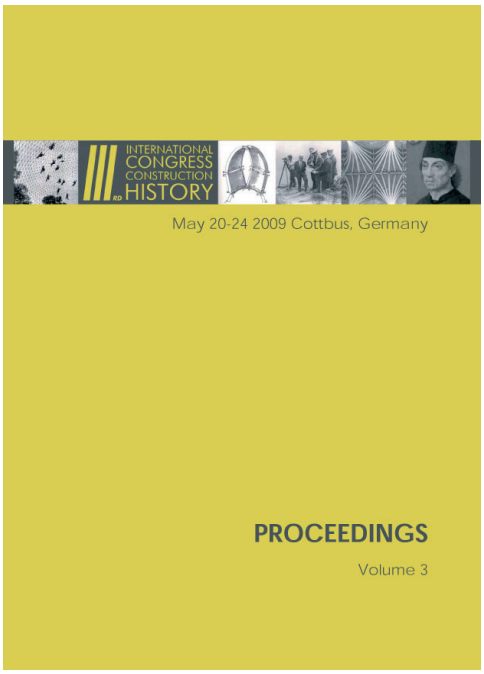

QUELLE

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Early Concrete Constructions in Germany – A Review with Special Regard to the Building Company Dyckerhoff & Widmann

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ABSTRACT: The birth of concrete construction in Germany has often been associated with the period of Modernism and its well-known architects. What is frequently forgotten, however, is that the essential principles in the use of the material had already been established in the late nineteenth and early twentieth century, and that this had been the work, not of architects, but of newly established building companies, some of which went on to become the most important in Germany. With reference to the company *Dyckerhoff & Widmann*, Karlsruhe, this paper will demonstrate how, in the course of just a few decades, these companies managed to establish a recognised and accepted place for the new material in the field of construction.

FIRST STEPS: THE COMPANY DYCKERHOFF & WIDMANN, KARLSRUHE

The foundation of the company

The company *Dyckerhoff & Widmann* was founded under the name *Lang & Co* as a factory for concrete components ("Zementwarenfabrik") in Karlsruhe, Baden on July 1st 1865. As the classification of the firm as a "factory" shows, this company was radically different from traditional craft enterprises. The three founders of the company were not skilled craftsmen but businessmen who looked to base themselves on industrial models. None of them had much practical experience in the field of the production of concrete components on a larger scale: *Wilhelm Gustav Dyckerhoff* (1805-1894) and *Heinrich Lang* (1818-1887) were merchants and *Franz Serger* (1817-1879) was responsible for the building department of Baden's railway company. It is clear that, for the most part, it was business considerations which underlay their participation in the firm of *Lang & Co*. *Wilhelm Gustav Dyckerhoff*, for instance, from Mannheim, hoped to gain economic advantages for the Portland cement factory of *Dyckerhoff & Söhne*, a factory which he had founded near Wiesbaden some years before. *Heinrich Lang*, the local representative of the company in Karlsruhe, had been active in the promotion of the interests of fledgling industries, while *Franz Serger* saw a profitable business opportunity, hoping to exploit the leading role he already had in Baden's railway industry to secure contracts for the firm in that area. As was normal the case in temporary manufacturing plants, the production line was set up by an experienced worker who came specially from Berlin, a city where many factories engaged in manufacturing concrete components had already been established (see e. g. Becker 1869). The founders of the firm used their connections to get not only this production supervisor from Berlin but also to recruit experienced workers from other cities who brought with them their work methods and sometimes even their tools. However, the methods of producing concrete components at *Lang & Co*, based mainly on those used by companies in Berlin, turned out to be far from satisfactory. The use of liquid concrete for the casting of concrete components often led to problems with fissuring. In March 1866 *Eugen Dyckerhoff* (1844-1924, Fig. 1) took over from his father, *Wilhelm Gustav Dyckerhoff*, as partner in *Lang & Co*. He was a trained merchant, but he had gained some experience in the field, working for a time in the Portland cement factory of *Dyckerhoff & Söhne* near Wiesbaden. When working for *Dyckerhoff & Söhne* he was mainly involved in the work of the company's laboratory. The laboratory worked to high standards as it had been established by his brother, *Rudolf Dyckerhoff* (1842-1917), who was a

