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RESEARCH ARTICLE

Proportion and Building Material, or Theory versus Practice in the Determination of the Module

Lex Bosman*

Architectural theorists have advocated the use of a module in the design process since the time of Vitruvius, but the responsibility for the creation of the module has remained largely unclear. The module has always been described as related or equal to the column shaft diameter. Since antiquity columns, for example, were mostly delivered in standard measures; the architect in charge was very limited in his selection of a module. In the 15th and 16th centuries, only gradually did theoreticians understand that here theory and practice were not in line. Things began to change with Vignola, who described a method for how to calculate the proper module for each individual design and building project.

Introduction

It may have been difficult in the past to describe various elements of the process of planning, designing and constructing architecture, and to consider the importance of each of these activities – not only as separate entities or disciplines, but also – and predominantly – in relation to each other. This problem is demonstrated by Vitruvius, who has carved out a formidable position for himself in the history of architecture and architectural theory. Even though his *De architectura libri decem* is of immense importance for our understanding of the architecture of antiquity, it is hard to gain a proper understanding of the fields of architecture described by Vitruvius commonly called practice and theory. To formulate it more clearly: reading Vitruvius, it is not always easy to distinguish when the author describes common practice, or common theory, and when he focuses on a descriptive or normative kind of rule.

Though it may often be possible to avoid this problematic side of Vitruvius' treatise, that is certainly not always the case. As Mario Carpo notes in his *Architecture in the Age of Printing*: 'With its elaborate yet confusing mode of expression, its uncertain syntax, and its inventive hybrid vocabulary of Greek and Latin terms, the Vitruvian text is discouragingly obscure' (Carpo 2001: 16). As Carpo mentions, Vitruvius seems to apologize for any obscurity in his text, noting that he did his best 'as far as [he] could indicate by writing' ('quoad potui significare scriptis, exposui', *De architectura* IV. c. VIII.7 = Vitruvius 2002, vol. 1: 244–247). According to Carpo, one reason for the problematic nature of the text is the absence of illustrations. The text is also difficult to comprehend because of its entanglement of the ideals of theory with the realities of practice, which is what concerns me here.

In much later times, architectural theory evolved into a discipline in its own right, no longer serving as a practical how-to-build guide, since theory does not always have a clear connection to the practice of designing and building. Yet the connection between architectural practice and written theory developed a problematic side, especially in those instances in which the texts relied on examples taken from extant buildings. Vitruvius and many architects and architectural authors in the Renaissance were looking for design rules. They went out of their way to build according to rules and methods that were considered necessary for beautiful and good architecture. It seems that the intertwining of extant architecture, which often provided the examples to learn from, with the written texts that were meant to aid architects in their design work has clouded our understanding of certain notions, instead of explaining them. In this article I will focus on two intertwined phenomena connected with the question of how Roman and Renaissance architects determined the module, and whether or not they were the persons to make these decisions. I will consider how the most important architectural theorists treated the concept of the module, and no less important, how their theoretical discussions of the module are related to the contemporary practices of design and building.

As I will show, it was with Giacomo Barozzi da Vignola's *Regola delli cinque ordini d'architettura* that architects were first introduced to a way of using the module to apply methods and rules independent of local or regional measurement systems. The use of such modules enhanced their control of the dimensioning of buildings. To understand the developments behind this change in practice, I will discuss some of the more important notions in this field prior to Vignola, and examine the way his views on metrology were applied by other architects. One important and much debated consideration in the translation of design and theory into the practical realisation of a building is the identification of a procedure by which all

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architectural components could be related to one another in a proportionally correct way. Typically, part of such a procedure was the module, derived from the diameter of the column shaft. By designing the building and its components in a specific relation to each other, none of these components, these architects believed, would seem out of place within the whole. Thus in Book I, Vitruvius tells the reader about the elements of architecture, and describes the second element as follows:

Order is the balanced adjustment of the details of the work separately, and, as to the whole, the arrangement of the proportion with a view to a symmetrical result. This is made up of Dimension, which in Greek is called *posotes*. Now Dimension is the taking of modules from the parts of the work; and the suitable effect of the whole work arising from the several subdivisions of the parts.

Closely connected is his explanation of symmetry, which he describes as the fourth element:

Symmetry also is the appropriate harmony arising out of the details of the work itself; the correspondence of each given detail among the separate details to the form of the design as a whole. As in the human body, from cubit, foot, palm, inch and other small parts comes the symmetric quality of eurhythmy; so is it in the completed building. First, in sacred buildings, either from the thickness of columns, or a triglyph, or the module [...]. (*De architectura* I. c. II.2 = Vitruvius 2002, vol. 1: 24–27)¹

Most important, however, would be to know how to properly relate a building with its parts. Vitruvius provides a theoretical framework for this operation both in design and construction. A comparison between the above-quoted passages and a few other parts of the text is elucidating. At the outset of Book III (C. I), Vitruvius describes the planning of temples as follows:

The planning of temples depends upon symmetry; and the method of this architects must diligently apprehend. It arises from proportion (which in Greek is called *analogia*). Proportion consists in taking a fixed module, in each case, both for the parts of a building and for the whole, by which the method of symmetry is put into practice. (*De architectura* III. c. I.1 = Vitruvius 2002, vol. 1: 158–159)²

He describes the use of modules again in the third chapter of Book III, when describing the elevations of temples: 'Further, of these parts, whether for tetrastyle, hexastyle, or octastyle, let one be taken, and that will be the module or unit. And of this module, one will be the thickness of the column' (*De architectura* III. c. III.7 = Vitruvius 2002, vol. 1: 174–175).³

The reader will have difficulty grasping exactly how Vitruvius intended the module to be put to work. The 'method of symmetry' is put into practice by 'taking a



Figure 1: Rome, Forum. Fragments of column shafts that were 12 Roman feet long. Photo by L. Bosman.

fixed module', aiming at correct proportions of the building as a whole as well as its parts. In the description in Book III, this problem comes to the fore when he notes that one of the parts should be taken to serve as a module. Subsequently, one module should be the thickness (diameter) of the column shaft, and this module should then be used in the proper way to achieve the necessary height of the columns and the building (*De architectura* III. c. III.7 = Vitruvius 2002, vol. 1: 174–175).⁴ He does not always refer to the module as a module but quite often calls it a 'part'.

As if in passing, Vitruvius mentions a crucial element in the origin of the concept of the module (Book I. c. II). The column diameter is taken as a module, but for the Doric order, the diameter of the column shaft will be two modules. So far everything may seem in order, until one wonders how the module in architectural practice may have served the purpose Vitruvius describes. He seems to describe a design system in which the architect is in complete control of all decisions relating to the design when he mentions that 'a fixed module is taken'. In reality, however, a factor from outside the design process appears to be decisive in this system. The building material appears to claim its importance. Since the great majority of column shafts in Roman architecture were delivered in standard lengths, the modules corresponded to the pre-existing shaft diameters. During the turn from the Roman Republic to the Empire significant changes took place in the process of designing buildings and the delivery of column shaft material from the quarries. Thus the basic element with which, according to Vitruvius, buildings should be designed was no longer invented by the architect from the beginning, but was in large part dependent on the available material.

Thanks to John Ward-Perkins, Mark Wilson Jones and others, we know that column shafts were delivered from the quarries in lengths of multiples of 5 or 10 Roman feet, and of multiples of 4 feet, of which 12 and 24 are common (**Fig. 1**) (Ward-Perkins 1992: 25–26, 63; Wilson Jones 2000: 155; Barresi 2002: 69–72). It would appear that diverging lengths were only ordered from a quarry in exceptional cases. Even with standard lengths, it was difficult enough to design and construct buildings, as can be

seen in the exterior of the Pantheon, for example. The portico was originally meant to display columns with 50-foot (14.88 m) shafts, but instead, another portico was built with columns having 40-foot (11.9 m) shafts. Column shafts were also delivered slightly taller than the standard lengths, in order to allow for specific adjustments in the buildings once the shafts were actually used. This practice may have determined an important factor in the practice of architectural design and construction for centuries beyond Roman antiquity.⁵ It may have also resulted in the reverse of what Vitruvius tried to explain to his readers.

Vitruvius thought of the module as a crucial tool in the design process, as a proportional concept, but not as a standard measurement (see Coulton 1989: 85). He thought the module should be taken from one of the parts of the building and that to select the module one had to begin with the thickness of the column; then the multiples of the module would produce other dimensions. This procedure is described as beginning with the length of the (in this case Doric) temple (Book IV, c.III.3):

The front of a Doric temple is to be divided along the line where columns are set, into 27 parts if it is tetrastyle, into 42 parts if it is hexastyle. Of these one part will be the module (which in Greek is called *embater*) and when this is determined, the distribution of all the work is produced by multiples of it. (*De architectura* IV. c. III.3 = Vitruvius 2002: 220–221)⁶

He then continues with a description of the details of the design and how they are to be regulated by the proper use of the module. The lower diameter of the column shaft determines the module (Book V. c.IX.3), but again the wording is interesting: 'The thickness of the column at the foot is to be of two modules' (in the case of Doric, that is: 'Et in imo columnae crassitudo fiat duorum modulorum'). While one could easily understand this as the way the architect should select the module for a building, in reality the architect in imperial Rome would have been confronted with a module already determined by the sizes of a limited range of standardized column shafts. The friction between the theory Vitruvius was writing and the architectural practice of using column shafts of standard sizes (and proportions) was not explicitly recognized in *De architectura*; most of the changes in architectural design were only gradually taking shape in this period.

