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TEXTBOOK
A Guide to the Teaching of Construction

Gabriel Bernard Guelle

Abstract: Between the 1920s and the 1970s in France, the teaching of construction in architecture schools has undergone major modifications in relation to its social, intellectual, and professional context. The present article aims to understand the role played by the teaching of construction in the architects' relationship to building techniques and to engineers. The study of a set of textbooks, considered as pedagogical devices and professional guides, and used in 1921 by Edouard Arnaud to teach construction at the Ecole Centrale des Arts et Manufactures, and at the Ecole Nationale Supérieure des Beaux-Arts, tackles the role of teaching construction in architecture and engineering curricula and its influence on the profession. This study relies on a comprehensive analysis of the set of textbooks, considering its materiality and its written and visual content, combined with relevant elements from its author's biography, publications, and pedagogical production.

Keywords: Teaching, Construction, Textbook, Architect, Engineer.

On the Teaching of Construction in Architecture Schools in the 20th century in France

In France, the teaching of construction in architecture schools has been debated among both teachers and professionals since the second half of the 19th century (Epron 1997: 120–121). From 1819 to 1968, construction was one of the three main disciplines of the training provided in the architecture section of the Ecole Nationale Supérieure des Beaux-Arts in Paris, one of the dominant models regarding architectural education in Europe (Pfammatter 2000). Yet, the teaching of construction in architecture schools in the 20th century in France has barely been studied, even if research on architectural and engineering education and those professions often hints at its importance (Epron 1997; Saint 2007). Moreover, the unifying aspect of the teaching of

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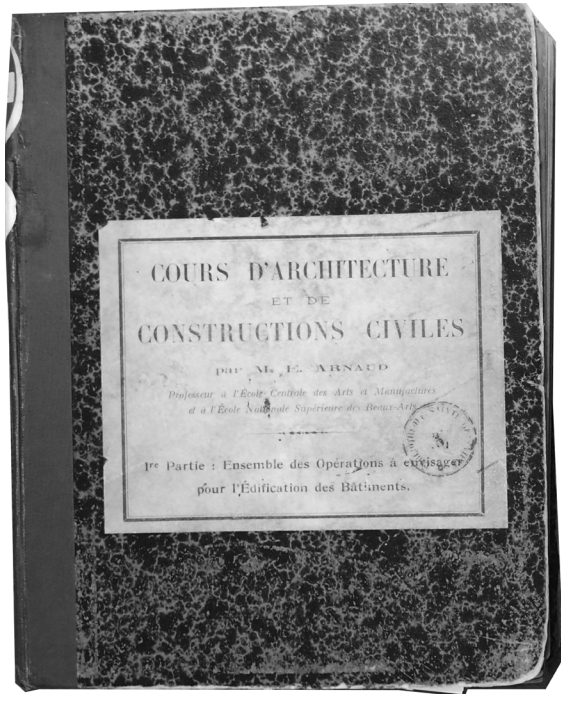


1.
Cover of the first volume (out of five) of the 1921 edition of Edouard Arnaud's textbook. Source: Bibliothèque Sainte-Geneviève, Paris, France.
Photographer: Gabriel Bernard Guelle.

construction for architects and engineers is seldom considered in the French research (Nègre 2011; Nègre 2012; Thibault 2017), while research from the German cultural space often underlines it (Lichtenstein 2012; Hassler et al. 2019).

To fill out the gaps in the existing research, my PhD thesis offers a historical study on the teaching of construction in France between the 1920s and the 1970s in relation to its pedagogical, social, and professional context. This historical study is complemented by a comparative approach between France and the German cultural space to debunk the myth of a »French cultural exception« regarding architectural education and the profession. This combined approach aims at understanding the importance of teaching construction in the definition of the architects' relationship to building techniques and to engineers, so that these aspects can be included in the design of current construction lessons.

In the first half of the 20th century, the architecture section of the Ecole des Beaux-Arts was the most influential architectural school in France as it organized the only competition that granted access to public procurement. This article offers an insight into the teaching of Edouard Arnaud in this architecture school through the study of an early version of his textbook, published in 1921, (fig. 1) which was found at the public library of Sainte-Geneviève in Paris, at a time when all archive centres in France had closed due to the Covid-19 pandemic.[1]

The existing research on Edouard Arnaud's professorial work barely analyzes the textbook itself. In his Master's thesis, Jean Thevenot (1994) studies Arnaud's teaching in both schools in relation to the teacher's career as an architect and an engineer, and to the schools' curriculum and pedagogical policy regarding construction at the time. Thevenot relies on the textbook to document Arnaud's pedagogy and focuses on the role played by reinforced concrete in its content. In his book, Jean-Pierre Epron (1997) uses Arnaud's textbook as a means to understand his pedagogy in relation to the contemporary »technical debate«. He only mentions the structure of the textbook and focuses on the chapter on »composition« to demonstrate the broader thesis of his research, the »eclecticism« theory in architecture. In her article on the use of photography in teaching construction, Amandine Diener (2016)

1 The teaching of construction provided at the architecture section of the Ecole Nationale Supérieure des Beaux-Arts by Edouard Arnaud (1864–1943) from 1920 to 1934, and then by François Vitale (1898–1962) from 1935 to 1962, is a focal point of my PhD research.

studies a collection of glass plates used by François Vitale, including a set designed by his predecessor Edouard Arnaud for his own teaching. In her introduction, she mentions the textbook in relation to the glass plates as part of the pedagogical devices designed by Edouard Arnaud for his teaching without cross-analyzing them. Finally, Antonio Brucculeri studies Arnaud's teaching in both schools to measure its impact on architectural and engineering training (Brucculeri 2006). He uses the textbook, presented as an »illustrated guide« complementing the glass plates to analyze Arnaud's pedagogy while focusing on the iconography, and mentions the evolution of the content between the 1920 and 1931 edition. To complement the existing research, a comprehensive study of the textbook that demonstrates its purpose as a pedagogical device, but also as a professional guide, would illuminate the role played by the teaching of construction in architectural education.