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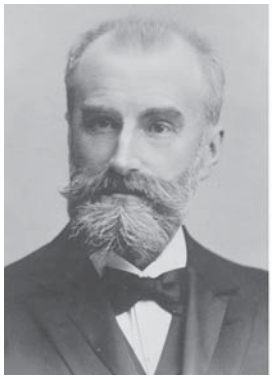
chemist. *Eugen Dyckerhoff* took as a model the systematic research in the Wiesbaden laboratory as he completed his own experiments in Karlsruhe, these being aimed at improving the production process of concrete components. These experiments in Karlsruhe were supported by his brother and the Wiesbaden laboratory for many years. *Eugen Dyckerhoff* visited factories in Germany, the Netherlands, Austria and France in order to find out about the latest developments in the production of concrete components. The knowledge he acquired here, together with the results he obtained in his own experiments, allowed him to develop a product named "Stampfbeton" (compressed concrete). This concrete got its special strength and low crack susceptibility from its earth-moist consistency and from the degree of its compression, this a result of the application of hand compressors. In the following years *Eugen Dyckerhoff* published several articles on compressed concrete in the contemporary technical literature (see e.g. Dyckerhoff 1888). It is these articles which helped to establish his reputation as the forerunner of working with concrete in Germany.




Figures 1/2: *Eugen Dyckerhoff* (left) and *Gottlieb Widmann* (right); (DMM FA 010/280 and author's archive)

The application of compressed concrete resulted in a steady improvement in the quality of concrete components, an improvement which promoted the growing use of the new products. But *Lang & Co*, still a young firm, needed a great deal of capital expenditure, expenditure that, by the end of the 1860s, the other partners, *Heinrich Lang* and *Franz Serger*, were no longer willing to invest. As a consequence, *Eugen Dyckerhoff* invited *Gottlieb Widmann* (1817-1894, Fig. 2), an experienced and successful businessman from Karlsruhe, to become partner in the company in 1869. *Gottlieb Widmann*'s interest in the young company was linked to the fact that his daughter was married to *Eugen Dyckerhoff*. Consequently, the company's name was changed to *Dyckerhoff & Widmann* in August 1869.

The range of products in the early years

Dyckerhoff & Widmann was listed in the companies' register as a factory for concrete components and, in the beginning, this was exactly what its main business was. The work they undertook in the building sector included simple tasks such as plasterwork and flooring using Portland cement. *Dyckerhoff & Widmann* was not, however, involved in the construction of supporting structures made of concrete. By avoiding this type of risky constructions, the company was able to gain experience in the use of the new material and establish its reputation as a reliable firm.

The concrete components the firm produced in the beginning can be roughly divided into two categories: artistic products and technical ones. Among the artistic products there were sculptures, as well as a great variety of ornamental objects that were often used in contemporary architecture. *Dyckerhoff & Widmann* introduced concrete as a substitute material. By using coloured Portland cement they were able to produce, for example, perfect, long-lasting imitations of sandstone. The company commissioned models for these artistic concrete components from well-known artists, in doing so, be creating products with attractive design features, they hoped to highlight the high quality of the new material. This was an inversion of the traditional relationship between artist and material: it was not the artist who searched for the suitable material to realize his ideas but the company which chose an appropriate artist to reshape the material according to its specifications. The artist did not produce the piece of art itself, only the model, of which the firm was then able to make multiple copies. One of the most famous artistic products from this early period is the sculpture group for fountains *Triumph of the Galatea* (Fig. 3), designed in 1870 by the well-known sculptor *Friedrich Moest* (1838-1923), from Karlsruhe (see e. g. Schmidt 1999, 30). The group, representing an episode culled from ancient mythology, was not typical of the artistic concrete components of *Dyckerhoff & Widmann*. With its enormous height of 4.5 m and a weight of about 5 t it was not suitable for mass production, unlike the smaller sculptures and ornamental architectural elements. However, it was only the large-scale production of such artistic concrete components that allowed the necessary finance to be available for the expensive models. The problem was that the endless reproduction of the same models signified, in the long run, the end of the artistic concrete component's success as it led to the growth of a certain degree of weariness as far as these products were concerned.

