, must have suggested the abundant concrete observations to Alberti, such as the precautions that needed be taken to repair cracks in a floor, which can only have come from workmen who actually handled the materials. For, in the years in which he was writing, before 1452, Alberti did not yet have any practical experience on a building site.

Some of the solutions described and recommended in *De re aedificatoria*, from the use of bricks and the *opera isodoma* to conglomerate coffered vaults *all'antica*, were actually employed, especially in Rome, in the decades following the printed edition of the treatise. It remains uncertain, however, whether these applications derived exclusively from the treatise, or whether they were also the result of indications provided directly by the author or by his own built works. In any case, the constraints imposed by the local availability of materials and of

workers familiar with the required techniques remained decisive, even when the Albertian construction methods were well known.

Pier Nicola Pagliara
CISA Andrea Palladio, Vicenza

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"*Di getto*" and "*intagliate*" Vaults in the Work of Giuliano da Sangallo and in Renaissance Architectural Treatises

In the fourth chapter of his introduction to the *Lives*, Giorgio Vasari provides a detailed description of a technique employed for "*di getto*" vaults, which were widely used during antiquity. He credits Giuliano da Sangallo with reviving this technique, and with bringing it from Rome to Florence. Although these kinds of vaults had been used throughout the Middle Ages for building relatively simple structures, interest in them was really only sparked in the last decades of the fifteenth century, firstly among the circle around Alberti, and then thanks to Giuliano da Sangallo and Bramante. In Florence, this technique is already documented in the 1470s for building "in the antique manner" the dome of the tribune in the Santissima Annunziata. It then proceeded to become a more common practice than one might think. Giuliano, in particular, uses it in different contexts and with different methods, in some cases in connection with the stucco ornamentation of intradoses. Using white stucco to imitate marble became a popular practice in the second half of the fifteenth century, and Giuliano employed it on various occasions – directly applying it to intradoses, or realising stucco decorations together with the casting of concrete vaults through an impressed layer of mouldable material placed on the centrings. The analysis and direct observation of the vaults in Palazzo Scala, in Palazzo

Ximenes da Sangallo – where Giuliano and Antonio the Elder lived –, in the Villa at Poggio a Caiano, and in Palazzo della Rovere in Savona allow for a better understanding of the techniques used to create these structures and their decoration. It is astonishing, nevertheless, that Giuliano abandoned the technique that combined a structural shell with superficial ornamentation in a sole casting. Indeed, the wide central vault of Giuliano's Florentine residence features no decorations, and the stucco works in the even larger vault of the main hall in Poggio a Caiano were most likely produced only after the structural centrings had been dismantled. Technical problems related to the dimensions of the vaults were probably the reason for this separation between structure and ornamentation. Unsurprisingly, fifteenth- and sixteenth-century architectural treatises completely neglect the technique of the sole casting (*getto*), and in building site praxis only the casting of decorative works survives, connected to a more traditional structure in brick or stone.

Gianluca Belli
Università degli Studi di Firenze

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Antonio da Sangallo the Younger and the Making of the Ionic Capital

My paper seeks to show how Antonio da Sangallo the Younger's (Florence 1484 – Terni 1546) understanding and vision of Roman architecture was affected by his reading of Vitruvius's *De Architectura Libri Decem*. Antonio was already celebrated as the most Vitruvian architect of the first half of the sixteenth century by his peers, including Guillame Philandrier, whose opinion has been shared by historians up to the present day. Whereas Philandrier's statement is largely correct, at least from the point of view of Antonio's design process, one can argue that