Edouard Arnaud's Textbook: From Pedagogical Device to Professional Guide

After his nomination to the position of Dean of Construction at the Ecole Nationale Supérieure des Beaux-Arts in 1921, Edouard Arnaud proceeded to reform the teaching of construction there, as he also did in 1920 at the Ecole Centrale des Arts et Manufactures where he had already been giving lectures for approximately ten years (Arnaud 1921g: 2). His conjoint reform is meant to rectify the shortcomings of the contemporary teaching of construction in both schools and is based on the professor's first-hand knowledge as their former student and his professional experience as an architect and engineer.

To achieve his goal, Arnaud relied on two pedagogical tools: a collection of glass plates and a set of textbooks entitled »Cours d'architecture et de constructions civiles« (Arnaud 1921a,b,c,d,e,f). While the glass plates represented a technical innovation, as their use was made accessible to the public in the 1890s (Diener 2016), textbooks had belonged to French architectural and engineering teaching since the modern era, with treatises such as *Nouvelles inventions pour bien bastir a petits frais*, published by Philibert de l'Orme in 1561. But, while the use of textbooks was instituted at the Ecole centrale, who owned a printing works to publish them, their use at the Ecole des Beaux-Arts relied on the teachers' initiative. Textbooks used there were therefore more diverse in their form and content, depending on the purpose their author gave them.

In 1921, Arnaud introduced his reform of the construction curriculum at the Ecole Nationale Supérieure des Beaux-Arts with the following statement:

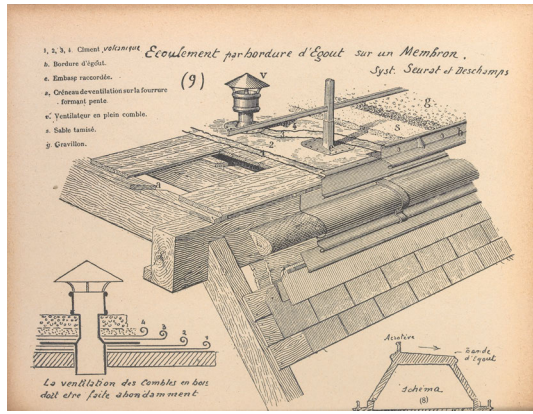
> »[E]n France nous avons le plus pressant besoin pour rebâtir nos régions dévastées d'une pépinière d'excellents constructeurs qu'il faut pouvoir former rapidement et sûrement, qui soient utiles sur les chantiers dès leur sortie de l'école et qui puissent se perfectionner, où qu'ils se trouvent, par leurs propres moyens.«
>
> »In France, we have the most urgent need for a body of skilled constructors, who can be trained properly and efficiently, who will be proficient on the construction site immediately after their graduation, and who will be able to complete their education, wherever they are, on their own, to rebuild our devastated regions.« (Arnaud, 1921g: 2).2

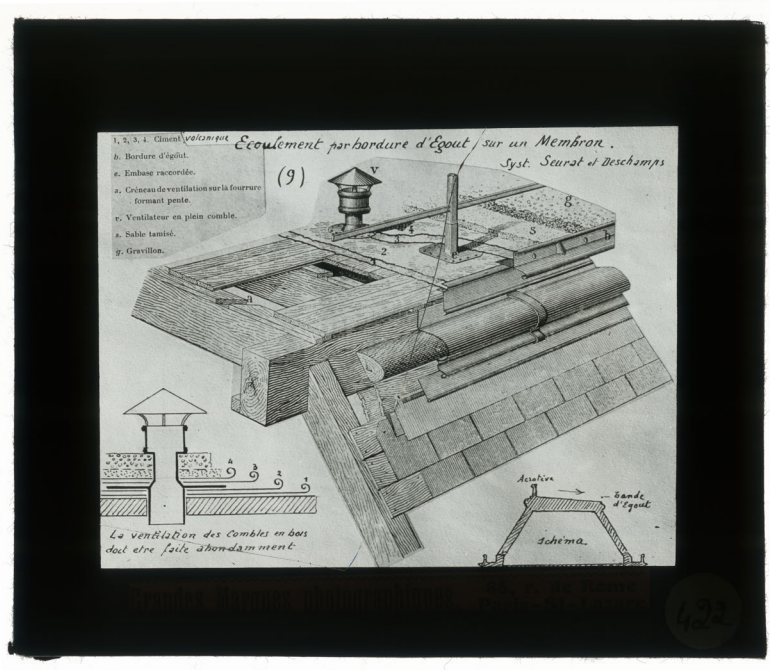
This statement indicates the orientation of the whole reform, including the textbook. To ensure the training of this body of skilled constructors before and after their graduation, Arnaud designed his textbook not only as a tool to improve the teaching of construction, but also as a professional guide responding to the needs of the French architecture trade after the First World War.

