
RESEARCH ARTICLE

The Matrix Regained: Reflections on the Use of the Grid in the Architectural Theories of Nicolaus Goldmann and Jean-Nicolas-Louis Durand

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In addition to the superficial visual similarities between the architectural theories of the Silesian-born, seventeenth-century Dutch mathematician Nicolaus Goldmann and the early nineteenth-century French architect Jean-Nicolas-Louis Durand, there is a more profound interconnection: their use of the grid. This article evaluates the relation between the two theories and argues how Durand could have been influenced by Goldmann's writings. It turns out to be more than likely that the two were linked by Durand's German pupils who brought the tradition of German eighteenth-century architectural theory with them. This corpus was nourished by Leonhard Christoph Sturm's 'Goldmannic' architecture.

Introduction

The gulf between Dutch seventeenth-century architectural theory and architectural education in early nineteenth-century France is large. This distance is more than one of time and space; it is defined by a cultural and intellectual context that differed radically, and by different ways of thinking about architecture. Nevertheless, this article will focus on two architectural theorists on either side of the divide, making a comparison between the mid-seventeenth-century architectural theorist Nicolaus Goldmann (1611–1665) in the Dutch Republic and the French architect and academy teacher Jean-Nicolas-Louis Durand (1760–1834) in the revolutionary years around 1800. Could Goldmann have been an Early Modern source for aspects of Durand's compositional method? Their writings show some remarkable similarities, the most obvious being aspects of the visual appearances of their theories; to be more precise, in their similar uses of the grid. Although they do so each in their own specific way, they both apply the grid as a modular design tool and as an elaborate proportional system, which constitutes the core of both theories.¹ The visual similarities between these two theories raise the question of whether their work could be historically interconnected in some way.

Goldmann's Universe

When, at the age of 54, the Silesian-born Nicolaus Goldmann died in the Dutch university town of Leiden in 1665, he left his magnum opus, a book comprising the whole field of architecture, unpublished. However, for several decades he had shared his insights with students

from all over Europe, especially the German states, Poland and Scandinavia, but even from as far away as Ireland. Following the publications of his books on fortification, an influential tract on the Ionic volute and two manuals on specific instruments for drawing architecture to scale, his comprehensive theory on civil architecture was about to be published in Berlin under the sponsorship of the Great Elector, Friedrich Wilhelm (Goudeau 2005; Semrau 1916; Bernet 2005). Had his life not ended prematurely, the influence of his work in northern Europe might have equalled that of Vincenzo Scamozzi's *L'Idea della architettura universale* (Venice 1615) – both being systematic handbooks in which architecture was conceived as a mathematical discipline, in accordance with contemporary scientific standards (Goudeau 2006–2007). Nevertheless, his legacy spread across northeastern Europe in the form of nearly identical manuscript copies taken home by his mainly aristocratic students.² Whereas in the north the treatises on the column orders typically occupied centre stage, Goldmann covered more broadly the whole of architecture in four books. In Book I he dealt with the general principles of architecture, similar to those laid out in the first book of Vitruvius's *De architectura*, including a set of architectural terms and other essentials presented in the Euclidian format of *definitiones*, *axiomata* and *postulata*; drawing methods; building materials; and construction methods for foundations, walls and roofs. This first part is followed by three books on, respectively, the orders, the interiors of buildings and an elaborate description of building types.

Halfway through the treatise, at the beginning of the third book, all of the topics listed above are brought together in a description of a city (Goldmann 1696; Goudeau 2005: 343–367).³ This theoretical city proves to be the key to evaluating the impact of Goldmann's architectural theory as a whole. Presented as a monarch's

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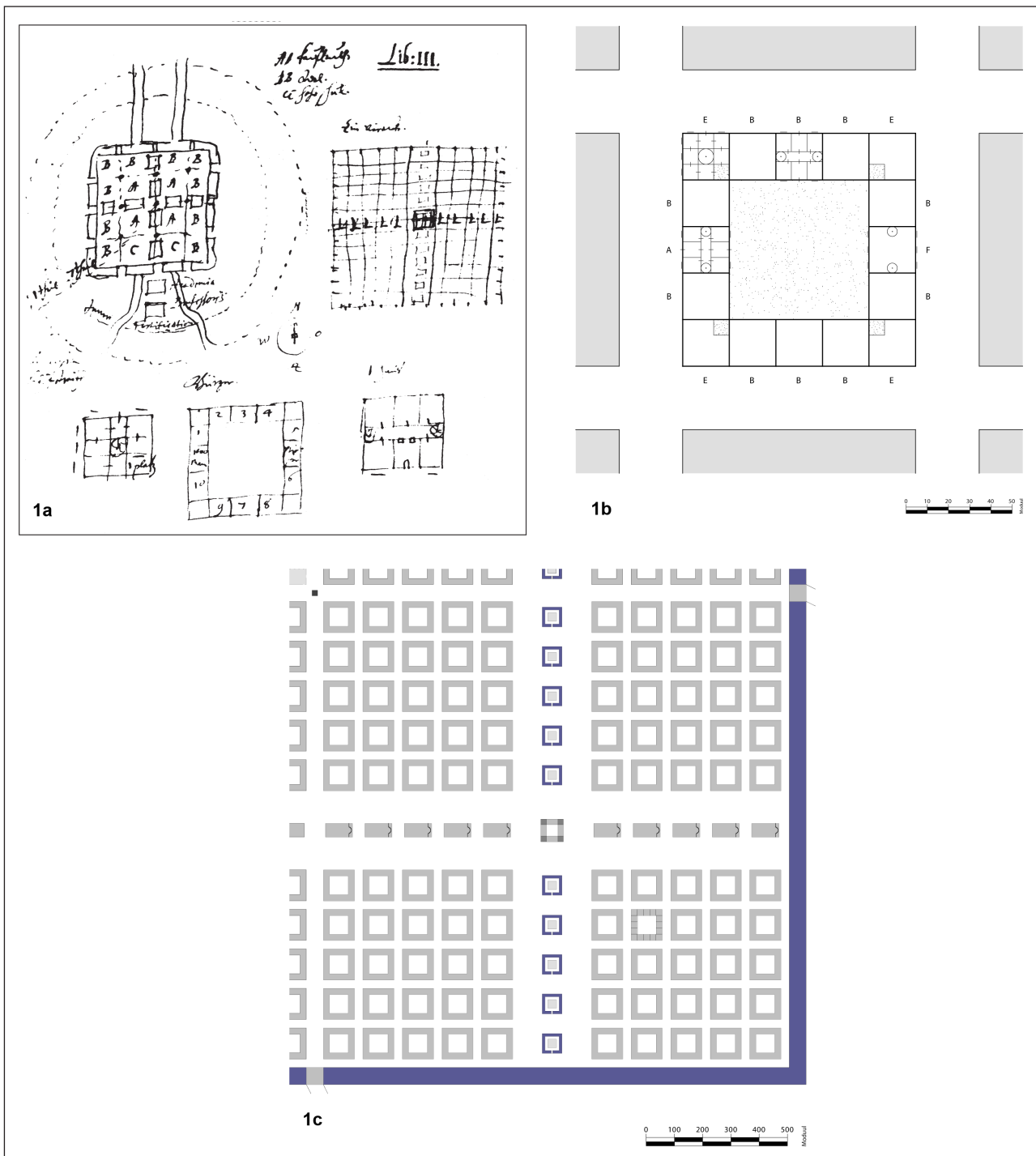


Figure 1: **a)** Nicolaus Goldmann, schematic presentation of the city centre, residential area and houses, ink sketches. N. Goldmann, *Architektonische Zeichnungen und Kupferstiche – 1*: 261. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71; **b)** Reconstruction of the housing block; **c)** Reconstruction of the residential area. Computer drawings by Jan A. C. Boot, 2005.

capital city in which all sorts of buildings and activities are combined, it is laid out on a grid. Within the context of this city, the building types of Book IV, with their arrangements of rooms described in Book III, up to the details of the columns discussed in Book II and all generated according to the principles defined in Book I, are apportioned fixed spatial positions and architectural forms within a strict hierarchical system. It is unfortunate that the description of the city has come to us in text

only. However, sketches scattered over Goldmann’s manuscripts can fill this void. Various small ink drawings refer explicitly to the third book.

In combination with other sketches they allow us to zoom in at the scales of the inner city, the city quarter, the housing block, and even individual houses (**Fig. 1**). The measurements of the houses and public buildings fit seamlessly and coherently into the larger entity of the capital.

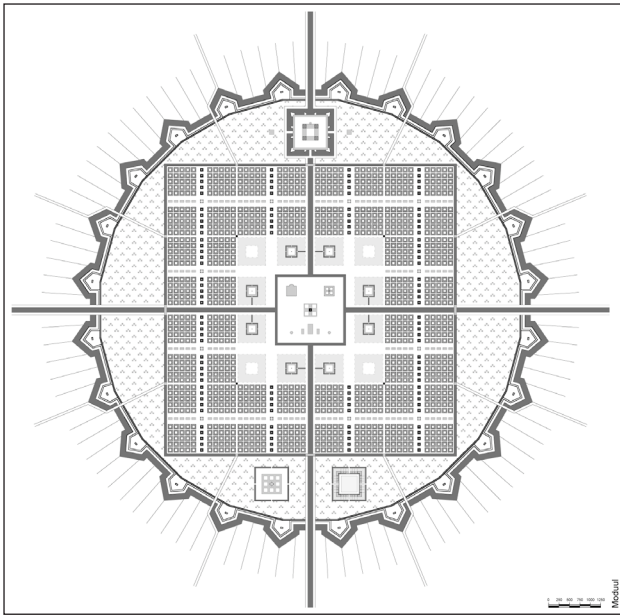


Figure 2: Reconstruction of Nicolaus Goldmann's inner city based on the descriptions of the city itself, the individual building types, the public spaces and Goldmann's theory of fortification. Computer drawing by Jan A. C. Boot, 2005.

When the city plan is reconstructed in a single drawing, its striking appearance as a whole becomes apparent (**Fig. 2**). The plan consists of sixteen square blocks, divided by the main streets in continuation of the twelve city gates. The eye-catching broad axes are in fact the cross-shaped zones with parish churches and governors' villas around which twelve outer squares are grouped. The four central squares have a different layout and together contain an outer ring of twelve marketplaces of two different shapes, surrounding a large open space. This central area is in fact composed of quarter parts in the heart of the four larger squares. Four large canals (not depicted in **Fig. 1a**) end in a square moat surrounding this central area. Here a domed church (at the very heart of the city), government buildings, a court of justice, a treasury, and a prison are located. The city within the walls thus has three concentric zones: the grand city centre is enclosed by a commercial zone with markets, reserved for traders and craftsmen. The twelve surrounding squares contain the residential areas. A university and the palace for the prince are situated in the planted areas between the square city and the circular fortification. The dimensions of the buildings, their rooms and detailing, as well as the city itself, are all described in the text spread over the four books. These dimensions are defined in terms of modules, the basic module being the semi-diameter of Goldmann's column orders.⁴ This module and its multiplications constitute the grid structure at all scales. The internal logic of the system supplies a hierarchy of building types that is expressed by their locations in the city, their dimensions, forms, column orders and ornamentation (Goudeau 2010).⁵ Outside this capital is a concentric outer city, also fortified, but now the grid is replaced by an arrangement of one hundred radial streets.⁶

We are in the dark as to Goldmann's ideological thoughts on the city. It is explicitly presented as neither an ideal city nor an Early modern social utopia.⁷ Nowhere in his writings is there any reference made to such ambitions. As his texts and sketches reveal, for Goldmann the grid city was the visualisation of an architectural thought construction – of the theoretical method itself. Remarkable, and in a way almost anachronistic, is that the proposed designs in fact were merely schemes; they were not yet architecture, and the city was not yet a city. The intention was evidently to provide a method by which one *could* come to real architecture and real urban design in an absolute way. Many sketches that accompanied Goldmann's teachings show how this rather elementary set of principles subsequently could be translated into real buildings. These resultant buildings then clearly resemble the sophisticated Dutch classicist architecture of his day.