the Florentine architect sometimes misunderstood Roman structures. During the Renaissance, most of the late Republican buildings described in the Roman treatise had already been destroyed, forcing Antonio to compare the text with the ruins available at the time – albeit mostly imperial, and therefore quite different. The discrepancy between the text and the visual evidence led Antonio to make intelligent, creative mistakes that gave him the wrong idea of Roman antiquity, while at the same time giving rise to an innovative mode of design. Through an analysis of Antonio's annotations (which are sometimes wonderful, unexpected descriptions of Roman architecture) and sketches drafted on the margins of the four editions of Vitruvius in his possession and through their comparison with some of his architectural drawings preserved in the Uffizi, my paper seeks to show how Antonio (mis)understood and described some major Roman monuments. Focusing on the specific case of the Ionic capital, I illustrate how Antonio interprets and sometimes – slightly but intentionally – modifies Vitruvius's rules, in order to bring them closer to contemporary construction practices.

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Philibert de L'Orme and the French Tradition of Vaulting

In his *Premier tome de l'architecture* (1567), Philibert de L'Orme mainly deals with two domains, which differ in terms of both subject matter and approach. The first concerns the classical orders, wherein de L'Orme transmits the doctrine developed in Italy based on the model of antiquity (especially Vitruvius) and presents himself as the one who introduced the

Renaissance in France. The second domain concerns vaulting, wherein de L'Orme takes up the tradition of French medieval architecture. He praises the contributions that French architects had made to vaulting techniques for several centuries and claims that the Italians had not mastered the field and had also failed to theorise it. Indeed, up to that point vaulting had barely been addressed in architectural theory, and later Italian theorists did not pay much attention to it either. However, de L'Orme's treatment of the subject enjoyed widespread success in France. After he had published the rules, a whole series of treatises specifically devoted to vaulting appeared.

In Italy, most vaults were built using brick, whereas in France carved stone was generally used. This was mainly due to the different geological conditions of the two countries. De L'Orme does not discuss the tectonics of the vaults any more than the Italian theorists. His main concern is stereotomy, the highly complex geometrical construction on which the stone carving of the vault is based. De L'Orme relies especially on the Romanesque spiral staircase of the Abbey of St. Gilles, which was very famous at the time. In my opinion, the statue of the architect in the Cathedral of Mainz indicates that the spiral staircase of St. Gilles, or at least its art of stone cutting, was already famous in the High Gothic. De L'Orme himself then built vaults using carved stone, and it subsequently became customary in French architecture to showcase such vaults, which ostentatiously display the difficult art of stone cutting with complex curvatures.

The first clear proof that vaulting was considered as a particular expertise of French architecture was the church of Santissima Trinità dei Monti in Rome, which was erected from 1502 for a French convent with money of the French Crown. The decoration of the interior walls followed the most modern Italian *all'antica* style, with an order of columns, but the vault and the whole clerestory were built in the Gothic style – indeed, the vault adopted the same design that was first used in 1264 in the Cathedral of Amiens.

Hubertus GÜNTHER
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From Stone to Paper. Philibert de L'Orme, the *Premier tome de l'architecture* (1567), and the Birth of Stereotomic Theory

The books that Philibert de L'Orme dedicates to stereotomy in his *Premier tome de l'architecture* (Paris, 1567) mark the beginning of a rich theoretical debate that engages architects and mathematicians alike through the eighteenth century. In France alone, more than a dozen stereotomy treatises centre on this debate, including the fundamental works of Gérard Desargues (*Brouillon projet*, 1640), Mathurin Jousse (*Le secret d'architecture*, 1642), and Amédée-François Frézier (*La théorie et la pratique de la coupe des pierres*, 1737–1739). By focusing on the geometry of solids, this body of literature made a crucial contribution to Gaspard Monge's theory of descriptive geometry (*Géométrie descriptive*, 1798), the branch of mathematics concerned with the two-dimensional representation of three-dimensional objects. De L'Orme's contribution to the history of stereotomy is twofold. As a designer, de L'Orme produced a number of extraordinary stereotomic vaults – such as the rampant trumpet vault of the Hôtel Bullioud in Lyon (1536), the ribbed dome of the Château d'Anet (1549–1552), and the floating staircase of the Tuileries Palace in Paris (after 1564, non-extant) – which exemplify the boundless possibilities of the practice. As a theoretician, he formalised the practice, disseminating it in printed text and drawings, thus turning what used to be ephemeral knowledge transmitted orally within the exclusive circles of initiated professionals into knowledge fixed on paper and potentially available to anyone well beyond the confines of the building trades. As de L'Orme wrote the *Premier tome* toward the end of his long career as a practitioner, historians generally agree that there is a close correspondence between the architect's theoretical work and his professional experience. Regarding the art of stereotomy more particularly, however, such a correlation is neither direct nor obvious. First, of the many stereotomic vaults that de L'Orme designed during the course of his career, only the trumpet vault of the king's cabinet in Anet is featured in the *Premier tome*. Furthermore, the book illustrates

