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Classicism and High Technology – the Berlin Neues Museum

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Introduction

150 years after its erection and more than 50 years after its partial destruction during the second world war, the Berlin Neues Museum (Figs. 1 & 2), a masterpiece of Prussian classicism, is presently awaiting rebuilding and restoration, the plans for which have been drawn up by the British architect David Chipperfield. The project, which can be considered the most important (and most expensive) rebuilding project in Germany after the reunification, poses great technical challenges to the engineers involved. The conservation approach adopted requires as much of the surviving historical structure as possible to be made to perform its function again: this includes various lightweight brick vaults as well as hollow pot vaults, but also of primary importance, a multitude of often hidden cast and wrought iron structural elements. The building's design expressed the new understanding of construction which had begun to gain acceptance in Prussia as well as other European countries in the wake of the Industrial Revolution. The new thinking about construction embraced every aspect of that term - the process of building, the building product, and the challenge which both presented to architectural and artistic expression.

This paper examines the wide range of unusual and innovative construction methods used in the building, and analyses the importance of this 'high tech' structure to its time. But before going into details of its history, the opening sections outline two interesting aspects of Berlin building technology in the first half of the nineteenth century - first the adoption of iron as a building material, and secondly the role of August Borsig, whose iron foundries supplied most of the cast and wrought iron component parts of the Neues Museum, and who can be regarded as the most successful Prussian engineer of that time.

The context 1 - Berlin builders and the discovery of iron

Compared with cities like London or Paris, Berlin was a small town at the beginning of the nineteenth century. In 1800 there were just 170,000 inhabitants, by 1850 about 400,000. But it was by far the biggest city in Germany, and it was 'Preußens Mitte', the heart of Prussia, where in a unique way politics and economics, science and art were concentrated. It was as well the most important centre of Prussia's textile industry: in 1800 Berlin had more than two thirds of Prussian cotton looms. And it was beginning to develop a powerful modern mechanical engineering industry. Especially after 1815, at a time of political recovery in Prussia, Berlin offered the promise of middle-class advancement via economic success. In the three decades up to 1848 Berlin became an important centre of mechanical and civil engineering, because it was able to attract young people from all the Prussian provinces; people who were full of motivation and eager to contribute their part to the beginnings of industrial progress and to making Berlin the biggest and most important industrial centre of the European continent. Peter Beuth (1781-1853) for example, the 'father' of Prussia's state-supported industrialisation and the highest politically-appointed civil servant in this field, came from the lower Rhineland; Franz Anton Egells (1788-1854) and the Freund brothers Georg Christian (1793-1819) and Julius Conrad (1801-71), the founders of the Berlin mechanical engineering industry, were native Westphalians; August Borsig (1804-54) was born in Breslau [now Wroclaw].