Notwithstanding the rather technical presentation of his design method, for Goldmann the legitimisation of his theory reached beyond such presentation. His theory was based on three main sources: the indubitable authority of Vitruvius, the architecture of Roman antiquity and the Old Testament. Examples of Renaissance and contemporary architecture were treated more or less on the same level as the classical buildings. The Old Testament was Goldmann's ultimate source. A devout Lutheran, the references Goldmann made to the Bible are manifold. They occur in important passages throughout his theory, in contrast to the topic of the city, which is dealt with almost in passing.

At the core of Goldmann's theory is the architecture of God – the Temple of Solomon. The invention of architecture came from God, Goldmann stated, and King David's son Solomon built the temple after the model given by Him (Goldmann 1696: 2–3).⁸ The Temple of Solomon was known from the Bible, especially from I Kings 6 and 7, II Chronicles 3 and the temple vision of Ezekiel, which Goldmann must have regarded as descriptions of one and the same building.⁹ In this Biblical interpretation he followed the most influential reconstruction of the temple by the Spanish Jesuit Juan Battista Villalpando (1552–1608) (Goldmann 1696: 33; Prado and Villalpando 1596–1605: Vol. 2).¹⁰ According to Goldmann, the dimensions of the temple as prescribed in the Bible should be normative for all architecture. In order to reconcile these Biblical prescriptions with the authority of the (heathen) antique Roman architecture, Goldmann concluded that Vitruvius must have still been aware of the true measurements of the temple (Goldmann 1696: 32).¹¹ If God had passed on the divine knowledge of building to Solomon in order to erect his temple on earth, then later architects also must have had to follow the temple as an example for their work. Thus they would have built according to God's instructions and, as a consequence, in harmony with the laws of the universe.

Finding this logic to be compelling, Goldmann made his whole architectural theory a Solomonic one. Goldmann thus came up with a temple reconstruction according to Ezekiel, just as Villalpando had done (Goldmann 1696:

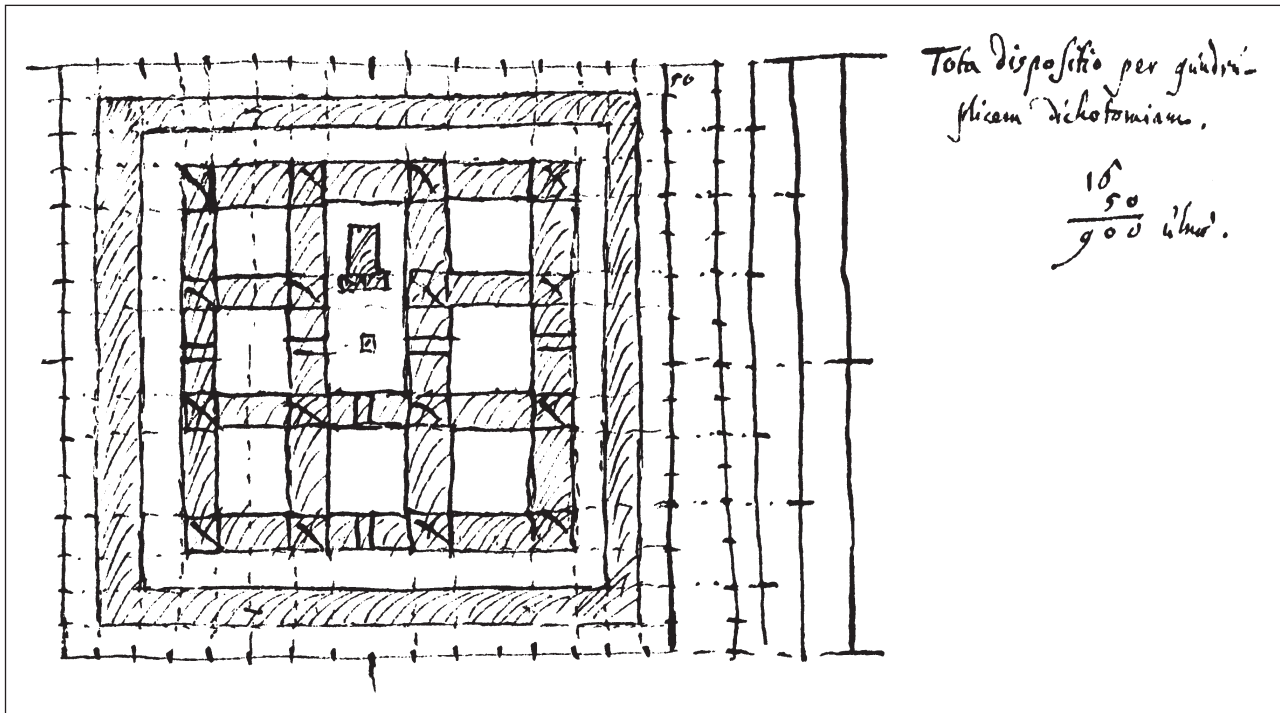


Figure 3: Nicolaus Goldmann, the Temple of Ezekiel as a grid system based on Aristotelian dichotomy; ‘tota dispositio per quadruplicem dichotomiam’: the disposition of the whole is determined by a fourfold division into two equal parts (in fact, $2^4 \rightarrow 16$ on each side), ink sketch. N. Goldmann, *Elementa architecturae*. Copy Willum Worm, Leiden 1658: 22. Royal Library, Copenhagen: Thott 267–20.

1–7, 30–46).¹² In one of his sketches Goldmann indicates that the temple was conceived on a grid (**Fig. 3**). This temple grid sketch is essential to his theory. By way of a fourfold division, the small sixteen by sixteen squares that constitute the different parts of the temple are derived from the main square of five hundred by five hundred ‘sacred’ cubits, or, including the outer court, with sides of eight hundred cubits (Goldmann 1696: 32–33).¹³ This is no mere arithmetical or geometrical operation but a *logical* one: ‘a fourfold dichotomy’, as Goldmann writes on his drawing. The notion of dichotomy refers to the Aristotelian principle of scientific ordering of a *genus* into two *differentiae* – a concept forcefully visualised in the so-called Porphyrian tree (e.g., Porphyre 1998; Porphyre 2008). The tree structure became a way of ordering scientific knowledge, being at the same time a visual representation of reasoning from a general concept to specific cases (e.g., Schmidt-Biggemann 1983). All of Goldmann’s books and his architectural theory were structured in this way, both in form and content. Thus Goldmann blended the temple, logical argumentation and mathematics into one coherent architectural theory. In this way Goldmann rooted his entire theory in God’s architecture, in his wisdom and, in accordance with his mathematical laws that ruled the whole universe, his ultimate creation.

At the beginning of his treatise Goldmann contrasted the transitory city of man on earth to the eternal, cubical city of God, the promised Heavenly Jerusalem (Goldmann 1696: 2).¹⁴ Although Goldmann did not mention the overall dimensions of his grid-patterned city, he depicted it as consisting of sixteen squares and possessing twelve gates, as in Ezekiel’s vision of the temple (**Fig. 1a**).¹⁵

Eighteenth-Century Dispersion

At Goldmann’s death in 1665, his theory on civil architecture was available only in manuscript form. Although the text and drawings were disseminated over different countries in the north, the audience for it proved to be limited. This changed dramatically at the turn of the century, when the German architect, theologian and prolific writer Leonhard Christoph Sturm (1669–1719) was asked to publish one of the remaining complete Goldmann manuscripts as a book. To this end, Sturm produced a set of new engravings on the basis of Goldmann’s sketches. This book, published in Wolfenbüttel in 1696 as *Vollständige Anweisung zu der civil Bau-Kunst*, became an instant success. Two reprints of this substantial folio edition followed in 1699 and in 1708. Even more important was that until his death in 1719 Sturm worked out Goldmann’s theory in many other publications, of which more than twenty bore the latter’s name in the title, each dedicated to one particular building type or architectural theme (Goudeau 2005: 441–460, 549–558; Küster 1942). For the eighteenth-century reading public these books were all Sturm’s achievement. Even though the term *Goldmannisch* (Goldmannic) appeared as an epithet on several title pages, after Sturm’s death the name Goldmann itself faded into a vague echo of an original source.

Via Sturm, Goldmann was to become one of the keys to the systematisation of architectural theory in the eighteenth century. Johann Jacob Schübler (d. 1741) for instance, made explicit use of Goldmann’s theory and advertised himself by using Goldmann’s name in recommendation of the quality of his own work: *Erste Ausgab [...] oder den neuen und vermehrten Goldmann [...]* (13

vols., Augsburg 1730–35). Moreover, many elements of Goldmann's theory had entered the public domain of architectural knowledge. Such elements included the emphasis on a coherent proportional system for all buildings, the methodology of providing meticulous definitions, mainly of architectural terms, at the beginning, illustrated by pages of small figures, and the 'mathematical' way of dealing with subjects.¹⁶ To a certain extent, this methodology was a legacy of fortification theory, a field in which Goldmann had started his career. Shortly after Schübler, Johann Friedrich Penther (1693–1749) integrated Goldmann's ideas into the four parts of his influential *Ausführliche Anleitung zur bürgerlichen Bau-Kunst* (Augsburg 1744–48). Perhaps most significantly, through Sturm, Goldmann's terminology and building hierarchy formed the basis of the eighteenth-century theory of building types, or *Baugattungen* in German (Goudeau 2005: 471–476; also Van Pelt and Westfall 1991: 138–167; Lavin 1992: 86–100; Jachmann 2008). This part of architectural theory became almost the dominant element in the architect's education in Germany as well as in France, up to the French *École des Beaux-Arts*. In addition to the theory of building types, and almost unnoticed, the grid structure took firm root in the education of the architect and in the design process in general. To a certain extent, the systematisation of building types in combination with the column orders, which still dominated architectural theory, implied this development (Fig. 4). Sturm had pointed to the great results Goldmann had achieved in this matter. He did not elaborate on the way in which Goldmann extrapolated the module of the columns to the grid of the city as a whole, as shown above. However, Sturm claimed explicitly the invention of the design grid based on the module of the columns as Goldmann's (Sturm 1699: [10]).¹⁷

Durand's Austerity

A completely new phase in the formalisation of architectural design was initiated in the first decade of the nineteenth century by the French architect Jean-Nicolas-Louis Durand (1760–1834). Just as Goldmann had worked under the aegis of the university and the famous school of engineers, *Duytsche Mathematique*, in Leiden, Durand taught architecture at the (post-) revolutionary *École Polytechnique* in Paris, holding this position from the start of the institute in 1794, and his architectural handbooks were the outcome (Szambien 1984; Pérez-Gomez 1984; Villari 1990; Madrazo 1994; Mallgrave 2005: 67–71). These treatises soon became very influential. As with Goldmann, who had built nothing at all, Durand's writings proved to have lasting value, rather than his few buildings. Of his six publications, three play a role here. The character of the first of these contrasts with the other two, being a diachronic comparison of historical buildings, classified according to type and all presented on a single scale, *Recueil et parallèle des edifices de tout genre, anciens et modernes [...]* (Paris 1799–1801).¹⁸ Although he was not the first author to draw architectural parallels – think of Julien-David Leroy – Durand is exceptional in transcending the differences in time, culture and style