a number of vaults that de L'Orme never executed in practice and some which he had no experience of, such as the *voûte en spirale*. In this essay, I explore the relation between de L'Orme's practice and theory of stereotomy in an attempt to complicate our understanding of the architect's choice of material for the treatise and to provide a more nuanced reading of his translation of stone vaults into paper diagrams.

Sara Galletti
Duke University

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PRÉSENTATION DES AUTEURS ET RÉSUMÉS

Caterina CARDAMONE et Pieter MARTENS, « Introduction »

Caterina Cardamone, architecte et historienne de l'architecture, a écrit sa thèse de doctorat à l'université de Florence sur la réception de l'architecture classique à Vienne au début du XX^e siècle. Ses recherches se concentrent sur l'écriture de la technique dans les traités italiens, notamment celui de Filarete. Elle a été chargée de cours à l'université catholique de Louvain et *Lehrbeauftragte* à l'Universität Trier.

Pieter Martens a obtenu un diplôme d'ingénieur-architecte à l'université de Leuven et s'est ensuite orienté vers l'histoire de l'architecture. Après son doctorat (2009), il a été chargé de recherches de la Research Foundation Flanders (FWO) et du Fonds de la recherche scientifique (FNRS). Ses travaux se concentrent sur l'architecture militaire, la guerre de siège et l'iconographie urbaine au XVI^e siècle.

Cette collection d'articles considère la relation complexe entre techniques de construction et traités d'architecture aux XV^e et XVI^e siècles. N'aspirant pas à offrir une approche systématique de ce sujet relativement peu étudié et situé au croisement de plusieurs disciplines, elle se propose plutôt de s'interroger, à travers des cas d'études qui confrontent les textes avec la réalité construite, sur les modes de contact potentiels entre écrire et bâtir.

Mots-clés : architecture, histoire de l'architecture, techniques de construction, traités d'architecture, écrire et bâtir

This collection of articles considers the complex relationship between building techniques and architectural treatises in the fifteenth and sixteenth centuries. Its aim is not to offer a systematic approach to this relatively little-studied subject, situated at the crossroads of several disciplines, but to present case studies which confront these texts with actual constructions, so as to raise questions about the potential modes of contact between writing and building.

Keywords: architecture, history of architecture, construction techniques, architectural treatises, writing and building

Pier Nicola Pagliara, « L'esperienza costruttiva nel *De re aedificatoria* di Leon Battista Alberti »

Pier Nicola Pagliara a enseigné l'histoire de l'architecture à Rome et à Milan puis il a été *visiting professor* à l'EPFL de Lausanne. Il a publié sur Vitruve, sur les antiquaires du XVI^e^ siècle, sur l'architecture, les techniques graphiques et constructives du XV^e^ et du XVI^e^ siècle, ainsi que sur le palais des tribunaux de Bramante. Il s'occupe des techniques de construction de l'Antiquité romaine et de la Renaissance.

