

Why Hennebique Failed in Germany. Strategies and Obstacles in the Introduction of a New Construction Technology

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ABSTRACT: In several countries, François Hennebique and his local representatives stand at the beginning of reinforced concrete construction. Hennebique's activities in Germany were first organized by the Martenstein & Josseaux construction company. In spite of massive problems with local building control, a number of regional construction companies realised *Hennebique system* constructions, among them Pommer in Leipzig, Thormann & Stiefel in Augsburg, Gebr. Rank in Munich and Eduard Zueblin in Strassburg. But, as in France itself, in Germany strong competitors opposed to the patent quests of Hennebique: Former Monier specialists Wayss & Freytag and Beton- und Monierbau had Hennebique's patents annulled in 1901. In spite, they initiated the publishing of structural and technical details. The business history of reinforced concrete demonstrates the possibilities and limits of technology transfer as well as the relation between national interests and international business.

INTRODUCTION

In several countries, French reinforced concrete pioneer *François Hennebique* (1842-1921) and his local representatives stand at the beginning of this new construction method. De Mollins in Switzerland (Gubler 1993), Mouchel in Great Britain (Cusack 1987) and Porcheddu in Italy (Nelva/Signorelli 1990) have been identified as responsible for a successful introduction and spreading of the technology in their respective countries; others like Ribera in Spain might be added.

The situation in Germany was quite different and much more resembled the problems Hennebique faced in France itself where strong competitors with other systems constantly opposed to his patent quests. As a result, Hennebique never really established in Germany, and the loss of his patent claims there seem to have anticipated the annulment of his patents in France in March of 1903.

The *performance* of Hennebique in Germany has, due to shortness of documents in the *Fonds Hennebique* in Paris as well as in Germany, not yet been described. Scattered Information, published or not, is incomplete and sometimes contradictory; the picture remains partly speculative. It is the objective of this study to verify the existing information, integrate the preserved documents and primal literary sources and to bring this together with the recent description and analysis of Hennebique's general business scheme and construction practice (Delhumeau 1993; Delhumeau 1999).

Hennebique's activities in Germany started with the help of the Martenstein & Josseaux construction company, which had already hold a Monier licence. A number of regional construction companies run for and qualified to execute Hennebique constructions, among them *Max Pommer* in Leipzig and *Thormann & Stiefel* in Augsburg. A special role was taken over by *Eduard Zueblin* in Strassburg.

The Hennebique projects were prepared in Paris or other central construction offices; but often, they were not concided by the local building control institutions, where no experience with reinforced concrete existed.

Therefore, the construction companies which were interested to apply reinforced concrete construction tried to gain official support in different ways: By publishing clear and scientifically accurate rules on reinforced concrete construction; by making these rules the basis of official and common regulations, and by developing a broad image campaign to introduce reinforced concrete in all fields of construction.

It can be argued that the strategy of German companies like *Wayss & Freytag* or *Beton- und Monierbau* to keep away Hennebique consisted in publishing and codifying their methods. Organisations like the *Deutscher Beton-Verein* were instrumentalized in this strategy.

As a study of business history behind the development and spread of a construction technology, the history of reinforced concrete can demonstrate the possibilities and limits of technology transfer in general, as well as the development of almost global company and technology networks in pre-WW I times.

BEGINNINGS OF HENNEBIQUE

Depending on the perspective of the author, François Hennebique is described as the successful pioneer of the worldwide establishment of reinforced concrete, or as a oscillating figure, a talented popularizer and businessman in the complex technical and commercial development and spread of reinforced concrete at the turn of the 19th to the 20th century.

Himself neither an academically trained engineer nor large-scale construction firm owner, he created the *Hennebique system*, defined by himself as a construction system and based on his own patent rights. Others understood it simultaneously as a business idea and scheme. Hennebique sold structural and execution designs for reinforced concrete to any construction company who paid ten per cent of the construction cost and could be expected to execute the works accurately. This relation was formalized in permanent licence contracts forming a network of concessionaires. National *general agents* had to organize the establishment of the *system* in the local building scene and promote their official acceptance.