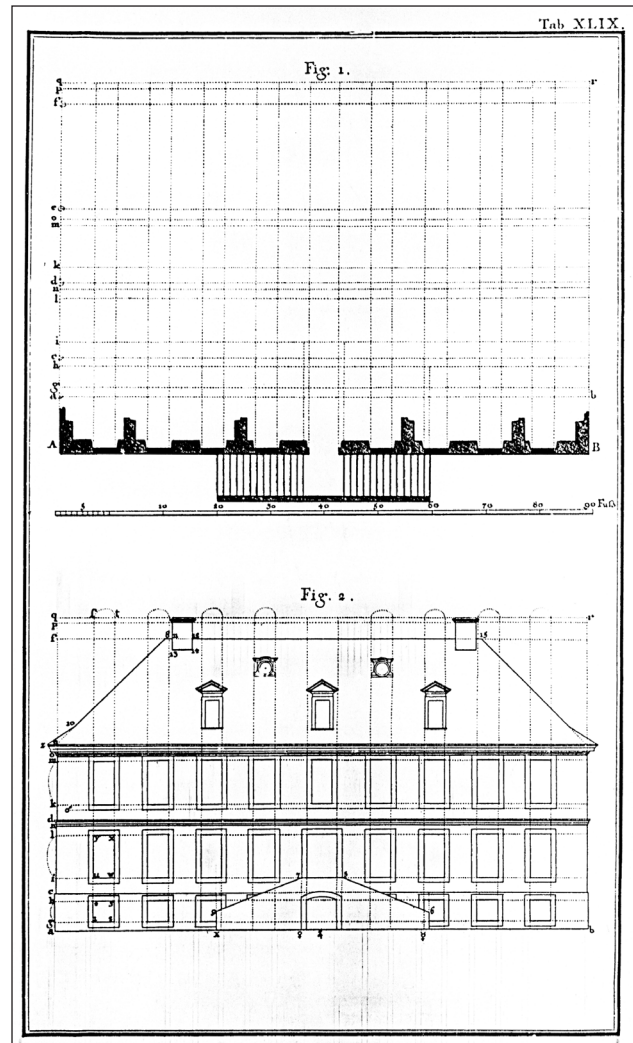


Figure 4: Johann Friedrich Penther, grid-like presentation of a house, engraving. J. F. Penther, *Zweyter Theil der ausführlichen Anleitung zur bürgerlichen Bau-Kunst [...]*. Augsburg: J.A. Pfeffel, 1745: Tab. XLIX. Herzog August Bibliothek, Wolfenbüttel.

for architecture as a whole (Leroy 1764; Armstrong 2012: 156–178, esp. 173–176). This attitude was not prompted by an eclectic inclination, but rather, must be understood as driven by a motivation to search for the essentials of architecture, regardless of time and space. In the two publications that followed, Durand departed radically from the concept of the historical development of architectural form. He presented architectural design as a process determined by timeless and universal principles that could be applied to buildings of any function. The dynamic interpretation and comparative study of typology was exchanged for a combinatorial methodology of universal, that is atemporal, form principles. This systematisation of architectural principles found its expression in the curriculum that Durand taught his *élèves* over the years. His work was not so much an architectural theory as a teaching method meant to provide an easy framework for design for students who had to be familiarised with civil architecture within a limited time.¹⁹ That is probably the main reason why his visualisation of architecture was pared down to the bone.

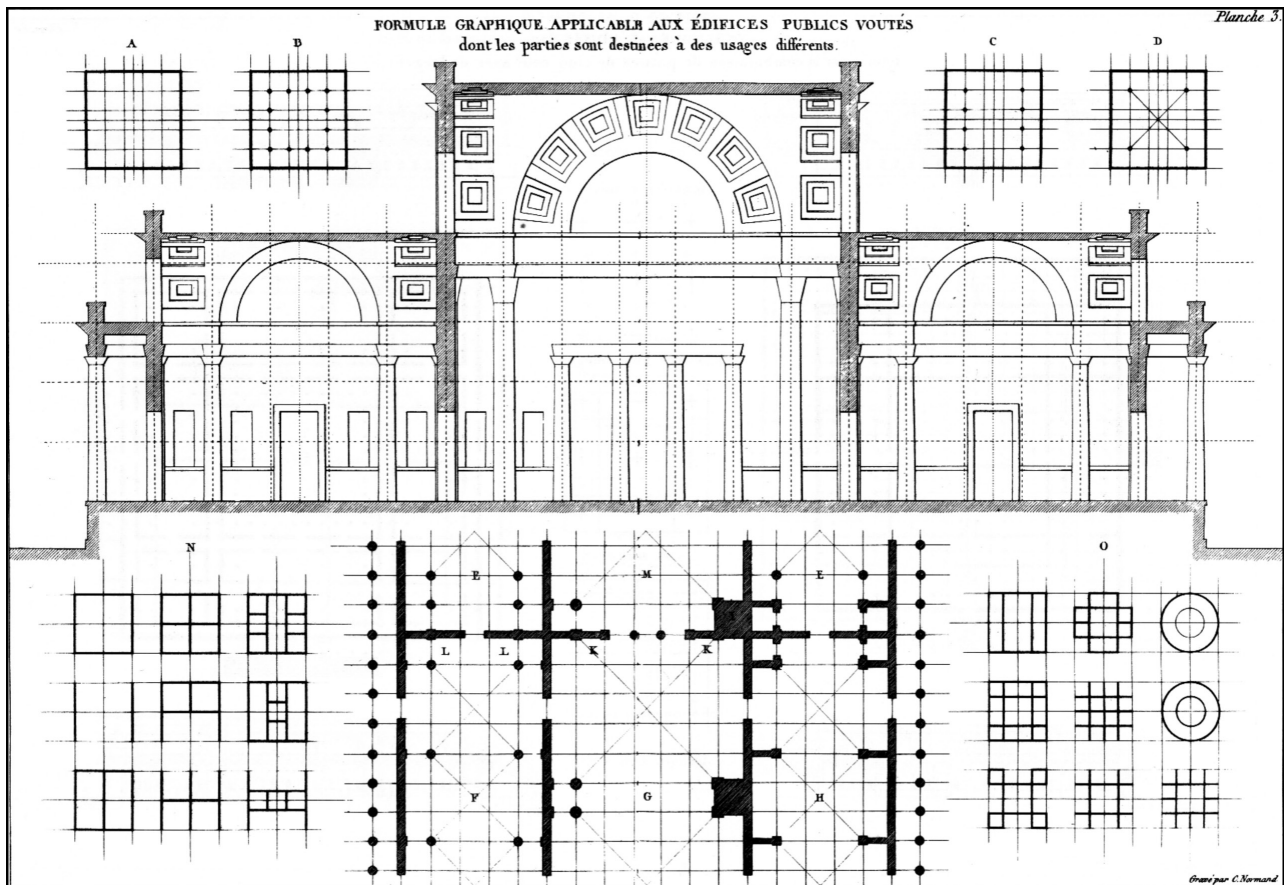


Figure 5: Jean-Nicolas-Louis Durand, combinatorial modular grid defining the walls and columns, and composition of the whole building by axes of symmetry, engraving. Reprinted from J-N-L Durand, *Partie graphique des cours d'architecture faits à l'École Royale Polytechnique depuis sa réorganisation [...]*. Orig. ed. Paris 1821. Reprint Unterschneidheim: Uhl Verlag, 1975: pl. 3.

Durand's lectures were embodied in his second influential publication, *Précis des leçons d'architecture données à l'École Polytechnique* (2 vols., Paris 1802–1805), the first volume of which underwent some alterations in various editions, between 1809 and 1840. The text of the second volume however, remained unaltered. His third major book, *Partie graphique des cours d'architecture faits à l'École Royale Polytechnique depuis sa réorganisation [...]* (Paris 1821), summarised the theory in a more compact way, and at the same time formed the culmination of a rather subtle genesis of insights. One of the most important developments in the context of this argument is that the design *principles* are completely detached from the purposes of the various building types and the large variety of local practices.²⁰ Oddly, in this detachment Durand went back to a seventeenth-century ideal of systematisation aspired to by Goldmann, and certainly went against the growing historicist tendency by cutting across the scientific archaeological enterprises of the late eighteenth century (Szambien 1982: 33).²¹

Evaluating Durand's work in the context of his own time is not as easy as it might seem. Durand's reputation in architectural history has been largely established by the visual strength of his engravings with their imperative grid. They create a high degree of abstraction, characterised by the repetition of a limited set of basic elements

and the equality of wall thicknesses and columns of as yet unspecified orders. What clouds the issue in this case is that Durand's writings are often evaluated in light of later developments. Thus it may seem that his plain grid would have deprived architecture of its traditional symbolic meaning, of which the orders had been the backbone. Sometimes his work is more-or-less held responsible for the alienating excesses of the modern movement in the twentieth century (Szambien 1982: 19, 250 n. 3, 5, 6; also Hitchcock 1977: 47–73; Collins 1965: 21–28, 179, 221–222; Pérez-Gomez 1984: 313–314; Oechslin 2008: 94–95, 285–287). Yet Durand himself could only look back and try to face the questions of his own time.

In the schematised ground plans the orders play an important modifying role in a way that is consistent with the traditional view (Fig. 5). The hierarchy of orders and the meanings of the individual species of orders are still present in Durand's work, as becomes clear from the attention he pays to this subject in his treatise, both in the text – criticising – and in the illustrations – systematising (Durand 1975a).²² The reason that the orders are indicated only in a rudimentary fashion in the drawings is that they do not yet determine this phase of design. In this respect Durand operates in a very unorthodox fashion. However, this radical modification of the design process and the simplification of the orders in their ratios and detailing

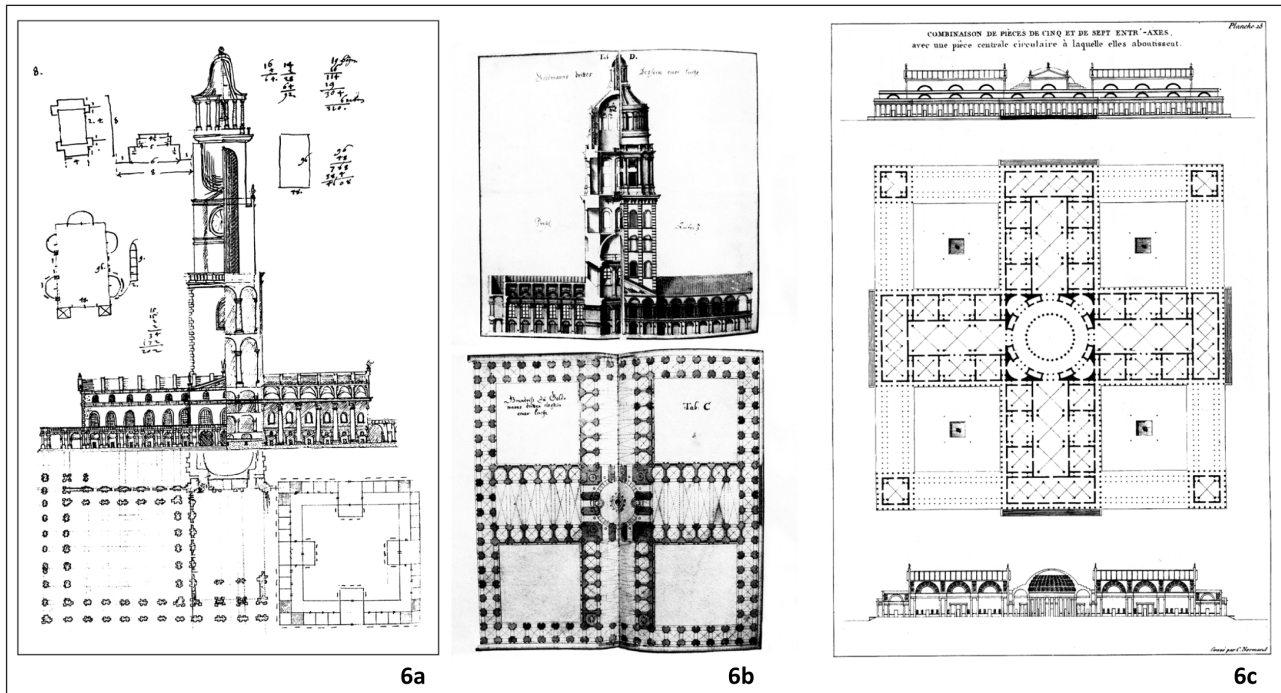


Figure 6: **a)** Nicolaus Goldmann, cathedral, ink sketch. N. Goldmann, *Architektonische Zeichnungen* [...] –1: 264vo. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71; **b)** Leonhard Christoph Sturm, cathedral, pencil and ink drawing. [L. C. Sturm], *Sturms' Architectonische original Handrisse*. 3 vols: Vol. 1, 45. Germanisches National Museum, Nuremberg: Fol. 94.142.; **c)** Durand: combinatory design (subject not specified), engraving. Reprinted from J-N-L Durand, *Partie graphique* [...] Paris 1821: pl. 15. Reprint Unterschneidheim: Uhl Verlag, 1975.