Le *De re aedificatoria* de Leon Battista Alberti, basé sur l'observation critique de contructions antiques et modernes, est un des traités qui permet de vérifier combien ces œuvres ont influencé la pratique architecturale. À Rome, le traité favorise la diffusion d'une maçonnerie en pierre carrée, de voûtes en mortier, de briques et de parements soignés. L'architecture d'Alberti à Mantoue, en revanche, démontre combien la disponibilité sur place de matériaux nécessaires ou d'une main-d'œuvre spécifique permet le transfert des techniques d'un lieu à l'autre.

Mots-clés : architecture de la Renaissance, histoire de la construction, traités d'architecture, Leon Battista Alberti, *volte di getto*

Leon Battista Alberti's De re aedificatoria*, based on his own critical observation of ancient and modern constructions, is one of those treatises that allows one to verify how much these works have influenced architectural practice. In Rome, the treatise promoted the spread of dressed stone masonry, mortar vaults, and careful brickwork and facing. By contrast, Alberti's architecture in Mantua demonstrates how the availability of materials or of specific expertise affected the transfer of techniques from one place to another.*

Keywords : Renaissance architecture, history of construction, architectural treatises, Leon Battista Alberti, volte di getto

Gianluca Belli, « Volte di getto e volte "intagliate" nell'architettura di Giuliano da Sangallo e nei trattati rinascimentali »

Gianluca Belli est professeur associé d'histoire de l'architecture à l'université de Florence. Ses domaines de recherche concernent principalement l'architecture italienne du Quattrocento et du Cinquecento, en se focalisant souvent sur les aspects constructifs. Il a consacré plusieurs essais à l'histoire de la ville et à l'architecture plus récente, en particulier celle du XIX^e^ siècle.

Dans ses *Vies*, Vasari affirme que les *volte di getto* à l'*antica* avaient été redécouvertes par Giuliano da Sangallo. En effet, Giuliano les utilise à plusieurs reprises et selon différentes modalités, en les associant aussi à une décoration

en stuc de l'intrados. Dans certains cas, cette décoration est réalisée en même temps que la voûte à l'aide de matrices modelées par estampage. Cette technique innovante sera par la suite abandonnée, laissant de faibles traces dans les traités et dans les chantiers postérieurs.

Mots-clés : histoire de l'architecture, histoire des techniques de construction, Renaissance, Giuliano da Sangallo, *volte di getto*

Vasari affirms in his Lives *that Giuliano da Sangallo rediscovered the* volte di getto all'antica*. Giuliano uses them on several occasions and in different ways, sometimes alongside stucco decorations on the intradoses. This decoration is sometimes carried out together with the vaults, using stamped moulds. This innovative technique was subsequently abandoned, and left few traces in written treatises or later projects.*

Keywords: history of architecture, history of construction techniques, Renaissance, Giuliano da Sangallo, volte di getto

Francesco Benelli, « Antonio da Sangallo the Younger and the Making of the Ionic Capital »

Francesco Benelli est professeur associé à l'université de Bologne. Il a étudié l'architecture à Rome et a soutenu sa thèse de doctorat en histoire de l'architecture à Venise. Il a publié sur l'architecture de la Renaissance et du Moyen Âge. Il travaille dans le domaine des *digital humanities* comme directeur d'un projet sur Sebastiano Serlio. Ses recherches se concentrent actuellement sur Antonio da Sangallo le Jeune.

Cet essai se focalise sur la méthode utilisée par Antonio da Sangallo le Jeune dans l'étude et le dessin du chapiteau ionique selon les règles du troisième livre du *De Architectura*. En analysant les annotations et les dessins d'Antonio, plusieurs questions se posent : quel usage peut être fait du traité dans l'architecture bâtie ? Que manque-t-il dans le texte pour parvenir à construire et qu'est-ce que le maître d'œuvre peut faire pour pallier ces lacunes ? Que signifie réellement être un architecte vitruvien ?