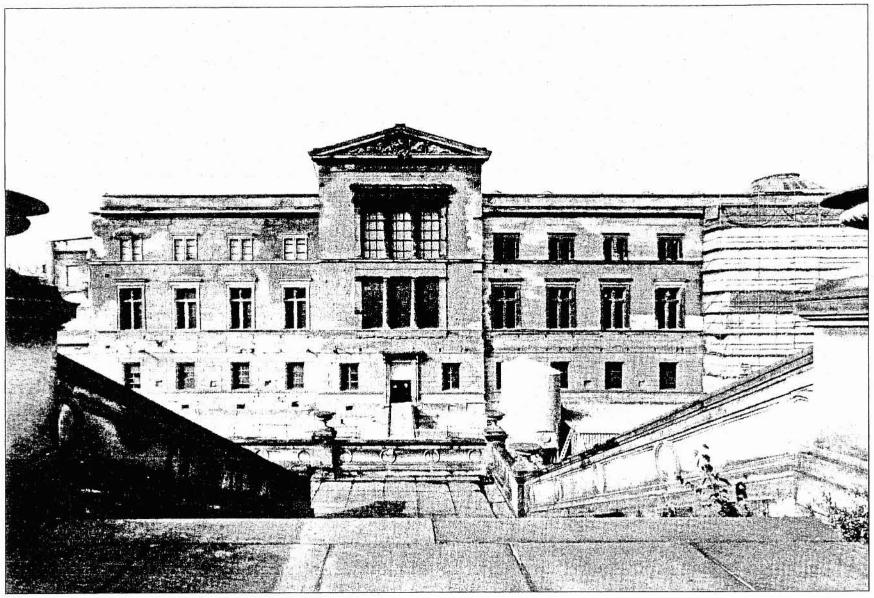

Fig. 1 Neues Museum, view from the Nationalgalerie (photograph 1993, W. Reuss).

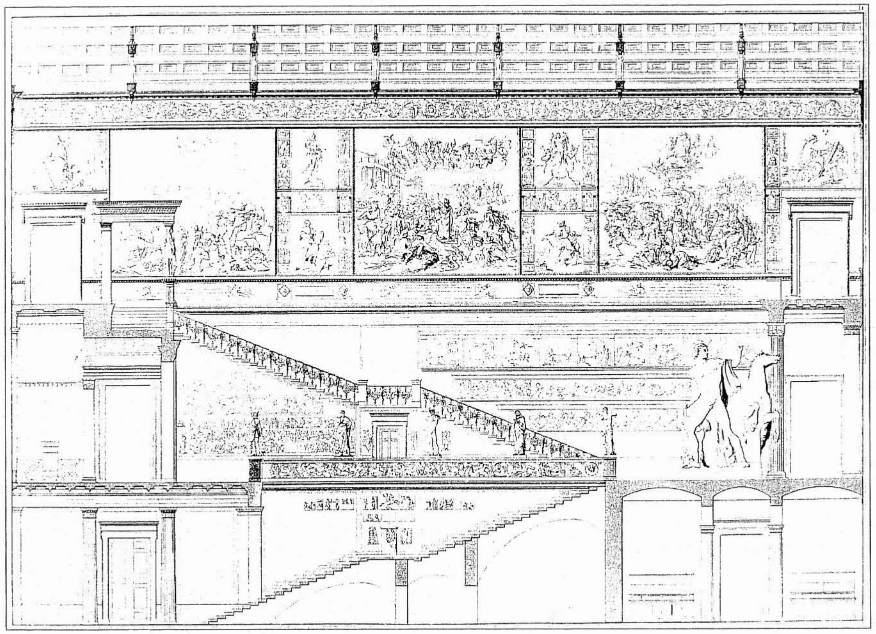

Fig. 2 Neues Museum, central staircase (from A. Stüler, *Das Neue Museum in Berlin*, 1862).

At the beginning of the century, new building meant building with iron. At first it was just a handful of iron founders, mechanical engineers and architects who were interested in the new structural and architectural possibilities offered by the new materials, and who were involved in the development of the first iron structures. Amongst them were engineers of the Königliche Eisengiesserei, the royal iron foundry established in 1803, as well as the most famous Prussian architect Karl Friedrich Schinkel (1781-1841). This small group were fascinated by the iron buildings already designed and erected in France and Great Britain. Newly-founded architectural periodicals reported regularly on innovations in building technology on both sides of the Channel. Even the opening issue of the first German building journal *Sammlung nützlicher Aufsätze und Nachrichten, die Baukunst betreffend,* which was published in Berlin in 1797, gave a detailed description of the first iron bridges; in 1798 it carried on its front page a fine engraving of the Wear Bridge at Sunderland, which had been erected two years before.

Nearly everything that was needed to build with iron had to be imported to Berlin, not only the technology but also the material itself. At the outset iron construction was literally based on British experience. Most of the iron structures erected in the first half of the nineteenth century in Berlin contained imported British pig and wrought iron. Despite high import duties, British iron came on the Berlin market at prices with which the Silesian producers could not compete. And it was of better quality. Whereas in Great Britain around 1800 more than 90% of wrought iron was produced as puddled iron, the first puddle furnaces in the Silesian iron works were not brought into use before 1830.

