THE "PARALLEL" AND THE COMPARATIVE METHOD IN JEAN RONDELETT TRAITÉ THÉORIQUE ET PRATIQUE DE L'ART DE BÂTIR

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Abstract
In Jean-Baptiste Rondelet's *Traité théorique et pratique de l'art de bâtir* parallels and charts which compare construction information frequently appear as relevant features. However, Midleton and Bandoin-Matuszek’s (2007) masterful study on Rondelet does not value them so much. This communication proposes to revisit the relevance of this features, taking into account the context in which they appear: a treatise that aimed to be a course and also, the first treatise on comparative construction.

Firstly, we shall examine the context that legitimated a project of comparative construction. At the beginning of the XVII century, in the Académie Royale d’Architecture, the search of rules through a comparative method was already a common approach when dealing with other architectural issues; this same approach began to expand to constructive elements (Desgodet’s domes). And in the middle of this century (with Patte) some voices started to demand the use of parallels in compared construction studies.

Then, we shall review how Rondelet's ambitious project may be seen as a reaction to that challenge, and how he could find in his preparatory travel to Italy a validation for his method, as he had the occasion to know that scientists (Lalande, La Condamine, Jacquier) had been as well collecting and comparing measurements of ancient buildings in their enquiries.

Finally, we shall evaluate the results obtained by Rondelet. Charts and Parallels proved to be less useful to determine design rules than expected. Nevertheless, some of them eventually served in some specific cases (stability of walls) to delimit a range of safe measures, or they were useful to verify different design formulas. The ratio tables of walls surface and supports versus space covered and the parallels associated to them were eventually destined to define a new criteria for evaluating whole systems of construction: their economy of constructive material.

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INTRODUCTION

The *Traité théorique et pratique de l'art de bâtir* by Jean-Baptiste Rondelet first appeared in 1802-1803, and with successive editions during the first half of the XIX century, may fairly be considered as the first treatise on construction in broad sense. This huge work, a compilation of ancient techniques, essays and comments on recent works has been masterfully studied by Middleton and Baudouin-Matuszek in his impressive *Jean Rondelet, Architect as technician* (2007).

Figure 1: Uses of Rondelet's parallel (1830-2, vol 6 planches) Plates illustrating ancient systems of construction.

However there is an appealing feature in Rondelet’s work which deserves more attention than this book devotes: his frequent use of comparative charts and plates displaying buildings or construction details at the same scale, that is, "parallels".

Middleton and Baudouin-Matuszek did not seem very impressed by that and underrated somehow their value, as they saw them as a mere continuation of a method already established and introduced by Jacques Tarade, G-P. Dumont and David Leroy, that afterwards was going “to be commonplace in France” (Middleton, Baudouin-Matuszek 2007, p. 83). In addition to that, they found that sometimes they were difficult to understand, as it happens with Rondelet's obelisks parallel (Middleton, Baudouin-Matuszek 2007, pp.213-4) and the comparison of Cecilia’s tomb with the Gize Pyramide (Middleton, Baudouin-Matuszek 2007 p.215). After reviewing his charts, Rondelet is portrayed sometimes as a man prone to compile series of tables, whose results “cannot be regarded as more than crude approximations of engineering design” (Middleton, Baudouin-Matuszek 2007, p.219).

Despite all this, Nègre (2009) has pointed out the relevance of Rondelet’s parallels in a communication to the third of our congresses, and he has cited some interesting precedents. I agree with her reassessment and I would suggest we should look at those parallels and tabulations under a more favourable light. To do this, first of all we should examine Rondelet's work as what he intended it to be: a course and a treatise on compared construction. The first ever made, with all the risks and uncertainties associated to a novel work. We also suggest a change of perspective. Instead of assessing Rondelet's work from the advantageous point of view of our current knowledge of what would be fruitful (modern engineering calculation). We should rather consider it as the mature result of a method that appeared promising since it started to be used in the Royal Academy of Architecture at the end of XVII century.