Figure 3: The *Galatea fountain* in Karlsruhe that still exists, photo before 1900; (DMM FA 010/028)

The situation was quite different in respect of the more functional concrete components such as concrete pipes or small basins. These were less dependent on current fashions, and aesthetic considerations were of little practical importance. The most important requirements for those components were, of course, high functionality and durability. Mass production served as a major advertising point in this product area. *Eugen Dyckerhoff* focused on the fabrication of concrete pipes. This seemed to be a promising business, for by this time German cities began to build drinking-water and sewage networks. *Dyckerhoff & Widmann* was able to produce concrete pipes with a high and – more importantly – constant quality by undertaking systematic research and by rigorous quality control (see Dyckerhoff 1888, p. 242). In order to accomplish the calculations for the pipes the company employed engineers. This professional approach, in combination with mass production, gave a big competitive advantage to *Dyckerhoff & Widmann* over the traditional craft enterprises which were also trying to break into the promising market for concrete components.
In the 1870s and 1880s *Dyckerhoff & Widmann* supplied almost all of the larger German cities with their concrete pipes. A contemporary photograph of the factory's courtyard in Karlsruhe gives an impression of the importance of this product area (Fig. 4). Local building departments began to become acquainted with concrete as a high quality material with a great durability, this in turn opening up new fields for its application. In many cities the company *Dyckerhoff & Widmann* did not only supply the pipes but also did the piping. Thus the company gained a reputation as a reliable firm in the field of public-works projects.
The concrete components were heavy, and long itineraries made them expensive. To be competitive, *Dyckerhoff & Widmann* started to build up a network of factories, just a few years after its foundation. The first factory was established in Biebrich near Wiesbaden in 1869/70. In the following years the company opened up other factories in Nuremberg (1878) and Chemnitz (1886) the latter being moved to Dresden in 1890. The network of branch offices was a great advantage for the later establishment of *Dyckerhoff & Widmann* as a construction firm because city building departments often preferred local or at least domestic companies.

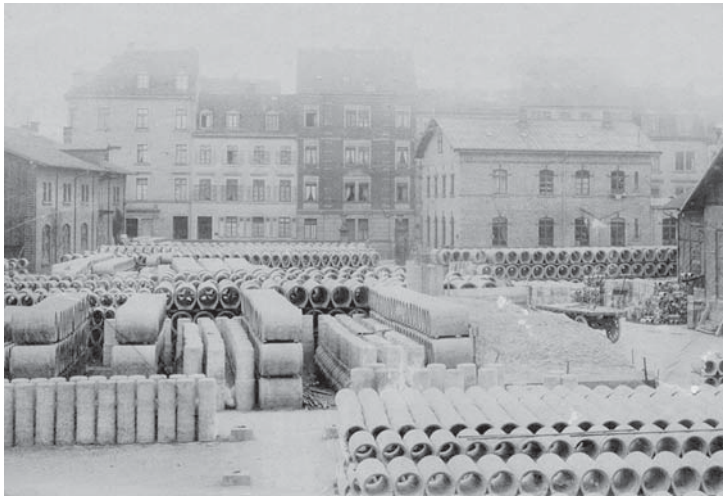


Figure 4: The courtyard of the factory in Karlsruhe with concrete pipes, probably 1880s; (DMM FA 010/290)

