ARCHITECTURE IN THE MAKING
AN ANALYSIS OF THE EMERGENCE OF REPRESENTATIONAL
CONVENTIONS IN ARCHITECTURAL DESIGN DURING THE 15TH and 16TH
CENTURY IN ROME IN THE CONTEXT OF THE CONSTRUCTION OF THE
NEW ST. PETER’S BASILICA

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ABSTRACT

The design and construction of buildings, the ‘making of architecture’, relies on the architects’ ability to graphically visualize their ideas using a variety of different media. Architects invent and refine artistic, spatial, and functional concepts through sketches, drawings, and models, hereby relying on personal artistic skills and preferences. In order to communicate their design intent, however, architects have to adhere to standards that define a graphical language that is shared and understood by others. In this essay, I discuss the possible origins and motivations leading to the emergence of orthogonal plan, elevation, section, and perspective illustration as standardized representational conventions that facilitate the communication of architectural design intent.

Architects used orthogonal drawings long before the sixteenth century, and perspective sketches and drawings were also part of their traditional representational repertoire. In this essay, I suggest that it was the necessity to survey and catalog ancient monuments in and around Rome in the late fifteenth century, and the need to manage St. Peter’s design and construction process in the sixteenth century that led to the refinement and acceptance of graphic conventions as representational standards for the building trades in Rome. The group of architects working under the direction of Bramante, Raphael, Peruzzi, Antonio da Sangallo the Younger, and Michelangelo established a de facto standard for the architectural practice that was then imitated throughout Europe. Five centuries later, these very same standards are still used by contemporary architects. The essay concludes with a discussion of potential changes to these
conventions motivated by the increased use of digital tools in the architectural design practice.
BIOGRAPHICAL SKETCH

The author was born in Brugg, Switzerland, on October 26, 1962. After living in Italy for some of his childhood years, he returned to Switzerland. He completed all of his primary education in Switzerland. After graduating from AKAD, he worked for several architectural firms and construction companies, where he found his vocation in Architecture. He attended the ‘Eidgenössische Technische Hochschule’ (ETH) in Zürich, and received his Diploma in Architecture in May 1993. While studying architecture, he developed a keen interest in design theory, architectural history, and digital media. After graduation he received a research fellowship from the ETH and worked at the chair for CAAD until July 1996. He came to Cornell University in August 1996 where he began work under Professor Donald Greenberg at the Program of Computer Graphics. He received his Master of Science in August 1998. He began this work under the guidance of Professors Mary N. Woods and D. Medina Lasansky in January 2000.
This work is dedicated to Janine.
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Thanks to Donald P. Greenberg and the Computer Graphics Lab at Cornell University. They gave me the opportunity to pursue my academic interests while working as a Research Associate in computer graphics, and teaching design studios in Rhodes Hall. It would have been impossible to manage my busy schedule without their continued support.

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Chapter 1

Introduction

1.1 Michelangelo & Co

In December of 1516, Michelangelo Buonarroti won the commission for the completion of the façade of San Lorenzo in Florence, the Medici church begun nearly one hundred years earlier by Filippo Brunelleschi. Giovanni de’ Medici, elected to Peter’s throne three years earlier as Leo X, intended to endow his native city with a monument worthy of his persona and resplendent of the Medici’s glory. Following Florentine tradition a competition was held among all
Florentine artists and architects of the time. Ultimately, and under suspicious circumstances, Michelangelo’s proposal prevailed.¹

Michelangelo had just returned from Rome, and was at the apogee of his artistic career as a sculptor and painter. With the work on San Lorenzo, and culminating with St. Peter’s, Michelangelo was about to cement his fame as an architect as well. The façade was the first of three major projects around San Lorenzo – the Medici Chapel and the Laurentian Library followed shortly thereafter.²

As a painter and sculptor Michelangelo had completed masterpieces such as the Pietà and the cycles of frescoes in the Sistine Chapel. However, unlike most of his colleagues, he never set up a permanent shop, a bottega, with assistants and apprentices, although, contrary to the myth, Michelangelo hardly ever worked alone.³ Unlike his previous projects, the highly ambitious design for the façade forced him to think and operate in different terms, or, as William Wallace has phrased it, to act more as “a building contractor than as a sculptor”.⁴

¹ The commission was jointly assigned to Michelangelo and Baccio d’Agnolo first in October 1516. The famous Florentine architect was to provide the architectural framework for the most acclaimed Florentine sculptor. However, Michelangelo, dissatisfied with Baccio’s work, persuaded Leo X to give him total control of the project by December of the same year. See William Wallace, in [Wallace94], pp. 9.

² The façade was never built, and the two other projects were not completed under Michelangelo’s direct supervision. For details about Michelangelo’s work on San Lorenzo described in this chapter refer to William E. Wallace’s book Michelangelo at San Lorenzo, [Wallace94].

³ Michelangelo did certainly not lack the ambition to complete his commissions on his own. Despite the efforts of his principal biographers to portray him as the solitary genius, he always worked with assistants. William Wallace reports two assistants for the quarrying of the marble of Julius’ tomb, five while casting the bronze for the statue of Julius II in Bologna, and thirteen that helped him paint the Sistine Chapel in Rome. The number of assistants increased dramatically as Michelangelo began his career as an architect. See William Wallace for more details.

⁴ Quoted from [Wallace94], p. 14.
After the final contract for the façade was stipulated in January 1518, Michelangelo set out to organize his *bottega* and to hire several assistants. Shortly thereafter, and as for nearly every sculptural project, he set off to the quarries of Seravezza, Pietrasanta, and Carrara. During the years from 1516 to 1520, he spent nearly a year and a half away from the construction site of San Lorenzo quarrying marble.5

Remarkably, nearly every assistant Michelangelo hired for the work on San Lorenzo was a relative, friend, neighbor, or an acquaintance of his immediate family.6 This familiarity helped him to recruit skilled labor, a difficult problem on Renaissance construction sites, where labor quality, reliability, and constancy was the exception rather than the rule.7 This careful selection process, based on thorough knowledge of the individual’s abilities, formed a closely knitted network of assistants that was to become a cornerstone of Michelangelo’s success as an architect.8

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5 Michelangelo needed plenty of stone for his façade. Although he left the day-to-day supervision to his on-site *capomastri* in the quarries, he wanted to be there personally, since he knew best where to look for the white marble – only the purest white marble was good enough for Michelangelo. See [Wallace94], p. 26, and pp. 70.

6 Michelangelo relied heavily upon acquaintances from his native Settignano to staff his *bottega* on *Via Mozza* in Florence, and on the advice of his immediate family, particularly his father and his brother Buonarroti.

7 For a detailed discussion of the Florentine construction industry during the Renaissance refer to Richard A. Goldthwaite’s book *The Building of Renaissance Florence. An economic and Social History*, [Goldthwaite80]. As Goldthwaite points out, the typical construction worker was a day laborer, paid a daily wage, and usually itinerant. Only skilled labor on major construction sites, usually in urban areas, could hope for a full-time employment the year around. See [Goldthwaite80], chapter six, pp. 287.

8 As Martin Wackernagel has pointed out, the employment of members of the immediate family or relatives was a long-standing tradition in artisans’ workshops throughout the Renaissance in Italy, providing stable and cheap labor for the painters and sculptors (see [Wackernagel38]). Although Michelangelo did not have a traditional *bottega*, he probably got acquainted with this tradition during his apprenticeship in Domenico Ghirlandaio’s workshop in Florence. The careful selection process of his assistants for San Lorenzo enabled him to tailor the group to his needs. His assistants usually worked with him for exceptionally long periods of time.
As most of his colleagues, Michelangelo worked on multiple projects simultaneously. He dealt with different clients, spent considerable time in the quarries, organized the work in his bottega, and supervised the construction of the façade. It was therefore critical for the successful realization of his artistic and architectural visions, to unambiguously and effectively communicate his intentions to his assistants. Michelangelo used to sketch ideas on paper, build simple models, and draw details on the walls and floor of his workshop. If necessary, his assistants would then build precise templates for the stonemasons and other craftsmen on the site, as was common practice throughout the Renaissance. However, most of the communication was probably verbal. Working closely with his assistants and knowing their individual skills, Michelangelo did not have to explain or supervise every detail of the work – he set the general directions, his assistants worked out and refined his ideas, and others executed them. Michelangelo & Co was an organizational structure that realized Michelangelo’s intentions effectively and expeditiously.

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Thus contributing to a constancy and continuation of Michelangelo’s work that enabled him to avoid the uncertainties and limitations of ad hoc employment of skilled workers once the construction was under way.

* It was general practice to draw directly on building surfaces on the construction site itself. Michelangelo was no exception as pointed out by the work of Paolo Dal Poggetto, in *I disegni murali di Michelangiolo e della sua scuola nella Sagrestia Nuova di San Lorenzo*, and discussed by [Parronchi79].

* Some of Michelangelo’s sketches for the work on San Lorenzo are illustrated in [Wallace94]. Michelangelo used to keep detailed records of the work and material in his bottega. These accounts list the names of the craftsmen, their activities, hours, and the material costs for the work on his workshop. It is through these accounts that it is possible to derive his modus operandi as an architect. See [Wallace94] for a detailed description. The bottega in Via Mozza does not exist anymore, but architectural drawings can be seen in San Lorenzo’s sacristy; for more details see [Parronchi79].

* Michelangelo reserved the work on the most important sculptural work for himself and, in exceptional cases, for some of his assistants.
Given the direct involvement of Michelangelo and his assistants in the construction process, there was no extensive need for detailed and precise drawings or models of the façade’s many architectural features. Throughout the work on San Lorenzo Michelangelo relied on this modus operandi to organize the work on the construction site.

Michelangelo never completed the San Lorenzo projects. Political events forced him to move to Rome, where he established his permanent residence. The San Lorenzo projects were also relatively small compared to his later work in Rome. Michelangelo’s careful selection of assistants was unique, and they worked with him for extended periods. In Florence, he could afford to work on other projects as well as leave the construction site quite frequently. Larger projects, such as St. Peter’s in Rome, with its extensive bureaucracy, the frequent changes in architects, and, at times, hundreds of workers on the site, could not be managed with such a system. The architects’ intentions needed to be codified in drawings and models well before construction began. Most importantly, this had to be done in a systematic way, adhering to conventions comprehensible to other craftsmen as well as to the fabbrica’s administrators. Verbal explanations and

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12 It was common practice for architects to present their intentions to the clients with refined models and renderings, as well as to elaborate complex designs on paper or with models. For example, drawings and models were requested for the competition of San Lorenzo’s façade. However, there was no need for complete and detailed construction documentation as it is commonly used in the contemporary architectural practice.

13 As described in the following chapters, the San Lorenzo projects were of a different magnitude compared with his later work on St. Peter’s in Rome. For example, there was no extensive bureaucracy with decisional authority and control of the construction site. In San Lorenzo Michelangelo managed the site and kept the books himself (at least during the first year). He had to seek approval for his design decisions from the pope, but he did not have to overcome the (often intransigent) opposition of other, intermediate administrative figures as in Rome.
sketches were not enough to ensure the correct execution of the architects’ intentions – the designers were required to provide detailed and dimensionally correct drawings. This was a significantly different approach from the one used by Michelangelo & Co in Florence. This essay is an inquiry into the roots of these changing practices. It describes the emergence and development of architectural representational conventions during the archeological surveys and excavations in and around Rome of the late fifteenth century, and it exemplifies their standardization in the context of the design and construction of the new Basilica of St. Peter’s in Rome in the sixteenth century.

1.2 Essay Structure

Architectural design is a goal-oriented endeavor. Architects use a variety of tools and media, develop and adhere to established conventions because they assist them in exploring and achieving their design intentions. While there are always opportunities for personal artistic explorations and inventions, there are usually stringent economic constraints that limit the potential outcome of design projects. Architects have therefore to strike a balance between their personal artistic and architectural ambitions and the clients’ interests to carry them out. In the following chapters, I investigate the emergence of representational conventions by emphasizing these process and goal-oriented aspects. In chapter two, I give a brief overview of the vast literature published on this subject. It is followed, in chapter three, by a discussion of some of the aspects of St. Peter’s history relevant to this work, beginning with the restorative interventions on the
Constantinian Basilica during the papacy of Nicholas V (1447-55) by Bernardo Rossellino and Leon Battista Alberti. Chapter four describes the architectural design practice in the fifteenth and sixteenth centuries, illustrating the traditional representational methods and media that were used by the architects working on the Basilica. The group of artists and architects working in Rome at the beginning of the sixteenth century was confronted with a variety of difficult tasks, among them the constructions around St. Peter’s, and the archeological survey of Rome’s antique monuments. Numerous members of this group were involved in both endeavors. They discussed methods, and experimented with technologies, that could help them to solve the problems at hand. The need for a set of generally accepted methods of representation arose in this unique environment. Chapter five discusses the emergence of the orthogonal plan, elevation, and section as the predominant representational methods used for the archeological surveys. It also exemplifies their gradual acceptance in the work of the group of architects designing the new Basilica. The standardization of these representational methods is interpreted as a response to the increasingly bureaucratic structure of its fabbrica, which created the need for a shared graphical language. Chapter six summarizes and discusses the impact of these standardized conventions, and it concludes the essay with an outlook on future work.
Chapter 2

Literature Survey

Any work of historical synthesis requires the imposition of an organization on the material, in order to make the extensive accumulation of information comprehensible, and to organize it consistently. In this chapter I survey the source material for this essay. It is subdivided into three sections: (1) Renaissance and Baroque history and architecture, (2) the history of St. Peter’s in Rome, and (3) publications on the methods and media used for architectural design during this period. For each category I identified one or two main publications that served as springboard for the in-depth investigation through their references. The Bibliography lists all publications consulted for this work.
2.1 Renaissance and Baroque History and Architecture

There are innumerable publications on the issues regarding Renaissance history and architecture. I used two introductory texts: Ludwig Heydenreich’s *Architecture in Italy, 1400 to 1600* [Heydenreich74], and Wolfgang Lotz’s *Architecture in Italy: 1500 – 1600* [Lotz74/95]. With Jacob Burckhardt, [Burckhardt85], they introduced me to the subject, and they provided a wealth of references. The essays in James S. Ackerman’s collection, *Distance Points: Essays in Theory and Renaissance Art and Architecture* [Ackerman91], particularly his *Architectural Practice in the Italian Renaissance*, have helped in structuring my work. His suggestion of dividing the field of study of the Renaissance in three distinct parts: Brunelleschi and Alberti, the High Renaissance (or Roman Renaissance), and the Renaissance of the later sixteenth century, permeates the structure of the following chapters.

Richard Goldthwaite’s account, *The Building of Renaissance Florence*, provides insights into the economic, political, and cultural settings of Florence. Given that most of the artists and architects discussed in this essay are of Florentine origin makes his work the more important. Goldthwaite sets Florence’s building industry in a wider economic context, emphasizing the motivations and constraints imposed upon prospective owners and their architects. His chapter on the practice of architecture, which has complemented Spiro Kostof’s *The Architect*, [Kostof77], outlines the emergence of the architect as a professional figure. Kostof’s book is a collection of essays, each of which illustrates some aspects of the architecture and the architects of
a particular period. However, unlike Goldthwaite, it does not provide an economic and political framework as a background to the individual accounts.

Michael Baxandall’s *Painting & Experience in Fifteenth-Century Italy*, [Baxandall80], as well as Martin Wackernagel’s *The World of the Florentine Renaissance Artist*, [Wackernagel38], has provided a more general insight into the organization of the artists’ workshops, their learning of artistic and technical skills, and their relationship to the commercial practice of painting in Renaissance Florence. Given the importance of these aspects for the architectural practice of the time, it is surprising that, even after fifty years, Wackernagel’s book is still the only comprehensive survey of these issues.

The individual artists and architects have also been studied by defining a key publication from which to follow the references for a more in-depth investigation. Joseph Rykwert and Anne Engel’s catalog for the 1994 exhibition on Leon Battista Alberti, [Rykwert94], offers a good insight into Alberti’s multi-faceted life. Alberti’s *De Re Aedificatoria*, in Giovanni Orlandi’s translation, [Alberti66] and [Alberti89], outlines the canon that artists and architects were supposed to follow. Alberti’s architectural representational conventions, especially his opinions on the use of perspective by architects, inform the discussion throughout the essay. References to Filippo Brunelleschi and Bernardo Rossellino are to be found in different papers and articles listed in the Bibliography. Brunelleschi’s invention of linear perspective, as well as Alberti’s contributions to its diffusion, and its impact on painting and architecture are discussed by Martin Kemp in his *The Science of Art*, [Kemp90], and in Judith Field’s *The Invention of Infinity*, [Field97]. Other articles on the
impact of perspective are mentioned in the notes throughout the text, and are listed in the Bibliography.

Franz Graf Wolff von Metternich, in [Metternich75], and Franco Borsi, in [Borsi89], describe Bramante’s tenure as chief architect of St. Peter’s extensively. References to Bramante’s work, and particularly to that of his successors are dispersed throughout this essay.