In the beginning, the Prussian state authorities were the most important clients for the development of building with iron. The government regarded the support of iron construction as a crucial aspect of technological progress, and aimed to assist the process through the promotion of model projects. Many of the new ways of constructing with iron were first tested in representative royal buildings. Just to mention some examples designed by Schinkel:

- the Kreuzbergdenkmal, a neogothic war memorial, about 60 feet high, in cast iron (1818-20, still extant);
- two cast iron staircases in the palaces of the Prussian princes Karl and Albrecht, which were wonderful examples of Schinkel's tectonic approach to construction (1827-28, 1830-32, destroyed);
- the rotating dome of the Royal Observatory, a filigree ribbed structure which was the first important wrought iron construction in Berlin (1834, destroyed).

It is also worth remembering the remarkable number of iron bridges built at that time, beginning in 1797 with the 6m span Kupfergraben-Brücke which was cast in Malapane in Silesia and erected under the direction of a Scotsman called Baildon not far from the site of the Neues Museum.

Many other contributory factors should be mentioned as making Berlin a centre of modern building technology. There was, for instance, the well organised system of Gewerbeschulen in different Prussian cities, of which the most prestigious was the Gewerbeinstitut in Berlin founded in 1821 at the instigation of Peter Beuth. Here young trainees were taught the theory and practice of mechanical engineering. There was also the Bauakademie, the legendary new school of building for architects and engineers which was founded in 1797 in opposition to the traditional Academy of Arts. In both schools worked men who can be regarded as leaders of engineering science; for example Johann Albert Eytelwein (1764-1849), who in 1808 had published his three volume work *Handbuch der Statik fester Körper,* in which he tried to summarise the results of engineering science of the eighteenth century. In both of the Berlin schools, civil engineers of the second half of the century like Johann Wilhelm Schwedler (1823-94) first came into contact with modern methods of modelling and calculation.

The context 2 - August Borsig and the art of building

Fig. 3 Johann Carl Friedrich August Borsig (photograph of a lost painting by Franz Krüger, from D. Vorsteher, *Borsig*, 1983).

In the first half of the century, when the technological principles for the erection of the Neues Museum were first explored, the fundamental impetus for the development of building technology arose from innovations within traditional craftmanship; in other words, it was based more on experience, feeling and creativity than on theory and engineering science. The most impressive amongst the craftsman engineers of the early industrial revolution in Berlin, and the only German engineer of that time comparable with great British personalities like Telford, Brunel or the Stephensons, was Johann Carl Friedrich August Borsig (Fig.3).

Borsig was born in Breslau in Silesia in 1804. Before leaving his native town and going to Berlin at the age of 19, he had passed an apprenticeship in carpentry. In Berlin he studied at the Gewerbeinstitut for two years. In 1825 he left that institution to enter service with Franz Anton Egells, whose engineering works was regarded as the most important and biggest in the Prussian capital. Borsig rose rapidly to become Egells' principal engineer and head of the foundry. For twelve years he worked there; then, in 1837 he started operating his own mechanical engineering works and iron foundry. It was characteristic of Borsig that he established his first factory in the immediate neighbourhood of Egells' works at the Chausseestrasse, which at that time was the main industrial area in Berlin and had acquired the name 'Manchester der Mark' - the Manchester of Brandenburg.

After just four years, in June 1841, his first railway engine called 'Borsig' was put into use on the Anhalter railway. Some months later the 'Borsig' achieved a triumphant victory in a locomotive race near Berlin against a Stephenson engine. King Friedrich Wilhelm IV decorated Borsig with the Rote Adler Orden 4. Klasse: at last the foundations of the future Borsig empire had been laid. When August Borsig died at the age of just 50 in 1854, every child in Prussia knew of him as 'Deutschlands Lokomotivkönig'.