Comparison, rules and the quantification of the architectural size as an end. The Royal Academy of Architecture

Determination of rules was one of the main tasks of the Académie Royale d'Architecture since it was founded and comparison was its favourite method. In the last third of the XVII century we find long sessions devoted to compare Palladio with Desgodetz measures, and both of
them compared with Vitruvius', sessions dedicated to examine the Parallel of Freart de Cambray (Lemonnier 1911 vol.3, p.233 and 1913, vol. 3, p.63). What eventually will lead quite naturally to the idea of using parallels to evaluate how real size was related to aesthetical effects, such as "greatness" or "power" (as in Jacques Tardate or Julien-David Leroy parallels, which are not analyzed here, as they are not directly related to construction).

On the other hand, architects were used for technical design to relay on rules often of a geometrical kind. Quite naturally, at some point, the question of determining the rules for technical design by comparing several buildings should arise.

This is what happened in 1708, when Desgodets presented to the Royal Academy a collection of drawings and plans of several great domes from Rome and Paris, to which he added the measures that Brunam took of the domes of Santa Maria del Fiore in Milan. In the consecutive sessions the domes of College Mazarino and the Invalides were discussed (Desgodets surprisingly enough considers this one as "legère"). Finally the dome of Saint Paul received attention in another meeting (Lemonnier vol.3. pp.299-307, p.334).

A generation later, Soufflot will deal with the same issue. In 1731 (or 1733-138) the dates are not still clear, he made a tour in Italy, inspecting the domes of Andrea della Valle, Il Jesu, San Carlo de Cinari or San Carlo al Corso (Middleton, Baudouin-Matuszek, 26).

**Parallels of construction asked for. Pierre Patte challenge**

Comparative studies and the determination of rules may find the parallel a suitable instrument. A parallel displays various examples of a selected collection of solutions to a problem, all at the same scale and ready to be looked at a glance, allowing to compare them and to reach conclusions about possible rules and also to guess how they depend on the size of the building.

In mid XVIII, the architect Pierre Patte was probably one of the architects more determined to promote the studies made in parallels at the same scale. In 1755 he criticized his "maître" Jean François Blondel for not having included comparisons and parallels in his celebrated cours. (Patte 1754, p.39). These should be instrumental in improving aesthetical appreciation. But in 1769, he places the question of the parallel on a different ground: precisely in terms of design and construction. He bitterly complains about the lack of cumulative constructions compendiums which would help to "transmettre les découvertes qui y ont été faites successivement". And he will commit himself to redress that situation by putting "en parallèle celles de même genre" that would serve to "déduire des principes capables d'éclairer les routines des Constructeurs & de les mettre en état de ne plus opérer au hasard" (Patte 1769, "epître" not numbered).

After this, only one year later, in 1770 Patte provokes a great controversy with his "Mémoire" on Sainte Geneviève, in which he attacks the weakness of the solution for the dome designed by Soufflot. He does so by comparing this one to the domes of San Carlo a Catinati, Madona de Miracoli, Il Jesu, Santa Margarita in Monte Flavone (all f them taken from Fontana), and adding Santa Maria del Fiore. To support his reasoning, he displayed a plate where Saint Peter, Saint Paul, Val de Grâce, la Sorbonne, les Invalides and Sainte Geneviève are drawn at the same scale. Ending in a challenging tone: "nous invitons ceux qui entreprendroient de répondre à ce Mémoire, de ne point donner pour raison, des conjectures ou des opinions particulières, mais de suivre à peu près notre marche, c'est-à-dire d'appuyer ce qu'ils avanceront, par des faits en parallèle" (Patte 1770, p.35).

A provocation that no doubt will resonate for a longtime in Rondelet's mind and will eventually oblige him to react, accepting the "parallel" as the battlefield where the combat was going to be fought.
Meanwhile, in 1775, as a first answer Soufflot requested Rondelet to prepare a memory comparing the areas and weight of several domes (Middleton, Baudouin-Matuszek 2007, p.67). In 1780, Soufflot counterattacked again by ordering to engrave several domes as Saint Augustin in Plaisance, Saint Carlo al Corso in Rome and Saint Laurent in Turin among others, as Rondelet said, "pour être mis en parallèle avec le sien: et pour refuter par ce moyen la comparaison desavantageuse de M. Patte" (Middleton, Baudouin-Matuszek 2007, p.302).

Rondelet's journey to Italy at the encounter of men of science, and the comparing and tabulation of architectural measurements

But more and more, it was becoming apparent that what Patte asked for was not so easy. The compared study of construction, especially that of domes, demanded to collect plans and drawings (with probably disparate scales and units which complicated not little the task) or take new measurements to check them, which implied much travelling around Europe.