Introducing and establishing concrete products

Dyckerhoff & Widmann had to face many problems when introducing their products on the market. The use of concrete products was not common in the home region of the company in the 1860s. At the beginning, the firm could not provide any of its own references to prove the quality of the new material. *Dyckerhoff & Widmann* was not the only company that tried to introduce a new material. In contemporary trade journals and newspapers you can find many advertisements for new materials, often containing quite grand promises. To complicate matters further, there were well-established ceramic companies that offered similar products. Besides this, the architects often did not know about the new material as it was not part of their training and there had been few articles in the contemporary technical literature dealing with concrete. As a result, bringing the product to market was largely dependent on either personal contacts or extensive promotion. In the first years the company made wide use of the personal contacts of the founders. *Franz Serger* supplied the company with contracts from Baden's railway company. *Heinrich Lang* and *Gottlieb Widmann* made use of their prominence in Karlsruhe to obtain public contracts. Among these were the deliveries in 1873 for the *Vierordtbad*, a public indoor swimming-pool, and of sculptures for the public parks, e. g. a *Galatea fountain* in 1872. However, reliance on personal contacts was not likely to allow large-scale business expansion. For this reason, *Dyckerhoff & Widmann* started to present their products at the popular industrial exhibitions in the 1860s. By the next decade the company sent exhibits to about a dozen greater exhibitions and gained many awards for their excellent products. The company printed pictures of the medals on their catalogues as a kind of seal of quality. Besides this, the contemporary trade journals and newspapers contained voluminous articles on the industrial exhibitions. The *Deutsche Bauzeitung*, an important German journal on architecture, mentioned the company in 1874 in the context of an exhibition in Berlin. Friedrich Wilhelm Büsing wrote that "the company Dyckerhoff & Widmann exhibited ornamental concrete components […] in perfection" (Büsing 1874, p. 318), doubtless important publicity with a nationwide effect.
Up to the year 1879 the company *Dyckerhoff & Widmann* only exhibited its standard range of concrete components. In most cases the stands were collaborative projects with the sister firm *Dyckerhoff & Söhne* that supplied *Dyckerhoff & Widmann* with the Portland cement. Contemporary photos show the stands in all their glory. The stand at the industrial exhibition in Arnheim/Netherlands in 1879 is a good example (Fig. 5): In the centre was a bust of the German emperor with artistic concrete components in the background. As usual, the concrete pipes that were economically important but less representative were arranged at the edge (on the right in the picture below). *Dyckerhoff and Widmann* presented concrete at the exhibitions as a versatile material: on the one hand it was a representative substitute material with the appearance of a natural stone and on the other a material with high functionality and durability.

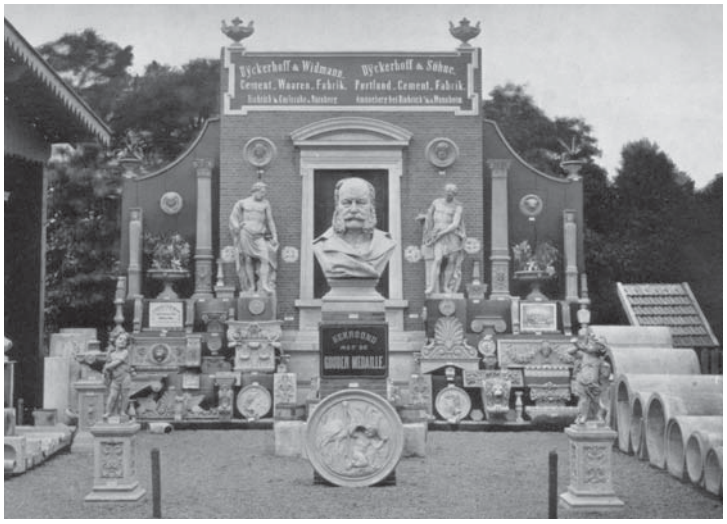


Figure 5: *Dyckerhoff & Widmann* at the exhibition in Arnheim/Netherlands 1879; (Klass 1965, p. 23)