Textbook as a Pedagogical Device: Improving the Teaching of Construction

As he himself explained when presenting his reform of the teaching of construction, Arnaud designed his handbook to offer three major pedagogical improvements (Arnaud 1921g). First, he claimed that his textbook was meant to free students from notetaking, an error-strewn and time-consuming practice observed in »traditional« dictated lessons. As the textbook provided exact, complete, and up-to-date content, the students could concentrate on the lecture without making notes, thus sparing time for the teacher to include more information in the session. Second, the pictures projected in the amphitheater using glass plates were also reproduced in the textbook to help students memorize the lesson and to develop a visual culture as part of their training as architects or engineers (fig. 2). At home, the handbook offers a reliable study support, free of mistakes, and richly illustrated so that students can use it to prepare for exams or as material for other classes.

2 All translations from French to English were made by the author.





2.

Illustration of a gutter technique from the second part of the lesson (Arnaud, 1921c:380) and matching glass plate (Vitale n.d.). The glass plate shows how Arnaud composed this illustration. First he clipped the central picture and its key out of a printed source, then added a title and diagrams to clarify the constructive system depicted in the original picture. Source: 1. Bibliothèque Nationale de France, Paris, France 2. Cité de l'Architecture et du Patrimoine/Centre d'Archives de l'Architecture contemporaine, Paris, France.

This use of the textbook was probably enforced at the Ecole Centrale des Arts et Manufactures, as indicated by the yearly editions from 1919 to 1929 that were found in the school's archives gathered at the Archives nationales de France. By owning a printing works, the Ecole centrale was probably able to publish its textbooks at minimal cost and sell them to students at a low price. This hypothesis is sustained by the collection of handbooks found in the archives of François Vitale, who studied at the Ecole centrale between 1919 and 1921 (Vitale 1919–1925). This collection indicates that the 1921 edition of Arnaud's set of textbooks was a standard production of the Imprimerie des arts et manufactures except for its numerous illustrations and its sixth volume, a folio album of the size of 44 x 29 cm gathering 262 plates. The set of textbooks was sold along with other similar publications to all the students at the Ecole centrale.

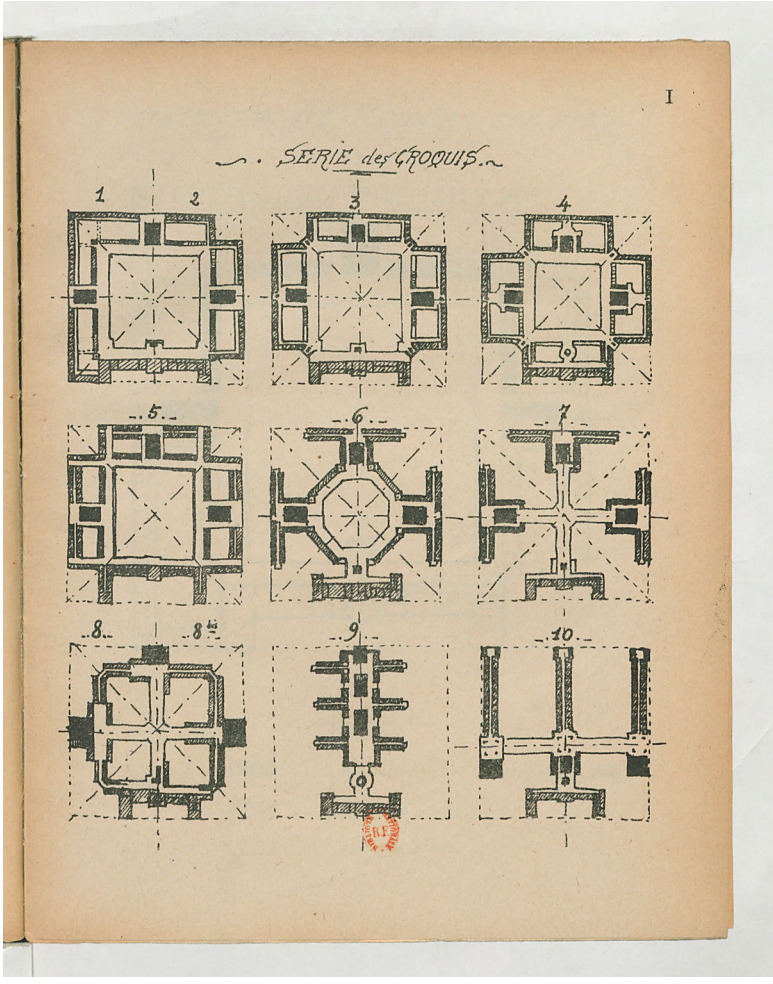
On the other hand, it is not certain that students at the Ecole Nationale Supérieure des Beaux-Arts could use this set of textbooks in the same way that their peers at the Ecole centrale did. As the textbooks were printed by the Imprimerie des arts et manufactures, students outside the Ecole centrale may not have been able to purchase it in the same condition, although the journal *L'Architecture* mentions a larger edition in 1923 which met demand from both architects and engineers in and outside of the Ecole centrale and the Ecole des Beaux-Arts (»Bibliogaphie« 1923). Students at the latter may have borrowed the textbook, whether from the school's library or from their peers, as it was common for an atelier, a group of pupils studying architectural design at the Ecole des Beaux-Arts under the guidance of a patron to share books in the form of a small private library (Garric 2011). In this case, the first improvement envisioned by Edouard Arnaud may have been reduced.