In most cases the architect could not determine the exact dimensions of the column shafts himself. Interestingly, when Vitruvius describes the procedure for tapering the column shafts, he mentions several of the most frequently used measures: shaft lengths of 10, 15, 20, 30, 40 and 50 feet (*De architectura* III. c. III.12 = Vitruvius 2002: 178–179). Of these, the last one of 50 feet was not widely used. Does Vitruvius's mention of these measures imply an awareness of the importance of these measures, which could not entirely be controlled by the architect anymore? He does not say so explicitly. However, in a few passages Vitruvius claims that the architect could not control all elements from design to construction and

that the architect should thus make adjustments. This limited control applied both to situations in which not all desired building materials were available, and consequently, also to particular situations of the construction site. Vitruvius urged the architect 'to make slight additions or subtractions, provided this is done with taste [*cum sensu*] so as to avoid a clumsy effect' (*De architectura* V. c. VI.7 = Vitruvius 2002: 286–287).⁷ Vitruvius referred to this passage again later:

An architect cannot control the kinds of material which it is necessary to use, for the reason that not all kinds of material occur in all places, as was explained in the last book. Besides, the client decides whether he is to build in brick or rubble or ashlar. Therefore the test of all building is held to be threefold: fine workmanship, magnificence, architectural composition. (*De architectura* VI. c. VIII.9 = Vitruvius 2002, vol. 2: 56–57)⁸

The limits of a theoretical point of view seem to be reflected here by Vitruvius. He described a procedure that takes the length of a temple as the starting point, from which the module can be derived. Then the design can be made, with the module as the determining element to relate the various parts of the whole to each other. This would seem a rather complicated procedure. Also, the design could only function with a limited number of modules, making the system rather inflexible in practice (Wesenberg 1994: 100; Knell 2008: 88–114). The theoretical procedure should be corrected if necessary, with taste and good judgement, but the decision on the module was left on its own and was apparently taken for granted. Vitruvius did not yet acknowledge the impact of the crucial changes in the production of column shaft material, which were taking shape during his time, resulting in the production of standardized column shafts that provided the architect with limited choices of modules. Vitruvius either did not recognize the conflict between his theoretical point of view and the changing reality of the practices of design and construction, or avoided it due to a lack of a definitive solution.

Later, in Renaissance architectural treatises, the same problem seems to appear every now and then: the question of who could decide on the module and would thus be in control of the design process. Alberti, in his *De re aedificatoria*, mentions the module and describes its use as a given element, without raising the question of who was in the position to decide on the measurements of column shafts and the corresponding modules. Both the available column in any given situation and the measurements of the shaft, including the module taken from the diameter, seem to be taken for granted by Alberti. In most cases in Alberti where in the Latin text the word *modulus* appears, in the Italian translation the word *modello* is used; though in these instances three-dimensional models are the subjects referred to rather than the modules as units of measurement. In Books VII and VIII the word module is used many times in the latter sense; Alberti also uses the term diameter where he could have used module ('Operculi

latitude quaqueversus habebit diametrum summi scapi suae columnae', Alberti 1966: L. VII. c. VIII, 580–581). No explanation, however, will be found about the module: nor does Alberti indicate precisely where at the lower part (*imoscapo*) of the column shaft the diameter should be taken (a point not specified by Vitruvius either), nor does he explain the origin of the module (see Morolli 2007: 767–768). In his explanation in Book VII of the columns and their capitals, bases and other details Alberti equates the word 'partes' with module; this usage would seem to reflect a Vitruvian influence ('parti, dette moduli', Alberti 1966: L. VII. c. VII, 572–573). In the description of the proportions, however, he does not use a similar explanation. While discussing in Chapter VI the supposed developmental process of the orders and the rules given by the ancient architects for their proportions, Alberti mentions the proportions of seven column diameters for Doric, nine for Ionic and eight for Corinthian (Alberti 1966: L. VII. c. VI, 566–567).

Perhaps Alberti accidentally mixed up the last two orders, because in the historical description of the invention of the orders in Book IX, Alberti lists the proportions that would become canonical in the 16th century. The Ionic column, for instance, was made by an ingenious process, at the end of which 'they made a column eight times the width of the base' (Alberti 1966: L. IX. c. VII, 834–837; see Morolli 2007: 767–768 n. 80).⁹ In another instance in which Alberti discusses the columns, he explains how the proper details of the columns should be made, and presents a column shaft 'whose size is neither too large nor too small, but in between: its length I shall set at thirty feet' (Alberti 1966: L. VII. c. VII, 569).¹⁰ One can only wonder whether he accidentally chose a length which was widely used in Roman architecture and which is one of the standard lengths of Roman column shafts, or deliberately. Of course, from the fifteenth century onwards Vitruvius' *De architectura* was digested in various ways, apart from the reflections we encounter in treatises. Architects made notes on specific elements both from their observations of remains of classical buildings and from their study of Vitruvius. They made notes in different ways, sometimes on drawings as well. On drawings by Antonio da Sangallo the Younger and Baldassare Peruzzi, for instance, the word *modulo* appears in obvious reference to the way Vitruvius used the term. Both architects used the word with the meaning as described by Vitruvius, writing down the length of a column in *moduli* (Burns 1988: 213; Frommel and Adams 1994: 233, U 1461A verso; Wurm 1984: T. 361, 469, U 547Ar, U 477Ar). Such notes testify to the way architects were trying to use Vitruvius and Vitruvian vocabulary and incorporate their lessons into their own practices. The concept of the module clearly belonged to this vocabulary.