Hennebique organized the marketing of the *Hennebique system* brand by exhibitions, articles, periodical meetings, yearbooks and, from 1898, the French-language journal *Le béton armé*. This was the most powerful and systematic marketing strategy of the time dedicated to a single construction system, and has, due to its omnipresence, until today influenced reinforced concrete history.

From six in 1892, the number of Hennebique's registered projects went up to several thousand in 1899, when the spectacular, rather untypical constructions for the 1900 World Exhibition in Paris brought him international attention beyond the construction world.

In countries like Switzerland (de Mollins) and Italy (Porcheddu), the Hennebique company could achieve early success due to the work of able national agents.

FIRST STEPS IN GERMANY

Right after his french patents, Hennebique had the same constructions protected in other countries all over the world, including Germany. The Frankfurt-based Martenstein & Josseaux construction firm, one of the German Monier concessionaires whose patents ran out in 1895, became general agents for Hennebique in Germany. A reference list, dating from around 1900, enumerates executions mainly in the Frankfurt region (Frankfurt/Main, Hanau, Offenbach, Weinheim...).

The only exception was Leipzig, where *Max Pommer* - himself an architect and construction company owner - managed to realize Hennebique constructions (Adam 1999; Pommer 2004). He was rivalled by another Leipzig architect, *Theodor Huelssner*, but claimed to have executed the first complete building in the *Hennebique system* in Germany for the Roeder printing company in 1898 and, more important, had it published in periodicals. Other licence takers could not overcome the impediments on the local building control. So Wilhelm Gaertner from Cologne even unsuccessfully intervened at the regional government (Bezirksregierung) to get permission for a first project. Max Pommer - after his first realization - even sent two leading Leipzig building supervisors to Paris to visit the Hennebique offices.

The modest success of the *Hennebique system* in Germany, officially explained by bureaucratic obstacles, could as well be caused by the situation that the Martenstein & Josseaux construction company as general agents was itself interested to execute the reinforced concrete specialist work rather than to sell licences to competitors. Other established construction companies might have taken a regional licence mainly to block business rivals and keep them out of the field.

The flagship reference object of Martenstein & Josseaux were the constantly growing *Adler bicycle works* in Frankfurt. *Wayss & Freytag* chronicler *Meisenhelder* reported that a visit of director *Otto Meyer* to the *Adler works* convinced him of the future potential of reinforced concrete (*Wayss & Freytag* 1925, p. 20), but when starting negotiations with Hennebique, the 10 % licence fee was considered to be much too high. So his company - a former Monier specialist based in the Middle Rhine region - decided to develop the construction on its own.

With success, because *Wayss & Freytag* was chosen to construct the storey part of a warehouse in Strassburg harbour in 1899, together with new Hennebique agent Eduard Zueblin, who was responsible for the silo part. This cooperation resulted in what was then regarded as first important reinforced concrete building in Germany.

NEW STRATEGIES

As Martenstein & Josseaux could offer only modest success, the Paris head offices started to build up a new structure. *Eduard Zueblin* (1850-1916), of Swiss origin, trained as a mechanical engineer, successful as an industrial architect in Italy, must have appeared to Hennebique as the personality able to conquer Germany as de Mollins had Switzerland. In 1898, Zueblin settled in Strassburg and became the General Agent for southern Germany; he was allowed to make his own designs and only had to pay a reduced licence fee (Hahn 1984).

To have part of the constructions designed in the country itself might have been one of the decisions made in order to meet the demands of the local control institutions and simplify permission processes. In the Martenstein & Josseaux office at Frankfurt, engineer *Johann Andina* was installed to work on the designs.

An additional sign of the confusion in the Paris head office might be that - in spite of Zueblin, Pommer and others - another engineer and agent, M. *Finkelstein*, was sent to Germany, equipped with a German-language brochure printed in Paris (Finkelstein 1901). It is documented that he even attended the annual Beton-Verein session, the *Betontag*.