Second, the textbook's organization and content reflected the global educational effort made by the teacher, as Arnaud himself declared in the introduction to the lesson:

> »Pour rendre ce cours plus pratique, plus ordonné et plus utile pour vous [les étudiants], j'adopterai dans mon enseignement l'ordre suivant lequel le bâtiment s'édifie.«
>
> »To make this lecture more practical, more methodical, and more useful to you [students], I will follow in my teaching the sequence in which an edifice is built.« (Arnaud 1921a: 9)

In the 1921 edition, Arnaud divides the lesson into three parts. In »Opérations à envisager pour l'édification d'un bâtiment« he defines twelve operations leading from the program issued by a client to the completion of the building. Then, in »Technique du bâtiment«, he presents the different construction techniques available at the time in order of their execution, from groundwork to roofing. In »Application du cours de constructions civiles«, he finally shows how his method can be put to practical use through a case study based on one of his own realizations, a housing estate in Paris. The structure of this lesson serves three didactic purposes. First, it facilitates the understanding and learning of the lesson's content by presenting it in a logical, practical order that the student can observe in architectural practice. Second, this partition offers a progression from a comprehensive approach to the act of building, with general guidelines given in the first part, to detailed knowledge of construction techniques which are presented in the second part of the lesson. Finally, it offers an evolution from theory to practice by putting the theoretical knowledge presented in the first two parts to practical use in the case study in the final part of the lesson.

This didactic effort is also apparent in the third chapter of the first part of the lesson, which can be regarded as its most important moment, consisting of 80 out of 170 pages. In this chapter, Edouard Arnaud observes the same progression from theory to practice to thoroughly explain the notion of »composition« which he regards as »the key to success« (Arnaud 1921a: 2). After an almost philosophical introduction, he presents the main concepts and rules of his composition theory, followed by a precise description of the design process and work method, and he concluded with an illustrated application based on the program of the Ecole centrale (fig. 3), which is well known to the students of this school. This thorough explanation is both didactic and unusual. As Edouard Arnaud underlined in his introduction, the teaching of the Ecole centrale dedicated little to no time to composition, while the teaching of the Ecole des Beaux-Arts revolved around it (Arnaud 1921a: 2). Yet, even if this notion was a central part of the former, it was never explicitly taught. Students had to learn it through practice, first in the atelier under the guidance of their patron, a famous architect appointed by the school or chosen by the students to teach architectural design, then, by helping with older students' projects, and finally, by submitting their own work to competitions to earn prizes. Thus, Arnaud's lesson on composition can be seen as an attempt to improve both schools' pedagogy by clarifying this key notion for students.



3.
Sketches illustrating the first steps of Arnaud's work method for composition (Arnaud 1921a: I). After designing multiple options that could accommodate the program (Arnaud 1921a: I), Source: Bibliothèque Nationale de France, Paris, France.

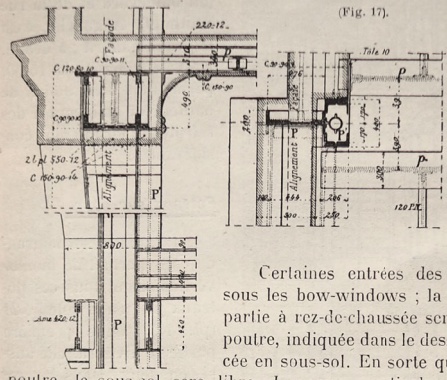
— 31 —

(40.83), comprenant, avons-nous vu, une partie tubulaire et une partie en forme de T supportant la poutre-ceinture. Depuis là, seule la forme tubulaire continuera.

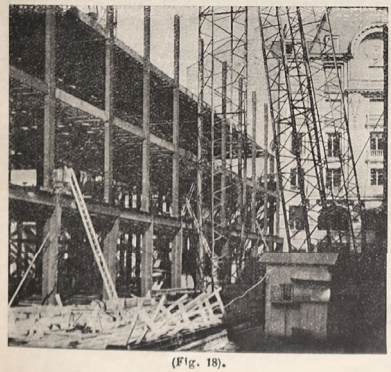
Poteaux au droit des Bow Windows.

Les bow-windows font saillie sur l'alignement de la façade (fig. 17). La poutre-ceinture devra en faire autant (elle sera élargie) et pour la supporter on donnera en élévation, à la partie supplémentaire en forme de T des poteaux, un élargissement affectant la forme d'une console très allongée.

(Fig. 17).



Certaines entrées des immeubles se font sous les bow-windows ; la maçonnerie de cette partie à rez-de-chaussée sera supportée par une poutre, indiquée dans le dessin (fig.17) en P placée en sous-sol. En sorte qu'en dessous de cette poutre, le sous-sol sera libre. La coupe verticale est faite dans l'axe du bow-window. La photographie (fig. 18) montre, dans les deux premiers poteaux, la forme de console support au droit des bow-windows dont je viens de parler.



(Fig. 18).

Je vous donne en façade (fig. 19) l'entrée d'un des immeubles situé sous un bow-window. Ces entrées seront les seules liaisons de maçonnerie entre la façade supérieure suspendue et le sol, parce que ce sont les seules qui pourront être déterminées d'une façon immuable et obligatoire.

4.

Presentation of the metal frame of the housing estate »Rue des Italiens« (Arnaud 1921e: 31). Photographs of the construction site and sections on bow-windows illustrate Arnaud's description of the construction work. Source: Bibliothèque Sainte Geneviève, Paris, France.