Thus, it originated a new kind of tour, focused on special technical features of buildings. Pierre Patte himself averred to have been in England to examine Wren's dome. And he claimed to have travelled extensively in Italy, England and Holland, part of France and Germany to examine "la construction de la plupart des coupoles et voûtes sphériques ou sphéroïdes". After that, he could deduce an empirical non scalar rule of design, being the "épaisseur des murs, a peu près le dixième de leur diamètre" (Patte 1770, p.10).

Three years later, in 1783, Rondelet decided to undertake his own journey to gain a cumulative knowledge of the techniques from the past until nowadays. He delineated a broad programme that curiously echoes what Patte had previously, in 1769, claimed to do: "je crois que j'aurai fait exprès de me tromper de l'architecture de ces Édifices fameux, les procédés qu'on y a employé, ceux mêmes qu'on emploie actuellement... serviront beaucoup au progrès de l'art de bâtir, sur tout si ces différents procédés étoient discutés et comparés aux nôtres, dans un ouvrage comme celui que je projette" (Middleton, Baudouin-Matuszek 2007, p.307 and for the trip, pp.79-88). Rondelet parted convinced of the necessity of comparative studies and parallel displays, but clearly had in mind something more ambitious, not limited to the discussion of dome's rules of design.

For different reasons, Rondelet began to be obsessed also with cost, an issue with a moral value for him. One thing he showed to be original at and not tried before was to study construction comparatively in economical terms. Not in terms of money -which he would imagine was hard if not impossible to determine for ancient buildings-, but in terms of a relation between "mass of construction/ space covered", which was easier to determine by simply measuring on the ground plan the areas occupied by walls and supports and the area of the space covered. And thus, a new criteria for analyzing and evaluating the merits of a construction in history was born, a judgement that was independent of the qualities of the architectural style of the building. (Middleton, Baudouin-Matuszek 2007, pp.82-83).

This travel was to be as unconventional as the matter itself. Once in Italy, Rondelet met often with mathematicians, scientists, scholars and astronomers such Abbé Matteucci of Bolonia, Abbe Ximenez or Father Jacquier. This could seem a strange company for a trained architect. It is clear that he was looking for information about advances in structural calculation and techniques. But they also had something in common with Patte or Rondelet: since the beginning of the XVIII century, they had been occasionally gathering measures from ancient buildings in order to create tables and compare them.
The reasons for this enquiry are complex (and involved fields such as geography of the ancient world or metrology). Anyhow, they were concentrating on the same problem and collecting valuable information for Rondelet.

In Rondelet’s baggage was a book from the celebrated astronomer Joseph Jerôme Lefrançois de Lalande, *Voyage d’un Français en Italie dans les années 1765-66*. Here Rondelet could read how the author could compare Saint Peter to Saint Paul measures, thanks to a drawing of Saint Paul which “a été fait avec soin par M. Patte”, his challenging opponent. Or see how Lalande referred to the Jacques Tarade’s parallel of Saint Peter, Notre Dame and Strasbourg’s dome, and compared Notre Dame with les Invalides and the Gize Pyramide (Lalande 1769, pp.58-59). Furthermore, Rondelet could know, thanks to Lalande, there were other men with a keen interest in comparing the measures of the inner space of buildings with their outside ones – anticipating somehow what he had in mind - . Lalande gave the measures – he obtained them from the man of letters Louis Gugenot – of the length of the central and transverse axis and the nave’s width - with and without walls- of Saint Peter, Saint Paul, Notre Dame, Strasbourg cathedral and Milan duomo (also the heightness of the building and the domes of Saint Peter, Paint Paul and Invalides) (Lalande 1769, pp.60-63).

In Lalande’s book, Rondelet found a reference to another astronomer and man of science, La Condamine, who was mentioned as having taken measures of the Pantheon and checking them with those by Desgodets (Lalande 1769, p 645). La Condamine had been looking for something which had interested the architects of the Academy as well: to determine the “true measure” of the Roman foot. Determining this would help to interpret the distances mentioned in ancient text, situate lost places of Antiquity, and solve the contradictions between the different surveys of Roman Buildings (mainly those by Desgodets or Palladio). La Condamine’s project was to deduce it by measuring some features of many ancient buildings, such as the axes of the Colisée, the diameter of the Pantheon or the façade of the Döcletian Thermæ, supposing that they had probably been measured in whole numbers. In fact, the idea was not new: in 1698 La Hire had already proposed it to the members of the Academy) (La Condamine 1757, p.25).