Until the second half of the sixteenth century, no real changes can be found in the ways in which authors wrote about the proportions of columns and column shafts. Sebastiano Serlio published the first of his books (Book IV) in 1537, on the five orders, and in it he based his theory on Vitruvius. In describing the proportions of



Figure 2: Title page of Vignola, *Regola delli cinque ordini*, 1562.

the orders he uses the word 'parts' to describe the basic elements of the proportional system, the diameters of the column shafts. The column of the Tuscan order, for instance, 'daversi far di sette parti' (Serlio 1584: L. IV. c. V, 127, 129; C. VI, 140; C. VII, 158; C. VIII, 169; C. IX, 183; Günther 1989: 154). In roughly the same period, Pietro Cataneo, in his *L'architettura* (1567) and Giorgio Vasari in the 'Introduzione all'architettura' in the second edition of the *Vite* (1568), both followed Vitruvius as well and though the first simply applied the word diameter, the latter used the word 'teste'. Cataneo confirms the general opinion that the diameter should be taken from the lower column shaft (Vasari 1985: 149–153; Cataneo 1985: 349–350). Where the module in a specific design came from and who would deliver the specific module for a given project remained untouched by these authors.

An important shift in the way architectural theory could relate to practice was made by Vignola. Vignola had a more practical, less intellectual attitude than some of his colleagues (Fig. 2). His treatise initiated a new branch in architectural theory, with its short text accompanying figures that were assigned greater importance. Vignola

intended his *Regola delli cinque ordini d'architettura* (1562) to show architects how to achieve correct proportioning of the five orders. He wanted it to be less a model book than a useful tool to aid architects in the application of the rules of classical architecture (Thoenes 1983/2002: 157–158). In a context in Italy where regional and local measurement systems were used to serve the study of architecture from antiquity, Vignola's work was novel and daring. It seems that Vitruvius had been aware of local measurement systems as well, but his theory does not aim to address this problem (see Thoenes 1983/2002: 163–164; *De architectura* VI. c. II.5 = Vitruvius 2002, vol. 2: 22–23). To avoid the potential confusion about many different local measurement systems, Vignola proposes an arbitrary concept of the module:

I made this choice for all the Orders, extracting only from ancient works and adding nothing of my own save the distribution of their proportions which were based on simple numbers, using not the *braccia*, or feet, or palms of whatever locality, but an arbitrary measurement called the module ('ho fatta questa scelta de tutti gli ordini cavan-dogli puramente da gli antichi tutti insieme, ne vi mescolando cosa di mio se non la distribuzione delle proporzioni fondata in numeri semplici senza havere a fare con braccia, ne piedi, ne palmi di qual si voglia luogo, ma solo ad una misura arbitraria detto modulo'). (Vignola 1562: 'Ai lettori', III; Vignola 1985: 516–517; Tuttle 1998: 206–207, 362)

The use of a module would avoid the problem of location-specific measures like *palmi*, or *piedi*, and be independent of local or regional differences (Carpo 2001: 105). Moreover, according to Vignola, the module would not be derived from the diameter of a column shaft, but from its radius, thus allowing for greater accuracy, at smaller increments, which Vignola deliberately extended to all the component parts of the order (Tuttle 1998: 206). Aiming to be more precise than his predecessors in the detailed design of the orders, Vignola divides his modules in 12 parts for Tuscan and Doric, and 18 for Ionic, Corinthian and Composite. The way in which Vignola then used the concept of the module is interesting, even though his remarks are brief.

In Tavola V (Fig. 3), the Tuscan order is divided, he notes, 'in 17 1/2 parts, and each of these parts we shall call module, which will be divided in 12 equal parts' ('in parti 17 1/2, e ciascuna di queste parti chiameremo Modulo, il qual partiamo in 12 parti uguali'). An interesting shift in the priority of the various elements can be traced in subsequent plates, however.

In Tavola IX (Fig. 4) the Doric order without pedestal is described as 'in its entire length divided in 20 parts; of one of these parts one makes the module, which will then be divided in 12 parts' ('partita tutta la sua altezza in parti 20, di una di queste parti se ne fa il suo modulo, il quale pur si divide in parti 12'). And while discussing the Ionic