Raphael’s work is discussed by Christoph Frommel, Stefano Ray, and Manfredo Tafuri in Raffaello architetto, [Frommel84], and in Carlo Pedretti’s book Raphael, [Pedretti89], by Stefano Ray, in [Ray74], and by Micaela Sambucco, [Sambucco87], again through articles by Ray and others. Raphael’s letter to Leo X, which is important for the understanding of his methodology for the representation of architecture, is described by Christof Thoenes in [Thoenes86]. Arnold Nesselrath, in [Nesselrath86], discusses Raphael’s archeological method. Wolfgang Lotz investigates similar notions as well in his article Das Raumbild in der Italienischen Architekturzeichnung der Renaissance, published in [Lotz77]. Lotz’s hypotheses on the evolution of the representational conventions are discussed in chapters four and five.

Christof Frommel, in [Frommel94], and Heinrich Wurm in his anthology, [Wurm84], illustrate the work by Baldassarre Peruzzi and Antonio da Sangallo the Younger.

The literature on Michelangelo is as vast as the literature on the Renaissance. The notions on his work for the Basilica have been distilled from various sources, since there is not one single publication totally devoted to his tenure as chief architect of St. Peter’s. Howard Saalman’s Michelangelo at St.
Peter’s, [Saalman78], and particularly William Wallace’s *Michelangelo at San Lorenzo*, [Wallace94], were used as the key sources for the investigation of the work by Michelangelo and his assistants. Wallace’s description of Michelangelo’s workshop organization in Florence is important for his tenure as chief architect of St. Peter’s. Wallace’s research sheds new light onto Michelangelo as an artist and entrepreneur. His findings portray an artist who surrounded himself with capable assistants. Only with their help was he able to complete his many masterpieces – a contradiction to Michelangelo’s traditional biographers, which portrayed him as a solitary genius. Frederick Hartt collects Michelangelo’s drawings in his anthology and was used a reference for his architectural sketches and drawings [Hartt70].

### 2.2 The History of St. Peter’s in Rome

The design and construction of the new Basilica of St. Peter’s lasted for approximately 200 years.\(^{14}\) The historical framework outlined in this essay has been condensed from six publications: Christof Frommel’s *San Pietro*, [Frommel94] (in [Millon94]), gives a comprehensive overview of the first two phases considered in this essay: Alberti and Rossellino’s interventions, and the works of Bramante, Raphael and his successors. In *Il cantiere di S. Pietro prima*

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\(^{14}\) The duration depends on the definition of what is part of the Basilica. The end of Bernini’s tenure in 1680 is also the end of the phase of interest for this essay. Considering the last major interventions on the Vatican complex, around 1934, the duration would be approximately 500 years. See Alberto Carlo Carpiceci, in [Carpiceci83], for more information on the complete building history.
di Michelangelo, Christoph Frommel describes the organization and institutionalization of the fabbrica with pope Leo X, [Frommel91]. Franz Metternich gives a detailed overview of the extant material on the Basilica in [Metternich72]. Together with Christof Thoenes, Metternich also outlines the early designs for the Basilica (until the work of Bramante), in [Metternich87], as well as in [Metternich75]. Alberto Carlo Carpiceci, in [Carpiceci83], describes the Basilica’s innumerable design and construction variations – his collection of graphical illustrations is a good introduction to the topic.

2.3 Design Techniques and Media

Most architects from Alberti to Borromini were trained as artists or craftsmen. Notions on how they developed their architectural ideas, and the techniques they used to represent them graphically, can therefore be derived to a certain degree from the research on painting and sculpting. Carmen Bambach’s Drawing and Painting in the Italian Renaissance workshop, [Bambach99], is an excellent introduction to the organization of the painters’ workshops as well as the methods used for fresco painting. Her findings, in combination with Rudolf Wittkower’s Sculpture, Process and Principles, [Wittkower77], demonstrate that the Renaissance painters and sculptors were not only talented artists - they were also excellent organizers and managers of large-scale workshops. It would have been impossible for them to create a

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15 See Richard Goldthwaite, in [Goldthwaite80], chapter seven, pp. 351, and Spiro Kostof, in [Kostof77], chapters three through five.
large number of masterpieces without the organized help of assistants, and the optimization of their production techniques. Articles by William MacDonald, Spiro Kostof, Leopold Ettlinger, and Catherine Wilkinson (Zerner), collected in [Kostof77], give an overview of the evolution of these methods in architecture.

Roland Recht, in his *Le dessin d’architecture*, [Recht95], compares the medieval architectural representation methods to those following later, particularly those developed from Brunelleschi and Alberti onwards. Recht exemplifies these differences effectively by comparing the drawings of Gothic master builders from northern Europe; for example, the elevation of the west façade of the cathedral in Reims, with drawings from the Italian Renaissance like the elevation of the Campanile of Santa Maria del Fiore in Florence (attributed to Giotto’s workshop). Recht emphasizes that the differing representational methods are probably a consequence of the artists’ different backgrounds. Hubertus Günther, in his *Das Studium der antiken Architektur in den Zeichnungen der Hochrenaissance*, [Günther88], provides insight into the evolution of the representational methods, particularly their emergence during the early archeological work in the second half of the fifteenth century in Rome and its surroundings.

Anthologies by Franz Metternich, [Metternich72], or Heinrich Wurm, [Wurm84], were essential for the analysis of the extant corpus of drawings. Christoph Frommel discusses the evolution of architectural drawings, with examples from the work on the Basilica, in his article *Sulla nascita del disegno*
architettonico, in [Millon94]. This article became the starting point for all further investigations outlined in this essay.

As for drawings, the use of plastic models is an old tradition in architectural practice. In many cases, architects had to provide models for their clients in order to win a commission, since the models’ inherent three-dimensionality made it easier for the laymen to understand the architects’ intentions. Henry Millon discusses the emergence of these architectural models in his article *I modelli architettonici nel Rinascimento*, in [Millon94]. Although centered on the models for Renaissance architecture, Millon’s article lists numerous references to previous use of architectural models. Ludwig Heydenreich’s and Martin Brigg’s articles, [Heydenreich37], [Briggs29a], and [Briggs29b], are the classic introduction to the subject. Other articles on the role of models in architecture are referenced throughout the text.
Chapter 3

The Basilica of St. Peter’s in Rome

The popes from Nicholas V (1447-55), to Innocent XI (1676-89), mobilized great resources to build the new Basilica of St. Peter’s. However, its construction was always subject to the political and financial fortunes of the Roman Church, and therefore not necessarily a top priority for all the popes. The history of its design and construction is thus highly fragmented. It is essentially a succession of periods of fervent activity, and periods of abandonment of the fabbrica - very much dependent on the successes or misfortunes of the men on Peter’s throne. This chapter illustrates the relevant episodes of the Basilica’s design and construction history, as well as the development of the administrative structures of the fabbrica.

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16 The Basilica was originally conceived as the chiesa sepolcrale for the apostle Peter. During the thirteenth century it became the destination of an increasing number of pilgrims, and the stage of liturgical functions by the pope. [Frommel94].

17 See [Carpiceci83], [Frommel91], [Frommel94], and [Metternich87] (passim.) for a detailed history of the Basilica.
Its main purpose is the identification of the various architects responsible for the design, as well as in the definition of a chronological framework, which is used as the basis for a taxonomy of representations (see Appendix A). The taxonomy lists the extant drawings, and models, created during the tenure of the various architects. It is used in chapter five in order to illustrate and exemplify the emergence of representational conventions during this period.

### 3.1 A Chronological History

The history of the Basilica has been subdivided into three phases in the context of this essay (refer to figure 3.1). The first phase, beginning with Nicholas’ V ascent to Peter’s throne in 1447, is marked by his intention to restore the Constantinian Basilica, which at that point had been used for more than thousand years. This restoration was part of the pope’s vision to rebuild Rome, the Eternal City, as a second Jerusalem. In order to realize his plans Nicholas V

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18 The term ‘architect’, as used in this and all following chapters, replaces the earlier notation “architects and artists”, and denotes all the personalities working on the Basilica, independent of their primary training.

19 Nicholas V is the first pope to permanently reside in Rome after the papacy’s exile period in Avignon. [Frommel94], p. 399. See also [Pastor25], vol. 1, pp. 513. For a detailed account on the Constantinian Basilica see [Carpiceci83], p. 14-42.

20 It is important to note, that Rome gradually substituted the traditional pilgrimage to the holy land after the fall of Acra (Accho, or Akka) in 1291. More and more pilgrims convened in Rome, and the infrastructure needed to accommodate their spiritual as well as physical needs had to be considerably extended. See Genoveffa Palumbo for a detailed account on pilgrimages to the Holy Land and later to Rome, in [Palumbo99]. See Stefano Borsi for the transformation of Rome in order to accommodate the increasing flow of pilgrims to the Eternal City, in [Borsi86] and [Borsi90].
organized the fabbrica by creating the first permanent and salaried positions, probably replicating the structure of the Opera del Duomo in Florence.  

He appointed first Bernardo Rossellino (1409-64), who became responsible for the restoration project.  

Leon Battista Alberti (1404-72), being in close contact

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21 Refer to Ennio Francia and Christoph Frommel, in [Francia77], and [Frommel76], p.57-136. Christoph Frommel also describes the institutionalization of the fabbrica through the nomination of the Florentine Antonio di Francesco as ingegnere di palazzo, directing the activities of soprastanti and capomastri, all of them receiving a fixed salary. Frommel suggests that Antonio di Francesco presumably introduced an organizational structure similar to the one of the Opera del Duomo in Florence, in [Frommel91], p. 175,

22 See Alberto Carpiceci, in [Carpiceci83], p. 42. Christoph Frommel notes that Rossellino’s appointment was probably due to a recommendation by Leon Battista Alberti, who at that point
with Nicholas V, played an equally important role for this first phase – to the point that it is difficult to distinguish the work of Rossellino from that of Alberti. Both architects worked on stabilizing the walls of the old Basilica (see figure 3.2). Alberti presumably designed the Loggia della Benedizione, and Rossellino (or possibly Francesco del Borgo) began its construction during the papacies of Callistus III (1455-58), Pius II (1458-64), and Paul II (1464-71). This first phase was characterized by an ever-increasing range of restorative interventions, and extensions to the original building program, mainly aimed at improving the functional aspects of the old Basilica. The period’s foremost contribution was the beginning of the construction of the choir of St. Peter’s by Rossellino (see figure 3.3 for a comparison of the old Constantine Basilica with the new St. Peter). 

consulted the pope on architectural and artistic issues (see also Vasari’s account in Le vite ... [Vasari86]), in [Frommel91], p. 175-176.

23 For more details on the roles of Rossellino and Alberti, see Ennio Francia, [Francia77], and Alberto Carpiceci, [Carpiceci83], p. 42.

24 The Loggia was one of the last structures to be demolished during the new building campaign in the sixteenth century. As one of Alberti’s designs it was highly respected and it attained a great significance as an architectural icon; see Alberto Carpiceci in [Carpiceci83], p. 44-45. Christoph Frommel indicates Francesco del Borgo as the architect in charge of the construction of the Loggia, in [Frommel91]. For a description of the Loggia’s development see also [Frommel94], pp. 399.

25 The main reason for these expansions were to be found in the increasing number of pilgrims visiting Peter’s grave in Rome. For more details on the pilgrimages to Rome see note #20.

26 See Christoph Frommel, Alberto Carpiceci, and Wolff Metternich, in [Frommel91], p. 175-177, [Carpiceci83], p. 45-52, and [Metternich75], pp. 49.
Figure 3.2 Perspective section of the Constantine Basilica. This print by Grimaldi shows the interior of the old Constantine Basilica at the time of Nicholas V, when Alberti and Rossellino worked on the restoration of the structure. From Alberto Carpiceci, in [Carpiceci83], p. 21, fig. 17.

The description of the events during this time is mostly based on administrative documents from the fabbrica, the correspondence between key personalities, and, to a great extent, on the accounts of early architectural historians, such as Giorgio Vasari (1511-74). There are no extant drawings and models illustrating the architects’ intentions.²⁷

²⁷ Alberto Carpiceci illustrates the architecture of this period with numerous drawings. While his reconstructions are mostly speculative, they are helpful in visualizing the potential design and structure of the Constantinian Basilica; see [Carpiceci83].
Figure 3.3 The Constantine Basilica and the new St. Peter.
This diagram compares the plan of the old Constantine Basilica (black and pink plan) with the new St. Peter (gray plan). Note that both churches are centered on Peter’s tomb. From Alberto Carpiceci, in [Carpiceci83], p. 36, fig. 17.

The second phase of importance to this essay begins with the tenure of Donato di Pascuccio, called Bramante (1444-1514), as the architect in chief of the
fabbrica, during the papacy of Julius II in 1505. Several circumstances had changed since the beginning of the first phase under Nicholas V. What began as the restoration of the existing building, a longitudinal structure based on a Latin cross, tended ultimately more towards a centralized structure, reflecting changes in liturgical practices. Bramante began his work on the new Basilica in 1506, with the participation of Giuliano da Sangallo (1445-1516), Fra Giocondo (1433-1515), and his main assistant, Antonio di Pellegrino. The construction work began shortly thereafter.

By this time, the fabbrica had already a stratified administrative organization, consisting of three leading figures, and 250 operai. The architect, responsible for the design and construction, represented the pope in all matters of design. Nevertheless, major design decisions were always subject to the pope’s approval. The misuratore, in charge of corroborating the actual work done on the construction site, and the computista, responsible for the financial accounting and

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28 Julius II, Giuliano della Rovere, became pope in 1503. As cardinal he employed Giuliano da Sangallo as his architect. Nevertheless, he appointed Bramante as the architect of St. Peter’s late in 1503, and called Giuliano only later, at the beginning of 1504, to the papal court. By this time, Bramante had already begun the work on the Cortile del Belvedere, and he was the architect in chief of all Fabbriche in the Vatican. See Christoph Frommel, in [Frommel91], p. 178, and [Frommel94], p. 401.

29 Architects reacted to the changing needs of the liturgy by proposing an ideal, highly symmetrical layout of the new church. Leonardo da Vinci developed centralized schemata while in Rome during this time. It cannot be ruled out that he might have participated in the formulation of Bramante’s initial design. See Alberto Carpiceci and Christoph Frommel, in [Carpiceci83], p. 54. [Frommel91], and [Frommel94], p. 399. On Leonardo’s ideas on central structures see Carlo Pedretti, in [Pedretti62], and [Carpiceci83], pp. 64.

30 For notes on Antonio di Pellegrino’s work see Wolff Metternich and Alberto Carpiceci, in [Metternich72], [Carpiceci83], p. 77-91, and [Frommel91]. On Antonio’s work as a draftsman for Bramante, see Hubertus Günther, in [Günther88], p. 141, 251.

31 Numerous scholars suggest that the construction of a totally new structure was prompted by Michelangelo’s proposal for Julius’ II mausoleum, which convinced the pope that it would be only appropriate to have a temple worthy of his mausoleum. See Alberto Carpiceci, in [Carpiceci83], p. 182.
operations, were appointed as overseers of the *fabbrica*. They became counterparts to the architect, and consequently diminished his authority.\(^{32}\)

This administrative structure forced the architects to change their method of working. Traditionally, architects were responsible for most of the process, and modifications to the design and construction could be made on the site, after seeking approval from the client or the supervising authority.\(^{33}\) For St. Peter’s, however, the architects had to increasingly design the structures and clearly specify the geometrical dimensions and materials to be used in the construction process *before* the actual construction began. Armed with the plans and models, the architects had then to build consensus among the other officials on the site, and, ultimately, seek approval from the pope. Once the design was agreed upon, modifications became more difficult, since they had to be coordinated with the *misuratore* and *computista*. Only by following this practice was it possible to

\(^{32}\) See Christoph Frommel, in [Frommel91], p.178. James Ackerman describes the Fabbrica’s structure as follows: “[…] At St. Peter’s, for instance, there was a hierarchy that became more complex as the building grew. In the 1520s and ’30s it apparently was organized with an architect (Sangallo) at the head along with a co-architect (Peruzzi). The execution was in charge of a *curatore* (Giuliano Leno) and a *computista* (Francesco Megalotti; later Jacopo Melegino) immediately below him, if not at par, who served as paymaster, and for this reason was a member of a board of three who measured and priced completed work; the *mensuratori* (Giov. Francesco da Sangallo and Rainieri da Pisa). The funds allotted by the *Camera* were distributed by two *depositari* or treasurers (Simone Ricasoli, Leonardo Bini). This staff had its *segretario*, whose hand is found in the records alongside that of the *computista*. On the job there was a group of 5 to 10 *sopristanti*, who might also be *misuratori*, indicating that this position was higher than what we would call “foreman” […]. Next there were the *sotto sopristanti*, who were foremen and occasionally specialists, as: *sotto sopristanti sopra i legnami* (carpenters). At the bottom of the official hierarchy came the *caponastri* directing crews in their special crafts: carpentry, masonry, carving, ironwork, etc.”. Cited from [Ackerman91], p. 368 (see also Ackerman’s note #21 for further details).

\(^{33}\) James Ackerman, Richard Goldthwaite, as well as William Wallace list numerous examples in which the architects assumed many of the administrative duties on the construction sites (e.g. chief estimator, paymaster, supplier of construction material, etc.). The organized *fabbrica*, with its stratified administrative structure, was exceptional. See [Ackerman91], [Goldthwaite80], and [Wallace94].
estimate the costs, to substantiate the progress of the construction, and to justify the ever-increasing expenditures.