can be regarded as an update of the traditional system of the orders. In fact this method demonstrates the orders' indispensability and enduring topicality rather than being an attempt to abandon them. With regard to the way the grid had developed during the seventeenth and eighteenth centuries, it must be stated that in Durand's theory the column orders, with their proportional qualities by means of the module, might no longer be the core of the design, but they still do articulate the grid.²³

A closer look at the engravings of the *Précis* and the *Partie graphique* reveals how seemingly equal lines and dots are used in different ways and for different purposes (Fig. 5). The overall grid determines the layout of the whole design, starting with the positioning of the walls and columns: but next to the lines of this screen there is a second set of axial lines in the voids of the designs. Here Durand draws as a second layer the axes of symmetry, which bind together the plan as a whole. Both matrices proportion the design, but each at a different level. The overall grid arranges the spaces and forms as a *combination* of the various architectural elements in two stages – first the disposition of the elements and then the formation of the larger parts. The axes of symmetry then organize the functional parts of the building – the rooms and the successions of the inner spaces; in short, they define the *composition* of the building (Durand 1975a: Vol. 1; Szambien 1984: 88–89; Villari 1990: 58–65).²⁴ With this method Durand partly reaffirmed the basic principles of classicist design that were already established at the Académie des Beaux-Arts under Louis XIV by François Blondel (1617–1686) (Egbert: 1980: 11–35; Chafee 1977). By this design

methodology, which was developed in the curriculum of the École Polytechnique, Durand also laid the foundation for the architectural curriculum of the École des Beaux-Arts during the nineteenth century, up to the lectures of Julien Guadet at the beginning of the twentieth century (Egbert 1980: 36–66; Guadet 1901–1904).

Revolutionary Examples

A comparison between the system exposed in the engravings of Durand's later publications and Goldmann's seventeenth-century grid-based theory brings some remarkable similarities to light. The Goldmann manuscripts contain drawings, ranging from quick sketches expressed with the pencil to a series of fully elaborated drawings intended to be transferred to copper plates for the engravings of his definitive architectural theory. From all these examples it becomes clear how the theory of the orders and the proportioning system of Goldmann's designs met in a grid structure and then were translated visually into architecture. Here the similarity with Durand's illustrations emerges clearly. Before reflecting on how this similarity could have arisen and whether this comparison implies a parallel on a theoretical level as well, the similarities between these authors' illustrations can be illustrated by three examples.

First, a purely formal but striking similarity can be found between Goldmann's scheme for a cathedral (Thum Kirche) and an engraving of an unspecified building by Durand in the *Partie graphique* (Fig. 6). Here Durand does not refer to any specific building type, but simply provides a ground plan to show the principle of combinatorial

design (Goldmann [Zeichnungen – 1]: 264vo; Durand 1975b: pl. 15). Second, apart from this correspondence between the two theories on the level of drawing and visualisation, the parallel can be extended to the typologies of the buildings. Durand's proposal for a royal residence, for instance, seems to reflect not only, evidently, Etienne-Louis Boullée's 1785 project for a Palace at St-Germain-en-Laye, but at the same time Goldmann's original scheme for the *aula regia* and his design for a royal palace (Königliches Hof) (Fig. 7) (Szambien 1982: 24; Goldmann [Elementa]: 17; Durand 1975a: ed. 1817, Vol. II-3, pl. 3).

The ground plan of the palace returned as the *domus* in Sturm's edition *Vollständige Anweisung* of 1696 and after that was elaborated by Sturm, who presented it as the royal palace according to Goldmann (Sturm [Handrisse]: Vol. 1, 85). Recurring features are the square-based layout with the rooms organised on a grid around a large inner court. The situation of the palace surrounded by water and by a fortification is alike in all three cases. Also notable is that Durand even includes radiating streets and four canals running up to the central moat, these being special features of Goldmann's city, which most likely had only been described by Goldmann in text.

A third resemblance between Goldmann's work and one of Durand's schematic layouts is found in Durand's university building (Fig. 8). Goldmann presented a plan of a square, divided into nine square inner courts, as a house of wisdom clearly referring to the layout of the Solomonic temple, with a library set in the heart of the building (Goldmann [Zeichnungen – 1]: 265). Sturm adapted this ground plan to a square divided into four square courts at the corners, a large central square and four rectangular courts on the main crossing axes (Sturm 1720: Tab. VIII). The solution with the rectangles and the central library, connected crosswise to the main building, also appears in Durand's drawing, though the rectangular courts are now not open spaces but cross-vaulted rooms. They must therefore be conceived on a much smaller scale than the building Sturm or Goldmann had in mind. Durand also provides his design with a surrounding small, colonnaded building. Goldmann's sketch suggests a similar small structure just inside a bridged moat, in this case without colonnade. The analogy ends, however, with the functions of the buildings: the university complex of Goldmann–Sturm in Durand's theory turns into a public treasury (*trésor public*) (Durand 1975a: ed. 1817, Vol. II-3, pl. 5).

These examples show three different correspondences. First and most elementary are the similarities in outer form of the ground plans regardless of function. Next, in some cases parallels can be found in both form and function. Lastly, sometimes a similar plan is meant for another building type. In an attempt to carry Durand's systematisation of architecture to the work of Goldmann–Sturm somewhat further, one could discern three main formal schemes that do not correspond with any specific building types. These schemes can be labelled: 1) the cross-in-square, 2) the square-with-inner-court, and 3) the composite plan (Fig. 9). The regular checkerboard layout that can be found most prominently in Goldmann's city

plan, as well as in his sketches of building types, consisting of nine squares, for instance in his *Academia*, occurs seldom in Durand's work and then even not as pure squares but squares and rectangles (Fig. 8). Though seldom used by Durand, this fourth formal resemblance constitutes in fact a fourth scheme. For Goldmann, however, this checkerboard solution was the most essential, because the layout with nine inner courts came close to the ground plan of the temple.

Goldmann to Durand

The decisive question arises whether these correspondences can be explained historically. Could Durand somehow have been acquainted with Goldmann's work? There is a gap of more than a century to be bridged, and both the contexts and the theoretical frameworks of the two theorists are quite different. Goldmann aimed at an exhaustive architectural theory according to seventeenth-century scientific – that is, mathematical and universal – ideals put into one coherent system. Durand's primary goal was to provide a concise standard design method for technically trained architects, to be applied in all sorts of commissions. The manuscripts of Goldmann's theory were accessible to only a few people. There are no indications that after his death, or certainly after the first half of the eighteenth century, his writings were treated as more than mere curiosities filed away in a very limited number of private libraries.

When in 1693 Sturm finally started to prepare the publication of the theory, he was in the possession of an original manuscript copy and he must have had at least a substantial portion of the relevant drawings by Goldmann at his disposal (Küster 1942).²⁵ Sturm transferred the material, which had been originally conceived in a Dutch classicist context, to a German contemporary architectural idiom (Lorenz 1995).²⁶ Sturm worked conscientiously and stayed very close to both his textual source material and the original sketches and drawings. Nevertheless, in the lavishly illustrated folio editions of 1696, 1699 and 1708 the character of the work was altered in such a way that the result was neither recognisable as Goldmann's austere classicism, nor particularly useful as a source of convincing architectural solutions for Sturm's own early-eighteenth-century context (Goldmann 1696). Sturm's later work would remain entangled with the legacy of Goldmann that he was determined to pass on. His executed architectural oeuvre is small. By contrast, his publications – about one hundred, of which more than fifty were dedicated to engineering, military and civil architecture – more than incidentally influenced German eighteenth-century architectural theory.²⁷

Sturm's publications appear to connect Goldmann to Durand. Durand was in close contact with architects and institutes in Germany, which was not exceptional. His contemporary, Antoine-Chrysostome Quatremère de Quincy (1755–1849), for instance, stayed in Germany from 1797 to 1800 and immersed himself in the arts and sciences there. In Durand's case this connection was with a number of young German architects who went to Paris to

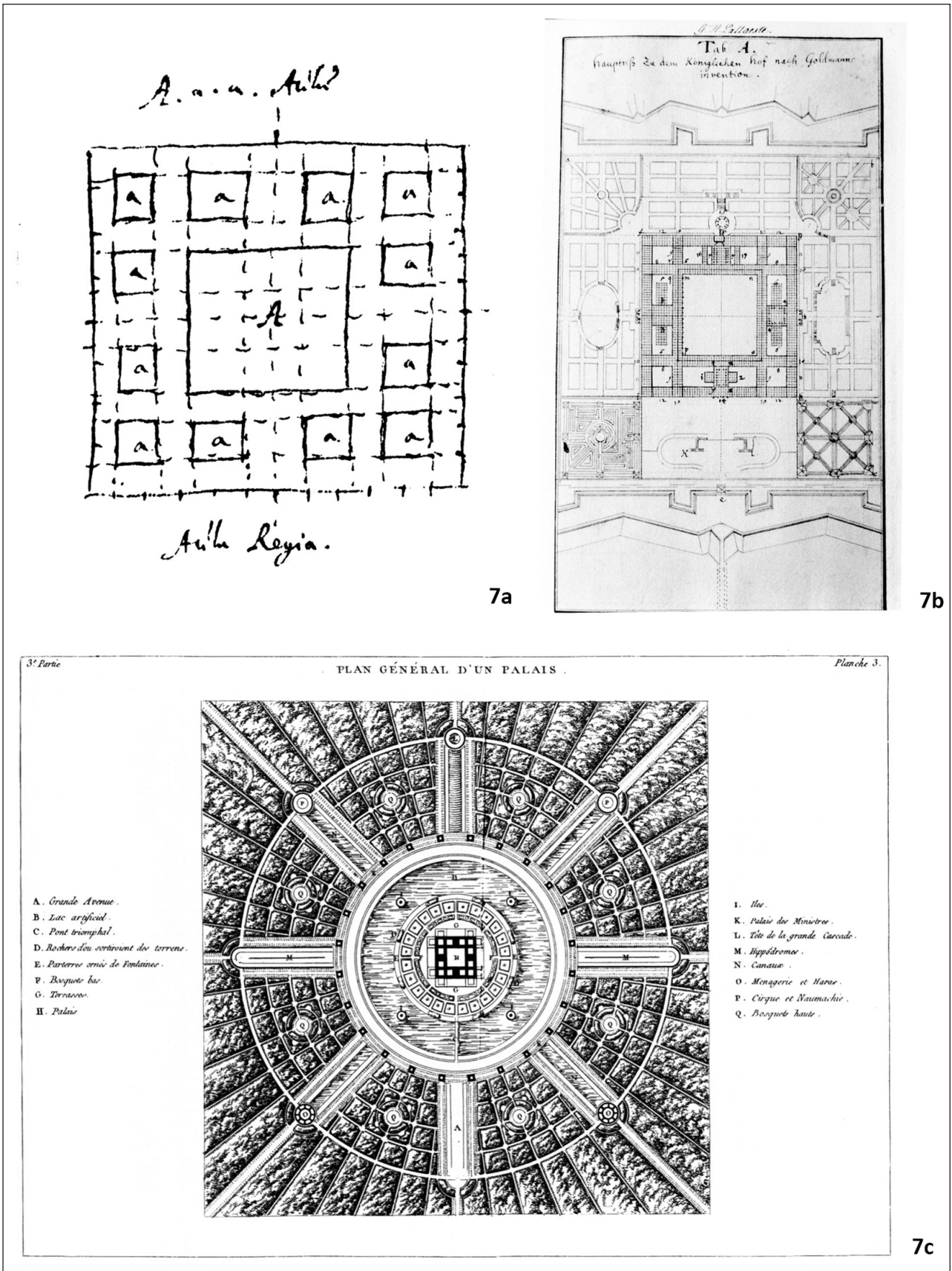


Figure 7: **a)** Nicolaus Goldmann, 'Aula Regia', ink sketches. N. Goldmann, *Ein Elementa der Baukunst* [before 1656]: 17. Det Kongelige Bibliothek, Copenhagen: Gaml.Kgl.Saml.332.fol.; **b)** Leonhard Christoph Sturm, 'königlicher Hof', pencil and ink. *Sturms' [...] Handrisse*. Vol. 1, 85. Germanisches Nationalmuseum: Fol. 94, 142; **c)** Jean-Nicolas-Louis Durand, 'un palais', engraving. Reprinted from J-N-L Durand, *Précis des leçons d'architecture données a l'École Royale Polytechnique*. 2 vols., Orig. ed. Paris 1819 and 1817: Vol. II, 3, pl. 3. Reprint Unterschneidheim: Uhl Verlag, 1975.