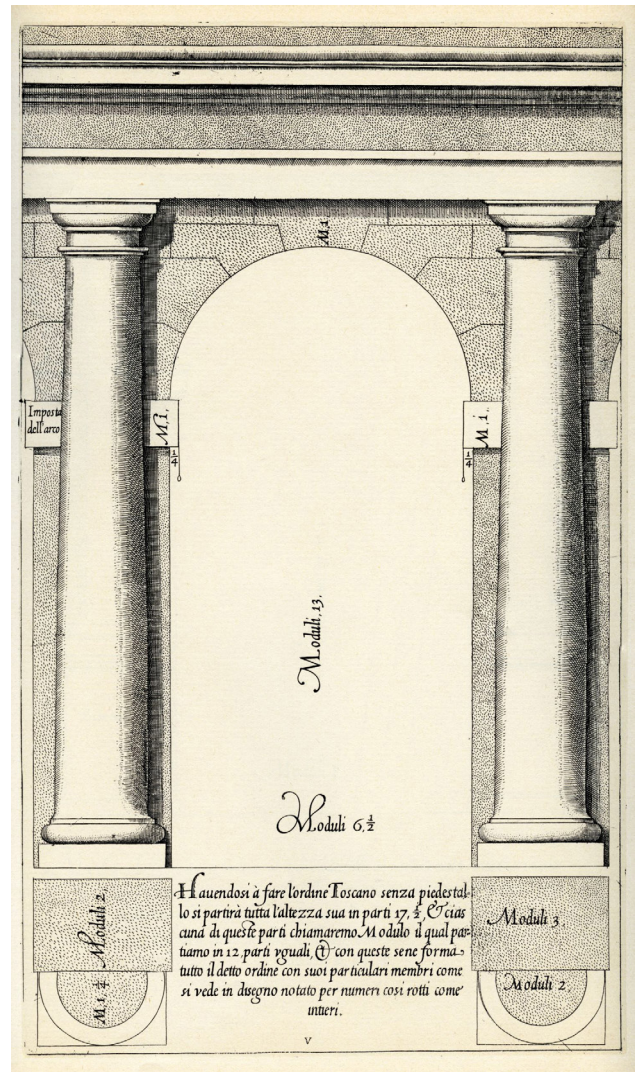


Figure 3: Tavola V from Vignola, *Regola delli cinque ordini*, 1562.

order in the same way in Tavola XV Vignola notes, 'If one has to make the Ionic order without the pedestal, one has to begin with 22 1/2 parts, and to make the module of one of these' ('Havendosi a fare l'ordine Ionico senza il piedestallo tutta l'altezza s'ha da partire in parti 22 1/2, et d'una di queste farne il modulo'). In Tavola XXI a similar stipulation is found, pertaining to the Corinthian order, for which 'the whole length will be divided in 25 parts, and one makes the module of one of these parts' ('tutta l'altezza si divide in parti 25, e d'una di queste si fa il modulo') (Vignola 1562: T. V, IX, XV, XXI, XXIII; Vignola 1985: 518–519, 522–523).

These remarks are interesting because in them we seem to witness another approach in the way in which Vignola works with the module. To begin with the module as the basic element for the design of a building is one thing and would seem logical, when we remember how Vitruvius described the process, and bearing in mind that column shafts in imperial Rome were usually delivered with standard dimensions. What Vignola mentions, however, may sound more difficult: to decide on the height of the building as a starting point for the design process and, from

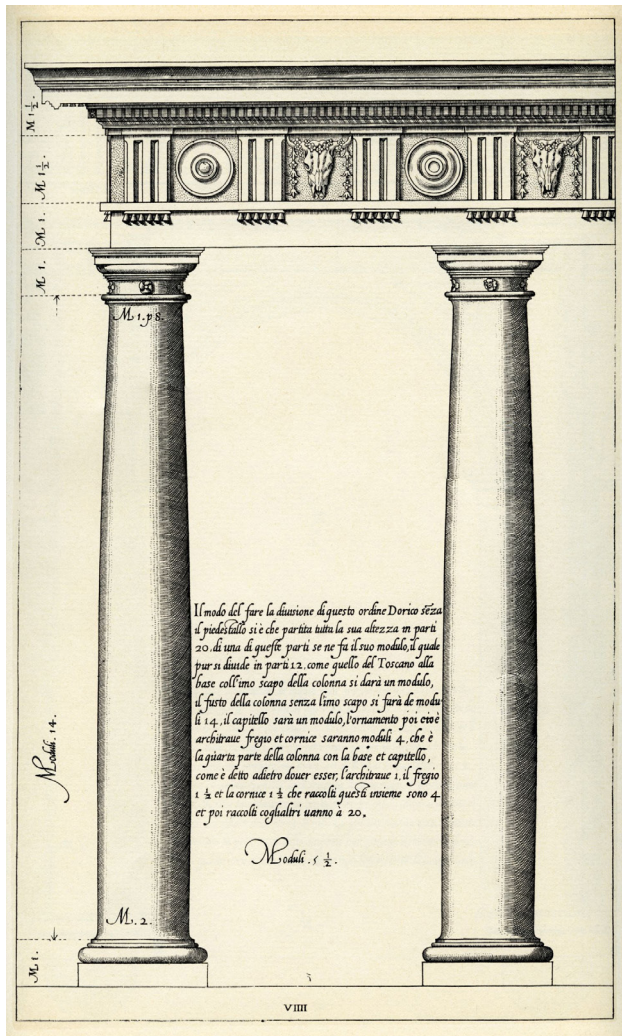


Figure 4: Tavola IX from Vignola, *Regola delli cinque ordini*, 1562.