Rondelet read with much interest La Condamine, and shared his fascination for the ancient metrology. For a man who wanted to make parallels at the same scale comparing ancient and modern buildings, the finding of a common measure, and the determination of real ancient measures were essential. A proof of this is that the first plate of Rondelet’s book of plates (Rondelet 1830-32, vol. 6) is granted to Egyptian Obelisks (in association with a text in which he discusses the problem of the finding the “Egyptian cubit”) as stressing this kind of preliminary studies as fundamental in a comparative work.

La Condamine’s project ended disappointingly with no conclusive answers, but anyhow Rondelet was able enough to take advantage of the measures taken by La Condamine for his own comparative “project”.

In Rome, Rondelet met another man of science, Father Jacquier, with whom he inspected Saint Peter. On this occasion, he would probably found out that his obsession to assess ancient construction from the economical point of view, determining it by gauging its volume and mass, was shared by scientists such as his host: we know by another astronomer, Barthélemy, that he had accompanied Jacquier to measure the Colisée, “pour determiner à peu près ce que coûteroit ajoyrd’hui la seule enceinte extererieure” (Barthélemy 1802, p.191).

Thus, Rondelet came back from Italy not only with calculations or techniques. He would come back also with the conviction that this comparative method, based on the tabulation of measures, was a good and scientific one. If men of science used them to ascertain ancient measures, it could as well serve to discover other rules relating to construction.
Uses of Parallels and charts in the final work: determining rules of design, testing formula, ranking systems of construction by their economy in terms of mass / space enclosed

Years after, all the information he had gathered would appear in his books under the form of parallels. Many of them. There were parallels at the same scale for discussing metrology, for reflecting about the ancient systems of lintel, vaulting, and domed construction, or for reckoning how timber structures depended on size. And he devoted parallels to what he view as one of the most promising capacities of the parallel compilation: to compare structural behavior.

Figure 2: Uses of Rondelet’s parallel (1830-2, vol 6 planches). Left, obelisks illustrating metrological search of ancient Egyptian units, Middle, (id., vol. 7), parallel of cross sections helping to check rules for the stability of walls. Right, (id. vol. 7) Parallel of ground plans related to the ranking of construction systems in terms of surface supporting elements / space covered.

We are going to concentrate on two sections related to the last issue. In the first one, entitled “des points d’appui et murs isolés”, the question to answer is to determine the safe dimension for a standing wall in the case of a building covered by a timber structure -not suffering then lateral thrust-. And the way to answer it was twofold.

Firstly, after reviewing a list of buildings, mostly paleochristian churches from Rome and churches of Florence and Naples, he noted the variations observed in the relation between the wall’s height and their base. He tried then to determine the maximum and minimum correlations.

He eventually found they were running from 1/32 in Saint Paul to 1/12 in the paleochristian basilicas (Rondelet 1805, vol. 3, pp.195-197).

This was perhaps too wide a range to be of any use. Then he changed tactics and tried another almost statistical rule, in this case correlating the width of the space to cover, with the breadth of the wall. After examining “280 buildings, modern and ancient, in France and Italy”, Rondelet found that a “minimum” safe was to give to the walls “la vingt-quatrième partie” of the breadth of the space to be covered (Rondelet 1805, pp.197-198).

With all this, he saw clearly he was only capable of giving empirical “limits” to the design of a wall. That is all he could reach by way of parallels and charts. To determine a precise dimension requires establishing a formula, a calculation that needs to be founded on the rational considerations of mechanical efforts. Rondelet conceived a really complicated one. We are not now to judge its rationality, what interests us here is to point out that this time the listing of measures and buildings serves for testing the goodness of the formulas. He discovered that the results obtained by using it were proved to be very near to the reality (Rondelet, pp.199-203).