In the beginning, these efforts seem to have improved the situation for Hennebique. Following the 1900 Paris Exhibition, several German construction companies caught interest in the system. Impressed by Paris, in the first editions of his famous *Beton & Eisen* periodical, Vienna-based engineer *Fritz von Emperger* celebrated the achievements of reinforced concrete in France.

THE 1901 BASEL CATASTROPHE

Not the only, but in the German-speaking world probably the most important event influencing the Hennebique business development was the *Hotel Zum Baeren* collapse, which took place in Basel on August 28th, 1901 (Haegermann; Huberti; Moell 1964, part B, pp. 124-126).

Even more than the accident itself, the results of the following examination which showed limits and bare failures of the Hennebique company as well as the local control institutions, found enormous interest. Neighter was the builder unexperienced, nor the technique bad by principle; a combination of lack of responsibility and transparency had led to the collapse.

In Switzerland, after early success of general agent de Mollins (Gubler 1999), academic structural engineers, especially *Wilhelm Ritter* of the ETH, had analysed and published a structural theory of Hennebique's system. It was here that the growing demand for transparent and regulated construction and design rules first seriously collided with the idea of the Hennebique company of rights protection and leadership.

Fritz von Emperger, who had been an admirer of Hennebique, drastically commented on the Basel accident (*Beton & Eisen* 1, Nr 3, pp. 15-19). Later he vividly criticized the concessionaire system as the basic mistake of the early years of reinforced concrete (Emperger 1909, pp. 195-196).

In 1903, in Switzerland the first ever general regulations on building in reinforced concrete were given out, after an initiative of the architects' association. Germany followed in 1904 by taking over the Prussian *Vorläufige Bestimmungen* (preliminary rules).

In Germany, the Beton-Verein organized a systematic notification and examination program to cope with the negative effects of construction accidents on the image of the new technology and the specialized construction companies. This was part of a new offensive strategy of the *Deutscher Beton-Verein*. Although his members, as *Josef Rank*, co-owner of an ambitious Munich construction company, reports in an unpublished manuscript, were in the beginning afraid of opening their technological advantage to competitors, then decided that only transparency, clear rules and methods would be helpful to promote their product. Within this framework, Hennebique and his patent claims on basic reinforced concrete principles and constructions were not acceptable.

Concerning the Hennebique organization, in spite of the Basel accident, Eduard Zueblin managed to bring some interested Bavarian builders into contact with Hennebique at the concessionaires' congress in Paris in December 1901. Obviously in order to enable the participation of all interested firms instead of giving one privileged licence, they were proposed to form a new company together. This also might have been a reaction on former conflicts in Germany. But the companies - more interested to expand themselves - refused. One of them, Heilmann & Littmann - another Munich company - went into a cooperation with Hennebique's competitor Wayss & Freytag, forming the *Eisenbeton-Gesellschaft mbH* (1903-1908) (Heilitbau 1971); *Gebr. Rank* (Rank 1962) and *Thormann & Stiefel* from Augsburg (Sachisthal 1951) worked with Zueblin for a while.

CONCESSIONAIRES AND COMPETITORS

Hennebique's mayor French patents, the technical and legal basis of his business, were taken in 1892, 1893 and 1897. It is known that Cottancin and other French reinforced concrete pioneers fought against this, and finally Hennebique's patent claims were refused in March of 1903, a fact which was understandably not spread by the company itself. In Germany, there also must have been heavy opposition towards Hennebique's German privileges, although no documents seem to survive, and contemporary notes are extremely rare. Nevertheless, the former Monier specialists *AG fuer Beton- und Monierbau* (Berlin) and *Wayss & Freytag* (Neustadt) must have had long legal disputes with Hennebique. The main argument was that the Monier patents were neglected by Hennebique. This made Wayss & Freytag even in the 1925 jubilee volume to give detailed information on the Monier patents and the non-Hennebique precursors of reinforced concrete (Wayss & Freytag

1925). The groundbreaking *Wayss & Freytag* publication by *Emil Moersch: Der Betoneisenbau* (Wayss & Freytag 1902) marked the offensive strategy.