But in these exciting years Borsig was not only successful as a locomotive and mechanical engineer. Like no other contractor in Prussia he also succeeded in designing and building iron bridges, sheds, domes and houses. Many of the great royal buildings that were erected in Berlin and Potsdam at the instigation of the passionate builder Friedrich Wilhelm IV, were connected with Borsig's name, as well as the innumerable iron bridges built on behalf of the new railway companies created after the inauguration of the first Prussian railway between Berlin and Potsdam in 1838.

The central foundation of Borsig's success was his ability to connect tradition and modernism - the tradition of carpentry and the most modern techniques of iron casting and mechanical engineering. Linking the well-known with the new he learned to build using a new structural vocabulary. To understand his approach to engineering it is useful to look at the three factories he established in Berlin within just ten years - the first at Chausseestrasse (Fig.4) and the other two in Moabit, where in 1847

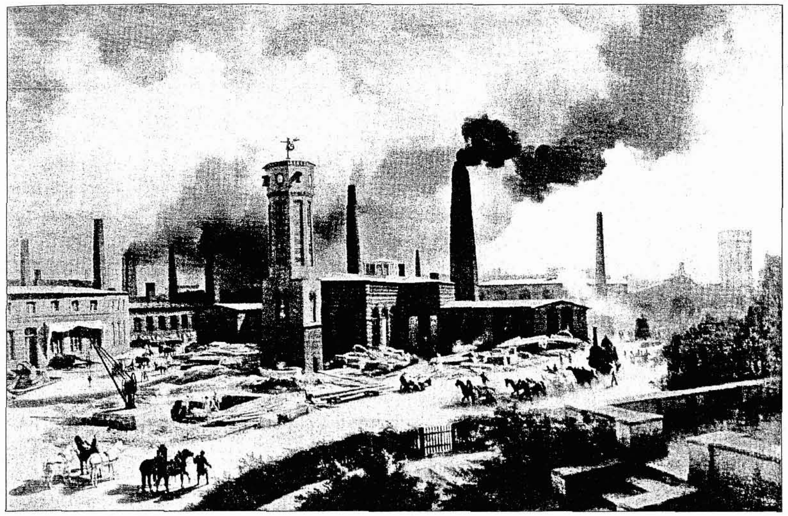

Fig. 4 Die Eisengießerei und Maschinenbauanstalt von A. Borsig im Jahre 1847, Borsig's factory at the Chausseestrasse (painting by Carl Eduard Biermann in the collection of the Berlin Museum).

he started to erect the first puddling and rolling mill in Brandenburg. From the beginning Borsig took care to use his own works as a testbed for the development of new structures and construction methods. None of his many iron shed structures were identical. In rapid succession different types of roof truss were erected, parts of a new vocabularly that slowly began to form the structural language of modern iron construction. To the visitor - as, for example at that time no less than the distinguished Architecten Verein zu Berlin - the noisy and smoking Borsig mills were extraordinary. They incorporated a wide range of contemporary roof trusses - from different English and French types (Fig.5) to the fascinating wrought iron trussed arches of the roofing of the new puddling and rolling mill in Moabit (Fig.6). Borsig was probably the first to design and realise this new load-bearing system, which was highly effective from a material as well as a cost point of view; a system, that in the following decades became the standard solution for widespan sheds in Europe. It was used for railway stations such as St. Pancras as well as for exhibition halls up to the legendary Galerie des Machines at the 1889 Paris World Exhibition with its span of 111m. By the early 1850s Borsig had started to prefabricate and export iron trussed arches of that type to Finland.

Around 1850 the three Borsig mills in and near Berlin were a theatre of innovation in the use of cast and wrought iron, employing no less than 1,200 workers and technicians. Today, after much destruction at the end of the nineteenth century, there is almost nothing left of them.