This “bureaucratic” approach to design and construction forced the architects to document their ideas and projects by using graphical conventions that could be understood by the *misuratore*, the *computista*, and the *soprastante*. Simple sketches were not sufficient anymore - detailed and dimensionally precise drawings and models were needed.

This system also separated the construction process from the designers. While the common practice of the architects being present on the construction sites in order to explain and supervise their designs persisted during the time, the role changed with the advent of more precise techniques of documentation and illustration. Standardized drawings and, to a lesser extent, plastic models, enabled the architects to convey their ideas with less and less verbal explanations. Several plans conceived by Bramante are known from this period (see figures 3.4 and 5.3).34

Bramante’s tenure was characterized by a gradual shift from the longitudinal scheme to a central plan, with an increased monumentalization of the proposed structure. Proposal after proposal document this process.35 However, Bramante’s projects were not necessarily accepted without discussion, as is illustrated by different concurrent *opinioni* (projects) of Giuliano da

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34 Refer to Wolff Metternich for reproductions and the history of the documents created during this period. Autograph drawings by Bramante are not known, in [Metternich72], [Metternich75], and [Metternich87]. Several drawings by his assistants of the time, Antonio di Pellegrino and Antonio da Sangallo the Younger, have been identified. It is legitimate to assume, given the documented role these assistants played, that they worked under Bramante’s supervision, essentially illustrating his ideas. See Christoph Frommel, in [Frommel91].

35 Refer to Christoph Frommel, in [Frommel94], pp. 403.
Sangallo, Antonio della Valle, and Menicantonio de’ Chiarellis. In 1506, Bramante resumed work on the choir initiated by Nicholas V, and work on the four main pilasters began in 1507. During 1508, he started with preparations on the construction of the four main arches of the crossing. This work is documented by drawings of his assistants, Antonio di Pellegrino and Antonio da Sangallo the Younger (1483-1546).

36 It is difficult to determine the degree of competition between these different project ideas. Given the relationships of the various architects, it is also difficult to estimate if they were competing or actually drawing a variant of the ideas in collaboration with Bramante. See Alberto Carpiceci, in [Carpiceci83], p. 84-109. It is known, for example, that Menicantonio also assisted Bramante as his draftsman during this time. See Hubertus Günther88, in [Günther88], p. 251.
Figure 3.4 Design variant for the new St. Peter’s Basilica.
This drawing was made by an artist from the San Gallo group, under the guidance of Bramante. Note the squared grid underlying the drawing, and the various scales with tick marks indicating the modular distances. From Wolff Metternich, in [Metternich72], p. 37, fig. 11.
During the same time, Bramante developed projects for a cupola. However, all work was interrupted by the death of Julius II in 1513, and Bramante’s design was not further pursued due to financial constraints, as well as his hesitations to begin construction work on the dome.  

The work on St. Peter’s resumed with the election of Leo X (Giovanni de’ Medici) in 1513. The project was extended, and the administrative organization was changed once again. A confidant and previous teacher of the pope, Cardinal Bibbiena (Bernardo Dovizi), directed the fabbrica, and Giuliano Leno became Curatore. The bureaucratic control over the fabbrica was tightened. The responsibility for the project was spread over two or more architects. This new administrative structure complicated the decision-making process considerably. Most importantly, it eroded the architects’ role and diminished their authority. Inevitably, rivalries among the various personalities arose. All work was interrupted once again when Bramante died in 1514.

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37 Scholars speculate about Bramante’s hesitations with the dome. While he devised schemata for the dome over the central crossing, he did not press on with its construction. Reasons might be found in the general dissatisfaction with the design expressed by other architects, as well as in questions about the structural stability of the pillars. See Christoph Frommel, in [Frommel91] (Passim), p. 181 for the note on Bramante’s hesitations, and [Carpiceci83], pp.84.

38 The election of Leo X (1513-21) had a major impact on several issues. The new pope was not very inclined to give the mausoleum of Julius II such a prominent position (the original intention was to place it in one of the arms of the choir). Bramante had to restudy the role of the choir, and Michelangelo had to redesign the mausoleum, reducing its size and sculptural program – this without knowing if and where it would be placed in the new Basilica. See Christoph Frommel, in [Frommel94], p. 417.

39 While Bramante remained chief architect, his authority was curtailed. See Christoph Frommel in [Frommel91], pp. 181. Frommel also suggests that the fabbrica became a permanent institution only with Leo’s changes. Howard Saalman notes that it was Clemens VII who institutionalized the new administrative structure. The fabbrica was subject to frequent changes before this reorganization; in [Saalman78], p. 484.

40 Christoph Frommel describes how Bramante had no problems to discuss the design with Julius II directly, i.e. without intermediaries. His successors, on the other hand, had to convince the pope and the curator of their intentions. No indication is given for the motivations of
Leo X’s admiration for Raphael (Raffaello Sanzio, 1483-1520), and, apparently, Bramante’s insistence, convinced him to appoint the artist as architect in chief of the fabbrica in 1516. However, Leo X’s extravagant lifestyle and love for everything artistic drove the papacy close to bankruptcy, and the fabbrica was characterized by a constant lack of financial resources and by concurrent projects of two competing groups of architects: Raphael with Fra Giocondo, versus Giuliano da Sangallo and his circle. This multiplicity of participating architects makes it difficult to establish the design responsibilities, as well as to determine the main project idea for this period. A leading project crystallized only in 1519, renewing Bramante’s design and combining it with ideas by Raphael, Antonio da Sangallo the Younger, and Baldassarre Peruzzi.

Raphael and Fra Giocondo were appointed to assist Bramante during his last year as a chief architect of the fabbrica by Leo X. Fra Giocondo was one of the most famous engineers of the period - the upcoming construction of the cupola required the presence of an experienced engineer. Raphael’s artistic talent was well known at the papal court. Giuliano da Sangallo was nominated in early 1514. See [Frommel94], p. 417, and [Frommel91], pp.414. [Carpiceci83], pp. 114. Raphael was appointed architect in chief in 1516, after Fra Giocondo and Giuliano da Sangallo’s deaths; [Frommel94], p. 418.

Alberto Carpiceci labels this trio, Raphael, Fra Giocondo, and Giuliano da Sangallo, the “triumvirate”; see [Carpiceci83], pp.102, and pp. 151. The situation was resolved by Giuliano’s death in 1516, which also helped to establish the role of Antonio da Sangallo the Younger as an architect, rather than a draftsman.

Alberto Carpiceci points out that Raphael was pursuing Bramante’s design together with Fra Giocondo (although there are several opinioni by Fra Giocondo, see [Metternich87], pp. 52). They proceeded with the construction of various parts of the Basilica: the foundations of the main pillars, which needed to be reinforced in order to support the dome, and the Chapel of the King of France, originally the Chapel of Santa Petronilla, in the southern part of the transept ([Frommel94], p. 419). Giuliano da Sangallo, on the other hand, started to make counter proposals in order to change Bramante’s original plans. In [Carpiceci83], p. 114
(1481-1536), with whom he collaborated.\textsuperscript{44} Raphael died unexpectedly in April of 1520. Shortly thereafter, Antonio da Sangallo the Younger became architect in chief. In the spring of 1521 he presented a model of his design to the pope.\textsuperscript{45}

The beginning of the tenure of Antonio da Sangallo the Younger was characterized by a reduction and simplification of Bramante’s design. The financial problems of the last years of Leo X’s papacy constrained the development of the Basilica severely.\textsuperscript{46} After Leo’s death, with Clement VII (1523-34), the work concentrated mainly on the southern transept, under the supervision of Antonio da Sangallo the Younger and Baldassarre Peruzzi. The Sack of Rome in 1527 interrupted all work. Clement VII’s departure from Rome precipitated the \textit{curia} into a deep political and financial crisis, and the \textit{fabbrica} was abandoned.\textsuperscript{47}

After Clement VII returned to Rome in 1531 work resumed work under drastically different auspices. The project was radically reduced, limiting the

\begin{footnotesize}
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\item\textsuperscript{44} It is not evident from the sources how they collaborated. Antonio and Peruzzi seem not to have been just assistants to Raphael. Antonio, who was nominated \textit{secondo maestro}, is known to have criticized Raphael’s design and construction efforts quite frequently and publicly. See [Frommel94], p. 420-421. Peruzzi was working in the Fabbrica during Bramante’s tenure. Some of the drawings attributed to him demonstrate Bramante’s intentions, and must have been made under his direction. See [Carpiceci83], pp. 128. Peruzzi is appointed \textit{secondo maestro} after Raphael’s death in 1520, succeeding Antonio in this position; see [Frommel94], p. 421. Peruzzi contributed his own ideas for the design of St. Peter’s in competition with Raphael and Antonio; see [Carpiceci83], p. 128.
\item\textsuperscript{45} [Frommel94], p. 421, and [Frommel91], p. 182. [Frommel91] indicates that Raphael and Fra Giocondo also used models.
\item\textsuperscript{46} [Frommel94], p. 421.
\item\textsuperscript{47} It is reported that Peruzzi was captured and held hostage, and that he had to pay a considerable amount of money to free himself. Disappointed, he left for Siena shortly thereafter [Carpiceci83], p. 128. The sources do not report on the activities of Antonio da Sangallo the Younger during this time.
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design and construction to the essential parts. Project ideas developed during these harsh times were almost exclusively of visionary nature. Paul III (1534-49) succeeded Clement VII in 1534. He resumed work on the Basilica with renewed vigor, and Antonio da Sangallo the Younger and Peruzzi were instructed to make new proposals for the design of the temple. The period was marked by a revitalization of Bramante’s original plan for a centralized church. Nevertheless, the work on the Basilica proceeded slowly, mainly due to the necessary improvements of the existing parts of the complex in order to insure its liturgical function. Both architects produced innumerable drawings and models of design variations during this time, most of which remained on paper and were never realized (see figure 3.5).

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48 See Christoph Frommel and Alberto Carpiceci for detailed illustrations of these visionary design proposals. In [Frommel94], p. 421, and [Carpiceci83], pp. 151.

49 During this period Peruzzi developed several proposals for an ideal temple. However, his ideas remained on paper, and are interpreted today as continuations of his quest for an ideal solution expressed in his projects for the Dome in Capri (1513-1514), his competition entry for San Giovanni dei Fiorentini (1516-17), and San Domenico in Siena. His ultimate goal, to make St. Peter’s the ideal temple, was not realized. Only later was Peruzzi elevated to the same rank as Antonio da Sangallo the Younger. Clement VII (or Paul III according to [Frommel94]) equaled his salary to that of Antonio da Sangallo the Younger in 1534, perhaps in recognition of his theoretical contributions. Peruzzi died in 1536. See [Carpiceci83], pp. 128, and [Frommel94], pp.421.

50 Alberto Carpiceci notes that following the election of Alessandro Farnese as Paul III in 1534, Michelangelo returned to Rome (effectively leaving the work on the Laurentian Library incomplete, see [Wallace94], pp. 135 for details). Despite the renewed efforts to complete St. Peter’s, Michelangelo did not participate in the design, which was monopolized by the Sangallos. Michelangelo completed the frescoes in the Sistine Chapel, with his Giudizio Universale, from 1536-41. Refer to [Carpiceci83], p. 182.

51 [Frommel94], p. 422, and [Carpiceci83], pp. 151.
Figure 3.5 A perspective drawing by Baldassarre Peruzzi.
The drawing depicts a perspective plan, elevation, and section for a project idea for St. Peter’s. Vasari describes Peruzzi with following words: (Baldassarre) fu dal papa Leone X in molte cose adoperato, il qual pontefice, volendo finire la fabbrica di San Pietro cominciata da Giulio II col disegno di Bramante, e parendogli che fusso troppo grande edifizio e da raggersi poco insieme, fece Baldassarre un nuovo modello Magnifico e veramente ingegnoso e con tanto buon giudizio, che d’alcune parti di quello so sono poi serviti gli altri architetto. E di vero, questo artefice fu tanto diligente e di si raro e bel giudizio, che non ha mai avuto pari nelle coe d’architettura …. Description in [Carpiceci83], p. 136. Uffizi 2 Ar, Florence. From [Wurm84], p. XXV.

Only after Peruzzi’s death in 1536 did Antonio da Sangallo the Younger become the unchallenged architect in chief. While supervising the fabbrica, he concentrated his energies on the creation of a wooden model summarizing his visions for the new Basilica. Antonio Labacco assisted him in this work, and has been credited with its realization (see figure 5.6). The model was not yet
completed in 1546, the year Antonio da Sangallo the Younger died, and most of
his intentions were never realized.\textsuperscript{52} The end of Antonio da Sangallo’s the
Younger tenure marked also the end of the architectural design evolution based
on Bramante’s architectural legacy.

The third and last phase of interest to this essay begins with the
appointment of Michelangelo Buonarroti (1475-1564) as chief architect of the
whole \textit{fabbrica} in 1547. Michelangelo assumed the direction of the work in his
usual way – commanding total control of the \textit{opera}. The administrative
organization of the \textit{fabbrica} was not at all suited for his \textit{modus operandi}, and he
had certainly no intention to change his way of doing things. He did not subject
himself to the control of the \textit{congregazione} of St. Peter’s (the \textit{fabbrica}’s governing
body), as his predecessors did, and stated that he would deal only with the pope
on matters concerning the design and construction of the new Basilica. He also
dismissed the design proposal, and model, of Antonio da Sangallo the Younger.
Driven by his aversion for the \textit{setta sangallesca} and their work, he also did not

\textsuperscript{52} Refer to Alberto Carpiceci for a detailed account of the proposals by Antonio da
Sangallo the Younger. The Congregation of St. Peter’s requested the famous model for St. Peter’s
in 1539. See [Carpiceci83], pp. 151. Christoph Frommel points out that the model’s purpose was
essentially to ensure that there was a project idea to realize, and not to verify the intentions
Antonio da Sangallo the Younger. After more than thirty years of work, and innumerable design
proposals, it is understandable that the \textit{curia} wanted to finalize the \textit{opera}. He emphasizes that the
model was not a mere architectural fantasy by Antonio da Sangallo the Younger – it would be
difficult to justify its high costs, approximately 5000 ducats, if it was not intended as a final
reference for the construction of the Basilica. The model’s scale was 1:25, which explains the
model’s physical size (approx. 8 x 4.5 m), and it was defined down to its sculptural details. See
[Frommel94], p. 423, [Frommel91], p.182. Alberto Carpiceci points out that Antonio da Sangallo
the Younger used the model for exploratory purposes as well, and that it was not built according
to a completely predefined design; in [Carpiceci83]. Sketches by Antonio da Sangallo the Younger
demonstrate that he was changing the parts of the models, e.g. the façade, as the model was built.
His death interrupted this process. For details on the model see Henry Millon, in [Millon94], pp.
35-43.
hesitate to suggest the demolition of the parts erected under Antonio da Sangallo the Younger. Paul III respected Michelangelo to the point that he consented to most requests, effectively altering the administrative organization of the fabbrica in order to accommodate the artist’s working habits – no other architect after Michelangelo had such a privileged position.

Michelangelo used a small wooden model in order to convince Paul III of his project, and only after gaining approval from the pope did he proceed with the construction of a larger, more detailed model representing his design proposals. Michelangelo’s major contribution was the remodeling of the interior spaces of St. Peter’s. He simplified the proposal of Antonio da Sangallo the

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53 Howard Saalman describes that one of his first actions was to oust most of the collaborators of Antonio da Sangallo the Younger, including Antonio Labacco, who was completing the model for St. Peter’s. See [Saalman78], pp. 483. Michelangelo’s main argument with Antonio’s project was that he had distanced himself from Bramante’s original design ideas: “chiusche s’e discostato da decto ordine di Bramante, come à facto il Sangallo, s’e discostato della verità …”. Quoted from Henry Millon, in [Millon94], p. 50. Nevertheless, there were only some minor demolitions, and Michelangelo was forced to build upon what Antonio had completed. See James Ackerman, in [Ackerman61], pp.95.

54 Alberto Carpiceci suggests that Paul III had his own reservations with the setta sangallesca completing the opera according to the model of Antonio da Sangallo the Younger. Michelangelo turned down the pope’s first request to direct the work of the fabbrica, and Paul III convoked Giulio Romano and Jacopo Sansovino. The former dying shortly thereafter, the latter being too busy in Venice, Paul III resorted to more persuasive methods, essentially ordering Michelangelo to assume the position. In [Carpiceci83], p. 182. Howard Saalman notes that Paul III had to mend fences with the congregazione by requesting Michelangelo to explain his intentions to the deputies, but that they had to respect Michelangelo’s design decisions. He describes the final showdown in [Saalman78], pp. 485. The controversy was ultimately resolved through a motu proprio by Paul III, giving Michelangelo full powers. A decision reinstated by Paul’s successor Julius III, essentially silencing the congregazione’s resistance to Michelangelo. See also [Frommel94], p. 422.