The firm gained experience with concrete components and simple tasks in the field of building for 15 years. On the back of this experience, by the 1880s the company wanted to establish the material for the use for supporting structures. At this time many people working in the field of construction engineering in Germany were still critical of the use of concrete as a construction material. As concrete constructions were not part of the training they were probably unknown to many architects. Other architects were probably discouraged because they had to rely on construction companies for dimensioning and designing work. There was much structural damage, too as most of these companies did not have enough experience. In order to establish the use of concrete for supporting structures, the construction firms had to put great efforts into the development of reliable forms of construction. Prototypes for the experiments in Germany were the arches with high bearing capacity that had already been produced in France. Arches could be used for various types of buildings such as arched roofs, sewers and bridges, especially for the new railways. In 1880 *Eugen Dyckerhoff* carried out an extensive series of experiments on concrete arches. (see Klass 1965, 28 figure). He loaded four different types

of arches with three different types of weight (weight on the whole arch, weight on half of the arch and weight on the summit of the arch), each combination being tested until the arch gave way. In the same year he published his detailed observations of the experiment.
In 1880 *Dyckerhoff & Widmann* built a footbridge at the industrial exhibition in Dusseldorf (Fig. 6) to demonstrate to a wider public the possibilities of the material. The temporary bridge was made of compressed concrete. It had a length of 22 m, a width of 4 m and a height of 13.5 m including the crowning figure. *Dyckerhoff & Widmann* ordered the design from the architect's office, *Mylius & Bluntschli*, Frankfurt/Main, that was famous for its designs in fashionable renaissance style. As the architect's office did not have any experience with concrete constructions (see Altmann 2000, 235) it is obvious that the company did not want the architects to develop a special "concrete style". The company made the architects reshape the simple arch, which had a span of 12 m and a thickness of 20 cm, in an artistic manner to improve its appearance. Once more, thus was an inversion of the tradition relationship in the field of building construction. The architects' work mainly consisted in decorating and arranging as the ornamentation originated from the standard range of concrete components of *Dyckerhoff & Widmann*. The mixture of an innovative arch combined with artistic concrete components showed the change in *Dyckerhoff & Widmann* from a firm whose factories produced concrete components to a fully-fledged concrete construction company. The monumental bridge was a success. It provoked a great deal of interest in the contemporary media. The newspaper *Düsseldorfer Zeitung,* for example, pointed out, that the bridge "with its impressive appearance would initiate other courageous projects" (Düsseldorfer Zeitung, 20 April 1880). In the following years the company got numerous contracts for larger buildings with concrete arches.

Figure 6: *Dyckerhoff & Widmann* at the exhibition in Dusseldorf 1880; (N. N. 1881, p. 185)

BUILDING IN CONCRETE

Early buildings

Dyckerhoff & Widmann had a building for display at the industrial exhibition in Dusseldorf in 1880. But the early contracts involved mainly technical constructions without great artistic demands. The constructions were part of the installation of the urban infrastructure. The company was very successful in this field of construction as it had introduced itself to many local building authorities with its high-quality concrete pipes in the 1870s. Local building authorities were also interested in the new building material because there was a lack of traditional constructions for such new tasks as the massive tank constructions for water and gas works. At the same time, contemporary architects' offices showed little interest in this new field of construction.
One of the most important early contracts came in 1882 with a high-level tank for the Wiesbaden water works (Fig. 7). The underground reservoir had a volume of 4500 m^3 which was divided into five chambers with concrete arched roofs (see Dyckerhoff & Widmann 1902, 37). The construction was designed by the staff of the waters works, probably with the help of the engineers of *Dyckerhoff & Widmann*. Using a concrete construction was a great risk for the awarding authorities as the company had never built any tank constructions of this size before. It can be assumed that the company was awarded the contract thanks to its good connections in Wiesbaden. The company's factory in Biebrich was considered as a local firm as it was only a few kilometres away from Wiesbaden. Besides this, the *Dyckerhoff & Söhne* factory which supplied the construction site with Portland cement was also located close to Wiesbaden.