there, to divide this height into the proper number of parts to make the module. This shift in the use of a module by Vignola is fascinating. Vitruvius described the procedure for determining the module as starting with the length of a facade, but omitted how actually to figure out the module. Though Serlio largely followed Vitruvius with regard to the proportions and started with the module in the design process, Vignola seems to have understood that design tasks could not be solved unless the architect could first gain control over the overall measurements, and thus start with the height of a building and from there work his way down to the module. These observations suggest that Vignola was the first to deliver a rule on how to work out a module for each design project. Proceeding in this way, the architect could then apply the module as a governing tool for the detailed design, for the module remained the means to connect the various parts of a building to each other and to the whole. The architect, who had to decorate a building with architectural orders, was not free in the choice of the module or column shaft diameter. Instead, his starting point should be the height of the building, such as the height of a façade or of a storey. But even so, a problem could still arise when the height of the building

could not be divided by the numbers from the formula Vignola described. In such cases the architect might also have to make some corrections.¹¹

We may comprehend how and why he decided to steer away from less understandable rules advocated by his predecessors such as Serlio. This may have been a crucial change from the way Roman classical architecture had been described in a more-or-less systematic way in antiquity, as indicated by Vitruvius, and in the fifteenth century. Apparently, the perceptions of Roman architecture in the fifteenth and sixteenth centuries began to change. Authors felt uneasy with the Vitruvian fashion of using a module, and Vignola introduced a fundamentally new approach. It is not very likely that Renaissance architects had any detailed awareness of the differences between the use of standardized column shaft lengths in antiquity and the greater freedom they enjoyed in choosing the shaft lengths and the corresponding modules, but their uneasy feeling about the use of the module to start the design process must have helped inspire this new approach.

In his *I quattro libri dell' architettura* (1570), Andrea Palladio does not theorize much about the module, but mainly follows Vitruvius (Burns 2009: 118). As Vitruvius had taught, Palladio explains both in Books I and IV that the module should be taken from the lower part of a column, and should be used as the tool with which to measure all parts of a building. Without referring to Vignola, in Book I c.13 the text and the way of thinking nevertheless seem indebted to the *Regola delli cinque ordini*. The explanation of the module clearly indicates this, since

one should be aware that in dividing up and measuring these orders I did not want to use any fixed and predetermined unit of measurement, that is, one belonging to a particular city, such as the *braccio*, foot [*piede*], or palm [*palmo*], since I am aware that units of measurement differ just as cities and regions do: but, imitating Vitruvius, who divides up the Doric order with a unit of measurement derived from the thickness [*groschezza*] of the column, which is universally applicable and called by him a module, I too will make use of such a unit for all the orders; the module will be the diameter of the column at the bottom. (Palladio 1997: I.13, 18–19)¹²

Vignola was the first to mention the irregularity of diverse regional units of measure as a serious argument in favour of a universally applicable module, as opposed to measures extracted from those specific measurement systems. And in Book IV this description returns, where Palladio describes temples with circular and rectangular ground plans, and he continues to explain how the facade should be organized:

[T]he whole facade of the temple should be divided (not counting the projections of the bases of the columns which will be at the corners) into eleven and a half parts, and one of these parts will be called

module, that is, the measurement with which all the other parts will be measured. (Palladio 1997: IV.5, 219–220)¹³

To indicate the operational use of the module Palladio also uses the words diameter and *testa*. Depending on the type of building, Palladio explained in Book I, the module should be made larger or smaller. Vitruvius and several authors after him were all writing in an architectural context in which the use of standardized marble, granite or other kinds of stone column shafts must have been taken for granted; and only by exception were non-standard column shafts used. When Vitruvius remarked that the architect might need to correct the proportions in a building because it would be necessary to get the best result, one wonders how this should have been translated into architectural practice. But when Palladio mentioned the possibility of diminishing or enlarging the module, he may have used his own experience, in which the use of columns of pre-determined standard proportions was no longer predominant, allowing the architect to design the exact column and module dimensions necessary for each particular building project.

Less well known is the interesting text *L'architettura* (c. 1587) by Pellegrino Pellegrini (or Pellegrino Tibaldi), which never reached the status of a printed treatise. Pellegrino makes use of the well-accepted points of departure in his theoretical text. He does not use the word 'module', but instead describes the same phenomenon by using the word 'diameter' and thus simply describes the height of a given column shaft in the prescribed numbers of diameters, such as 7, 8 or 9 diameters. Although he admires the richness of Roman architecture and mentions the use of different kinds of marble, such as *marmo numidio* – now known as *giallo antico* – Pellegrino Pellegrini does not bridge the gap between the recommended or prescribed ways in which buildings should be designed and practical considerations such as the acquisition of materials such as column shafts (Pellegrino 1990: 295, 299, 302).¹⁴ Apparently, this gap, which Vitruvius does not mention, was later either overlooked in architectural treatises or had become non-existent in a period when the architect could select not only the proportions of the orders and their details, but the module itself.