55 Michelangelo built several models to illustrate his ideas; some of them in wood, others in clay (as for San Lorenzo and for San Giovanni dei Fiorentini). The model mentioned here was the first model, and was intended to get the pope’s permission to pursue Michelangelo’s design, and to build a new, more detailed model (the third one known). The last model, Michelangelo’s fourth model (together with Giacomo della Porta), illustrated Michelangelo’s proposal for the dome of St. Peter’s. See Henry Millon, in [Millon94], pp.50. See also note #141 on p. 88 of this essay.
Younger, emphasizing the role of the central crossing, drastically diminishing the number of collateral spaces, and unifying the spatial composition (see figure 3.6). 56

Driven by Michelangelo, the construction work on the Basilica resumed with great fervor. 57 Work on the drum began in 1554/55. The dome was designed between 1558-61, culminating in the model representing Michelangelo’s ideas. 58 Julius’ successors were not always supportive of Michelangelo’s efforts, despite his artistic fame and the progress of the fabbrica under his tenure. Support for the construction dwindled during the papacy of Paul IV (1556-59). Like his predecessor Antonio da Sangallo the Younger, Michelangelo worked with fewer assistants, creating mainly drawings and models of his design intentions during these years. Only with Pius IV (1559-65) did the work resume at full scale. 59 By the year Michelangelo died, in 1564, he had completed the southern apse, and almost the entire drum. The advanced stage of the construction, and the models and drawings left by Michelangelo ensured that his successors would be forced to fulfill his visions for St. Peter’s.

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56 Refer to James Ackerman for detailed explanations on Michelangelo’s designs for St. Peter’s. Ackerman also notes Michelangelo’s clever use of the structures built by Antonio, without having to demolish too much of the work under way; in [Ackerman61], pp. 92. See also Antonio Carpiceci, in [Carpiceci83], pp. 188 – 195, for further details.
57 This swift pace, once the basis of the project was defined, was similar to Michelangelo’s work as architect of the San Lorenzo projects. See the introductory chapter for more details.
58 See James Ackerman and Alberto Carpiceci; in [Ackerman61], p. 99-100, and [Carpiceci83], pp. 183.
59 Refer to Alberto Carpiceci, in [Carpiceci83], pp. 182.
Figure 3.6 Comparison of four projects for St. Peter.
This diagram shows the four variants elaborated by Bramante, 1506 (a), Bramante-Peruzzi, before 1513 (b), Antonio da Sangallo the Younger, 1539 (c), and Michelangelo, 1546-64 (d). From James Ackerman, in [Ackerman61], p. 93, fig. XI.

Giacomo da Vignola (1507-73), and Giacomo della Porta (1537-1602), Michelangelo’s immediate successors, continued the work on the central dome.
Although they altered his original design, they were essentially bound by the constraints imposed by Michelangelo’s original work.\textsuperscript{60}

Although Michelangelo defined crucial parts of the project, he did not elaborate any definitive proposals for the main façade. It has been speculated that the reason for this omission was rooted in the centralized plan of his design, and the subsequent problem of destroying the harmonious equality of the four sides of the cross by preferring one of the façades.\textsuperscript{61} His successors after Giacomo della Porta did not solve this difficult aspect of Michelangelo’s design. Nor did the popes following Pius IV have the resolute power of imposing a solution. It took the authority of Paul V Borghese (1605-21) to resolve the issue. His determination, and the ruinous state of the remains of the old Basilica, forced the congregazione to proceed with the construction. Giovanni Antonio Dosio, Ludovico Cardi (Il Cigoli), Domenico and Giovanni Fontana, and Carlo Maderno were the architects convoked by Paul V to propose solutions. The Fontanas and Maderno supported Paul’s intention to transform Michelangelo’s centralized design into a longitudinal scheme. Hence, Maderno was appointed architect in chief after Giacomo della Porta’s death in 1603, and he was commissioned by the pope to transform the church in 1605-06. The work resumed after the

\textsuperscript{60} Both Ackerman and Carpiceci point out that it was a fortunate circumstance that Michelangelo’s immediate successors were not as renowned architects as he was. According to Alberto Carpiceci this is essentially the reason why Michelangelo’s design survived their interventions. Carpiceci hypothesizes that if they would have had the fame, and as strong a personality as Michelangelo, his design would have suffered the same fate as the proposals of Antonio da Sangallo the Younger. In [Ackerman61], pp. 103, and [Carpiceci83], pp. 199. [Carpiceci83], p. 220, p

\textsuperscript{61} See Alberto Carpiceci, in [Carpiceci83], p. 234.
construction of a model by Maderno, and the main façade was essentially completed by 1617 (see figure 3.7).\textsuperscript{62}

The two last major interventions consisted in the design of St. Peter’s square, the (failed) design of the bell towers, and the restorative interventions on Michelangelo and Della Porta’s dome, by Ferrabosco, Rainaldi, Lorenzo Bernini, and Carlo Fontana respectively.\textsuperscript{63} The competition for the new Sacristy in 1715, won by Filippo Juvarra, who became director of the \textit{fabbrica} in 1725, was never realized. Projects for a new loggia at the opposite end of St. Peter’s square, and the extension of the avenue to Castel Sant’ Angelo were proposed after Carlo Fontana’s tenure, but never completely realized.

\textsuperscript{62} See Alberto Carpiceci, in [Carpiceci83], p. 234-244.

\textsuperscript{63} See Alberto Carpiceci and Franco Borsi, in [Carpiceci83], p. 247-308, and [Borsi80].
Figure 3.7 Arial view of the new St. Peter’s Basilica.
The image shows the St. Peter’s Basilica as it stands today. From Spiro Kostof, in [Kostof95], p. 486, fig. 20.2.
3.2 A Taxonomy of the Representations

All architects in charge of the fabbrica had to communicate their design intent to their assistants, as well as to the computisti, misuratori, soprastanti, capomastri, and operai. The traditional communication media were sketches, drawings, models, and templates made of wood, clay, and zinc. This was a constant throughout the long design and construction process of St. Peter’s. Although only a small part of these documents survived, there are many traces of this process, and most of the design history of the new Basilica, and that of innumerable variants, has been construed through the interpretation of these drawings and models.

In order to identify emergent conventions in these representations I have categorized and cataloged the published drawings produced during the periods from Bramante to Michelangelo. The categories in the catalog have been defined according to a contemporary classification scheme: plan, elevation, section, perspective, and model. Approximately 300 sketches, drawings, and partial drawings have been cataloged. They can be subdivided as follows (see figure 3.8): 100 plans, 76 elevations, 42 sections, and 41 perspectives. Orthographic projections (plans, elevations, and sections) form, as expected, the largest part of the representations, roughly 75 percent. The rest consists of (mostly exterior)

\footnote{The sources for the catalog, mostly anthologies of various architects, are listed in the Bibliography.}

\footnote{Eleven percent of the representations could not be categorized at all. These are mostly unidentifiable, rough sketches. Sections are often combined with perspective views of the interior spaces to form perspective sections. They have been categorized as sections, since the original intent was to show the interior spaces.}

\footnote{This figure includes also drawings, mostly sections, that combine orthographic and perspective.
perspectives (approx. 14 percent), and uncategorized representations (11 percent).

Figure 3.8 Distribution of cataloged representations.
The diagram shows the distribution of the cataloged representations. A total of 292 sketches, drawings, and models were analyzed.

3.3 Discussion

The representations cataloged in the taxonomy show evidence of a gradual refinement of the drawing and modeling techniques during the construction of St. Peter’s. Freehand sketches were traditionally used as graphic explorations throughout the period. However, due to the increased need of precise and detailed graphic representations, drawings with scales, made by ruler and compass gradually displaced them as the design evolved. By the time of the competition for the new Sacristy of St. Peter’s in 1715, it is evident that
architectural drawings were based on uniformed methods of representation. Plans, elevations, and sections, strictly orthogonal, highly detailed, and often rendered with shadows were the norm by the beginning of the eighteenth century. The growing administrative structure of the fabbrica of St. Peter’s, its ever-increasing control of every aspect of the design and construction of the new Basilica, indirectly imposed the use of these conventions. Architects working for the fabbrica had to develop or embrace methods of representations that enabled them to communicate with their administrative counterparts. Thus, the standard emerged through the gradual acceptance of these conventions by the designers and administrators of the fabbrica.

Sophisticated models were usually submitted as supplements to the drawings. Despite the highly refined drawing techniques there was evidently still the need for a three-dimensional, plastic representation of the architecture. Given that models could be walked around, inspected, and analyzed, without the understanding of a particular graphic language and projection methods, they were well suited for presentations to clients and the general public. In other words, orthographic drawings and models were two different types of representations used to convey design proposals to two different audiences.

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67 See [Hager70] for a detailed description of the competition for the new Sacristy of St. Peter’s in 1715 under Clement XI (1700-21); in particular Filippo Juvarra’s work. Hager illustrates Juvarra’s drawings and models as well.

68 These findings are also consistent with the arguments discussed in chapter four, reflecting the interpretations of Wolfgang Lotz presented in his essay Das Raumbild in der Italienischen Architekturzeichnung der Renaissance, [Lotz77], and the discussions by Henry Millon and Christoph Luitpold Frommel, presented in Rinascimento da Brunelleschi a Michelangelo: La Rappresentazione dell’Architettura [Millon94], and The Architectural drawings of Antonio da Sangallo the younger and his circle, [Frommel94], respectively.
The next chapter explores these representational methods and the media used by architects during the design process.
Chapter 4

Design Methods and Media

“Omnium operationum prima est indubiter cогitatio, et haec est locutio intellectualis …”

Guillaume d’Auvergne, Bishop of Paris (1218-1249).

What Guillaume described with these few words is the fundamental nature of architectural design – a process of intellectual abstraction through which architectural space is conceived. Drawings and models are the primary media through which these concepts are visualized. Their abstractive quality, and their inherent potential for subjective artistic expression, is highly conducive to the intellectual exploration of spatial concepts. These media have therefore been used to conceive and represent architectural space since the history of architectural design and construction can be documented. What has changed

[69] In Opera Omnia, Paris, 1674, De Universo, XX, Quod tribus intentionibus dicitur verbam. Quoted from [Branner63], p. 143.
over time is the role they played in the process of design. From geometric descriptions of canonical architectures, and as aids to the construction process, they have been transformed into graphical means for the exploration and expression of architectural concepts. This development parallels the emergence of professional architects. This chapter is an overview of the origins and the evolution of these media and representational methods in architecture.

4.1 Drawing in Architecture

The depiction of architecture with drawings, paintings, and mosaics was common practice in ancient Egypt, Greece, and Rome. Ancient architects drew plans and elevations on a regular basis, following sacral architectural canons and empirical construction rules. With the help of rulers, compasses, and a variety of knotted cords, they drew or carved on surfaces such as papyrus, leather, stuccoed and stone tablets, and wooden panels. Plans and elevations were the principal illustration methods, and the combination of two or more of these orthogonal representations was practiced since ancient Egypt, and was also

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70 In the context of this thesis, the term “architect” refers to the person in charge of the design and the construction of a building. Depending on the time period, the literature refers to this role as the “architector”, “architectus”, “architekton”, “architetore”, “magister operis”, “capudmagister”, and its equivalents in the languages of Europe. For a detailed account of the emergence of the architect as an identifiable professional figure refer to articles by Spiro Kostof, William MacDonald, Leopold Ettlinger, and Catherine Wilkinson (Zerner), in [Kostof77]. For an introduction to and examples of architectural drawings see [Kostof77], pp. 3-6, pp. 32-40, 71-74, pp. 87-91, pp. 99-104., See [Borchardt96] and [Kaderávek35] for examples of Egyptian drawings and their significance in the design and construction process in ancient Egypt. The best known example is probably the drawing of the frontal and side elevations of a temple at Ghorâb, currently at University College of London, Petrie Museum of Egyptian Archeology. See [Clarke90], [Kostof77], p. 8, and [Millon], pp. 20-21 for illustrations.

71 See [Kostof77], p. 7, pp. 31-33.
common knowledge of Greek as well as of Roman architects. Their familiarity with these techniques is exemplified by extant drawings as illustrated in figure 4.1.

Figure 4.1 Frontal elevation, parchment drawing from Ghorâb. The parchment shows an orthographic elevation of a temple at Ghorâb, XVIII Dynasty. The lines are drawn with a clarity and simplicity of modern technical drawings. The orthographic projection is accurate even in the curved parts of the capitals, demonstrating the familiarity of the author(s) with the technique. London, University College Petrie Museum of Egyptian Archeology. From Henry Millon, in [Millon94], p. 20.
In order to fully appreciate the achievements of these ancient architectural cultures, it is important to understand the inherent problems of the creation of this kind of graphical representations. What today seems to be obvious and straightforward required several levels of geometric abstractions in order to be drawn: (a) significant edges of the building needed to be determined (this included edges and points invisible to the observer, but important for the construction, such as axes, centers, etc.); (b) the position and orientation of the projection planes needed to be established – this defined the type of the illustration, either plan or elevation; (c) a reduction factor, the scale, was required in order to correlate the geometric size of the drawing with the given, physically limited drawing surface; (d) parallel lines (the projection rays) needed to be drawn from relevant points and intersected with the (perpendicular) projection planes (thus eliminating one geometrical dimension) – this resulted in a collection of geometric points; and, finally, (e) these points needed to be connected with straight lines or arcs in order to form the shapes representing the building. Contemporary architectural practice relies on modern geometrical treatises to describe the mathematical operations underlying the orthogonal projection techniques. All of these geometric rules, in an empirical form or not, must have been known as early as in ancient Egypt, and their application must have been familiar to the architects of the time. This is even more remarkable if we consider the documented difficulties of most of the architects in the 13th through the 16th century in applying these very same principles.\footnote{The reading of such representations poses similar problems. Understanding an architectural drawing implies the acceptance of the underlying representational conventions. This required, and still requires, extensive training by the observer. Lack of such understanding is the main reason for the difficulties of non-architects to correctly interpret architectural drawings, and}
Egyptian and Roman architects used squared grids, overlaid onto plans and elevations, for the transformation of scaling factors, as well as to control the carving of stone and wood (see figure 4.2).  

Figure 4.2 Plan, front and side elevation of a Sphinx.
The *Berlin Papyrus* shows a plan, front and side elevation of a Sphinx. The various drawings are superimposed with a squaring grid. This document, reconstructed by Borchardt demonstrates that the artist knew how to combine different views of the same object, and how to correlate them in order to illustrate the artifact (Greek-Roman period, after third century B.C.). From František Kaderávek, in [Kaderávek35], p. 14, fig. 6.

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73 For examples from ancient Egypt see František Kaderávek. Although his examples are solely sculptural, it is difficult to imagine that this practice was not recognized for architectural design; in [Kaderávek35], pp. 14-18. A famous example of an urban plan is the *Forma Urbis Romae*, a diagram of Rome carved in marble, ca. A.D. 200, showing houses, shops, and public spaces. Door openings as well as stairs are depicted with symbols; for an illustration see Spiro Kostof, in [Kostof77], p. 7 and p. 32.
These architects knew that parchment, as well as paper, were subject to dilatation depending on climatic factors. Measuring geometric dimensions directly from a drawing would usually yield wrong results, and ultimately lead to mistakes in the construction. The drawings are therefore extensively annotated and commented, in order to facilitate the construction process. Symbolic pictorial diagrams, illustrating the functions and spatial hierarchies, were used to depict the buildings in their entirety and independently from their physical reality.

The fall of the Roman Empire, and the shift of the center of power from Rome to Byzantium, marked the beginning of a period in Europe and in the Middle East for which there are no extant drawings or models documenting the architectural design and construction practice. The emergence of a Western medieval architecture for this period can therefore solely be traced through the surviving buildings of the period and from written accounts. Traditional Roman design and construction methods were carried on, but there was a gradual...
transition from late Roman to medieval architectural canons. This trend culminated in a distinctly defined architecture during the eighth to the twelfth century. The role of the architect changed gradually from the Vitruvian ideal of the humanist architect to that of the medieval master-builder. The earliest extant drawing from this period is the plan for the monastery of St. Gall, illustrated in figure 4.3. The projection method and the drawing techniques demonstrate great similarities with the ancient drawings discussed so far. Despite the scant records, it is to be assumed that the practice of depicting architectural space with orthographic drawings was continued along the traditions originating in antiquity.

The number of extant graphical records grows by the end of the thirteenth century, documenting a surge in architectural production, as well as an increasing complexity of the projects.