What we know from two independent sources is that Hennebique cancelled certain rights in Germany already in 1901, as Max Pommer reported (Pommer 2004, p. 6); this might have been the company version of a forced annulment. Josef Rank implies the same when writing that at the end of 1901, as they were told in Paris, the company intended to take new patents in Germany. The Hennebique engineer Andina in Frankfurt was taken over by Rank and settled in Munich, but in 1903, probably together with the patent annulment in France, it became clear that there was no chance to achieve protection again.

Rank praised Hennebique's generosity in this situation, who might have been hopeful to stay in business, but from 1903, it was only the prominent name and reputation and the service provided by his central offices, probably together with remaining foreign national privileges, which allowed Hennebique to work successfully for some time. He still had impressive project and turnover numbers; but in regions with traditionally close links with Germany, its industry and science, like Scandinavia, Eastern Europe and the Balkans the Hennebique organization never really managed to gain a foothold.

Hennebique's former German licensees, as their national competitors, immediately founded their own design departments; Pommer engaged Emanuel Haimovici; Rank specialized – after the model of Zueblin – in silo and bunker construction. Also other, less well known concessionaires, like *Czarnikow & Cie* in Berlin or *Carl Brandt* in Düsseldorf, who had managed to realize first buildings under the *Hennebique system* label in 1901/02, soon developed independently.

The handy German term of *Eisenbeton*, coined around 1902, proved strong enough to replace *Hennebique*, as structural engineers which were familiar with the academic basis as well as the needs and demands of companies and administration quickly learned how to develop and manage their own projects. Specialized structural design offices provided the smaller companies with material, and businessmen like *Gustav Lolat* even tried to copy Hennebique's business scheme, being successful especially where they met with ambitious local companies.

RESUMEE: HENNEBIQUE AND GERMANY

Compared with neighbour countries, the performance of Hennebique in Germany can only be characterized as catastrophic. Inefficient general agents, minor provincial successes, massive administrative and commercial resistance, legal failure, and finally the development of a competing, independent reinforced concrete culture under the term of *Eisenbeton*.

But what were the fundamental reasons for this? Germany and France were the mayor economic, cultural and political rivals on the continent, having no outlet in colonies like Britain or an endless virgin backyard and a *pragmatic spirit* like the US. In the field of technology, not only construction, Germany, based on a modern system of technical education and networking business and science organizations, had decades ago begun to equal and surpass the French (and English) technical avantgarde by a theoretically based and systematic development. The *Germanization* of building technology (as it was called in the US) had begun.

The Hennebique system was perfectly tailored to fit the hierarchical structures of centralized countries with a clear descent of knowledge and complexity, and to manage the technology transfer between regions and countries, even continents, by enabling local businessmen to profit from imported knowledge and standardized execution. But in Germany academic, commercial as well as bureaucratic structures were equally complex and diverse.

Not at last, Germany was one of the few countries where, regardless of pioneering experiments elsewhere, the Monier system had been successfully introduced and developed, and its serious exponents naturally opposed a new, costly system restricting and neglecting their own achievements.

A politically motivated opposition can rather be excluded, because in many other cases, French inventions and patents were correctly marked and payed for. There is no direct proof that French technology was consciously discriminated against in Germany.

So Germany brought the *Hennebique system* - construction as well as business - to its limits. Although it responded with utmost flexibility, conditions and resistance in Germany were not to overcome by Hennebique's schemes. His admired marketing efforts and manifold technical solutions served the German companies as prototypes, but also stimulated own strategies which were directly opposed to Hennebique's fundamental ideas. The commercial vision of a globalized technology and business expansion set into motion nationally organized competition and, via academic and commercial cooperation, the rapid development of reinforced concrete technology as we know it today.

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