Mots-clés : architecture de la Renaissance, histoire de la construction, Antonio da Sangallo le Jeune, chapiteau ionique, vitruvianisme

This paper focuses on the way Antonio da Sangallo the Younger studies and designs the Ionic capital according to the rules recorded in the third book of the De Architectura*. The analysis of Antonio's annotations and drawings raises several questions. How much of the contents of the treatise could be transformed into real architecture? What was missing in the text, and what could the architect do to fill the gap? What did it really mean to be a Vitruvian architect?*

Keywords: Renaissance architecture, history of construction, Antonio da Sangallo the Younger, Ionic capital, Vitruvianism

Hubertus GÜNTHER, « Philibert De l'Orme and the French Tradition of Vaulting »

Hubertus Günther fut titulaire de la chaire d'histoire de l'art et de l'architecture pour la période moderne à l'université de Zurich. Après avoir obtenu l'éméritat, il a enseigné à l'université de Munich. Ses principaux domaines de recherches portent sur l'architecture, l'urbanisme, la théorie architecturale et l'étude de l'Antiquité à la Renaissance.

Dans son *Premier tome de l'architecture*, Philibert De l'Orme traite principalement de deux domaines, très différents. D'un côté, il diffuse la doctrine des ordres développée en Italie pendant la Renaissance, de l'autre, il explique la tradition médiévale française de construction des voûtes et il la propose comme propriété nationale reconnue dans tous les pays du Nord des Alpes. Après lui, l'architecture française mettra souvent en évidence, avec ostentation, les difficultés liées à la taille des pierres.

Mots-clés : histoire de l'architecture, histoire de la construction, stéréotomie, Philibert De l'Orme, Trinità dei Monti

Philibert de L'Orme in his Premier tome de l'architecture *mainly treats two domains, which differ in both subject matter and approach. He propagates the doctrine of the classical orders that had been developed in Italy during the Renaissance, and he explains the tradition of French medieval vaulting, commending it as a national property renowned in the countries north of the Alps. He took up the art of stereotomy also in his buildings; afterwards in French architecture vaults often ostentatiously display the difficult art of stone carving.*

Keywords: history of architecture, history of construction, stereotomy, Philibert de L'Orme, Trinità dei Monti

Sara GALLETTI, « From Stone to Paper. Philibert de L'Orme, the *Premier tome de l'architecture* (1567), and the Birth of Stereotomic Theory »

Sara Galletti est professeure associée d'histoire de l'architecture à Duke University. Ses recherches portent sur la théorie et la pratique architecturale en France au début de l'époque moderne. Elle a publié *Le Palais du Luxembourg de Marie de Médicis* (Paris, 2012). Elle travaille à deux livres : *Stereotomy: a*

Mediterranean History et *Practice into Theory: Philibert de L'Orme, the Premier tome de l'architecture (1567), and the Profession of Architecture in Early Modern France*.

Cet essai analyse la théorie stéréotomique de Philibert De l'Orme, publiée dans son *Premier tome de l'architecture* (Paris, 1567). Il se concentre sur la relation entre la pratique architecturale de Philibert De l 'Orme et sa théorie stéréotomique, en soulignant que cette relation n'est pas directe ni évidente. Cette compréhension du choix des contenus que De l 'Orme fait pour son traité permet une lecture plus nuancée de sa transcription des voûtes en pierre sous forme d'épures.

Mots-clés : architecture de la Renaissance, traités d'architecture, stéréotomie, géométrie, Philibert De l'Orme

This essay explores Philibert de L'Orme's theory of stereotomy, published in the Premier tome de l 'architecture *(Paris, 1567). It focuses on the relation between de L'Orme's practice and theory of stereotomy. It shows that this relation is neither direct nor obvious. By doing so it complicates the understanding of de L'Orme's choice of material for the treatise and provides a more nuanced reading of his translation of stone vaults into paper diagrams.*

Keywords: Renaissance architecture, architectural treatises, stereotomy, geometry, Philibert de L'Orme