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78 Spiro Kostof gives a detailed description and provides references on the emergence of a medieval architecture, in [Kostof95].
79 Spiro Kostof, in [Kostof77], pp. 65-67.
80 For more details on the plan of St. Gall see Roland Recht, in [Recht95], pp. 10-11, and Spiro Kostof, in [Kostof77], pp. 71-74.
81 See François Bucher, in [Bucher68], p. 50.
82 François Bucher cites over 2200 medieval plans and designs as well as theoretical treatises for this period, ranging from 1350 to 1572. Covering a region from Paris over Strasbourg to Prague, Austria, and South Germany, Bucher categorizes these drawings in sketch plan, examination drawings, key plan, general plan, detail plan, placement plan, plans for staircases, show plan, dynamic plan, vault-patterns and cutouts, fantastic plan, and, finally, the memorial sketch. Refer to [Bucher68], pp. 49-69. Roland Recht notes that the extant drawings for the thirteenth and fourteenth centuries are mostly elevations of façades of cathedrals. During the fifteenth century there is an increase in general and detail plans, horizontal plans at varying levels, and plans for supports and vaults. In [Recht95], pp. 57-58.
Figure 4.3 Plan of monastery of St. Gall.
The drawing is a schematic diagram of an ideal monastery complex that incorporated the official policies enunciated at the council of Aachen in 816-17. The various buildings are drawn at relative scale. The plan is also vastly annotated. This is the oldest extant drawing of the period. From Roland Recht, in [Recht95], p. 11, and Spiro Kostof, in [Kostof77], pp. 71-75.
The various lodge books and sketchbooks of medieval architects are a testimony to the growing importance of graphic representations in architecture. The plan became the primary illustration method, reflecting the Gothic tradition of geometric design principles and systems of proportions. The plan for the north tower of St. Stephen in Vienna exemplifies this principle quite well (see figure 4.4). Multiple plan views are nested in one single drawing. They depict the change of the base of the tower at various heights. This results in a concise method of representing the essential information for the construction of the tower in one single drawing, enabling the architect to derive each plan (and elevation) from the previous ones. This plan demonstrates the intricate nature of Gothic architectural drawings. It is quite obvious that only architects familiar with the representational conventions were capable of understanding and interpreting such intricate drawings.

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83 On the medieval sketchbook see [Branner63], [Bucher68], [Kostof77], [Bucher79], [Kimpe85], and [Recht95].

84 The main approach practiced in the late Romanesque and early Gothic periods consisted in the applications of a module, in multiples, submultiples and in combinations thereof. Robert Branner suggests that project drawings prior to the Gothic have been programmatic or simply representational in nature, and not used in the early medieval west for the construction of buildings. Due to the simplicity of the building methods, buildings could be erected without the use of intermediary drawings, and under the direction of an architect on the site. Drawings became common practice during the late 13th century. In [Branner63], pp. 129-130. John Harvey notes that the Gothic tracing-house is first mentioned in an English text of 1274. Given that Egyptian and Roman architects were well versed in drawing plans and elevations for their projects, it is legitimate to assume that the tradition might have continued into the early Medieval times – the lack of extant drawings does not necessarily prove that the practice was not known. In [Harvey50], pp. 29-30.

For the role of the master-builder, his education, and the methods employed for the design and construction of Gothic architecture see: [Harvey71], pp. 27-46; [Harvey78], pp. 13-74 (particularly for England); [Bucher79], pp. 7-14. See also [Kostof77], chapter three.
Figure 4.4 Plan of the North tower, St. Stephen, Vienna.
This drawing contains multiple, nested plans outlining the tower’s geometry at different heights – an effective way of collapsing the essential information into one drawing. From [Koepf69], p. 40, fig. 15. See also notes in [Bucher68], pp. 60.

Elevations were extracted directly from the plans and used in conjunction with them (although usually for presentation purposes only, see figure 4.5).  

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85 In this category fall the drawings categorized by François Bucher as *show plans*, drawn by Gothic architects mainly for the presentation to the client(s) or authorities, in order to raise funds for the construction, for competitions, and in general for the study of variations of the design of a façade. In [Bucher68], pp. 65-66. Relevant examples of such drawings are the palimpsest of Reims, from around 1220-30, and the various elevations for the cathedrals in Strasbourg, Regensburg, Cologne, Ulm, and Freiburg im Breisgau. Some of these drawings represent only half of the façade [Recht95], p. 58. For details on the palimpsest of Reims see also [Branner58], [Murray78], and [Recht95], p. 38. For a description of the façade drawings of Gothic
Figure 4.5 Elevation of the tower of the cathedral of Ulm.
The drawing shows the frontal elevation of the tower of the
cathedral of Ulm. The plan beneath shows a partially orthogonal
projection with some empirical foreshortening on the ground level.
Note the absence of the sculptural program, as well as the strict
linearity of the drawing. From Roland Recht, in [Recht95], p. 80, fig.
55; also in [Koepf69], fig. 65 c.
It was common practice to draw architectural elements in full-scale for the production of templates and as aids to the construction, not unlike the procedures followed by the Egyptian, Greek, and Roman architects.  

The drawings mentioned so far, originating mostly in France, Germany, and Austria, exhibit a clear preference for graphical linearity - edges are drawn with great accuracy, surfaces and sculptural decorations are mostly ignored.

Drawings from the same period in Italy show an opposite tendency. Surfaces and material qualities were exalted by coloring the surfaces as well as the background, particularly in elevations, to the point of achieving a quasi-plastic relief effect (see figure 4.6). In contrast to their northern variants these drawings also illustrate the sculptural program. The drawing techniques employed are usually not strict orthographic projections. Frontal views and foreshortening are used at the same time in order to achieve a more realistic

86. Robert Branner notes that parchment drawings were still a relatively new idea in the process of planning and construction in the later thirteen century, see [Branner63], p. 131-141. Full-scale tracings on walls and floors of Gothic cathedrals, e.g. Clermont-Ferrand and Reims, are illustrated by Branner and Recht, in [Branner63] and [Recht95]. Branner also suggests that they have been invented in response to the technical developments, and to the need for greater precision in stereotomy, in [Branner63], p. 135. Small-scale drawings on parchment are then to be considered corollaries to these full-scale representations. For further illustrations on Clermont-Ferrand, see also [Kimpel85], pp. 227. Richard Goldthwaite suggests that drawings during the early Gothic were products of the architect trying to invent new methods of representations for improving the communication with clients; in [Goldthwaite80], see pp. 370-372. For the use of drawings as templates on the construction site, see Lon Shelby’s account. Shelby describes the production of drawings on parchment and paper, and their transformation to zinc templates for the masons in England. In [Shelby71]. Ross King reports that during the summer of 1420, Brunelleschi used a cleared area of half a mile by half a mile along the Arno, in order to trace the full-scale plan (and probably section) of the Dome of Santa Maria del Fiore in Florence. Templates were then made from the drawings and used to produce the architectural elements. In [King00], p. 84.

87. See [Recht95], pp. 57-66 for examples of Giotto’s campanile, and the drawings for the façades of the Baptistery, and the Capella della Piazza in Siena. In Gothic architecture the graphical method of representation corresponded to the period’s design method; Giotto’s approach also reflected a new perception of architecture. The material quality of the surface replaced the strict linearity. See [Frommel94], pp. 101-102.
rendering of the proposed architecture. These drawings were obviously commissioned as presentation drawings for the patrons or the public – the more realistic the rendering the more effective was the presentation of the architects’ ideas.

The differences in northern and southern European architectural drawings were probably related to the architects’ training and education, reflecting different modes of conception of architectural space, materials and colors, as well as regional preferences for representational methods and media. Gothic architects throughout Western Europe were initiated to the building trades through an apprenticeship in a lodge as stonemasons, carpenters, or wood carvers. A period as journeymen followed, which ended with a master exam. The prevalence of the stone, wood, and glass trades in the late fourteenth and early fifteenth century building industry was gradually reduced by an increasing number of architects with a background in painting and/or sculpture. This professional diversification, particularly by the Italian painter-architects, had a major impact on the design methods.

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88 On the problems related to the illustration of depth in two-dimensional drawings of the middle ages see [Recht95], pp. 27-36, and p. 63. The use of elevations is well established in the sketchbook of Villard de Honnecourt, although foreshortening and shadows were achieved empirical. They considerably dilute the orthographic nature of the drawings.

89 The best-known examples of this period are probably Giotto as a painter, Brunelleschi as a goldsmith. This becomes the general pattern during the late 15th and early 16th century in Italy; see chapter five. For a detailed description of the education of architects from antiquity to the Renaissance see articles by Spiro Kostof, William MacDonald, Leopold Ettlinger, and Catherine Wilkinson, in [Kostof77]. See also [Goldthwaite80] and [Baxandall80]. For a description of the general education of the public, particularly for commercial skills, see [Baxandall88].
Figure 4.6 Elevation of the campanile for the Duomo of Florence. The drawing shows a proposal for the campanile of Santa Maria del Fiore in Florence. Note the plasticity, which is achieved through the rendering of the various surfaces of the tower. Unlike Northern Gothic drawings, this elevation attempts to convey the material quality of the structure as well – qualities that make the drawing unsuitable as guide to the construction. This drawing as been attributed to Giotto and his circle. From Roland Recht, in [Recht95], p. 64, fig. 43.
The period from the end of the fourteenth century to the end of the sixteenth century witnessed a gradual change of the role of the architectural drawing, particularly in central and northern Italy. Whereas the northern Gothic architectural drawing had been primarily used for the representation of canonic architectures and as aid to the construction process, the architectural drawing in Italy gradually attained the role of an exploratory vehicle for the designer. This change was initiated and promulgated by the increasing number of painters and sculptors working as architects, supported by innovations such as perspective representation and fresco painting techniques. It was common practice for painters and sculptors to outline their work with initial sketches and drawings.\textsuperscript{90} The painting of large mural frescoes, a practice that required the painter to sketch the envisioned work on the underlying surface before starting the actual painting process, ultimately fostered the use of intermediary drawings as preparatory representations. First on the wall itself, later, with the general availability of paper, and with the emergence of the cartoon as an intermediary medium, on separate sheets of paper that could be applied to the painting surface. This approach evolved into an effective production process in the Renaissance painters’ workshop. Sketches and drawings on paper became important stages in the division of labor. Since most architects had a working knowledge of these techniques through their background in painting, it is legitimate to assume that they continued the practice of preliminary sketching as architects.\textsuperscript{91}

\textsuperscript{90} See Robert Oertel for a general introduction to the role of preliminary drawings in the painter’s workshop, in [Oertel40]. Refer also to Carmen Bambach for the role of exploratory drawings and techniques in the Italian Renaissance Workshop, in [Bambach99], chapters six, seven, and nine.

\textsuperscript{91} Carmen Bambach outlines a detailed history of this evolution as well as for the evidentiary basis exemplifying and supporting her findings, in [Bambach99], chapters eight
Perspective representations played an essential role in the quest for realism of Renaissance painters. However, it had a lesser impact on the architects’ design process (although the architect and the painter might have been the same person). These methods, and the use of intermediary drawings developed mainly in Tuscany within a broad group of figural artists and architects. The northern European Gothic method of design, with its clear linearity and its strict orthogonal projections, had apparently a limited impact on this group. This group’s seeming unawareness of a different mode of representation might have been one of the reasons for the development their own methods of representation of space in painting and in architecture. These efforts culminated with the invention of perspective in the first half of the fourteenth century by Filippo Brunelleschi.
The impact of Brunelleschi’s invention, and that of Alberti’s treatises on painting and architecture, as well as the gradual standardization of these representational methods will be the topics of the next chapter.

4.2 Plastic Modeling in Architecture

The use of models in architecture was as ubiquitous in antiquity as the use of drawings. Egyptians, Greeks, Etruscan, and Romans used miniature models of buildings for representational purposes as well as for funerary and votive donations (see figure 4.7). Models might have been used as complements to drawings and written documentation about the projects at hand, but their definitive role in the design process has yet to be assessed.

attributes the missing application of these methods in Tuscany mainly to the strong local building traditions of this region, which hindered the diffusion of new construction methods among the building trades. By the same token, artists like Giotto could develop their own design methods based on their experiences as painters, therefore preparing the ground for Brunelleschi’s central perspective method by investigating architectural representations in the pictorial space of their paintings. The fabbrica for the cathedral in Florence became the testing ground for these “Tuscan” design methods. See [Frommel94], pp. 101-102. On the role of architects and masons in Milan during the fifteenth and sixteenth century see [Scotti91] and [Giordano91].

For examples of Egyptian models of houses see [Freed81], pp. 25-36. For Greek house models see [Schattner90]. Romans were also known to display models of the conquered cities during their triumphal parades in Rome (see note #9 in [Millon94], p. 21). For Roman models see [Berti90]. Martin Briggs points out that there is no reason to assume that the Egyptians, which were very skilled builders, never used models in designing; see [Briggs29a], p. 174.

Henry Millon indicates that although the models in antiquity were ubiquitous, they seem not to have been part of an exploratory design process. They might have been used to present architecture to prospective clients, authorities, or as donations to deities; see [Millon94], p. 19. Given the scant records it is difficult to conclusively document their role and importance.
Figure 4.7 Model of Egyptian house.
Model of an Egyptian house used as funerary object. The model captures what seem to have been the defining details of the architecture it represented. Details were carved into the surfaces. This is an interesting combination of modeling and drawing techniques on one single object. Similar methods were used by Renaissance architects for their models. From the New Kingdom or later, provenance not known. Height 17 cm, length 7.1 cm, width 10 cm. Musée du Louvre, Paris. From [Freed81], p. 35, fig. 1.

Similar to architectural drawings, the number of models increased during the thirteenth, fourteenth, and fifteenth centuries. However, the extant models show a considerable quantitative discrepancy between northern and southern Europe. While they are ubiquitous in Italy, particularly in Tuscany, there are only few examples for the northern regions of Europe (see figure 4.8 and 4.9).% 

% The best-known example is probably the model of St. Maclou in Rouen, at the Musée d’Art Normand in Rouen. Many scholars have discussed this papier mâché model. Particularly the date of the model has been controversial. Whereas some of the authors date it around the beginning the fifteenth century, see [Frothingham07], others see it as a representation of a stage
The complexity of Gothic sacral architecture might have been an important inhibitory factor for building representational models of these structures. In order for the model to be credible, the architects would have had to model the sculptural programs along with the structure of the cathedrals - a daunting task considering the richness of the sculptural decorations. Moreover, the way Gothic architecture was conceived, by aggregating programmatic and functional elements according to canonical rules, might not have required models as conceptual devices.

The use of architectural models in the design and construction process became common practice in Italy during construction of the cathedrals of Milan, Florence, and Bologna in the fourteenth century. As representational models, they played a crucial role in seeking approval from communal authorities and patrons (see figure 4.9). This practice might be indicative for the different commissioning procedures between Northern Europe and Italy, e.g. it was common in Florence to assign building commissions through competitions, and architects were usually requested to submit drawings and models of their designs (e.g. the competition for Santa Maria del Fiore, the façade of San Lorenzo in 1516).

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97 Howard Saalman emphasizes this aspect for both drawings and models. See [Saalman59], p. 103.
Figure 4.8 Model of St. Maclou in Rouen.
This model is one of the few extant models of a French Gothic church. The model has apparently not been used for the design of the structure, since it was built in the sixteenth century. The model is highly detailed, and shows the main sculptural program of the façade. See [Bischoff89] for more details. From Roland Recht, in [Recht89], p. 286.
The models were also physical records of the architects’ intentions. They became guarantees for the clients that the architects’ ideas were serious and developed before the construction begun. It was also simpler for the client to refer to the model, instead of drawings, if the actual construction differed from his/her expectations. Models also constituted a reference lasting beyond the specific architect’s tenure. They protected the original plans from unmotivated modifications later on (e.g. the Opera del Duomo in Florence regularly destroyed models that did not represent the accepted design in order to avoid any confusion. At the beginning of each year all architects had to solemnly pledge that they would follow the design represented in the current model). 98

98 On the role of the models in the Florentine Renaissance and its impact on competitions see Richard Goldthwaite, in [Goldthwaite80], pp. 372-385. Saalman’s investigations on the history of Santa Maria del Fiore in Florence, and on the role drawings and models played during its construction, attenuates the potential referential nature of models. The models for the cathedral were not precise and elaborated enough to provide the basis for measurements during construction. Although the authorities wanted the model to be followed, they did not hesitate to change their mind, or request the architects to modify the original plan. Moreover, Saalman points out that the architects had to convince the authorities that the building would stand up, i.e. that their static concepts were sound. The best way to accomplish this was to build a model that could then serve as the basis for discussions between the architects and the clients. See [Saalman59], pp. 102-105.
This model was built in 1519 by Cristoforo Solari. It shows quite well the type of plastic model solicited by Alberti in his *De re Aedificatoria* – a model that shows the essential spatial configuration but avoids all ornamentation. Como, Musei Civici. From Henry Millon, in [Millon94], pp. 53, and 465.

Models commissioned during the early Renaissance were not standardized in function, size or materials. Their role was determined ad hoc by
the architects or by the clients. However, the architects’ backgrounds as sculptors and/or painters might have encouraged the use of plastic forms for the elaboration of architectural concepts in three-dimensional space, therefore taking advantage of their sculptural skills. And, given that Alberti and Filarete’s treatises, both widely publicized during the time, recommended the use of models, along with drawings, there might have been expectations from the clients for the architects to provide models of their proposals. Extant models document and confirm their continued use for a large number of major and minor commissions throughout the Renaissance. With this increased use came also a diversification in materials and scale. Models were built of wood, wax, and adobe. Full-scale models of architectural elements were also used as templates for the construction site.