The next author to discuss is naturally Vincenzo Scamozzi. In his *L'idea della architettura universale* he attempted to invent a precise method for the proportioning of columns, in the process openly criticizing Vitruvius, Palladio and others for their inconsistencies. As could be expected, however, he trusted Vitruvius more than Serlio or Palladio, and mentions and quotes Vitruvius many times. Scamozzi considered Vitruvius to be his most eminent predecessor, and took it upon himself to clarify points that he thought were not clear enough in *De architectura*. Apparently Scamozzi also mentioned and quoted Vitruvius to enhance the theoretical basis for the use of a module (Hopkins 2003: 518). Scamozzi designed a modular system, with a module to be divided in 60 minutes, allowing for greater dimensional specificity in the design

of smaller building components. Like Vignola and Palladio before him, Scamozzi explained the use of a module by stating that any other fixed or predetermined sizes are unsuitable. He described the knowledge, skills, insight and judgement architects should possess and repeatedly stressed the importance of the module. In the second chapter of Book 6, Scamozzi states,

The first and fundamental principle is to calculate the module since it determines not only the proportions and measurements of column bases and capitals, but also the heights and parts of their pedestals and those of the entablature that will go on top ('Come da vera origine, e principio di Fonte si cavino il Modulo, e per conseguenza anco le proporzioni, e misure: non solo delle loro Basi, e Capitelli; ma le altezze, e parti de Piedistilli, e parimente quelle, che aspettano a gli ornamenti, che vanno sopra d'esse'). (Scamozzi 1615 [1964]: L. VI. c. I, 4; Scamozzi 2008: 55)

He was well aware of the importance of the module for every element in the design, since it not only governs the thickness and the height of the columns, but also the dimensions of cornices, pedestals and intercolumniations. From his first book onwards, the module was expressed as a crucial principle:

Because in architecture the module, or the thickness of the column, is the measure with which one reaches the knowledge of the proportions, and the correspondence of the parts with the whole body of the building ('Perche nell'Architettura il Modulo, ò grossezza della Colonna, e misura con la quale si viene in cognitione delle proporzioni, e corrispondenza delle parti di tutto il corpo dell'edifico'). (Scamozzi 1615 [1964]: L. I. c. IV, 47).

Moreover, he explains that the module

is not, as many have claimed, of a fixed, predetermined size like a palm, a foot, a *braccio* or other similar units of measurement, but rather a ratio [*portione rationale*] or uniform standard measure which can be adjusted – either increased or reduced – according to the judgement and discretion of the architect ('à giudizio, e volontà dell'architetto'; 'la quale non è misura sempre ferma, e terminate à guise del Palmo, del piede, del braccio, e simiglianti; come hanno affermato molti; ma una portione rationale, overo regola Homogenea, con la cosa regolata; hor maggiore, & hor minore: à giudizio, e volontà dell'Architetto'). (Scamozzi 1615 [1964]: L. VI. c. II, 4–5; Scamozzi 2008: 55; see also Ottenheim's Introduction in Scamozzi 2008: 13, 20)

With the latter remark Scamozzi acknowledges the decisive role of the architect in the determination of the

module as the element according to which the building and all of its components should be organized. His explanation of the module is more thorough than those offered by other authors, and even includes some history and etymology of the concept of the module as well. He explicitly mentions that the differences between the orders are governed by the different uses of modules (Scamozzi 1615 [1964]: L. VI. c. I, 2). Using more words than most of his predecessors, he also repeats concepts explained by both Vignola and Palladio when addressing the necessity of designing or inventing a unit of measure that could be adopted independent of any predetermined measure or unit. Remarkable is the explicit way in which Scamozzi specifies that the module should be calculated, as opposed to ‘taking’ the module as Vitruvius had mentioned. This specification indicates a much more active role of the architect with respect to the module than either Vignola or Palladio envisioned. Interestingly, unlike his predecessors, Scamozzi briefly mentions that the way in which a module could be calculated might be different than in Vitruvius’s time – on the matter of the module Scamozzi’s emphasis is on the good judgement of the architect. He thus brings theory closer to the practice of design and construction than it had been previously. The connection that was developing during Vitruvius’ lifetime, and that had become fully entrenched during imperial Rome, between the module and a limited number of standardized shaft lengths and diameters is no longer mentioned.

To an unprecedented degree, the Renaissance architect took control over the crucial design element of the module. Whereas in antiquity the module typically depended on the length of the column shaft, this practice was not recognized by architectural theory until Vignola advocated a crucial change in the design process: instead of starting with a module (and implicitly taking its measure for granted), Vignola recommended beginning with the height of a building and deriving the module from it. The module would subsequently be used to establish a proportionate interdependence of all elements in the design. At least in this respect, Vignola reached his goal of presenting a more practical guide than most of his predecessors.

The fact that in architectural treatises until deep into the sixteenth century the discrepancy between the prescribed way of using the module and actual architectural practice was not duly acknowledged may also indicate another element of architectural practice. While in imperial Rome the vast majority of column shafts were delivered in standard proportions – and thus with a predetermined module – Vitruvius does not mention this practice, although he seems to have been aware of it. Alberti’s similar silence on this matter raises the question of whether in his time many column shafts were still delivered in standard lengths. This possibility would coincide with the fact that until Vignola’s *Regola* the procedure for determining the module was not mentioned in architectural writing. It may be that once the architect gained wider control over the building materials, the practice of delivering column shafts in standard lengths to the construction sites was finally left behind.