Finally, Arnaud designed the application part of his textbook to replace visits to construction sites. Even if he claims that »practice is actually learnt on the construction site« the teacher argues that such visits are time-consuming, dangerous, and profitable to only a few students (Arnaud 1921g: 1). Therefore, he conceived of a paper alternative which offered both a comprehensive overview of the act of building and a concrete example of how his teaching could be implemented. Following the same course as the lesson, Arnaud presents the realization of the housing operation »Rue des Italiens« that he conducted for the company l'Urbaine-Vie in the 1910s. His presentation emphasizes the relationship between program, design, and construction and links every step of the project to the construction site. This relation is underlined by italicized remarks in the text and by the illustrations, mostly photographs taken on the construction site (fig. 4).

Textbook as a Professional Guide: Accompanying Practice

In the last part of his textbook, Edouard Arnaud declares, regarding operations such as »Rue des Italiens«:

> »L'Architecte, qui ne construit pas avec ses deniers et qui est responsable du bon rendement des capitaux qui lui sont confiés, a le devoir de sacrifier à l'utilité son sentiment de l'unité, de l'harmonie et son désir, en toute autre circonstance bien légitime, de faire une belle œuvre.«

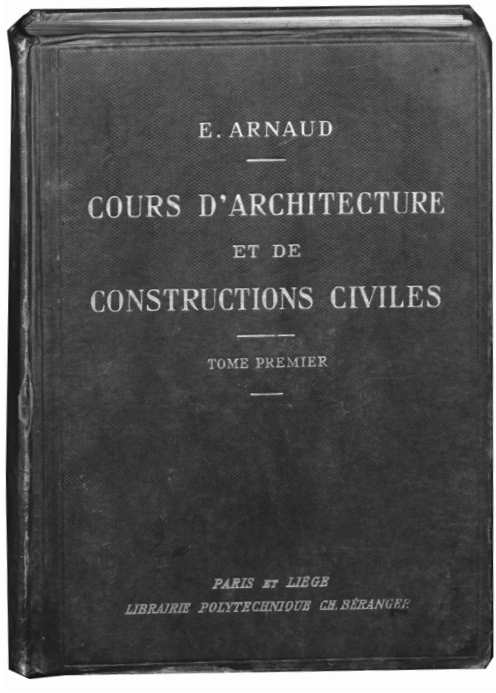
> »The architect, who does not build on their own dime and is responsible for the good return of the capital they were given, has the duty to sacrifice their sense of unity, of harmony, and their desire, otherwise legitimate, to achieve a masterpiece to utility.« (Arnaud, 1921e: 8)

This statement clashes with the approach to architectural design presented in the previous part of the lesson. As a result, the author's view of composition in the application part of the lesson reveals the gap between the ideal program of the Ecole Centrale des Arts et Manufactures, which was used in the chapter dedicated to composition, and the reality of the trade for which Edouard Arnaud prepared his students. Arnaud's textbook can therefore not only be seen as a pedagogical device but also as a professional guide.

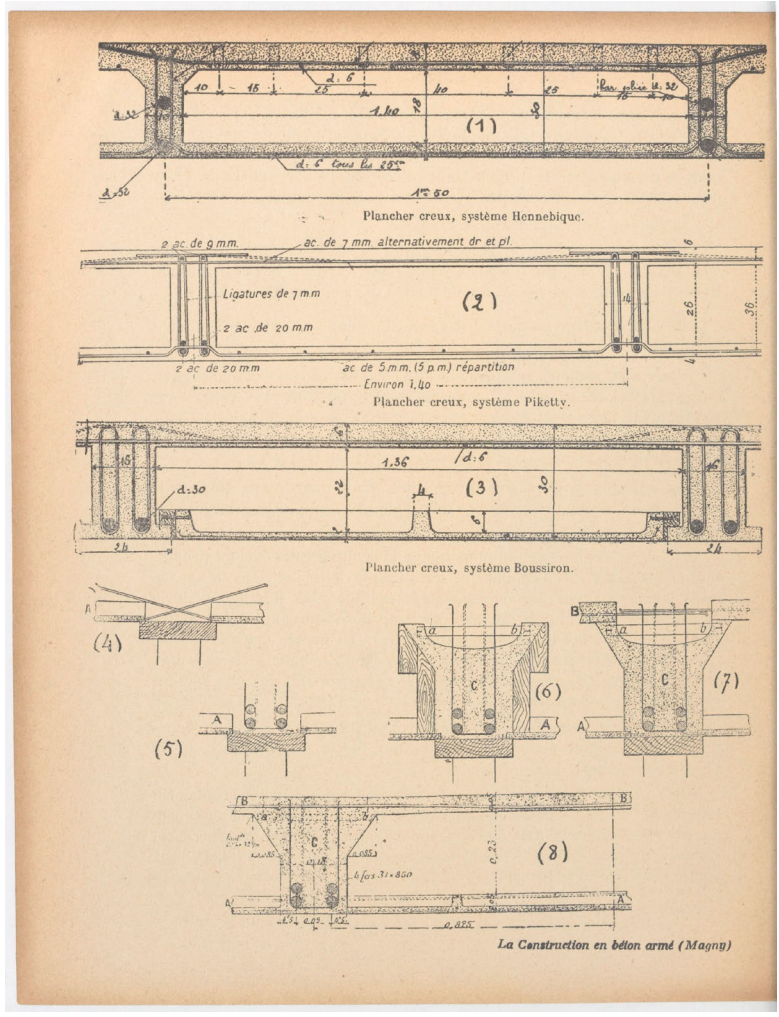
This aim was first expressed in the textbook's material form. The octavo format of 22 x 16 cm, and the relative slimness of the five first volumes made them easy to handle and carry around. This format was the same as most of