The role of the models in the design process described so far did not change throughout the Renaissance. Models made it easier for patrons to understand the architects’ intentions. But the complexity and costs of the buildings ultimately determined the necessity of a representational model - their cost was relatively small compared to the costs for large buildings, whereas they

99 The models’ materials and sizes varied greatly. A model made of bricks is documented for the cathedral in Florence around 1367. With the beginning of Brunelleschi’s tenure as architect of the cathedral, the number of wooden models increases considerably. Architects were requested to submit models for their proposals for the doors of the Baptistery (see [Briggs29a], p. 179), as well as for the various competitions for the dome and its lantern later on. [Millon94], pp. 19-21.
100 See [Goldthwaite80], p. 375.
101 On Alberti see next chapter, as well as the notes in Orlandi’s translation of Alberti’s De re Aedificatoria; in [Alberti89], II, chapter one; IX, chapters eight and ten. On Filarete see his Trattato II, p. 40, or, for a citation of his recommendation on the use of models, see [Goldthwaite80], p. 375.
103 See [Manetti70], p. 93, with annotations by Howard Saalman, suggesting that even vegetables were used as modeling materials.
added significantly to the costs of modest constructions. It is therefore not surprising that the extant models of this period are almost exclusively churches, with a few examples of palaces, fortifications, and cities (see figure 4.10). Although architects used simple models made of clay, wax, and wood to explore their designs, the vast amount of time and material, and, consequently, the prohibitive costs, ultimately prevented the model to attain the same importance as drawings as an exploratory medium in the design process.

Figure 4.10 Model of Palazzo Strozzi in Florence.
This model, built by Giuliano da Sangallo, is the only Renaissance model of a private building that has survived. The model has been built from the inside out, and can be taken apart to show the interior spaces. Only two façades have been decorated. The model measures 147,5 x 117 x 73.7 cm. Museo Nazionale del Bargello, Florence. From Henry Millon, in [Millon94], pp. 72, catalog entry #519.
Chapter 5

The Emergent Standardization of Representational Conventions

Plans, elevations, perspective views, and models were widely used in the architectural practice at the end of the fifteenth century. Architectural treatises by Alberti, Filarete, Francesco di Giorgio, and later, the translation of Vitruvius by Fra Giocondo, and the work of Vasari, Serlio and others, either explicitly recommended the use of orthographic plans and elevation, or they implicitly promulgated this custom by illustrating their writings with such drawings.104

104 The chronology of architectural treatises of interest in this essay starts with Alberti’s De Pictura (1435), and his De re Aedificatoria (written around 1452, and published in 1485). Filarete’s Trattato di Architettura was written around 1460-64. Francesco di Giorgio’s Trattato di Architettura Civile e Militare followed shortly thereafter. In 1511, Fra Giocondo published his illustrated edition of Vitruvius’ De architectura. Sebastiano Serlio’s Tutte l’opere d’architettura, et prospetiva was written and published in 1537 to 1575. His work Regole generali di architettura, published in 1537, introduced the illustrated architectural manual, using scale projections of plan, section and elevation in order to exemplify Vitruvian principles, hereby greatly contributing to the diffusion
However, it was up to the individual architect to decide, which of these representations to use, if any at all. There were no professional standards defining an appropriate set of graphical conventions.¹⁰⁵

This situation changed during the second half of the fifteenth century and first half of the sixteenth century. This chapter describes the stages of these transformations, along with the motivations that led to the standardization of these representational conventions. It begins with the description of the impact of Brunelleschi’s invention of linear perspective, and Leon Battista Alberti’s *De re Aedificatoria* on the architectural practice. It is followed by an account of early archeological work done in and around Rome by architects and artists of the generation of Donato Bramante. This particular period witnessed the emergence of a typology of representational conventions and their practical implementation. The last section of this chapter describes the acceptance and standardization of these conventions by the architects working on the *fabbrica* of St. Peter’s, and the propagation of these standards in Europe through their continued architectural work.

### 5.1 Brunelleschi and Alberti’s Contributions

Filippo Brunelleschi (1377-1446), a goldsmith and scholar of antique Roman architecture, was not involved in the design and construction of the new
St. Peter’s Basilica. Leon Battista Alberti consulted Nicholas V in architectural matters concerning the restoration of the old Constantine Basilica. However, both practiced as architects, and both had a major impact on the work of architects from the fifteenth century on.

Brunelleschi’s work in Florence, particularly Santa Maria del Fiore, liberated architecture from the aesthetic and technological constraints imposed by Gothic traditions. His celebrated invention of linear perspective formalized a new method of representation of three-dimensional space, and opened new venues for artistic and architectural expression for generations to come. Painters and architects were provided with a geometrical (“scientific”) method to visualize three-dimensional space on two-dimensional surfaces. Their perspective representations did not only look credible to the observer, they were also proven to be geometrically accurate, and they could therefore be used as predictive, analytical tools in the representation of architectural space.

Contemporaries of Brunelleschi, such as Donatello (1386-1466), Masaccio (Tommaso di Giovanni di Simone Guidi, 1401-1428), and Lorenzo Ghiberti (1378-1455), quickly embraced his method and achieved a previously unknown degree of realism in the representation of spaces in their paintings and relief panels.

106 Brunelleschi had to explore new concepts and techniques given the difficulties imposed by projects such as the dome of Santa Maria del Fiore in Florence. Hubertus Günther notes that Brunelleschi was in some sense more conservative than his contemporaries when it came to the adoption of antique architectural canons, in [Günther88], pp. 19. On Brunelleschi’s work see [Manetti70], [Goldthwaite80] (passim), [Heydenreich74] (passim), [Ettlinger77] and [Wilkinson77], in [Kostof77], [Kostof90] (passim). [Lotz77], chapter one. For a detailed account on Santa Maria del Fiore see Howard Saalman, in [Saalman64].

107 On the invention of linear perspective, see Martin Kemp, in [Kemp90], pp. 9-14, and Judith Field, in [Field97], pp. 1-24.

108 For a detailed description and innumerable examples of the use of perspective in painting, see [Kemp90], pp. 1-162, and also [Field97], pp. 1-61. For a detailed analysis of Masaccio’s (1401-1428) Trinity fresco see Judith Field’s account in [Field97], pp. 43-61.
Brunelleschi devised the rules of linear perspective, but Leon Battista Alberti, his friend, gave a first written account of the new method in his *De Pictura*, written in 1435. Alberti’s architectural oeuvre is overshadowed by his theoretical work, although his designs certainly contributed to the definition of Renaissance architecture. In his *De re Aedificatoria*, written about 1450, he expressed his views of an architect as the “complete designer”, essentially defining the professional profile of the Renaissance architect, and beyond.\(^{109}\)\(^{110}\) Whether Brunelleschi drew plans and perspectives, and whether he built models can only be inferred from written accounts, and few extant models. Records of Alberti’s design process are even scarcer.\(^{111}\) However, in his *De re Aedificatoria* he expressed a clear opinion of the architectural design process. He differentiated between the architect and the painter’s method of representing architectural space, and he essentially confined the architect to the orthographic representation, whereas he emphasized the use of perspective and shading for the painter.

\(^{109}\) The first Latin edition was published in 1485. It was followed by two later Latin editions in 1512 and 1541. The first Italian translation, by Pietro Lauro, dates from 1546, followed by Cosimo Bartoli’s edition in 1550. The first French translation is published by Jan Martin in 1553; the first Spanish edition, by Francisco Lozano, in 1582. For a commented and contemporary Italian edition, see Giovanni Orlandi’s translation [Orlandi89]. For a detailed account of the publication history, see Paolo Portoghesi’s introduction, pp. XLVII; in [Orlandi89].

\(^{110}\) On Alberti’s *De re Aedificatoria*, which was a theoretical work addressed to the patrons rather than to the practicing architects, see Leopold Ettlinger, [Ettlinger77], in [Kostof77], pp. 111-113. See also [Lotz77], pp. 3-5. On his architectural contributions see [Heydenreich74] (passim), [Goldthwaite80] (passim), and [Kostof77] chapters one through six (passim). The quote is from Leopold Ettlinger, in [Ettlinger77], p. 112. Howard Saalman points out that while Alberti’s treatise is more revealing about the author, it is a poor primer of architectural theory and practice as it existed in the early Renaissance. See [Saalman59], p. 89.

\(^{111}\) There are no extant drawings or models of Alberti and Rossellino’s work on the restoration of the old Constantine Basilica. However, Joseph Rykwert in his article *Theory as Rhetoric: Leon Battista Alberti in theory and in practice*, mentions that for Alberti’s Tempio Malatestiano in Rimini there must have been drawings and models, since there is evidence that a model was taken apart for the masons to understand Alberti’s intentions. In [Hart98], pp. 38.
He considered the plan, elevation, and section, with their correct depiction of position and proportions, the only adequate graphical representations of architectural space. Perspective was to be used as a supplement, at best, since it impeded the perception of the essential *proportio* and *divisio*.

“Tra il disegno del dipintore, e quello dello architetto, ci è questa differenza, che il dipintore si affatica con minutissime ombre e linee ed angoli far risaltare di una tavola piana in fuori i rilievi: e lo architetto, non si curando delle ombre, fa risaltare in fuora i rilievi mediante il disegno della pianta, come quello che vuole che le cose sue sieno riputate non dalla apparente prospettiva, ma da verissimi scompartimenti, fondati sulla ragione”.112

Alberti also considered the model to be an adequate medium for the exploration and the presentation of a design.

“Laonde io certo lodo sempre grandemente lo antico costume delli edificatori, che non solamente con disegno di linee e con dipintura, ma con modelli ancora ed esempi,

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112 Quoted from *Della Architettura*, Bartoli’s edition in 1550; book II, chapter one. Wolfgang Lotz interprets Alberti’s opinion as follows: “Perspektive und Schattierung, für den Maler unentbehrlich zur wahren, d. h. theoretisch richtigen Abbildung dreidimensionaler Formen auf der zweidimensionalen Fläche, sind also dem Architekten allenfalls als zusätzliche Hilfsmittel gestattet. Seine Wahrheit liegt in der “proportio” und “divisio” der zweiten und dritten Dimension, die nach Alberti nur im Grundriss ein wahres Abbild finden können, im perspektivischen Raumbild dagegen notwendigerweise in Verzerrung und deshalb “unwahr” erscheinen müssen.” Quoted from [Lotz56], p. 194. It is interesting to note the differences to Howard Saalman’s interpretation of the same passage, in his case derived from the first Latin edition in 1485. In accordance with Lotz, he concludes that Alberti actually clearly outlined the use of plans. However, Bartoli’s edition of 1550 erroneously omits that Alberti also suggested the utilization of orthogonal elevations and sections. See [Saalman59], p. 105. For the original Latin passage, see Saalman’s note #21. James Ackerman notices this omission in his postscript to the English translation in [Lotz77], p. 39.
fatti di assicelle o di qual altra cosa si voglia, si esamini e pensi e ripensi … tutta la opera e tutte le misure delle parti sue … ”.\textsuperscript{113}

However original, Alberti’s descriptions were theoretical reflections of well-engrained traditions of the fourteenth and fifteenth century, and probably directed at prospective patrons rather than practicing architects. Considering the time and the costs it took to build a model, it is not surprising that architects continued to prefer (sketched) perspective views for their exploration of design ideas – models were used as presentations vehicles once the design was completed.\textsuperscript{114}

Brunelleschi was still revered as a great designer by the end of the fifteenth and the beginning of the sixteenth century.\textsuperscript{115} His work was studied by most architects of the time. Alberti’s theoretical work was no less widely read. Together they conditioned the modus operandi of the Renaissance architects.

\textsuperscript{113} Quoted from Della Architettura, Bartoli’s edition in 1550; book II, chapter one.

\textsuperscript{114} Wolfgang Lotz, Robert Oertel, and Ludwig Heydenreich document this practice with innumerable examples; in [Lotz56], (p. 194 with Andrea Vincenti’s plan for the cathedral in Milan from 1339), [Oertel40], and [Heydenreich37]. Howard Saalman doubts that there was a fundamental distinction between perspective view and a plastic model in the practice of the fifteenth century. He suggests that both were actually used interchangeably, pointing out, based on Wolfgang Lotz’s work, that practically every known fifteenth century Italian architectural elevation drawing is a perspective of one kind or another; in [Saalman59], p. 105.

\textsuperscript{115} Brunelleschi’s work for Santa Maria del Fiore in particular was the subject of continued admiration by generations of architects. Bramante, Raphael, and Michelangelo are known to have carefully studied the architecture of the dome, as well as all the machinations Brunelleschi invented in order to build it.
5.2 The Study of Antiquity in and around Rome

The interest of poets, philosophers, artists, and architects in antiquity is documented throughout the late Middle Ages. Guided by historic curiosity and an interest in an idealized culture (and, in some cases, by the writings of Vitruvius), artists and architects regularly studied the ruins of Roman monuments.\[116\] The return of the *curia* to Rome and the papacy of Nicholas V (1447-1455) reinvigorated these trends. Nicholas, a Tuscan scholar, diplomat and theologian, was very ambitious when it came to consolidate the pope’s office. By moving the principal papal residence from the Lateran to the Vatican, he set the seed for all future developments around St. Peter’s. Moreover, he summoned scholars and artists to his court, hereby establishing a group of people with a vivid interest in Roman history, art, and architecture - among them Leon Battista Alberti, who was to become one of the most influential papal advisors. Alberti dedicated significant time to the study of Roman ruins while working at the papal court as a pontifical abbreviator. This desire, to understand an extinct culture in all its aspects, particularly its architecture, manifested itself in the growing urgency to record the architectural features of decaying buildings, as well as the visual context of the city and its territory as a whole. Numerous, increasingly ambitious, archeological projects were undertaken and accompanied by a growing number of publications dealing with antique Rome.\[117\] It was this

\[116\] Manetti gives a detailed account of Brunelleschi and Donatello’s travels to Rome, in [Manetti70]. Ghiberti, Niccolò Pisano, and Ambrogio Lorenzetti are reported to have spent time in Rome as well; see [Günther88], p. 21.

\[117\] Alina Payne cites following early examples of such publications: Leon Battista Alberti’s *Descriptio urbis Romae*; Flavio Biondo’s *Roma instaurata* (1470, conceived c. 1444-6) and his *Roma triumphans* (Brescia 1482); Francesco Albertini’s *Opusculum de mirabilibus novae et veteris Urbis Romae* (Rome 1510 – the first modern guide to the city); Pomponio Leto’s *Antichità di Roma* (1510); Fabio
quest for archeological facts that shifted the focus from mere observations
towards the scientific study of measures and proportions, thus gradually leading
to a systematic understanding of the *antichità di Roma*. This new approach to
antique monuments required different methods of measurements and recording.
Ambiguous sketches were not sufficient. Methods had to be devised that enabled
the architect-archeologist to locate and precisely measure architectural artifacts
in the field – a substantial effort considering the number of ruins in and around
Rome. Nevertheless, the results of these efforts formed the foundations for
(archeological) maps, guides for pilgrims, vedute, books, and catalogues.

Architects began to produce drawings that depicted only the monuments’
esential features, and by using accepted representational conventions such as
orthographic projections. These drawings were often extensively commented
with textual descriptions, and annotated with numerical dimensions. The
addition of textual information and numerical dimensions to the drawings was

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Calvo’s *Antique urbis Romae cum regionibus simulachrum* (Rome 1527). Important archeological
books published later are Serlio’s third book, *Le antichità di Roma*, 1540; Pirro Ligorio’s *Antichità di
Roma* (Venice 1553); Andrea Palladio’s *L’antichità di Roma* (Venice 1554); Antonio Labacco’s *Libro
appartenente all’architettura* (Rome 1552). Payne points out that the previous city-guide tradition
continued to flourish, paralleling this new genre of archeological publications. For further details
see Alina Payne, in [Payne99], pp. 20. See also Hubertus Günther for a description of the writings
of Poggio Bracciolini, Flavio Biondo, and Leon Battista Alberti, and their impact on Renaissance
treatises. In [Günther88], p. 22 and note # 75.

This is to be contrasted with the traditional, rather subjective, reconstruction of
imaginary architectures used to describe the history of Rome. For example, the *Mirabilia Urbis
Romae*, a Medieval Latin description of the city of Rome, dating from about 1150, was the first
widely distributed guidebook to the historical sites in Rome. Unhampered by any very accurate
knowledge of the historical continuity of the city, the unknown author described the monuments
of Rome, displaying a considerable amount of inventive faculty. From the pontificate of Boniface
VIII (1294-1303) to that of John XXII (1316-34) it was revised and attained unquestioned authority,
despite the increase in the already large number of misconceptions and errors. The *Mirabilia*
concentrated on historical background and the fantastic legends associated with the sites.
Included were also the descriptions of tourists’ itineraries through the eternal city. Lists of relics,
stations, and indulgences were appended to the text after the Holy Year of 1300. Some of these
texts were collected under the title of *Libri indulgentiarum (et reliquiuarum).*
an important step forward. Drawings could now be interpreted and reproduced independently of the distortions caused by the paper, or the draftsmen imprecision.\textsuperscript{119} Architects could then compare different buildings, and search for emergent patterns or \textit{exempla} that could later be assimilated into their personal designs. These practices were widely adopted by the end of the fifteenth century, contemporary to the publishing of Alberti’s \textit{De re Aedificatoria}.\textsuperscript{120}

The painting of \textit{vedute}, the realistic reproduction of landscapes, and later that of urban settings, paralleled this trend in architecture. The architectural \textit{veduta} was a popular subject by the end of the fifteenth century in Italy, depicting architectural monuments within landscapes with increasing realism.

\textsuperscript{119} See Hubertus Günther, in [Günther88], p. 41.