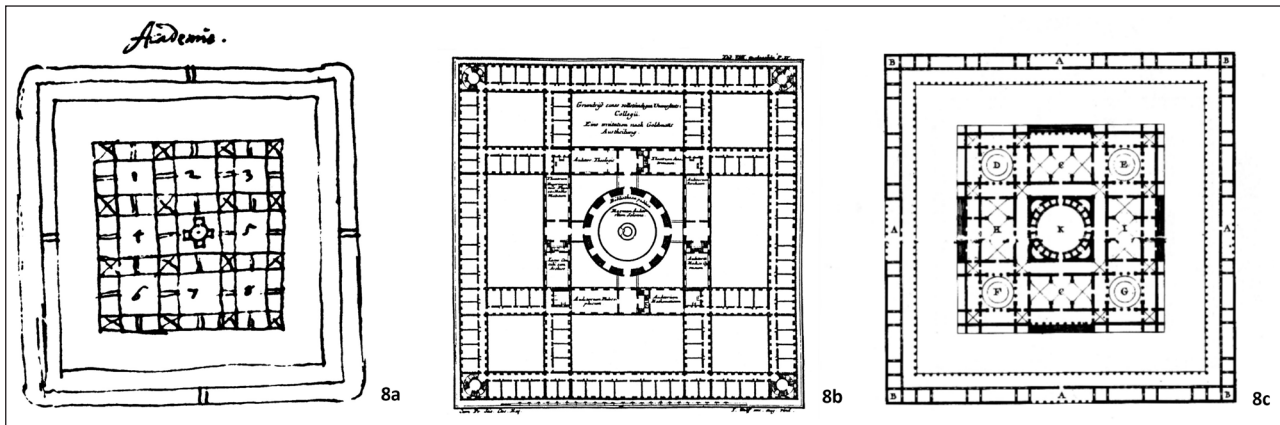


Figure 8: **a)** Nicolaus Goldmann, 'Academia'. N. Goldmann, *Architektonische Zeichnungen* [...] –1: 265. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71; **b)** Leonhard Christoph Sturm, 'Collegium', engraving. L. C. Sturm, *Vollständige Anweisung, Allerhand öffentliche Zucht- und Liebes-Gebäude* [...] wohl anzugeben [...]. Augsburg: Jeremias Wolff Erben, 1720: Tab. VIII. Herzog August Bibliothek, Wolfenbüttel; **c)** Jean-Nicolas-Louis Durand, 'Trésor Public', engraving. Reprinted from J-N-L Durand, *Précis des leçons d'architecture* [...]. Paris 1819 and 1817: Vol. II, 3, pl. 5. Reprint Unterschneidheim: Uhl Verlag, 1975.

study at the *École Polytechnique* and worked in his *atelier*. The Germans formed a relatively large part of the total of Durand's students. At least nine of them with whom Durand stayed in contact or worked later are known: the architect Abel, Gottlob Georg Barth, Karl Friedrich Anton von Conta, Clemens Wenzeslaus Coudray, Johann Peter Cremer, Johann Friedrich Christian Hess, Leo von Klenze, Heinrich Friedrich Rumpf and Adolph Anton von Vagedes (Szambien 1984: 112–113, 121–133).²⁸ Durand travelled to Germany several times to meet colleagues and exchange architectural advice. In 1802 he stayed with Coudray in Frankfurt am Main and in 1821 with Vagedes (1777–1842) in Düsseldorf (Szambien 1984: 18 ns.23, 123, 125). After studying in Paris in 1802, Cremer (1785–1863) worked with Vagedes until 1817, when he became district architect of Aachen (Szambien 1984: 124–125; also Friedrich 2008).

Coudray (1775–1845) attended Durand's lectures and worked at his Paris studio between 1800 and 1804 (Szambien 1984: 122–125, 161–163; Wirth 1957; Bothe 2013). The two became close friends. In late 1815 Coudray was invited by Johann Wolfgang von Goethe to Weimar and became head of the state building department (Oberbaudirektor). There in 1831 he translated and edited Durand's *Précis des leçons* under the title *Abriss der Vorlesungen über Baukunst* (Coudray 1831). Heinrich Friedrich Rumpf (1795–1867) went from Frankfurt to Paris after working for Coudray at Fulda (Hansert 2005). Through his father, Rumpf was acquainted with the French architect of a generation earlier, Nicolas Alexandre Salins de Montfort (1753–1839), who had emigrated to Frankfurt after the French Revolution. Back in Frankfurt, Rumpf worked in the circle of the city architect Johann Friedrich Christian Hess (1785–1845), who had travelled with Coudray to Rome in 1805 (Hils 1988). In Rome these two met the architect Georg Gottlob Barth (1777–1848), whom Coudray had introduced to Durand in 1801. Barth became court architect in Stuttgart in 1806. Another of

Durand's German students, Karl Friedrich Anton von Conta (1778–1850), published a practical manual based on his French experiences, *Grundlinien der bürgerlichen Baukunst*, shortly after his stay in Paris (Conta 1806; Hecker 1903). The most famous and independent of Durand's students was Leo von Klenze (1784–1864), who studied at the *École Polytechnique* in 1803. He must be mentioned here especially for his *Glyptothek* in Munich (1816–1830), which is influenced by Durand's *Précis*, and above all for his use of squared paper for some of his designs (Szambien 1984: 67, 90, 126; also Buttlar 1999; Collins 1962).

Of course these students from Germany went to Durand to be taught by him and not the other way round. They were in the first place moulded according to his insights and method. Besides this inner circle of pupils, many other German architects were also influenced by Durand, such as Karl Friedrich Schinkel, especially in his *Altes Museum* in Berlin (1823–1830) (e.g., Goalen 1991).²⁹ Despite this, it is inevitable that there must also have been a two-way exchange of information. Most of Durand's students were already trained, at least to some extent, as architects or engineers in Germany before they came to Paris. Just as Coudray was sent to purchase a copy of the *Recueil* for the father of Friedrich Rumpf, Durand must also have received material from Germany in this way (Szambien 1984: 122). The systematisation of eighteenth-century German architectural theory had started with the works of Sturm on military architecture, civil engineering and all sorts of separate building types. Of about thirty publications dedicated exclusively to civil architecture by this prolific author, at least some of them must have been used by his pupils during their education in Germany. During his career Durand collaborated with his former German pupils, in some cases on an equal footing as fellow architects. Apart from the question whether Durand used Sturm's works himself, it is unlikely that they could have escaped his notice. Moreover, it is possible that the

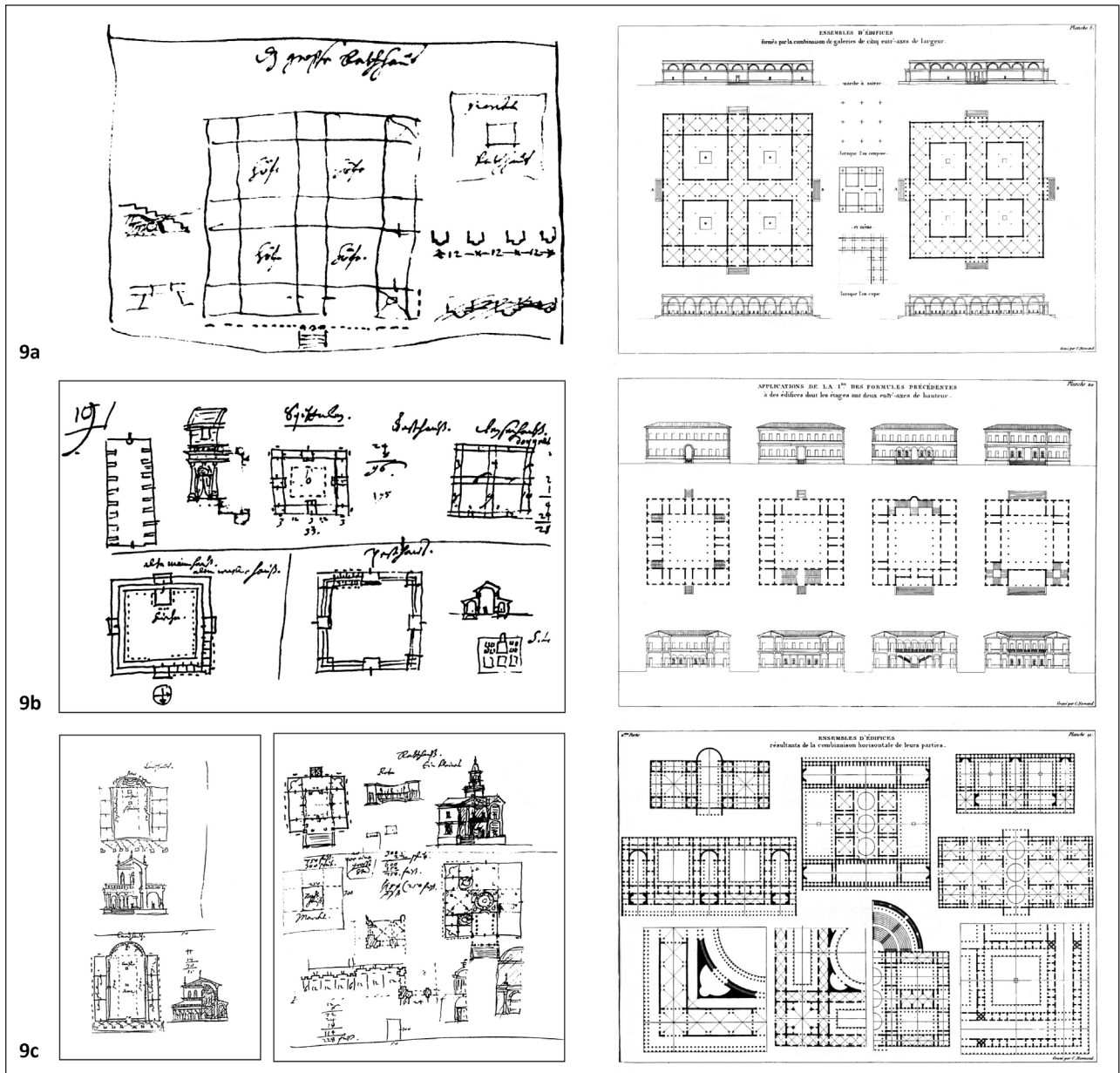


Figure 9: a) Cross-in-square; **b)** Square-with-inner-court; **c)** Composite plan. Left: Nicolaus Goldmann, *Architektonische Zeichnungen [...]* –1: 79vo, 80ro, 265vo, 266ro. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71. Right: reprinted from J-N-L Durand, *Précis des leçons d'architecture [...]*. Paris 1819 and 1817: Vol. I, 2, pl. 19. Reprint Unterschneidheim: Uhl Verlag, 1975; reprinted from J-N-L Durand, *Partie graphique [...]* Paris 1821: pls. 5, 20. Reprint Unterschneidheim: Uhl Verlag, 1975.

stress in Sturm’s writings on engineering and military architecture fitted the technical environment of Durand at the École Polytechnique.