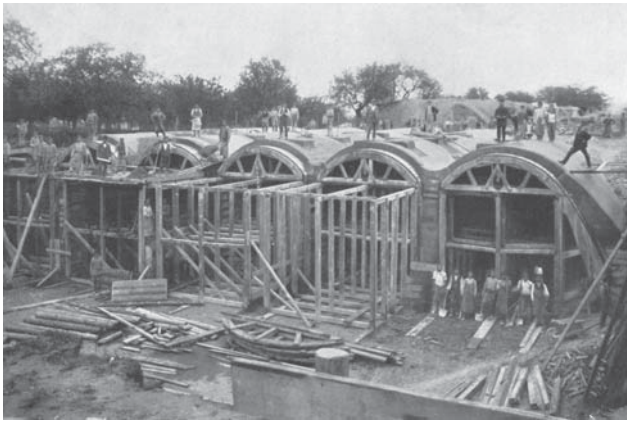
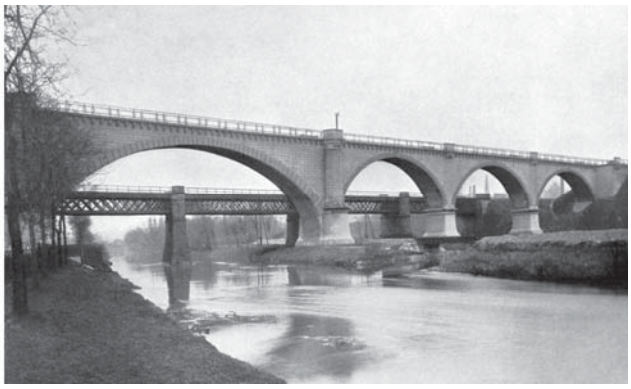


Figure 7: A high level water tank for the Wiesbaden water works, 1882; (Dyckerhoff & Widmann 1910, p. 39)

The innovative construction of the tank evoked a great deal of interest in the contemporary trade journals. This is one of the reasons why *Dyckerhoff & Widmann* obtained more than 100 contracts for similar constructions in the following two decades (see Dyckerhoff & Widmann 1902, 12). Concrete arches were not only used for tanks but also for vaulting inner-city streams and for sewer construction. Compared to the public works, the early bridges were unspectacular. In Bad Wildbad/Black Forest the company built a small footbridge with a span of 11 m and a width of 2.9 m in 1882 that still exists. It looks far less artistic than the bridge built for the exhibition in 1880. Even less representative is the first railway bridge the firm constructed in Seifersdorf/Saxony in 1882 (Fig. 8).



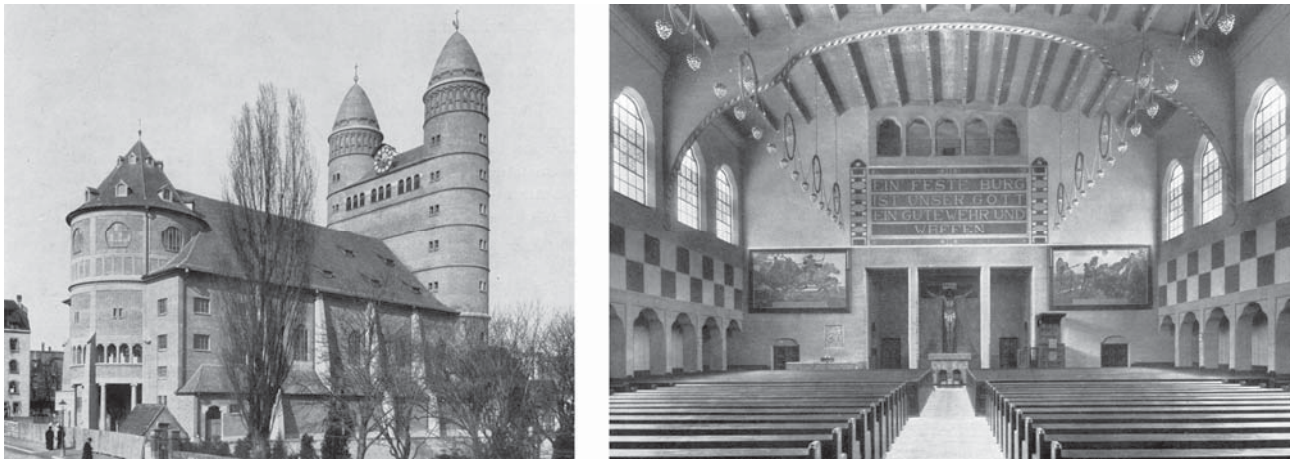
Figures 8/9: Railway bridge in Seifersdorf/Saxony, 1882 (left) and *Chemnitztalviadukt*, 1898/99 (right); (Dyckerhoff & Widmann n. d., unnumbered p. and 1910, p. 7)