\textsuperscript{120} Hubertus Günther notes that Ciriaco da Ancona’s drawings were of a similar quality as those of Villard de Honnecourt. Alberti’s drawings reflected his belief they should only illustrate the salient features of the architecture, omitting all perspective distortions, shading and decorative additions. Whereas Brunelleschi’s drawings were crude, Alberti’s drawings are reported to have been very precise but unadorned, very much along his opinions expressed later in the \textit{De re Aedificatoria}; in [Günther88], p. 23-25. Günther points also out that the treatise has certainly contributed to the diffusion of the techniques, however, most probably not directly through the architects themselves, but through some of their patrons fluent in Latin. Considering the interpretative difficulties imposed by the Latin text and the lack of illustrations it must have been difficult for artists to understand the theoretical descriptions. Filarete (Antonio di Pietro Averlino, 1400-1469), Francesco di Giorgio, and Giuliano da Sangallo had only superficial first-hand knowledge of the text; in [Günther88], p. 26-27, and p. 44. On the publication history of the \textit{De re Aedificatoria} see the previous section.
Figure 5.1 Drawing of S. Sebastiano in Mantova by Alberti.  
It is supposed to have been drawn from Alberti’s original by Antonio Labacco. It is a good example for what Alberti describes as an architectural drawing: it is linear, it avoids all shading, the walls are drawn in relative proportions and dimensions are marked with numbers – all of the essential geometrical information for the plan is in the drawing. Uffizi A 1779, Florence. From [Günther88], p. 25, fig. 9.

Painters of the period continuously refined these techniques, meticulously drawing architectural details and particularities of the context. This trend might have been a response to the public’s growing realization that buildings existed as
part of the city’s fabric, and not in isolation.\textsuperscript{121} The archeological drawing and the vedute painting converged eventually in technique and choice of subjects. Around 1500 it was quite common for painters and architects to work in both realms (see figure 5.2 and 5.3).

\textbf{Figure 5.2 Veduta from the Campidoglio.}
This veduta from the Campidoglio from the first half of the fifteenth-century, illustrates the growing interest of painters and architects for the urban landscape. Musée du Louvre, Paris.

\textsuperscript{121} The tradition of the \textit{vedute} was first developed north of the Alps. In Florence it was adopted by Alessio Baldovinetti, Antonio Pollaiuolo, and particularly in the workshop of Domenico Ghirlandaio (see figure 5.2); see [Günther88], p. 39-41. See [Kemp90], pp. 144, for later \textit{vedute}, particularly in Venice. The painters’ \textit{vedute} and the architects’ elevations showed great similarities. The only significant difference were the annotations on the plans, which the vedute did not require, and the use of the projection method: perspective for \textit{vedute} and orthographic projections for elevations. Moreover, \textit{vedute} painters tended to group architectural artifacts in their paintings in order to achieve the desired effect, i.e. they adapted the architecture to their needs for the pictorial composition of the \textit{vedute}, whereas the architect would record the scenery as it was.
Architects and painters used a variety of media to sketch and to draw. Exploratory sketches were often made with charcoal, pen, or stylus. Ink was used for more detailed drawings that were prepared by incising lines with stylus, ruler, and compass. Paper of different, standardized sizes was widely available by then. Following the painter’s practice, smaller sheets of paper were glued together to form bigger drawings if necessary. Walls and other elements in plans and sections were often filled (pochéed) in order to distinguish them from other surfaces.

The tradition of the exact architectural drawing was definitely established by the circle of artists working under Sixtus IV (1471-84) in Rome. Five artists embraced these methods for their work with unprecedented precision: Simone del Pollaiuolo (“Il Cronaca”; 1457-1508), Giuliano da Sangallo (1445?-1516), Francesco di Giorgio (Martini, 1439-1502), Gian Cristoforo Romano (1460-1512), and Donato Bramante (1444-1514). In their drawings they distilled Alberti’s advice, and through their work they actually established the orthographic plan and elevation as the architect’s modus operandi.

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122 See Carmen Bambach for details on the use of paper in the painters’ workshops. Joining sheets of paper in order to create bigger surfaces was common practice in the fifteenth century. See [Bambach99], chapter 2. Lucien Febvre describes the emergence of the paper industry in Fabriano during the early fourteenth century, and its growth throughout Italy, and later Europe until the sixteenth century. By the end of the fourteenth century paper was widely available in Central Italy. Although not cheap, it was affordable to artists and writers. See [Febvre99].

123 According to Vasari, it was Simone del Pollaiuolo’s accurate accounts of the marvels of Rome, where he studied, that earned him the nickname of “Il Cronaca” (“The Chronicler”). According to Hubertus Günther, Bramante seems not to have studied the ruins systematically, at least not like Simone il Pollaiuolo, or Giuliano da Sangallo. There are no extant drawings of Roman monuments by Bramante. See [Günther88], pp. 46-47.

124 Refer to Hubertus Günther and Howard Saalman, in [Günther88], p. 42, and in [Saalman59], p. 105.
Domenico Ghirlandaio combines the *veduta* with a highly precise rendition of the coliseum in Rome. The view is *not* idealized, and it shows the state of the ruin as it was. Note that Ghirlandaio used shading to depict the spatial qualities of the Coliseum’s architecture. This drawing is representative of the convergence of *vedute* painting and architectural drawing. Codex Escurialensis 28 II 12, 24v. From [ Günther88], p. 41, fig. 30.

The widespread knowledge of the perspective method, fostered by the painters’ ever increasing quest for realism, led also to extensive experimentation
by successive generations of artists. This trend culminated with the development of new types of perspective representations, specifically the bird’s eye view and the perspective section.

5.3 The Standardization of the Representational Conventions

When Bramante was appointed by Julius II as chief architect of the fabbrica of St. Peter’s in 1503, he had already completed several important commissions in Milan and in Rome, demonstrating his architectural creativity, his professional

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125 Consider for example works by Paolo Uccello (1397-1475), Piero della Francesca (1420-1492), Andrea Mantegna (1431-1506), and Leonardo da Vinci (1452-1519). These artists experimented with different viewpoints, horizon lines, and increasingly complex architectural settings in almost every painting.

126 Wolfgang Lotz gives a detailed description of the various developmental stages of the bird’s eye-views and the perspective section by artists working at the court of Lodovico il Moro in Milan, particularly in Leonardo’s drawings; see [Lotz77], pp. 8-11. While the former was best suited for the depiction of exteriors, the latter allowed for a geometrically correct and simultaneous illustration of the exterior and the interior of a building. However, architects used the same constructive parameters for these different views. In both cases the viewpoints were set high above the imaginary ground plane, and the viewer’s location was distant from the objects depicted in the scene. Walls were partially removed in the sections, which allowed the view of the interiors, but it also heightened the artificiality of the representations. It is important to note that the simultaneous representation of exterior and interior was not novel by then. Drawings by Villard de Honnecourt, in his sketchbook from the thirteenth century, prove that this form of representation was of great interest well before the end of the fifteenth century. For an example see Villard’s drawing of the central nave of Reims, in [Branner63], p. 139, or [Recht95], p. 29. In difference to Villard, Leonardo drew the interior and the exterior from the same vantage point, therefore achieving a geometrically correct correlation of the spaces.

127 Interestingly, with the papacy of Julius II (1503-13), the focus shifted towards the rebuilding of St. Peter’s and the modernization of Rome. However, the representational conventions were well established by then, and their development continued with Bramante and Giuliano da Sangallo as architects of St. Peter’s. The change is also documented in a sharp decrease of drawings documenting monuments in and around Rome; see [Günther88], p. 55. Julius II was much more interested in leaving a visible mark during his tenure rather than continuing to record what others had done. In Bramante he found a willing associate.
skills, as well as his profound understanding of representational methods.\footnote{128}{During the 1480s Bramante was working on the church of Sta. Maria presso S. Satiro, the first structure definitely attributed to him. This church shows traces of the influence of Alberti, Mantegna, and Brunelleschi. It is known for its choir, which was painted in perspective to give an illusion of a much larger space. In Rome he had completed works such as Santa Maria della Pace, the Tempietto, and the Palazzo Caprini. See [Frommel94], pp. 401-402. Bramante was also known as a perspectivist (see [Kemp90], p.43). He constructed and invented architectural spaces for his fellow painters. On his possible contribution for Raphael’s School of Athens, see [Valtieri72]. Raphael’s respect for his teacher Bramante motivated him to portray him as Euclid in the painting. See [Lotz77], p. 11. Hubertus Günther points out that by 1493 Bramante was a renowned architect – and that he was quite aware of that fame. E. g. he did not hesitate to leave Lodovico il Moro’s court in Milan for two months, just after the start of the construction of the choir of St. Maria delle Grazie and the canonica of S. Ambrogio, which prompted Lodovico to search from him in Florence and Rome, without attempting to arrest him – something that would have happened to every architect of lesser fame. See [Günther88], p. 46.} He began the work on the Cortile of the Belvedere for Julius II in 1503, and on the Basilica in 1504-06.\footnote{129}{See [Metternich87].}

Whether Bramante’s design process for St. Peter’s differed from that of his contemporaries is difficult to determine. The only drawing that can be directly attributed to him is a plan illustrating one half of his project for a centralized church (see figure 5.4).\footnote{130}{The plan is the famous Pianta di Pergamena, now at the Uffizi in Florence (1Ar), dating from the summer of 1505. See [Metternich72], p. 35, fig. 1. For a detailed discussion see [Frommel94], pp. 404-409. An additional depiction of Bramante’s project is Caradosso’s medal, which was cast in order to celebrate the start of the work in April 1506. None of the illustrations allow a full understanding of what Bramante’s intentions were, since they show only part of his ideas, and because the proposed project was never realized. Christof Frommel suggests that the drawing was part of Bramante’s efforts to convince Julius II of the advantages of centralized plan, which was a widely circulated concept among architects of the period. See [Frommel94], p.403. Julius II was persuaded to radically change the plan for the new St. Peter’s through discussions with Michelangelo. Michelangelo was working on the monumental tomb for the pope at that time. Apparently Julius wanted to make sure it was placed in an adequate structure. See [Lotz95], pp. 17-18.}
Figure 5.4 Pianta di Pergamena by Donato Bramante.
The plan, showing only half of the proposed design, is drawn on parchment, with dark brown ink, with ruler and compass, some details are freehand. It illustrates Bramante’s idea of a centralized structure that concentrates the attention of those attending religious functions to its center. Note that there are no dimensions or other annotations on the plan itself (although it is drawn on a regular grid). This makes it difficult to determine the purpose of the drawing. 54.4 x 110.5 cm. Uffizi 1 Ar, Florence. From [Metternich72], p. 35, fig. 1.
Bramante relied on several assistants to create the drawings and models for his designs - Antonio di Pellegrino, Antonio da Sangallo the Younger, and Baldassarre Peruzzi. Rome provided unparalleled opportunities for practice at the beginning of the sixteenth century, and all of them were introduced to architectural drawings by either working on one of Rome’s innumerable construction sites, or by surveying antique monuments in and around the city. And, most importantly, Rome’s vibrant intellectual context enabled them to engage in discussions about art and architecture, and to develop and exchange ideas with other artists, architects, and scholars, hereby exposing them to the latest theories and design methods.

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131 The sources do not describe how Bramante worked with his assistants, or the organization of his workshop at St. Peter’s. It is known that later in his life, and affected by near blindness, his assistants had to draw for him. An elevation of the main façade made for Bramante is also known (Uffizi 5Ar). This drawing is supposed to be derived from a wooden model, which was apparently made by Bramante and his group. See [Frommel94], p. 411, and [Millon94], pp. 607-608. No pure orthogonal sections exist. Perspective views and perspective sections were used to represent studies of particular parts of the Basilica. According to Wolfgang Lotz, Bramante’s interiors are mostly defined by projections and recesses of the enclosing walls, therefore by their sculptural character, and enhanced by the interplay of light and shadow. Particularly Bramante’s tendency to interpret architectural interiors as spaces to be seen in perspective, and thus to be represented in perspective, is not always reflected in the drawings by his assistants. Bramante’s designs for San Satiro, i.e. the painted choir, and for the Tempietto are examples of his predilection for spaces that can be perceived from one particular vantage point. Lotz points out that in the prevalent type of perspective sections for St. Peter’s, his assistants freely mingled different perspective viewpoints in order to depict the interior spaces, e.g. Peruzzi in U161A. This overlaying of multiple perspectives resulted in a type of representation that was basically different from those collected in the Codex Coner. See [Lotz77], pp. 11-16.

132 This particular context differentiated Rome from other cities of the first half of the fifteenth century. The sheer number of artists and architects in the city, the exceptional variety and difficulties of building projects, and the constant exposure to the treasures of Rome’s past glory, must have created a very stimulating context. Note that the mode of representation did not differ when these architects recorded contemporary architecture and antique monuments: Giuliano da Sangallo used the same meticulous drawing style while depicting the Coliseum, or Bramante’s Tempietto (the most drawn ‘contemporary’ building of the time).
The extant drawings document their expertise with orthogonal and perspective projections. Both, Antonio da Sangallo the Younger and Baldassarre Peruzzi, have left a considerable corpus of sketches and drawings that illustrates their continued refinement of these projection methods while working as assistants to Bramante, and later with Raphael (see figure 5.4).

Raphael succeeded Bramante as chief architect of the fabbrica in 1514. His limited practical architectural knowledge prompted pope Leo X to appoint Fra Giocondo as his collaborator. Progress on the construction however was slow due to the limited financial resources. Nonetheless, Leo X’s enthusiasm for antiquity led to the continuation of another important project: the cataloging of Roman monuments by Giuliano da Sangallo. Raphael supervised this endeavor as he was appointed inspector of antiquities in 1515, after Giuliano da Sangallo’s departure from Rome.

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133 See chapter three for details on the convoluted history of successions after Bramante’s death in 1514. On Raphael’s architectural oeuvre see [Ray74], [Frommel84], and [Pedretti89].

134 Christof Frommel notes that at the beginning of Raphael’s tenure was essentially characterized by restorative interventions on Bramante’s pillars. Further projects for the Basilica are also illustrated with wooden models by Raphael and Fra Giocondo, and later by Baldassarre Peruzzi and Antonio da Sangallo the Younger. See [Frommel91], p. 182.

135 Bramante had continued the studies for Leo X as well, but it was Giuliano da Sangallo, assisted by Antonio da Sangallo the Younger, who completed the first part of the project under Leo X. This effort culminated in a set of drawings by Bernardo della Volpaia, now collected in the Codex Coner. The Codex is essentially a categorized collection of uniform and accurate drawings, with measurements and annotations. See [Günther94], pp. 269-270.
Figure 5.5 A drawing by Antonio da Sangallo the Younger.
The drawing demonstrates the increasing precision in the drawings in the circle around Antonio da Sangallo the Younger. It contains only the essential information for the understanding of the pilaster’s base. Shading is applied only in order to differentiate between background and foreground. Radii and construction lines, as well as measurements and annotations were left in the drawing – the author did not intend to embellish the representation. The drawing was obviously intended for the stonemasons and therefore did not need any additional decorations. From [Metternich72], p. 46, fig. 47: Uffizi 7976 Av, Florence.
Antonio da Sangallo the Younger and Baldassarre Peruzzi spent considerable amount of time investigating and surveying antique monuments for Raphael. Together with Antonio da Sangallo the Younger, Raphael set out to create a map and a complete catalog of antique monuments in and around Rome. Their efforts led to the establishment of new archeological documentation methods, such as precise measurements with a compass, and further cemented the utilization of precise orthographic projections for the graphic illustrations of the various monuments. The standardization of these drawings was essential in order to allow comparisons among the various buildings.

Raphael’s tenure as chief architect of St. Peter coincided with Leo X’s reform and expansion of the fabbrica’s administration. The appointment of Cardinal Bibbiena as the fabbrica’s curatore in 1513, and the further separation of the architects from the construction site, led to an increased delegation of responsibilities. The architects discussed the project with the curatore, the computista, and the various soprastanti; the soprastanti in turn instructed the operai. It was essential for a timely and successful completion of the new Basilica that

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136 See [Thoenes86], p. 373.
137 It has not been determined what the purpose was for such a catalog. Thoenes points out that one of Raphael’s jobs was to find suitable construction material in the ruins, paying attention only to important artifacts. But in order to differentiate between valuable remains and potential construction material, it was essential to establish a hierarchy of these monuments. Moreover, the archeological survey was part of the efforts to create a topographic map or antique Rome. See [Thoenes86], pp. 373, 375. (See also following remarks on the Castiglione Letter). Arnold Nesselrath describes Raphael’s archeological methods in detail. The surviving autograph material is very sparse and heterogeneous, and it does not provide good insight into Raphael’s personal studies of antiquity. See [Nesselrath86].
138 Günther points out that humanists like Fabio Calvo and Andrea Fulvio probably guided Raphael in his efforts. The information collected during this work was intended for the (graphical?) reconstruction of the various monuments in their urban context. See [Günther94], pp. 270-272.
the architects formulated their intentions clearly and unambiguously – standardized representations were essential to promulgate the information through all ranks.