With the probability of a German influence by his pupils in mind, the published work of Durand reveals something remarkable. His *Précis des leçons* displays a shift in the architectural schemes between the first and the second volumes. The first edition of the *Précis* appeared in two volumes in 1802 and 1805 respectively. In 1809 a second edition was published, which contained a series of modifications (Szambien 1984: 198–204). The changes made, however, were confined to the text of the first volume. The text was condensed and concerned the theoretical foundation of Durand’s design principles, which would

from the first edition of the *Précis* to the *Partie graphique* gradually develop into an increasingly reduced set of operations. However, the shift in question lies in the illustrations, that is, the difference in character between the engravings of the first volume of the *Précis* (of 1802 and 1809) and those of the second volume (of 1805 and 1809). For the second volume Durand had called upon his gifted German student Coudray in 1804 to prepare the drawings to be engraved by Charles Normand (1765–1840) (Szambien 1984: 162).³⁰ The illustrations in the second volume appear to be indebted to the German visual idiom developed by Goldmann–Sturm. Durand’s compositional system in the second book of the *Précis* is illustrated in a manner that resembles the composition of the

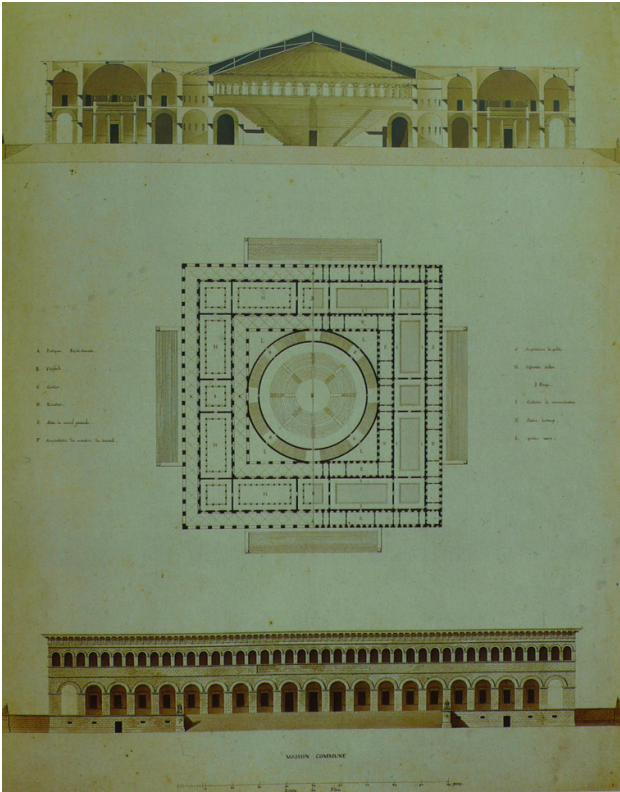


Figure 10: Clemens Wenzeslaus Coudray, 'Maison commune', 1801, pencil and watercolour. Reprinted from W. Nerdinger, K. Philipp, and H.-P.Schwarz, *Revolution-sarchitektur: Ein Aspekt der europäischen Architektur um 1800*. Exhib. cat. Frankfurt am Main, Deutsches Architekturmuseum, and Munich, Neue Pinakothek 1990, Munich: Hirmer, 1990: 139.

designs by Goldmann and Sturm. There is also a similarity with the early work of Coudray. An example is Coudray's 1801 design for a cathedral on the plan of a Greek cross with a central dome. Another is his design of the same year for a town hall (*maison commune*) on a square surrounded by colonnades and a circular assembly hall (**Fig. 10**) (Nerdinger, Philipp and Schwarz 1990: 136–139). It is remarkable that in the visual representation of his theory, between 1802 and 1804 Durand seems to have moved in the direction of German architectural schemes and those of his German pupil Coudray. These schemes originated in the designs of Goldmann, a seventeenth-century Dutch source that most likely was no longer recognised at that time. This change was to reach its conclusion later in the *Partie graphique* of 1821. It is no wonder then that the preceding comparison between Goldmann–Sturm and Durand is almost exclusively found in the *Partie graphique* and the second volume of the *Précis*.

Durand operated in times of turmoil. He taught at the École Polytechnique between 1794 and 1833, under three radically different regimes. The curricula, as well as the students and their professors, were pawns of, successively, the revolutionary Jacobins, Napoleon's First Empire and the Bourbon Restoration. As one of the persons in authority, Durand had to go with the tide or risk losing his position (Szambien 1984: 64–72; Shinn 1980: 9–37).³¹ These events undeniably had their effect on Durand's teaching.

Regardless of the political situation, however, it is very likely that the new step described in the visualisation of Durand's curriculum was primarily nourished by the intellectual exchange with his German students and, via this exchange, by the publications of Sturm and eighteenth-century German architectural handbooks.

Of course, the ways in which Goldmann's or Sturm's legacies spread and reached Durand could also have been more indirect.³² Such influence may be illustrated by Penther's influential architectural handbook *Ausführliche Anleitung* of 1748. In it one finds the design of an arsenal, which is echoed in Durand's granary (*grenier public / halle au blé*; **Fig. 11**). Penther's ground plan, in its turn, can be traced back to an engraving by Sturm, and through Sturm to the description and sketches of this building type by Goldmann (Durand 1975a: ed. 1817, Vol. II–3, pl. 13; Penther 1748: Tab. LXIII; Sturm 1719; Goldmann 1696: 140–141; Goldmann [Zeichnungen – 1]: 267).

Conclusion

Durand eventually developed a radical new teaching method, not so much by discarding tradition as by redefining the traditional elements of architectural theory.³³ In a way, with his spare, almost mechanistic approach to design he demonstrated an interest in questions of architectural type and in the grid as a coordinating tool for the operations of *combination* and *composition* in which the orders still had their place. He removed the classical notion of a traditional iconographic and intellectual context from architecture, thinking it no longer relevant or at least too restrictive. The frugal and pragmatic way of presenting his method was probably motivated by the limited time in which Durand was expected to teach the principles of architecture to future engineers – architecture was only one component of the technical education at the École.³⁴ Furthermore, the influences of the traditional French academic strait jacket are unmistakable (though Durand perhaps influenced the architectural education of both the Polytechnique and the Beaux-Arts more than the other way round).

The preceding discussion has focused on Durand's German connections, and brings some remarkable correspondences to light. The way in which Durand systematised architectural knowledge and reduced it to a set of theoretical design principles with emphasis on architectural type, as well as the way in which he articulated his method by means of a grid, bears the hallmarks of eighteenth-century German architectural theory, to a certain degree. On a more abstract level, Durand's method betrays scientific ambitions, expressed as operations of deduction and induction, at least in the presentation of the material. Durand taught a design *mechanism* that appeared as *inductive* (i.e., combinatory), but was *deductive* in essence. In his schematic visualisations this double character is reflected in the synchronism of the grid (corresponding with the walls and columns) that allows an inductive way of ordering spaces and the axes of symmetry (i.e., placing these axes in the voids) from which the overall design can be deduced (cf. Szambien 1984: 88). By contrast, the French architectural theory of the later eighteenth

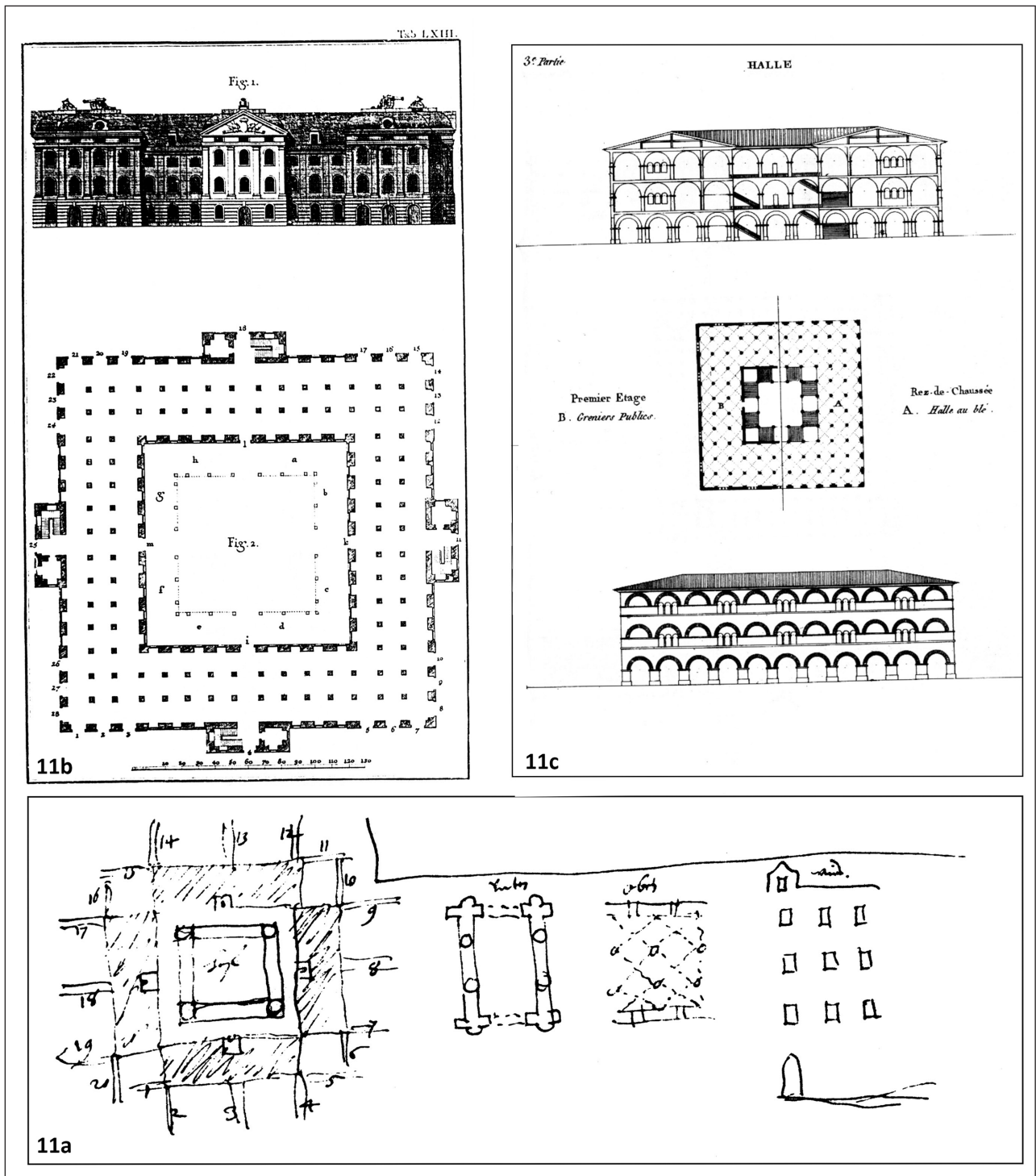


Figure 11: a) Below: Nicolaus Goldmann, arsenal, ink sketch. N. Goldmann, *Architektonische Zeichnungen* [...] –1: 267. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71; b) Upper left: Penther, arsenal, engraving. J. F. Penther, *Vierter Theil der ausführlichen Anleitung zur bürgerlichen Bau-Kunst* [...]. Augsburg: J.A. Pfeffel, 1748: Tab. LXIII. Herzog August Bibliothek, Wolfenbüttel; c) Upper right: Durand 'grenier public / halle au blé'. Reprinted from J-N-L Durand, *Précis des leçons d'architecture* [...]. Paris 1819 and 1817: Vol. II, 3, pl. 13. Reprint Unterschneidheim: Uhl Verlag, 1975.

century in which Durand was trained had focused on three tendencies – archaeological study of monuments *in situ*, the debate on the origins and beauty of architecture, and didactic consolidation.

In their emphasis on the modular grid, type and elementary form, Goldmann and Durand are comparable.³⁵ As teachers they both concentrated on the system

as a method – a coherent and consistent way of thinking about architecture and architectural form before it became 'architecture' or even a fully fledged design. It is important to keep in mind that the resemblances are limited to the ground plans. One and the same schematic plan can eventually lead to buildings that are totally different in their outward appearances of elevations and

architectural styles. In fact, this was also the case in Sturm's translations of Golmann's building types into designs of his own taste.