The Neues Museum

For Borsig the Neues Museum was his second great royal commission. The first, which he had received in 1841, was to supply the steam engines and pumps for the fountains in Potsdam-Sanssouci including

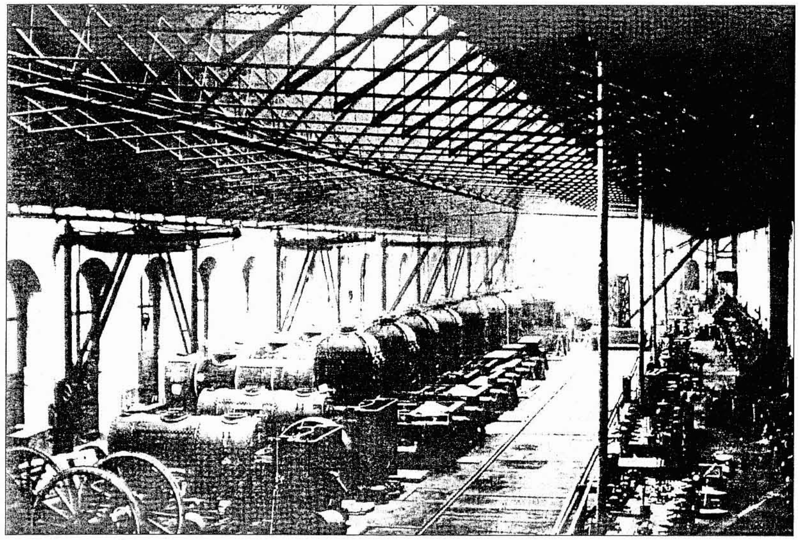

Fig. 5 Borsig's factory at the Chausseestrasse, locomotive assembly room (photograph of 1856 from D. Vorsteher, *Borsig*, 1983).

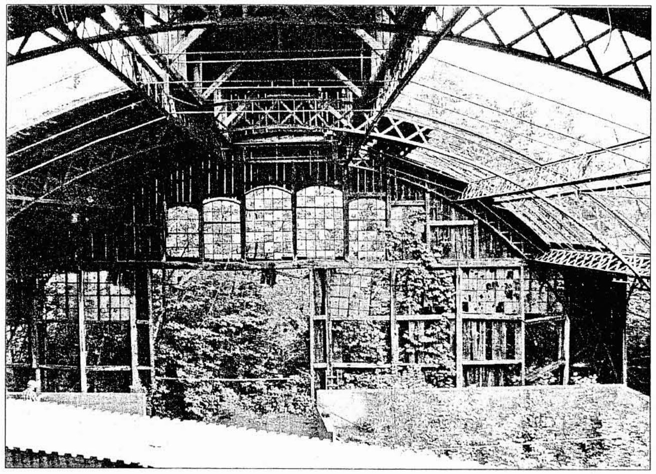

Fig. 6 Borsig's puddling and rolling mill in Moabit: wrought iron trussed arches taken down and rebuilt in Eberswalde near Berlin around 1900 (photograph 1993, W. Lorenz).

the iron components for the fine Moorish style engine house, a difficult installation which he successfully completed in 1843. The foundation works for the Neues Museum were started in 1841. The most important part of the basic construction was finished in 1843, but it took another 16 years before the final sections of the collection were opened. The building was in use for less than a century until its closure in 1939, followed by the heavy damage inflicted upon it during the war.

The Neues Museum was the second royal museum in Berlinand, directly connected by a bridge to the first museum which had been designed by Karl Friedrich Schinkel and opened in 1830. After the erection of the new one, Schinkel's museum was renamed simply the Altes Museum. In may seem

surprising that a second museum had to be provided just a decade after Schinkel's had been finished, a building which had been commonly regarded as his masterpiece and one of the highlights of the neoclassical movement in Europe. But after only a couple of years it had proved to be too small to take the rapidly increasing collection of royal art treasures. Within a decade the aims of the public presentation of art in Prussia had changed. Whereas in 1830 it had been restricted to the the ancient world and its interpretation, ten years later a much wider historicism, connected with a new Prussian interest in excavations and expeditions (for example to Egypt in 1841), had led to an immense increase in the Royal Collections.