The bridge, which served only as a local track, had a width of only 2.6 m and a span of 10 m. It also still exists today. These small bridges, together with the public works, were important steps in the establishment of the use of concrete in the construction of larger buildings. By erecting the early smaller buildings, *Dyckerhoff & Widmann* gained a lot of experience and it could demonstrate to sceptical building authorities that the new material was reliable und durable. Especially in Saxony the smaller bridges were soon followed by bigger ones. In the years 1898-1899 the company obtained a contract for the *Chemnitztalviadukt*, a railway viaduct that crossed a valley, and which had 11 arches each with a span from 28–43 m (Fig. 9). The railway viaduct still exists today.

There were, of course, other factories making concrete components and other firms involved in concrete constructions at the end of the 19th century, firms which also had success in promoting their products in the building trade. Those companies founded their own association, the *Deutscher Beton-Verein*, in 1898. After a year *Eugen Dyckerhoff* took the chair of this organisation and kept it until 1911, an indication of the leading position of *Dyckerhoff & Widmann*. In the *Deutscher Beton-Verein Eugen Dyckerhoff* continued working on his concept for the establishment of concrete in a larger scale. Extensive test series and presentations at industrial exhibitions were accompanied by efforts to elaborate a new standardization in the creation of concrete buildings. This standardization was meant to convince the building authorities of the reliability of concrete constructions. The new association also tried to convince architects to use the new material. Beginning in 1904 the concrete association, together with the German association of the Portland cement manufacturers, the *Verein Deutscher Portland-Cement-Fabrikanten*, financed a multilateral supplement to the *Deutsche Bauzeitung*. This supplement, with the title *Mitteilungen über Zement, Beton- und Eisenbetonbau*, mainly contained reports about new concrete buildings. The concrete association also put pressure on the administration to make concrete construction part of the training of architects.

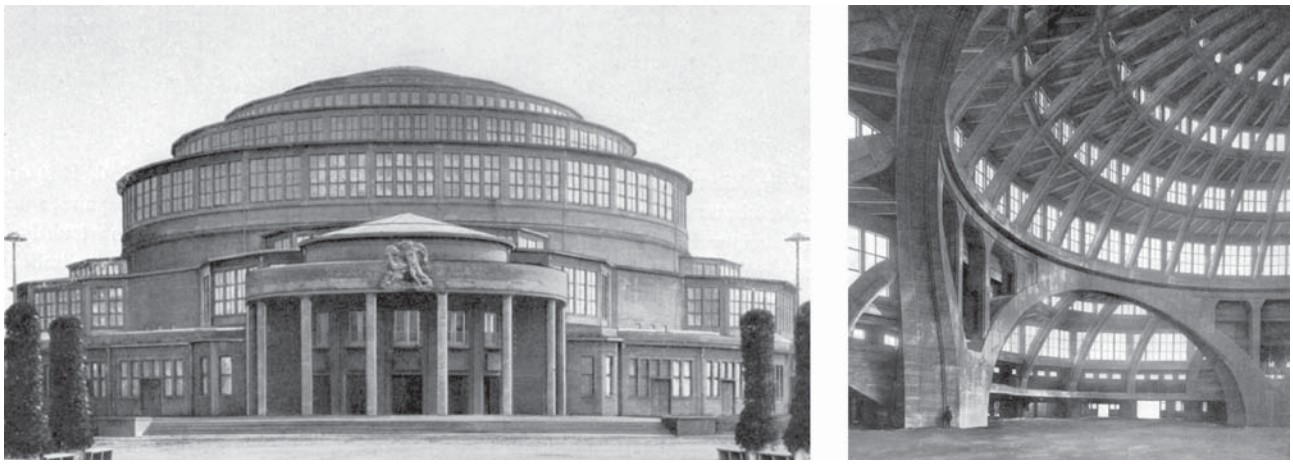
Prestige large-scale buildings in concrete