Raphael expressed all of these experiences in his famous *Castiglione Letter* to Leo X in 1519/20, in which he suggested a systematic method of representation of architecture in plans, elevations, sections, and combinations thereof, as the only practical approach to the solution of the complex architectural and archeological problems. This insight, and the further work by Antonio da Sangallo the Younger and Baldassarre Peruzzi for the *fabbrica* of St. Peter’s, created a *de facto* standard for the depiction of architecture with drawings and models. These conventions were applied throughout the work of Raphael’s successors. Plans, elevations, and sections became progressively orthographic. The drawing techniques were continuously refined, e.g. line thickness and colors were unified, and shading of architectural surfaces was restricted to the bare essential. Measurements, scale factors, and annotations were integrated in the overall layout of the drawings. This normative process further reduced the architects’ artistic autonomy in architectural drawings - essentially enforcing Alberti’s recommendations expressed half a century earlier, and eliminating superfluous subtleties from the drawings (see figure 5.6). Models continued to be used as

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\(^{139}\) The letter seems to be Raphael’s description of his efforts to create topographical map or antique Rome. The descriptions of the graphical methods with which to create the map, make up for the greatest part of the letter. Additional evidence of this purpose is given by Hubertus Günther – he notes that a set of important archeological drawings by the Sangallo group can be dated around 1519, or later. For an in-depth discussion of the letter to Leo X see [Thoenes86] and [Frommel86].

\(^{140}\) Howard Saalman describes Raphael’s contribution as follows: “The so-called Castiglione letter of 1519 to Leo X, is, after all, nothing else than (in contrast to Bartoli!) a *correct*
supplements to architectural drawings (see figure 5.7). As noted in the previous chapter however, their utility was limited due to their prohibitive costs. Antonio da Sangallo the Younger, Baldassarre Peruzzi, and Michelangelo used small models in order to determine intricate parts of St. Peter’s.

Large-scale presentation models were specifically commissioned after the acceptance of the architects’ ideas. For example, when Michelangelo became chief architect of the fabbrica in 1547, he had to first present his project ideas to the pope, Paul III, in form of a small wooden model. Only after the pope’s acceptance was a bigger model built. This was a direct consequence of the enormous costs of Antonio da Sangallo the Younger and Labacco’s model of St. Peter’s – the pope did not want to repeat the same experience again (see figure 5.6).

\[\text{translation and interpretation of the Alberti passage, made by a man for whom the problem of developing more effectual means of architectural representation to meet the needs of a changing architecture was no longer a matter of theoretical interest but of pressing everyday necessity on the building site of new St. Peter’s. Alberti was, as usual, fifty years ahead of his time.” In Howard Saalman, [Saalman59], pp. 105-106. (Emphasis by Howard Saalman).}

\[\text{141 See Henry Millon for an overview of the various models used for St. Peter’s in particular, and in the Renaissance in general, in [Millon94]. The cost of Antonio’s model was approx. 5000 scudi, relatively insignificant compared to the costs of the new Basilica, however, it was enough to build a smaller church. Refer to Henry Millon, in [Millon94], catalog entry # 346, pp. 364. K. Frey, cited by James Ackerman, estimated the cost of the model at between 5,500 and 6,000 ducats. Ackerman converts the value to over $10 per ducat (in 1950). Michelangelo’s model for the dome of the Basilica is estimated at 600 ducats. In [Ackerman91], note #26, p. 381.}\]
Figure 5.6 A perspective drawing by Baldassarre Peruzzi.
The drawing depicts a perspective plan, elevation, and section for a project idea for St. Peter's. Although constrained in their artistic vocabulary by graphical conventions, Peruzzi did not hesitate to draw a suggestive rendering of his project ideas. In one drawing, Peruzzi illustrates analytical views, such as plan, elevation, and section, and a (partial) perspective rendering of the inner spaces of the new Basilica, effectively combining architectural analysis with artistic expression. Description in [Metternich72], p. 62, fig. 107: Uffizi 2 Ar, Florence. From [Wurm84], p. XXV.
Figure 5.7 Model of St. Peter’s by Antonio da Sangallo the Younger.
The model was made with the assistance of Antonio Labacco, built from 1539 to 1546. It was not completed when Antonio da Sangallo the Younger died. This model was the biggest, and most expensive ever constructed for a Renaissance project in Italy. Nevertheless, as soon as Michelangelo was appointed he dismissed Antonio’s design, which made the model useless. See [Millon94], pp. 35-43.
Michelangelo was already an experienced architect by the time he was appointed chief architect of the \textit{fabbrica} in 1547. He successfully persuaded the pope to exempt him from the administrative organization of the \textit{fabbrica}. As in his previous commissions, Michelangelo continued to use sketches, orthographic drawings, perspective views, and models for the illustration of his ideas, and as aids to the construction process. As for San Lorenzo, he again relied on his organizational skills, hiring many friends and neighbors, all skilled artists and artisans, as assistants. The strength of Michelangelo’s group was, once again, that it fully embraced the communication of ideas through graphic illustrations and plastic models. The closeness to his assistants, and the familiarity with their individual skills enabled him to minimize the production of drawings and to streamline the construction activity – a process that was honed while working in Florence.\textsuperscript{142} With his group he realized most of his intentions, or at least created circumstances that made it difficult for his successors to radically change his visions for St. Peter’s - despite innumerable obstacles, political and economic constraints, and technical difficulties. Only with the assistance of this organizational infrastructure was it possible for Michelangelo to pursue his ideas for the new church. The work after Michelangelo is marked by a consistent adoption his mode of practice. By the time of the first competition for the new Sacristy of St. Peter’s, the architects were all required to submit orthographic drawings and a model of their proposal.\textsuperscript{143}

\begin{footnotes}
\textsuperscript{142} See the introduction to this essay and William Wallace’s book, [Wallace94].
\textsuperscript{143} See Helmut Hager’s description of the competition in general, and for illustrations of Filippo Juvarra’s contributions in particular; in [Hager70].
\end{footnotes}
5.4 Beyond St. Peter’s

St. Peter’s became a model imitated throughout Europe, mainly for its innovative architectural ideas, but also for the administrative organization of the fabbrica. The many architects who worked on the construction site disseminated these ideas through Europe. Some of them, for example Juan Bautista de Toledo, adopted similar administrative models and followed the representational standards for their own work.¹⁴⁴

The advent and refinement of new technologies such as printing, engraving, and etching contributed to further improvements of the drawing techniques.¹⁴⁵ Drawings could now be reproduced with an unprecedented clarity and variety of textures and shades. Antonio Labacco’s prints of the projects for St. Peter’s by Antonio da Sangallo the Younger were only the first of many examples (see figure 5.8 and 5.9).¹⁴⁶ Printing eventually became the main

¹⁴⁴ As an example of this trend see the efforts by Philip II and Juan de Herrera for the Escorial outside Madrid. The drawings made by Juan Bautista de Toledo for the royal palace followed the conventions adopted at St. Peter’s - Juan Bautista had worked on St. Peter’s. See [Wilkinson91], pp. 263-264. Juan de Herrera epitomized this tendency by communicating with the construction site solely through drawings. See [Wilkinson74] and [Wilkinson94] for further details. For a detailed description of Phillip II’s efforts to reform Spanish architecture see also [Powell91].

¹⁴⁵ Primarily the refinement of the intaglio printing process (particularly engraving and etching) played an increasingly important role. Florentine and Roman artists of the second half of the fifteenth century used engraving to print some of their work. Andrea Mantegna is known to have experimented with printing at the court of Mantova. Alessandro Boticelli designed engraved illustrations for the 1481 edition of Dante’s inferno. Marcantonio Raimondi, who used to print pirated engravings of Albrecht Dürer’s work (the unsurpassed master of this technique), moved from Venice to Rome in 1510 and worked with Raphael. The latter was well aware of the importance of printing for the distribution of his work. Whereas these artists favored etching for their original work, engraving became the preferred technique for the reproductive specialists. For a detailed description of printing techniques refer to Antony Griffiths, in [Griffiths96].

¹⁴⁶ Catherine Wilkinson-Zerner notes that Juan de Herrera’s printed drawings of the Escorial were the first set of architectural prints to illustrate a completed building, rather than a construction in progress, with measurements and comments. See [Wilkinson91], p. 268.
diffusion mechanism for architects to publicize their ideas, and this practice was well established by the end of the sixteenth century. The quality of prints allowed for highly detailed depictions of architectural examples, and their mass production made them affordable, therefore contributing to the dispersion of innovative architectural ideas among architects and the general public, as well as the representational conventions used to illustrate them.
Figure 5.8 Print of St. Peter by Antonio Labacco.
These prints were engraved by Antonio Labacco to illustrate the design project for St. Peter’s by Antonio da Sangallo the Younger. The first print shows the south elevation of the Basilica, whereas the second is a section through the central axis. Notice that both prints are strictly orthogonal, indicating that Labacco did not intend to show the building from a specific viewpoint. These are analytical views of the building that emphasize spatial sequence, relative sizes and proportions. From [Carpiceci83], p. 171, fig. 273 and 274.
Figure 5.9 Print of the minor dome of St. Peter by Carlo Fontana. These print by Carlo Fontana is a combination of elevation and section. It shows simultaneously the exterior as well as the interior of one of the lateral domes of St. Peter’s. A measured profile is added on the upper left, and a partial plan (1/4) of the dome on the upper right. An extensive caption indicates the different parts of the domes. In contrast to Labacco’s print (figure 5.8), this print was most probably for architects, since the correlation of plan, elevation, and section required the understanding of the various drawings. From [Carpiceci83], p. 222, fig. 351.
Chapter 6

Conclusions

6.1 Architectural representations in the 16th Century

Orthographic plans, elevations, sections, perspective views, as well as models - the representational conventions described in this essay - were known since ancient Egypt. Architects in Egypt, Greece, and Rome commonly used these methods in order to illustrate their designs, and as aids to the construction process. This tradition continued throughout the early Middle Ages. A new appreciation for antiquity, particularly in central Italy, led to a growing interest for the achievements of Roman architecture, which promoted an increasingly precise observation and illustration of the monuments and construction techniques surveyed during archeological campaigns. The invention of linear perspective, describing a perceptually correct method for representing three-
dimensional space, led to an augmented realism in Renaissance painting. By the end of the fifteenth century it was common practice to create realistic illustrations of landscapes and highly detailed architectural settings on large mural surfaces (see figure 6.1). More and more painters and architects adopted drawing, particularly freehand sketching, as an exploratory procedure, enabling them to visualize and refine their architectural concepts through graphical depictions.

In Rome, during the fifteenth and sixteenth centuries, there was an exceptional concentration of artists and architects working on innumerable architectural projects with large construction sites. The refinement and standardization of the representational conventions within the building trades occurred in this environment, fostered by the design and construction of the new Basilica of St. Peter’s, with its complex administrative structure, as well as the efforts to survey and catalog antique monuments on a large scale in and around Rome. Orthographic projections, the preferred methods of illustration by St. Peter’s architects, became the main vehicles through which they studied design problems and then communicated potential solutions to their colleagues, to administrators, and to the craftsmen on the construction sites. This standardization, however, was not the result of a concerted action by a group of people or a specific profession. It was the solution to practical problems faced by architects and administrators of increasingly complex building projects. Furthermore, it was a gradual process, extended over several centuries, which culminated in a general acceptance of these standards throughout the profession.
Figure 6.1 View of the Sala Della Prospettiva in the Farnesina.
The Farnesina was commissioned by Antonio Chigi from Baldassarre Peruzzi. The image shows the Sala Della Prospettiva, with frescoes by Peruzzi, depicting a virtual architecture and a surrounding landscape. Peruzzi’s fresco incorporates the architectural elements of the room within the painted architecture.

Standardized drawings and models eventually became part of the architects’ contractual obligations with their clients. Theoretical and practical architectural treatises promulgated this tradition either by directly suggesting this modus operandi for architecture, and, indirectly, by illustrating their subject matter following these very same conventions.

The refinement of printing technologies contributed to an increased precision of architectural illustrations, and therefore to a greater dissemination and increased appreciation of the standards throughout the building trade and beyond. Drawings became viable substitutes for the physical architecture.
Knowledge of this graphical language enabled others to interpret the architecture depicted in the plans, elevations, and sections: the architect’s intentions could be followed, the spaces and their functions understood, and the three-dimensional design could ultimately be mentally reconstructed. Architects, now empowered by these new techniques and standards, began to publicize their projects for their professional colleagues as well as for the general public, thereby disseminating their ideas and attracting potential patrons.

6.2 Architectural representations today

When a contemporary architect such as Frank Gehry works on a design project, he essentially follows traditions and adheres to the very same conventions established during the fifteenth and sixteenth centuries. Like Michelangelo & Co, Frank O. Gehry Associates (FOGA) consists of a number of assistants and employees, each with particular skills and mastery of specific tools. Gehry develops his ideas in close collaboration with two main assistants. Together they elaborate solutions to the architectural and programmatic requirements in models and sketches. Other employees then refine these initial ideas and work out the details using traditional methods and digital tools. The resulting designs are then discussed, refined, and, ultimately distilled into a final design proposal.

Unlike Michelangelo & Co in San Lorenzo however, FOGA is not manufacturing the parts for the construction of the building – the firm delegates the construction to various contractors and subcontractors. In order to
communicate their intent, FOGA needs therefore to produce drawings conforming to standardized representational conventions: plans, elevations, and sections – a daunting task considering the complexity of Gehry’s architecture, which cannot be adequately represented solely by orthographic projections. This usually results in a plethora of particularized drawings. FOGA has acknowledged this problem by making the digital models of their designs an integral part of the construction documentation, complementing drawings and written specifications. Firms collaborating with FOGA are required, by contract, to have the ability to read and extract information from drawings and the digital models. FOGA hereby imposes the use of their tools and their modus operandi, effectively extending the industry’s traditional representational conventions.

Nowadays more and more architects resort to digital tools, not only for drafting, but in order to build three-dimensional models of their designs. What today appears to be a particular design and production method of a few architectural firms is the beginning of a reversal of a trend established during the

147 Drawings produced by FOGA are interspersed with pointers to digital models, which carry the dimensional information and geometric location of parts of the buildings. Contractors are explicitly instructed to extract the information from the digital models and not to measure or derive them from the drawings themselves.

148 There have been similar developments in the building industry during the late 1980s and 90s. State and federal agencies started to require architects to submit their projects using standardized digital formats in order to be able to process the digital data (for example DXF). Architects wanting to work for these agencies needed to acquire the production tools (computers and CAD programs), and they had to develop the expertise to use them (hire CAD operators, or train drafters). The integration of these tools altered the traditional production process for the construction documentation. Frank Gehry’s approach is different in that the use of digital tools is dictated by the architecture that is being conceived, and the impossibility to represent it using conventional methods, and not through the obligation imposed by an external agency.
last five centuries: the (digital) model will gradually displace standardized
drawings as the main vehicle for the communication of architectural information.
Today, the digital model is to Frank Gehry what the physical template was to
Michelangelo: a guide according to which physical form can be built. Its creation
is still a labor intensive and expensive operation. Like its physical counterpart,
the digital model is therefore not yet commonly used for the exploration and
development of conceptual and schematic design variations.\footnote{149}

Tomorrow, digital models will play an increasingly important role in the
design practice. Buildings will be designed in three dimensions, within virtual
environments of varying degree of realism, using simple and direct interfaces.
Furthermore, due to the digital medium’s versatility, they will serve as the basis
for the solution of a multiplicity of design aspects. The very same models will be
used for interactive simulations, for presentations, for the extraction of
construction information, as well as for the maintenance of buildings well after
they have been built.\footnote{150} This versatility is the digital model’s main asset, and its
production will add economic value to the architects’ design process, hereby
expanding the range of services architects can offer to their clients. This ubiquity
in all stages of the production process will ultimately establish a different set of

\footnote{149} In fact, Frank Gehry’s digital models are not built as exploratory vehicles. Initial
solutions are developed with physical models first. Only when the concepts have been sufficiently
formulated, is the effort to build a digital model undertaken. This practice is mainly motivated by
the current inadequacy of digital tools, as well as by Gehry’s personal preference for physical
media.

\footnote{150} Digital models are already used for simulations, presentations, and the extraction of
construction documentation. However, each of these functions requires a particular model, which
is usually built separately (the model might be extracted from the project’s basic CAD model,
which is then enhanced with additional information to allow for the inference of new
conclusions). This is a time consuming and therefore expensive operation, which is usually
undertaken only if the questions to be answered are of crucial importance to the outcome of the
project.
representational conventions for the design and construction industry - eventually, multi-dimensional, digital models will replace two-dimensional representations as exploratory vehicles for the design of buildings.

### 6.3 Future Work

The goal of establishing the digital model as the central communication medium in architecture can only be achieved if the creation of three-dimensional, digital information can be integrated in the architects’ traditional design methods. Providing the designers with digital tools that afford the immediacy of pen and paper, and building upon the graphical representational conventions and methods described in this essay, is therefore essential, and will be one important aspect of my future work. Furthermore, since architectural design is a collaborative effort, enhancing the importance of the digital model will inevitably change the communication patterns among designers, thus impacting how architecture is conceived. A second aspect of the future work will therefore be the definition of alternative methods of navigation, inspection, and representation of digital data - contributing methods that will enable designers to easily communicate their ideas, share, and develop alternative concepts in their continued effort to improve their designs.
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The History of St. Peter’s in Rome


Methods, Design Techniques and Media


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