the publications of the Imprimerie des arts et manufactures which may initially result from an economic and practical decision made by the Ecole centrale, which acted as a publishing house for all its textbooks. However, this format also served Edouard Arnaud's design as he conceived of his textbooks as a set of references which could be carried around by professionals and used on the construction site (Arnaud 1921g: 2). Plus, the division of the lesson's content into five volumes identifies the general guidelines to lead a project (Part 1: »Opérations à envisager pour l'édification d'un bâtiment« vol.1) from the set of references on building techniques (Part 2: »Technique du bâtiment« vol.2, vol.3, and vol.4), and the application of the lesson (Part 3: »Application du cours de constructions civiles« vol.5). This division facilitates the process of referring to the lesson and makes the more »didactic« third part able to be detached from the other two. This reflexion on the format is exposed when comparing the 1921 edition of the lesson printed by the Imprimerie des arts et manufactures with the 1931 edition published by the Librairie Polytechnique (Arnaud 1931). While the 1921 edition was designed for students, the 1931 edition is intended for a larger public as indicated by the content of the catalog of the Librairie Polytechnique that covers a large range of subjects from architecture to sports. This change in the target audience is further shown in the form and content of the 1931 edition. Adopting the standard format set by the Librairie Polytechnique for its publications, the 1931 edition of the »Cours d'architecture et de constructions civiles« is composed of two quarto volumes of around 30 x 22 cm of 600 and 755 pages each, covered in a crimson percale cotton engraved with the title of the lesson and the name of the author in silver letters (fig. 5). The first volume gathers the first part of the lesson and 27 chapters of the second part of the lesson, while the second volume covers the remaining 38 chapters of the second part of the lesson, leaving the third part of the lesson out. Those changes in the format and the content indicate that the 1931 edition of the lesson is not designed for students anymore, as it is likely to be expensive and it discards a major didactic part. For established professionals however, it can be included in their library and used as a reference point. Thus, this edition of the »Cours d'architecture et de construction civiles« loses its role as a pedagogical device and only serves as a professional guide.

This dimension is already underlined by Edouard Arnaud in 1921, when describing his textbook:



5.
Cover of the first volume (out of two) of the 1931 edition of Edouard Arnaud's textbook. Source: Personal archives of Françoise Boudon.
Photography: Gabriel Bernard Guelle.



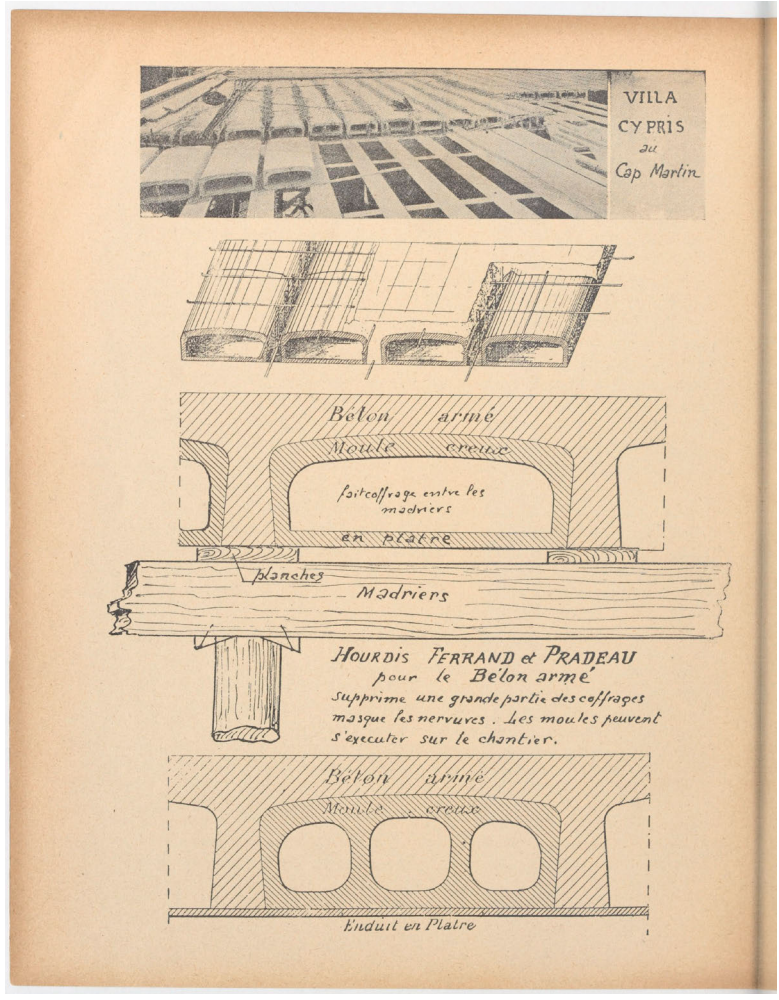
6.