The architecture of the Neues Museum reflects this change in an impressive way. The kind of fascination that it held for visitors in the nineteenth century as well as today, is multi-faceted. One can read the building as a late piéce de resistance of 1840s classicism, which in spite of its immense dimensions remains noble and restrained in its proportions. It can also be interpreted as a compendium of the world's cultures, a museum that uses the building itself as part of the exhibition, in which the character and the decoration of each room corresponds to the different objects of art on display.

The building can also be read simply as a structure, which highlights its difference from the Altes Museum. Far more than a decade appears to separate the two museums as structures. While Schinkel had based his design for the Altes Museum primarily on the traditional building vocabulary of stone and wooden components, his pupil, the architect Friedrich August Stüler (1800-65), countered with a 'high tech' structural concept. Working with Carl Wilhelm Hoffmann (1818-after 1865), the first site manager, who as normal in Prussia had to work out the technical details, and in close cooperation with August Borsig, he produced a design characterised by a wide range of unusual and, for the time, innovative construction methods. Built in the midst of the first phase of industrialisation in Prussia, dating from 1830 to 1870, the Neues Museum constitutes a unique microcosm of the new Prussian arts of construction.

The process of building

Considering first the building process, it is only possible here to give a short summary of some of its aspects These will serve to illustrate the novel methods implemented by the builders to organise the on-site construction and the manufacture of structural elements for a building larger than ever seen before in Berlin.

Thus, for the first time in Berlin a special railway was installed to open up the building site and to transport the building materials as fast as possible from the mooring at the embankment of the River Spree to the site (Fig.7). In the centre of the site a 120 ft. high wooden hoist was erected to carry the trucks, without unloading and reloading, to the upper floors of the growing structure, where they could be moved on iron rails to any corner of the building (Fig.8).

Equally important was the comprehensive use of steam power. A Borsig steam engine of 5 hp served as the central energy source for the site. It had many jobs to fulfil. It had to power the pumps for the lowering of water, run the mortar mixer and the wooden lift. First and foremost, however, it was used for the pile driver which set the 2,344 wooden foundation piles. Considering that construction was taking place in the historic centre of Berlin, where other types of foundations often had to be excluded, and considering the extremely hard working conditions associated with the use of traditional manually operated hammers, one can easily appreciate the value of steam power for pile driving.

Some significant changes in the building process should also be emphasised, which evolved as a direct result of the extensive use of cast and wrought iron structural elements; changes that were to become typical of the further development of the building process in the nineteenth century. Important manufacturing operations were shifted from the site to the factory, the site itself being reduced to a mere assembly place for the prefabricated elements. It is interesting to observe that Stüler and