Goldmann's theory is universal; Durand's method is pragmatic and as far as possible stripped of fossilised principles that in his view were merely outcomes of history. In their own time their methods should both lead to universally applicable, secure and satisfactory solutions, in an infinite variety of forms, that 'porte jusqu'à l'infini le nombre de projets'.³⁶ The grid was the underlying form by which this infinite variety of real building projects could be achieved. This grid had to be filled in according to the situation, the building type and the discretion of the individual architect.

Notes

- ¹ The concept of the grid in architecture is widely used but far from theoretically well defined. Grid structures have been applied in various ways, ranging from a proportional system, to a mere modular screen, to the rectangular network of streets in urban planning. Most commonly the grid is formally conceived as an orthogonal modular device, a set of straight lines at a regular distance and intersecting with right angles, thus forming a pattern of proportionally related squares or rectangles. Being visually strong and helpful and at the same time a theoretically complex proportional system, the phenomenon of the grid in Early Modern architectural theory and the exact motivation behind its application cannot be embodied in one all-inclusive interpretation. For a series of interpretations of the Early Modern city grid, see Lombaerde and Van den Heuvel (2011).
- ² Today manuscripts are kept in the Berlin State Library, the Royal Library of Copenhagen and the Library at Wolfenbüttel. Staatsbibliothek Preussischer Kulturbesitz: Ms.lat.fol.191; Ms.germ.fol.238; Ms.germ.fol.7(1); Libr.pict.fol.A71; Ms.germ.fol.239; R.94.IV.Ha 6. Det Kongelige Bibliothek: Gaml.Kgl.Saml.332.fol.; Thott-267-2o; Thott-270-fol. Herzog August Bibliothek: 1.7.11.Aug.fol. For further archival data, see Goudeau (2005: appendix 2).
- ³ Here the posthumously published first edition is used: Goldmann (1696): III-1, 112-113. A reconstruction of this city and a discussion in detail are given in Goudeau (2005: ch. 15).
- ⁴ For the column orders Goldmann devised a proportional system of his own, with a module divided into 360 minutes, whereas no one before had ever divided the module into more than 60 minutes. This division served in fact the same goal as with Vignola's orders, i.e., providing a modular system in which the five orders could be easily related to each other.
- ⁵ Other authors before Goldmann, such as Daniel Speckle, Simon Stevin and Joseph Furttenbach, had thought about the (fortified) city as a whole in relation to the (hierarchy of) buildings in it.
- ⁶ It is possible that with these two systems Goldmann tried to solve the duality that derives from Vitruvius' description of the layout of cities in relation to the winds, which implies a radial and at the same time checkerboard pattern (Vitruvius 1981: I-6, 7).
- ⁷ Goldmann's city has never been dealt with before. On the ideal city and utopia, see Krufft (1989) and Saage (2001-2002).
- ⁸ 'Die Erfindung der Bau=Kunst rühret ohne Mittel her, von der Hand des Herren; dann also bezeuget David seinem Sohn Salomon, nach dem er ihme das Muster oder Vorbild der Lauber, des Tempels, des Obersaales, und der Kammern gegeben hat [...] Darauß wird gewiß gemacht, das Gott nicht weniger die Vorbilde und Muster des Tempels [...] gegeben habe, als zuvor die Hütten des Stiftts, auf dem Berge, Mosi im Vorbilde gewiesen war worden' (Goldmann 1696: 2-3).
- ⁹ Most likely Goldmann did not use the Jewish Mishnah, especially the passages from Middoth II and IV, which were also a source for the temple used in his time and circle.
- ¹⁰ 'Allhier ist uß Villalpando anzumercken, daß Salomonis Tempel durchauß mit dem Tempel Ezechielis einerley sey gewesen, und derohalben können die Masse auch durchauß mit einander übereintreffen' (Goldmann 1696: 33).
- ¹¹ 'Alles was Vitruvius gutes von gegeneinander Messungen aufgezeichnet hinterlassen hat, dasselbige hat er auß dem Bau des Tempels Salomonis, oder dessen Nachkömmlinge, dem neuen Tempel erlernt [...]' (Goldmann 1696: 32).
- ¹² On the influence of Villalpando's reconstruction, see Ramirez (1991).
- ¹³ 'Zu erst ist dieses Baues Eigenschafft, daß alles durch Zweitheilung leichte gemacht ist'; 'Ja wir befinden, daß wann die gantze Breite des Schachts, welcher den gantzen Tempel=Bau umschreibet, durch viermal wiederholte zwey Theilung, in sechszeihen Theile getheilet wird [...]' (Goldmann 1696: 32-33).
- ¹⁴ 'Die Städte unserer Wohnungen, da wir bleiben sollen, werden uns von dem Baumeister, welcher Gott selber ist, verheissen [...] auff der neuen Erden, nicht auf der Verfluchten, dann dieser Erden Kloß, waltzt sich herum und ist Vergänglich, aber die neue Erde, die Stadt Gottes, das Himmlische Jerusalem, ist als ein Würffel beschrieben, gleicher Länge, Breite und Höhe, und diese Erde stehet ewiglich fest [...]' (Goldmann 1696: 2).
- ¹⁵ The gates correspond to the three times four access roads in the drawing. On the influence of Ezekiel's vision on temple reconstructions in the Dutch Republic, see Goudeau (2014).
- ¹⁶ The system of *axiomata—definitiones—postulata* stems from Euclid. During the seventeenth century this became a standard of reasoning for all disciplines which strove to be scientific – then meaning mathematical. One of the most voluminous enterprises in this respect is probably the work of Christian Wolff (1679-1754), who based his knowledge of architecture on the systematic theories of Goldmann and Sturm.
- ¹⁷ 'Die Unterweisung in dem dritten und vierdten Buche, wie man durch Hülffe einens nach Moduln oder Seulenweiten eingetheilten Gitters inventiren, und

alle sorten der Gebäude austheilen soll, ist ebenfalls von keinem bißher, so viel ich weiß, gelehret worden' (Sturm 1699: [10]).

- ¹⁸ Durand spoke of *genre* and *espèce* instead of 'type'. See Vidler (1977: 95–115) and Lavin (1992: 88, 238 n. 84).
- ¹⁹ The course consisted of only thirty lessons. For the curriculum over the years, see Szambien (1984: 64 ff., 155–161).
- ²⁰ Durand divides the types into the traditional categories of public and private buildings – *édifices publics*, *édifices particuliers*: 'Ces deux genres se subdivisent en un grand nombre d'espèces, et chaque espèce est encore susceptible d'une infinité des modifications [...] La différence des mœurs, des usages, des climats, des localités, des matériaux, des facultés pécuniaires, introduit nécessairement une foule de variétés dans chaque espèce d'édifice, et porte jusqu'à l'infini le nombre de projets que l'architecte peut concevoir et exécuter' (Durand 1975a: ed. 1819, Vol. I–1, 26–27).
- ²¹ Szambien states, 'In practice Durand upheld inherited traditions. He broke with them only in his radical theories'.
- ²² Durand (1975a: ed. 1819, Vol. I–1, 10–16, pls. 5–9 and Vol. I–2, 79–81, 86, pls. 3–4).
- ²³ This notwithstanding the fact that in his argumentation Durand refutes fully the theory of the columns as a whole: '[les] ordres ne forment point l'essence de l'architecture' (Durand 1975a: ed. 1819, Vol. I–1, 16). See for example his and Jean-Thomas Thibault's design for the Temple à l'Égalité of 1794, where the classical orders have been replaced by square-based columns with lines of horizontal text instead of vertical fluting channelling, and human heads in the places of the capitals (Szambien 1982: 27–32; Szambien 1984: 74–80).
- ²⁴ In Durand's words: 'disposer les uns par rapport aux autres', 'la formation des diverses parties des édifices', 'la composition de l'ensemble des édifices'. In the second part, 'De la composition en général', the process is divided in 'combinaisons des éléments des édifices' and 'formation des parties des édifices'. Durand (1975a: ed. 1819, Vol. I–1, 29; Vol. I–2, 73, 81).
- ²⁵ Leonhard's father, Johann Christoph Sturm, produced a manuscript copy by his own hand when he studied with Goldmann in Leiden in 1660. From 1694 to 1702 Sturm taught at the Ritterakademie in Wolfenbüttel where he satisfied his hunger for reading in the Herzog August Bibliothek. This library also held a German copy of Goldmann's original manuscript that was, according to the autograph on the title page, acquired from the Dutch prince Johan-Maurits van Nassau-Siegen (Goldmann 1663).
- ²⁶ A fine series of Sturm's drawings are in the Germanisches National Museum, Nuremberg; Sturm [Handrisse].
- ²⁷ Although Sturm has been the subject of various studies, the significance of his work in architectural history at large has yet to be determined. A more recent addition to the existing insights has been given in Franke (2009).
- ²⁸ Szambien (1984) provides more information on these architects, except for Conta and Rumpf. Friedrich von Gärtner studied from 1812 to 1814 with Percier and Fontaine. Although suggested by, among others, Hederer (1976: 18) and Watkin and Mellinghoff (1987: 188), there is, however, no evidence for Gärtner's connection to Durand (Szambien 1984: 128 n.70).
- ²⁹ I thank Caroline van Eck for bringing this article to my attention. Many other German architects were influenced not by Durand himself, but by his writings, such as Georg Moller in Darmstadt. These are, however, outside the scope of this article. See, e.g., Watkin and Mellinghoff (1987).
- ³⁰ 'Herr Professor Durand bearbeitete damals den 2. Teil seiner Leçons d'architecture und liess mich dazu einen grossen Teil der Zeichnungen für die Kupferstecher fertigen' (Szambien 1984: 162).
- ³¹ For general overviews see Braham (1980: 250–258), Pérouse de Montclos (1989: 459–487) and Loyer (1999: 17–62). On the complex reciprocity between architecture and the French Revolution, see Vidler (1991).
- ³² For a condensed survey of eighteenth-century German architectural theory, see Kruft (1991: 198–217). Still of importance is Schütte (1979), especially pages 203 to 223.
- ³³ Mallgrave (2005: 69) summarises that Durand's teaching at the *École* allowed him 'to rethink the classical underpinnings of architecture, or rather to reassess classical architecture's social relevance to modern industrial society'.
- ³⁴ See note 19.
- ³⁵ Szambien (1984: 97) considers the grid as Durand's main legacy: 'La "methode des petits carreaux" reste l'apanage de Durand'.
- ³⁶ See note 20.

References

Primary sources, unpublished

- Goldmann, N** [Elementa] *Ein Elementa der Baukunst*. [before 1656] Det Kongelige Bibliothek, Copenhagen: Gaml.Kgl.Saml.332.fol.
- Goldmann, N** [Zeichnungen – 1] *Architektonische Zeichnungen und Kupferstiche –1*. Staatsbibliothek Preussischer Kulturbesitz, Berlin: Libr.pict.fol.A71.
- Goldmann, N** 1658 *Elementa architecturae*. Copy Willelm Worm. Leiden. Royal Library, Copenhagen: Thott 267–2o.
- Goldmann, N** 1663 *Entwerffung dehr Baukunst*. Herzog August Bibliothek, Wolfenbüttel: 1.7.11.Aug.fol.
- Sturm, L C** [Handrisse] *Sturms' Architectonische original Handrisse*. 3 vols. Germanisches National Museum, Nuremberg: Fol. 94.142.

Primary sources, published

- Conta, K F A von** 1806 *Grundlinien der bürgerlichen Baukunst: Nach Herrn Durand für Teutsche Bau- und Werkschulen bearbeitet*. Halle: Neue Societäts-Buch- und Kunsthandlung.
- Coudray, C W** 1831 *Abriss der Vorlesungen über Baukunst, gehalten an der königlichen polytechnischen Schule zu Paris*. 2 vols. Karlsruhe and Freiburg im Breisgau: Herder'schen Kunst- und Buchhandlung.