Illustrations of foundation and reinforced concrete techniques from the second part of the lesson (Arnaud 1921b: 528). The inscriptions at the bottom right of p. 528 indicate it's pictures' source. On p.528, he numbered the graphics from (1) to (8) to refer to them in the text. Source: Bibliothèque Nationale de France, Paris, France.

> »Il [L'élève] doit trouver dans cette documentation tous les procédés de construction et une expérience que sans cela il ne pourrait acquérir qu'à la fin d'une longue carrière. «
>
> »They [the student] must find in this documentation all the construction techniques and an experience that they would otherwise acquire only at the end of a long career«. (Arnaud 1921g: 2)

While the »Cours d'architecture et de construction civiles« may serve as a point of reference for established practitioners it is first meant to guide young graduates' first steps into the professional world. This aim is evident in the textbook by the position of mentor Edouard Arnaud adopts toward the reader. At the age of 57, the teacher had been working on various projects as an architect and an engineer for 25 years, among which included the first reinforced concrete building realized by Hennebique. His nomination as Architecte des bâtiments civils et palais nationaux (1919) distinguished him as a knowledgable expert on construction matters who was recognized by the state (cf. Teyssot 1982). Thus, Edouard Arnaud addressed his students as a seasoned professional using first-person narration in the textbook and providing advice and remarks on various subjects, including professional policies and construction techniques. His expertise was shown not only in the information he shared, but also by the multiple sources of the illustrations that were presented in the second part of the lesson, among which were the *Encyclopaedia of Construction*, edited by Planat, the architectural theory lesson of Guadet, and technical booklets issued by firms (Arnaud 1931b: 737–738). To better include those illustrations in his lesson, Arnaud annotated them (fig. 6) and combined them together with photographs of his own realizations to depict the execution of the building techniques they illustrated (fig. 7). By skilfully arranging his own professional knowledge with other references, Edouard Arnaud offered a comprehensive professional guide for architects and engineers.

Finally, the 1921 edition of this textbook addresses both the architect and the engineer. Through its form, Arnaud's textbook combines the traits of architecture handbooks, which had a preponderant graphic dimension and were often presented in the form of a folio album, and engineering handbooks, characterized by their thorough written explanations (Garric 2011). Although it was printed by the Imprimerie des arts et manufactures, it was probably used for lectures at both the Ecole centrale and the Ecole des Beaux-



7.
Illustration of the hollow bricks system from »Ferrand et Pradeau« from the second part of the lesson (Arnaud 1921b: 534). Drawings illustrating the system are complemented with a photograph of its execution on the construction site of the Villa Cypris in Cap Martin, France, one of Arnaud's realizations. Source: Bibliothèque Nationale de France, Paris, France.

Arts, as it was available at the library of the latter and no Beaux-Arts edition can be found. This hypothesis of a double audience is also supported by the fact that, despite addressing second-year students at the Ecole centrale who are to obtain an engineering diploma, Edouard Arnaud makes several references to the architectural practice in the introduction. His description of the trade, mentioning composition and »public competitions«, his shift from the content of engineering studies to the professional role of the architect, and the repeated use of the term »constructeur« (Arnaud, 1921a: 4) when referring to his students' future careers shows that his lesson is relevant to both architects and engineers. In doing so, Edouard Arnaud reminds us that neither professional title was regulated at the time. In France, the »Loi sur les conditions de délivrance et usage du titre d'ingénieur diplômé« passed on July 10, 1934 and the »Loi instituant l'ordre des architectes et réglementant le titre et la profession d'architecte« passed on December 31, 1940 are the first to regulate the architect and engineer titles, even if both the engineering and the architecture diploma precede them. Prior to these laws, the distinction between architects and engineers was less clear than the division between the schools would have us believe which justifies the use of the same textbook in both schools.

The Teaching of Construction: A Key to the Definition of the Architects' Relationship to Technique and to Engineers

With his textbook, Edouard Arnaud answers both contemporary pedagogical and professional questions that his experience as a student, a teacher, an architect and an engineer allowed him to identify. As a pedagogical device the textbook improves on the material and didactic aspects of teaching construction at both the Ecole Nationale Supérieure des Beaux-Arts and at the Ecole Centrale des Arts et Manufactures. As a professional guide, it furthers the training of young professionals outside the school, therefore improving on the practice generally.

Furthermore, Arnaud's handbook demonstrates that the teaching of construction is key to the training and professional practice of architects and engineers. First, it connects education with the profession by organizing all the knowledge gathered in the training into a coherent sequence regarding the reality of the trade and puts it into practice using concrete examples. Second, it provides a body of architectural and technical solutions to which the student can refer once they have become a professional. Finally, it lays

the groundwork for the professional relationship between architects and engineers, as it is part of both curricula. Regarding this last aspect, Edouard Arnaud's decision to use the same textbook at the Ecole centrale and at the Ecole des Beaux-Arts can be seen as a way to ensure that architects and engineers share a common language and culture and are informed by each other's professional habits, thus improving their collaboration.

This study of Edouard Arnaud's teaching of construction brings new light to the debate on the teaching of construction in architecture schools in France which has been revived by the latest reform of the European architectural curriculum (Voyatzaki 2002). For example, the growing popularity of the double architect-engineer curriculum first instituted in the 2000s and now offered within twelve out of twenty-two architecture schools in France according to the the Ministry of Culture illustrates the need for a reflection on the collaboration between architects and engineers which could be prompted through the teaching of construction. In this context, I hope that my research can be used as a basis upon which to reflect on the contemporary teaching of construction in architecture schools. It could either serve as a set of pedagogical references for teachers to design their lessons or reflect on their own pedagogy, or as a comprehensive study to help institutions deliberate on the role of current construction pedagogy in the architectural curriculum as it relates to the present social and professional situation in France.