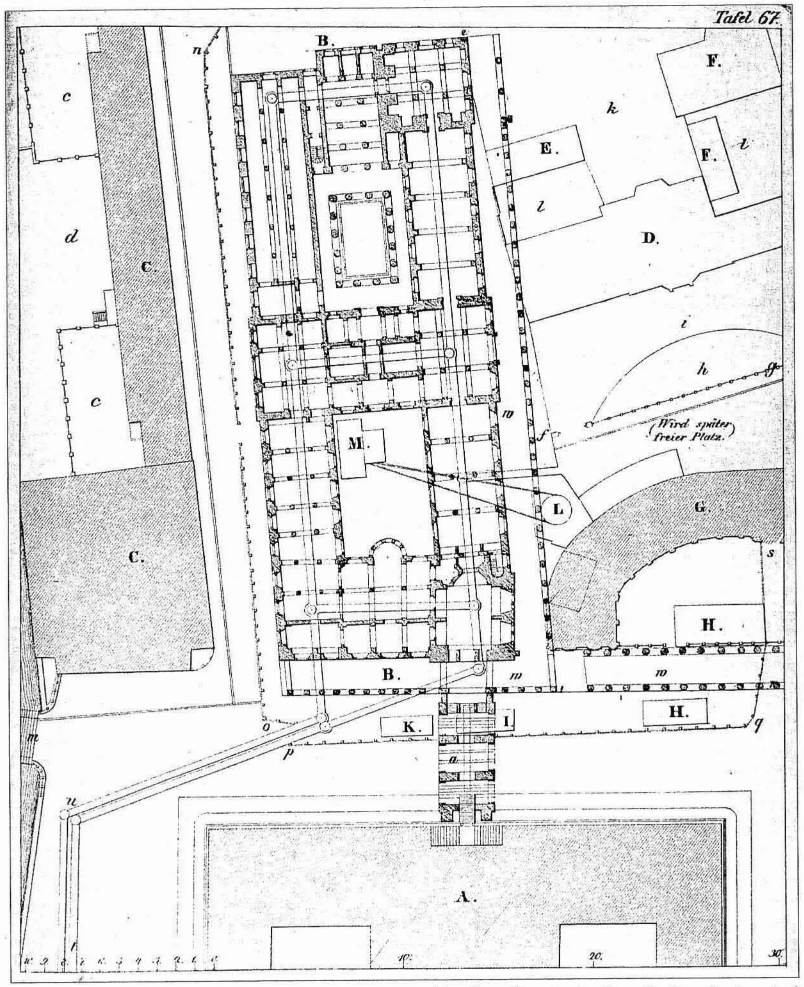

Fig. 7 Neues Museum, ground plan of the vaulted basement with railway lines coming from the the embankment of the River Spree, at the bottom of the bridge to the Altes Museum (from *Notizblatt des Architektenvereins zu Berlin*, 1842).

Hoffmann had obviously still not realised all the new options which prefabrication provided until they worked out the first details. In climbing up from the ground floor to the second floor in the building and looking at the different iron structures, one can see how they learned, step by step, to reduce the range of different cast iron elements and to think in standardised categories. The advantages were obvious. The standardisation of the girders allowed for their being cast in only a small number of different moulds, with the junctions and the connecting bolts treated in the same way. The standardisation of structural elements - as manifested, for example, in the already highly developed serial production of railway engines in Borsig's factory some hundred metres away from the Museum