The other section to be taken into account is devoted to vaulted buildings (Rondelet 1805, pp.214-235). Here, Rondelet seems to have changed his mind from the earlier editions to the last one. At first, he wanted to use all the measures he had of walls and space enclosed of 280 buildings to deal with the general problem of the stability: “une comparaison des murs et points d’appui de plusieurs edifice (...) avec l’espace qu’ils occupent, pour faire connaitre le degré de
stabilité qui leur convient". But what he really did this time was to address "economy" almost in amoral sense. Buildings may be listed and paralleled, as Le Roy did, by their beauty, "grandeur" or other aesthetical qualities. But if we search for those that have used less constructive material, a different ranking could be made that eventually would determine the superiority and efficiency not only of one building over another, but of some general systems or typologies over others.

Thus he tried first to contemplate them in a typological order -not always thoroughly sustained:- paleochristian churches, Greek temples, circular temples, palaces, domed buildings, Roman thermae and other great structures of Gothic and Renaissance periods (Sainte Geneviève included) were reviewed. Then, he listed them simply by their "solidité", their degree of hea-

Figure 3: Left and middle. (Rondelet paralles, 1830-2, vol. 7) Parallel of ground plans related to the ranking of construction systems in terms of surface occupied by supporting elements /space covered. Left Durand parallel putting at the same size two buildings for a better perception of this relation. In this case shows the superiority of the Basilica of Constatine's design over Saint Peter.

This approach to construction, this evaluating its quality by determining the cost of a building in terms of mass employed /space covered was not an oddity, idiosyncratic of Rondelet. At the beginning of the century he was not alone on this. Probably this is not better explained than in the Précis de Leçons de J.N.L. Durand. With this important difference: Durand extended its use to judge the quality of architecture. Good architecture should select a good economical system of construction, reflected on the relation of areas of walls and supports /areas of space covered. And those demonstrated by comparison and parallel to be the more efficient were just precisely those simple primitive basilica celebrated by Rondelet. For Duran, the point was obvious when an amplified Constantine basilica was compared in parallel to Saint Peter (Durand 1817, pp.24-25).

The irony is that the same reasoning served to blame Saint Geneviève. Durand remarks that in this church the perimeter of the walls, 612 meters, enclosed an inner surface of 3.672 meters, that "has cost eighteen millions", while the apparent space enclosed is even less considerable. The building of his proposal, he noted, was better because he enclosed much space, 4.292 meters, with a wall of only 248 meters, thus it would eventually cost half this quantity (Durand 1802, 20-22). It is intriguing to see that this interpretation coincides with the first edition of the first and second "livres", both together making up the volume I of Rondelet's treatise, dated 1802-1803. A coincidence that invites to a deeper research.
REFERENCES

La Condamine, Charles, Marie. 1757. "Extrait d'un journal de voyage en Italie, par M. de la
Condamine." *Histoire de l'Académie Royale des Sciences. Avec les Mémoires de Mathéma-


Durand, Jean Nicolas, Louis, *Précis des Leçons d'architecture donnés à l'Ecole royale poly-
technique*, vol.1, 1802, Paris: chez l'auteur.

Durand, Jean Nicolas Louis, *Précis des Leçons d'architecture donnés à l'Ecole royale poly-
technique*, vol.1, 1817, Paris: Chez l'auteur.

Lalande, Joseph Jerôme de. 1769. *Voyage d'un français en Italie. fait dans les années 1765 &

Lecoy de la Marche, Albert ed. 1874. *Académie de France a Rome: correspondance inédite de
ses directeurs, précédée d'une étude historique par A. Lecoy de la Marche*, Paris: Didier.

Lemmonnier, Henry. 1911. *Procès-verbaux de l'Académie Royale d'Architecture, 1671-1793*,

as Technician* New, Haven and London: Yale University Press.

Nègre, Valérie. 2009. "Some considerations on Traité de l'art de Bâtir by Rondelet and the
Technical Literature of his time". *Proceedings of the Third International Congress on Con-
struction History, Cottbus, Brandenburg University of Technology. 20-24 May 2009*, The
Construction History Society.


Patte, Pierre. 1770. *Mémoire sur la construction de la coupole projetée pour couronner la

l'auteur.

Rondelet, Jean-Baptiste, *Traité théorique et pratique de l'art de bâtir*, vol 6. vol.7, 1830-32,
Paris: Chez l'auteur.