References

Arnaud, Edouard (1921a): *Cours d'architecture et de constructions civiles: Première partie. Opérations à envisager pour l'édification d'un bâtiment*, vol.1, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921b): *Cours d'architecture et de constructions civiles: Deuxième partie. Technique du bâtiment: Tome I. Edification du bâtiment. Béton armé – maçonnerie – plancher*, vol.2, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921c): *Cours d'architecture et de constructions civiles: Deuxième partie. Technique du bâtiment: Tome II. Edification du bâtiment. Combles – couverture – escaliers*, vol.3, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921d): *Cours d'architecture et de constructions civiles: Deuxième partie. Technique du bâtiment: Tome III. Edification du bâtiment. Serrurerie – installations diverses et décoration*, vol.4, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921e): *Cours d'architecture et de constructions civiles: Troisième partie. Application du cours de constructions civiles*, vol.5, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921f): *Cours d'architecture et de constructions civiles: Recueil de planches*, vol.6, Paris: Impression des arts et manufactures

Arnaud, Edouard (1921g): »Le Nouvel Enseignement de la Construction à l'Ecole Nationale et Supérieure des Beaux-Arts«, in: *L'Architecture* XXXIV, 3–5

Arnaud, Edouard (1931): *Cours d'architecture et de constructions civiles*, 2 vols., Paris/Liège: Librairie polytechnique Ch. Béranger

»Bibliographie« (1923): *L'Architecture* 36/10, 29

Brucculeri, Antonio (2006): »Renewal and Tradition in the Teaching of Building Construction at the Ecole des Beaux-Arts of Paris: The Course of Edouard Arnaud, 1920-1934«, in: *Second International Congress on Construction History*, 417–440

Diener, Amandine (2016): »La photographie au service de l'enseignement de la construction à l'école des Beaux-Arts. La démarche de François Vitale«, in: *Livraisons d'Histoire de l'Architecture* 31, 39–49

Epron, Jean-Pierre (1997): *Comprendre l'éclectisme*, Paris : Norma

Vitale, François (1919–1925): *Formation de François Vitale: Notes de cours et dessins d'école*. Paris: Centre d'archives d'architecture contemporaine. 186 IFA 35/1-2.

Vitale, François (n.d.): *Enseignement à l'Ecole nationale supérieure des beaux-arts. Cours de constructions civiles de E. Arnaud et F. Vitale: Hygiène de l'habitation*. Paris: Centre d'archives de l'architecture contemporaine. 186 IFA 404: SV-15-11-17-01

Garric, Jean-Philippe (2011): »Bibliothèques d'atelier«, in: *Bibliothèques d'atelier: Édition et enseignement de l'architecture*, Paris 1785-1871 [online]. Paris: Publications de l'Institut national d'histoire de l'art

Hassler, Uta/Meyer, Torsten/Rauhut, Christoph (2019): *Versuch über die polytechnische Bauwissenschaft*, Munich: Hirmer Verlag

Lichtenstein, Katrin (2012): »Modell oder Schule? Das ›Dortmunder Modell Bauwesen‹«, in: Klaus Jan Philipp/Kerstin Renz (eds), *Architekturschulen: Programm, Pragmatik, Propaganda*, Tübingen: Wasmuth, 219–232

Nègre, Valérie (2011): »Architecture et construction dans les cours de l'Ecole centrale de arts et manufactures (1833 –1864) et du Conservatoire national des arts et métiers (1854 –1894)«, in: Jean-Philippe Garric (ed.), *Bibliothèques d'atelier. Edition et enseignement de l'architecture*, Paris 1785 –1871, Wavre: Mardaga, 42–59

Nègre, Valérie (2012): »Oral Transmission and the Use of Models in the Teaching of Architecture and Construction at the Turn of the 19th Century«, in: Robert Carvais/André Guillerme/ Valérie Nègre/ Joël Sakarovitch (eds), *Nuts and Bolts of Construction History*, Paris: Picard, 555–563

Pfammatter, Ulrich (2000): *The Making of the Modern Architect and Engineer: The Origins and Development of a Scientific and Industrially oriented Education*, Basel: Birkhäuser

Saint, Andrew (2007): Architect and Engineer: A Study in Sibling Rivalry, New Haven/London: Yale University Press

Teyssot, Georges (1982): »The Planning and Building in Towns: The System of the Bâtiments civils in France, 1795–1848«, in: Robin Middleton (ed.), *The Beaux-Arts and Nineteenth-century French Architecture*, London: Thames & Hudson, 3–49

Thevenot, Jean (1994): »Edouard Arnaud et l'enseignement de la construction«, Paris : Université Paris IV. Unpublished Master's thesis.

Thibault, Estelle (2017): »Les cours d'architecture de Gustave Umbdenstock dans le premier tiers du XXe siècle: Formes orales et documents imprimés«, in: *Histoire de l'Enseignement de l'Architecture au XXe siècle* 3, 25–32

Voyatzaki, Maria, (ed.) (2002): *The Teaching of Construction in Architectural Education: Current Pedagogy and Innovative Teaching Methods*, Thessaloniki: Aristotle University of Thessaloniki