- Durand, J-N-L** 1975a *Précis des leçons d'architecture données à l'École Royale Polytechnique*. 2 vols., orig. ed. Paris 1819 and 1817. Reprint Unterschneidheim: Uhl Verlag.
- Durand, J-N-L** 1975b *Partie graphique des cours d'architecture faits à l'École Royale Polytechnique depuis sa réorganisation [...]*, orig. ed. Paris 1821. Reprint Unterschneidheim: Uhl Verlag.
- Goldmann, N** 1696 *Vollständige Anweisung zu der Civil Bau-Kunst [...]*, ed. L.C. Sturm. Wolfenbüttel: C.J. Bißmarck. [2nd ed. 1699; 3rd ed. 1708].
- Guadet, J** 1901–1904 *Éléments et théorie de l'architecture: Cours professé à l'École Nationale et Spéciale des Beaux-Arts*. 4 vols. Paris: Librairie de la Construction Moderne.
- Leroy, J-D** 1764 *Histoire de la disposition et des formes différentes: Que les Chrétiens ont données à leurs temples depuis le règne de Constantin le Grand jusqu'à nous*. Paris Chez Desaint & Saillant, Libraires.
- Penther, J F** 1745 *Zweyter Theil der ausführlichen Anleitung zur bürgerlichen Bau-Kunst [...]*. Augsburg: J.A. Pfeffel.
- Penther, J F** 1748 *Vierter Theil der ausführlichen Anleitung zur bürgerlichen Bau-Kunst [...]*. Augsburg: J.A. Pfeffel.
- Prado, H, and Villalpando, J B** 1596–1605 *In Ezechielem explanationes et apparatus vrbis, ac Templi Hierosolymitani: Commentariis et imaginibus opvs tribvs tomis distinctvm*. 3 vols. Rome.
- Sturm, L C** 1699 *Erste Ausübung der vortrefflichen und vollständigen Anweisung zu der Civil-Bau-Kunst, Nicolai Goldmanns, Bestehend in neun ausführlichen Anmerkungen [...]*. Braunschweig: Keßler.
- Sturm, L C** 1719 *Architectura civili-militaris [...]*. Augsburg: Jeremias Wolff Erben.
- Sturm, L C** 1720 *Vollständige Anweisung, Allerhand oeffentliche Zucht- und Liebes-Gebäude [...] wohl anzugeben [...]*. Augsburg: Jeremias Wolff Erben.
- Vitruvius Pollio, M** 1981 *De architectura libri decem*. ed. C. Fensterbusch. Darmstadt: Wissenschaftliche Buchgesellschaft.
- Secondary sources**
- Armstrong, C D** 2012 *Julien-David Leroy and the Making of Architectural History*. London and New York: Routledge.
- Bernet, C** 2005 Nikolaus Goldmann. In: *Biographisch-Bibliographisches Kirchenlexikon*. Bautz, F-W, and Bautz, T (eds.). 22 vols. 1990–2003. Vol. 24. Nordhausen: Verlag Traugott Bautz. Cols. 722–736.
- Bothe, R** 2013 *Clemens Wenzeslaus Coudray 1775–1845: Ein deutscher Architekt des Klassizismus*. Vienna, Cologne and Weimar: Böhlau.
- Braham, A** 1980 *The Architecture of the French Enlightenment*. London: Thames and Hudson.
- Buttlar, A, von** 1999 *Leo von Klenze: Leben Werk, Vision*. Munich: C.H. Beck.
- Chafee, R** 1977 The Teaching of Architecture at the École des Beaux-Arts. In: Drexler, A (ed.), *The Architecture of the École des Beaux-Arts*. New York: Museum of Modern Art. 60–109.
- Collins, P** 1962 The Origins of Graph Paper as an Influence on Architectural Design. *Journal of the Society of Architectural Historians* 21(4): 159–162.
- Collins, P** 1965 *Changing Ideals in Modern Architecture 1750–1950*. London: Faber and Faber.
- Egbert, D D** 1980 *The Beaux-Arts Tradition in French Architecture: Illustrated by the Grands Prix de Rome*. Zanten, D van (ed.). Princeton, NJ: Princeton University Press.
- Franke, M** 2009 Leonhard Christoph Sturm. Zwischen pietistischer Überzeugung und Repräsentation am Berliner Hof. In: Oechslin, W (ed.), *Architektur und / versus Baumeister: Die Frage nach dem Métier. Siebter Internationaler Barocksommerkurs 2006*. Zürich: gta Verlag. 142–151.
- Friedrich, F-M** 2008 *Karl Friedrich Schinkel: Der Baumeister Preußens und sein Schüler Johann Peter Cremer, der 'Schinkel' Aachens und seine Architektensöhne*. Starnberg: Verlag Creativstudio.
- Goalen, M** 1991 Schinkel and Durand: The Case of the Altes Museum. In: Snodin, M (ed.), *Karl Friedrich Schinkel: A Universal Man*. Exhib. cat. London, Victoria and Albert Museum. New Haven and London: Yale University Press. 27–35.
- Goudeau, J** 2005 *Nicolaus Goldmann (1611–1665) en de wiskundige architectuurwetenschap*. With an English Summary. Groningen: Philip Elchers.
- Goudeau, J** 2006–2007 A Northern Scamozzi: Nicolaus Goldmann and the Universal Theory of Architecture. *Annali di Architettura: Rivista del CISA Andrea Palladio* 18–19. 235–248.
- Goudeau, J** 2010 A Typology for the Well-Ordered Society: Nicolaus Goldmann on Public Buildings. In: Ottenheim, K, Jonge, K de and Chatenet, M (eds.), *Public Buildings in Early Modern Europe*. Architectura Moderna 9. Turnhout: Brepols. 13–26.
- Goudeau, J** 2014 Ezekiel for Solomon: The Temple of Jerusalem in Seventeenth-Century Leiden and the Case of Cocceius. In: Goudeau, J, Verhoeven, M and Weijers, W (eds.), *The Imagined and Real Jerusalem in Art and Architecture*. Leiden and Boston: Brill. 88–113.
- Hansert, A** 2005 Rumpf, Heinrich Friedrich. In: *Neue deutsche Biographie* 22: 251–252. Available at <http://www.deutsche-biographie.de/pnd139517243.html> [accessed 12 August 2014].
- Hecker, M F** 1903 Conta, Karl Friedrich Anton von. In: *Allgemeine deutsche Biographie* 47: 517–521. Available at <http://www.deutsche-biographie.de/pnd100089925.html?anchor=adb> [accessed 12 August 2014].
- Hederer, O** 1976 *Friedrich von Gärtner, 1792–1847: Leben und Werk*. Munich: Prestel Verlag.
- Hils, E** 1988 *Johann Friedrich Christian Hess: Stadtbaumeister des Klassizismus in Frankfurt am Main von 1816–1845*. Frankfurt am Main: Waldemar Kramer.
- Hitchcock, H-R** 1977 *Architecture: Nineteenth and Twentieth Centuries*. 4th ed. Harmondsworth: Penguin Books.
- Jachmann, J** 2008 Enzyklopädische Architekturtypologie im 18. Jahrhundert: Die 'Architektonischen Risse' von

- Anckermann, Hofmeister und Engelbrecht. In: *Marburger Jahrbuch für Kunstwissenschaft* 35: 169–214.
- Kruft, H-W** 1989 *Städte in Utopia: Die Idealstadt vom 15. bis zum 18. Jahrhundert*. Munich: C.H. Beck.
- Kruft, H-W** 1991 *Geschichte der Architekturtheorie*. 3rd ed. Munich: C.H. Beck.
- Küster, I** 1942 *Leonhard Christoph Sturm: Leben und Leistung auf dem Gebiet der Zivilbaukunst in Theorie und Praxis*. Unpublished thesis (PhD), University of Berlin.
- Lavin, S** 1992 *Quatremère de Quincy and the Invention of a Modern Language of Architecture*. Cambridge, MA and London: MIT Press.
- Lombaerde, P, and Heuvel, C, van den** (eds.) 2011 *Early Modern Urbanism and the Grid: Town Planning in the Low Countries in International Context; Exchanges in Theory and Practice 1550–1800*. Turnhout: Brepols.
- Lorenz, H** 1995 Leonhard Christoph Sturms 'Prodrömus Architecturae Goldmanniana'. *Niederdeutsche Beiträge zur Kunstgeschichte* 34: 119–144.
- Loyer, F** 1999 *Histoire de l'architecture française: De la Révolution à nos jours*. Paris: Mengès.
- Madrazo, L** 1994 Durand and the Science of Architecture. *Journal of Architectural Education* 48(1): 12–24.
- Mallgrave, H F** 2005 *Modern Architectural Theory: A Historical Survey, 1637–1968*. Cambridge and New York: Cambridge University Press.
- Nerdinger, W, Philipp, K, and Schwarz, H-P** (eds.) 1990 *Revolutionsarchitektur: Ein Aspekt der europäischen Architektur um 1800*. Exhib. cat. Frankfurt am Main, Deutsches Architekturmuseum, and Munich, Neue Pinakothek 1990, Munich: Hirmer.
- Oechslin, W** 2008 *Palladianismus: Andrea Palladio—Kontinuität von Werk und Wirkung*. Zürich: gta Verlag.
- Pelt, R J van, and Westfall, C W** 1991 *Architectural Principles in the Age of Historicism*. New Haven and London: Yale University Press.
- Pérez-Gomez, A** 1984 *Architecture and the Crisis of Modern Science*. 2nd ed. Cambridge, MA and London: MIT Press.
- Pérouse de Montclos, J-M** 1989 *Histoire de l'architecture française: De la Renaissance à la Révolution*, Paris: Mengès.
- Porphyre** 1998 *Isagoge: Texte grec, Translatio Boethii*. Libera, A, de, and Segonds, A-Ph (ed. and transl.). Paris: Vrin.
- Porphyre** 2008 *Commentaire aux Catégories d'Aristote*. Bodéüs, R (ed., transl. and introd.). Paris: Vrin.
- Ramirez, J A** 1991 *Dios Arquitecto: J. B. Villalpando y el Templo de Salomón*. Madrid: Ediciones Siruela.
- Saage, R** 2001–2002 *Utopische Profile*. Vol 1: *Renaissance und Reformation*; Vol. 2: *Aufklärung und Absolutismus*. Politica et Ars 1–2. Münster: Lit Verlag.
- Schmidt-Biggemann, W** 1983 *Topica Universalis: Eine Modellgeschichte humanistischer und barocker Wissenschaft*. Hamburg: Felix Meiner Verlag.
- Schütte, U** 1979 'Ordnung' und 'Verzierung': Untersuchungen zur deutschsprachigen Architekturtheorie des 18. Jahrhunderts. Inaug.-Diss. University of Heidelberg.
- Semrau, M** 1916 Zu Nikolaus Goldmanns Leben und Schriften. *Monatshefte für Kunstwissenschaft* 9 (10): 349–361; 9 (12): 463–473.
- Shinn, T** 1980 *L'École Polytechnique 1794–1914*. Paris: Presses de la Fondation nationale des sciences politiques.
- Szambien, W** 1982 Durand and the Continuity of Tradition. In: Middleton, R (ed.), *The Beaux-Arts and Nineteenth-Century French Architecture*. London: Thames and Hudson. 18–33.
- Szambien, W** 1984 *Jean-Nicolas-Louis Durand 1760–1834: De l'imitation à la norme*. Paris: Picard.
- Vidler, A** 1977 The Idea of Type: The Transformation of the Academic Ideal, 1750–1830. *Oppositions* 8 (Spring): 95–115.
- Vidler, A** 1991 Researching Revolutionary Architecture. *Journal of Architectural Education* 44: 206–210.
- Villari, S** 1990 J.N.L. Durand (1760–1834): *Art and Science of Architecture*. (orig publ. 1987; transl. from Ital.). Rizzoli Essays on Architecture 3. New York: Rizzoli.
- Watkin, D, and Mellinshof, T** 1987 *German Architecture and the Classical Ideal 1740–1840*. London: Thames and Hudson.
- Wirth, I** 1957 Coudray, Clemens Wenzeslaus. In: *Neue Deutsche Biographie* 3: 381–382. Available at <http://www.deutsche-biographie.de/pnd119414619.html> [accessed: 12 August 2014].

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