From its very beginnings *Dyckerhoff & Widmann* sought to highlight the aesthetic as well as the functional quality of concrete. The aesthetic quality of concrete first played an important role in the construction of bridges in major cities. The foreshore bridges of the *Königin Carola-Elbbrücke*, an important railway bridge crossing the Elbe in Dresden from 1892, for example, showed how uncovered concrete could be used as a perfect imitation of sandstone. This bridge was destroyed in World War II. In the field of traditional building construction, especially ecclesiastical architecture, concrete was only used as an invisible construction material. The design for the *Garnisonkirche* in Ulm, a military church erected in 1908–10, was a turning point (Figs. 10/11).



Figures 10/11: The *Garnisonkirche*, a military church, in Ulm, 1908–10; (Petry 1913, pp. 185, 187)

The well-known architect of the church, *Theodor Fischer* (1862-1938), had already worked together with *Dyckerhoff & Widmann* on the erection of a railway bridge in Bamberg in 1903/04. The architect's task in this project was limited to the artistic reshaping of the construction (see Nerdinger 1988, 205). In Ulm, Fischer was responsible for the complete design of the church. He pointed out the importance of the concrete construction for his design in the competition of 1906. As he said "it could be hardly justified not to use the resources that were offered to the architects by engineers." (cited in Nerdinger 1988, 236). The quotation implies that Theodor *Fischer* only used concrete for the construction. However, he also used uncovered concrete, which had been gone over by a stone cutter, on the inside and outside of the church. The church is still in use today.
The growth in the number of prestige buildings making use of uncovered concrete shows that this material gradually became a material that architects were happy to use. Well-known examples are the railway stations in Leipzig (1909–11, destroyed in World War II) and Karlsruhe (1909/10) and the *Deutsche Museum* in Munich (1909–16). The crowning point came just before the outbreak of the First World War with the erection of the *Centennial Hall* in Wroclaw 1911/12 that still exists (Figs. 12/13).



Figures 12/13: The *Centennial Hall* in Wroclaw, 1911/12; (Vischer; Hilberseimer 1928, p. 47)

A bidding process took place for this hall between the great concrete and steel companies. While concrete companies had not been successful at all in the prestigious bidding process for the design of the factory shed for the airship company *Zeppelin* in the year 1908 (see Eiselen 1909), the result of the Breslau competition was completely different: in the bidding process, *Dyckerhoff & Widmann* enjoyed success, not only against other well-known firms operating in the same branch, but against steel companies as well. The *Centennial Hall* caused a stir not only because of its enormous dimensions but also because of its surface of uncovered and

board-marked concrete. Thanks to the efforts of the industry itself, concrete finally gained acceptance as a material fit for use in the creation of prestige buildings.

CONCLUSIONS

As demonstrated, *Dyckerhoff & Widmann* is a good example of the great influence the newly emerging concrete products industry had on German building construction. Long before the renowned architects of the modernist school discovered concrete as "their" material the company had managed to succeed in having concrete accepted as a new construction material. The main steps on the way to the creation of the large-scale buildings of the early 20th century was the advent of the first concrete components, particularly of the technical type deployed in public works. *Dyckerhoff & Widmann* was not headed by architects or engineers but by businessmen, the sole exception being *Franz Serger*, who worked for the company for only a few years. They established the utility of the new material through, on the one hand, systematic research and, on the other, by extensive marketing campaigns. The starting point was the material they wanted to sell. They engaged architects and engineers to reshape and improve concrete constructions. The methods for the artistic use of concrete (e. g. face concrete went over by a stone cutter again) and the design of concrete constructions they developed were taken over by architects and engineers later on.
The importance of the building industry in the establishment of concrete is disproportionate to its neglected presentation in the history of building. Even important companies such as *Dyckerhoff & Widmann* are mentioned only in passing, with biographical information on the main characters in the company being difficult to find. The history of German architecture ought not to be a history mainly of the work of architects and engineers but one in which the important influence of the building industry and its protagonists is given due prominence.

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