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Notes

- ¹ The original reads, ‘Ordinatio est modica membrorum operis commoditas separatim univarseque proportionis ad symmetriam comparatio. Haec conponitur ex quantitate, quae graece posoles dicitur. Quantitas autem est modulorum ex ipsius operis sumptio e singulisque membrorum partibus universi operis conveniens effectus’, ‘Item symmetria est ex ipsius operis membris conveniens consensus ex partibusque separatim ad universae figurae speciem ratae partis responsus. Uti in hominis corpore e cubito, pede, palmo, digito ceterisque particulis symmetros est eurhythmia qualitas, sic est in operum perfectionibus. Et primum in aedibus sacris aut e columnarum crassitudinibus aut triglypho aut etiam in Vitruvius (2002) embatere’. All translations of Vitruvius are by Granger unless otherwise indicated.
- ² ‘Aedium compositio constat ex symmetria, cuius rationem diligentissime architecti tenere debent. Ea autem paritur a proportione, quae graece analogia dicitur. Proportio est ratae partis membrorum in omni opera totiusque commodulatio, ex qua ratio efficitur symmetriarium’; see also Payne (1999: 35–36).
- ³ ‘Item ex his partibus sive tetrastyli sive hexastyli sive octostyli una pars sumatur, eaque erit modulus. Cuius moduli unius erit crassitudinis columnarium’.
- ⁴ ‘Cuius moduli unius erit crassitudinis columnarum’; ‘Ipsarum columnarum altitudo modulorum habebunt iustam rationem’; see also Wesenberg (1994: 91).
- ⁵ Ward-Perkins (1992: 25–26, 63). The Pantheon: Wilson–Jones (2000: 130–131, 199–212). In St. Peter’s in Rome several column shafts were taller than their standard length; see Bosman (2004: 39–41).
- ⁶ ‘Frons aedis doricae in loco, quo columnae constituuntur, dividatur, si tetrastylos erit, in partes XXVII, si hexastylos, XXXII. Ex his pars una erit modulus, qui Graece *embater* dicitur, cuius moduli constitutione ratiocinationibus efficiuntur omnis operis distributiones’.
- ⁷ ‘[...] paulum demere aut adicere, dum id ne nimium inprobe fiat sed cum sensu, non erit alienum’.
- ⁸ ‘Quibus autem copiarum generibus oporteat uti, non est architecti potestas, ideo quod non in omnibus locis omnia genera copiarum nascuntur, ut in proximo volumine est expositum; praeterea in domini est potestate, utrum latericio an caementicio an saxo quadrato velit aedificare. Itaque omnium operum probationes triperito considerantur, id est fabrilis subtilitate et magnificentia et dispositione’. See Geertman (1994, 27–29); Wesenberg (1994: 96).
- ⁹ ‘[...] e quindi assegarono alla colonna una lunghezza uguale a otto volte il diametro della base.’ For English translations of citations from Alberti’s *De re aedificatoria* herein, refer to Alberti (1988).
- ¹⁰ ‘[...] ne sceglierò una di dimensioni intermedie, né grande né minuta; la sua lunghezza sia fissata di trenta piedi’.

- ¹¹ See Thoenes (1983/2002: 160–161, 164); Mitrovic (2004: 98). A detailed analysis of Vignola's *Regola* is in Morolli (2003). See Thoenes and Roccasecca (2002: 88–90). An analysis of the words used by Vignola is in Canali (2003: sp. 216–217).
- ¹² Palladio (I.13, 31): 'non ho voluto tor certa e determinate misura, cioè particolare ad alcuna città, come braccio, o piede, o palmo, sapendo che le misure sono diverse come sono diverse le città e le regioni. Ma imitando Vitruvio, il quale partisce e divide l'ordine dorico con una misura cavata dalla grossezza della colonna, la quale è commune a tutti, e da lui chiamata modulo, mi servirò ancor io di tal misura in tutti gli ordini; e sarà il modulo il diametro della colonna da basso diviso in minuti sessanta, fuor che nel dorico, nel quale il modula sarà per il mezzo diametro della colonna, e diviso in trenta minuti, perché così riesce più commodo ne' compartimenti di ditto ordine. Onde porrà ciascuno, facendo il modulo maggiore e minore secondo la qualità della fabrica, servirsi delle proporzioni e delle sacome disegnate a ciascun ordine convenienti'. Palladio (1980, I.13, 29): 'e si toglie il diametro nella parte più bassa della colonna'.
- ¹³ Palladio (1980: IV.5, 259): 'se l'aspetto si farà di quattro colonne, di dividerà tutta la facciata del tempio (lasciati fuori gli sporti delle base delle colonne che saranno nelle cantonate) in undeci parti e meza, et una di queste parti si chiamerà modulo, cioè misura, con la quale si misureranno tutte le altre parti'.
- ¹⁴ *Marmo numidico* is mentioned in Pellegrino (1990: 190). On the treatise, see Scotti (1988).

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