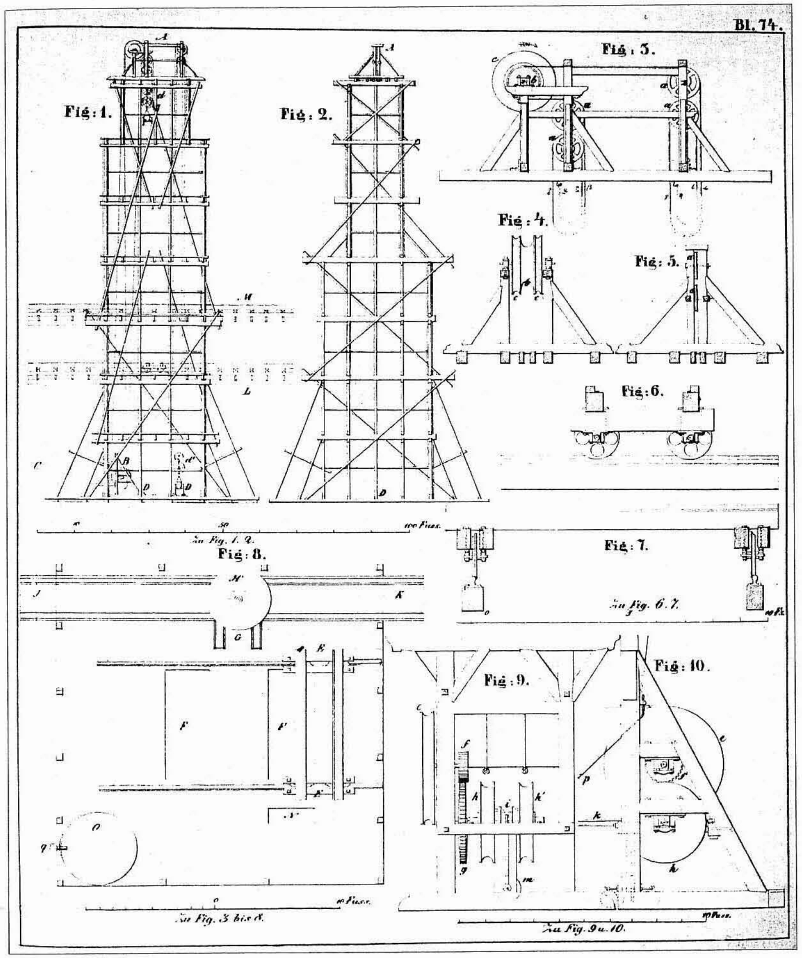

Fig. 8 Neues Museum, wooden hoist in the centre of the future museum with trucks for supplying materials (from *Notizblatt des Architektenvereins zu Berlin*, 1842).

Island - took into account the new manufacturing conditions of the early industrial age. A quite impressive acceleration in the speed of construction was the direct result of these innovations. Schinkel, after having finished the foundations, had needed nearly two years to finish the basic construction work on his museum. At Stüler's museum, the same works took less than one year.

As with construction methods, changes in design methods are also worth mentioning. It is true that the innovative power of engineers like Borsig was still anchored primarily in traditional craftmanship rather than engineering theory, but the erection of the Neues Museum also demonstrated changes in the engineer's approach which were to become characteristic of the more scientifically based development of engineering. Thus one finds the careful inclusion of theoretically founded dimensioning as a first

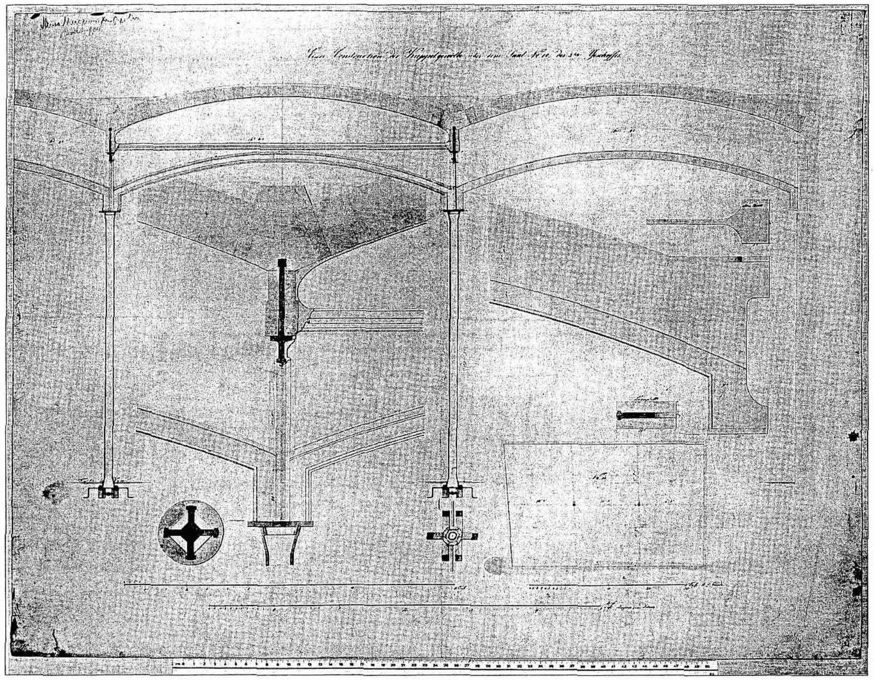

Fig. 9 Neues Museum, Room of the Majolicas, details of iron structure (working drawing c 1843, from the Plansammlung der Staatlichen Museen zu Berlin Preußischer Kulturbesitz).

step towards statical calculation. One also finds a precision in draughtsmanship previously unknown; a new, independent culture of construction draughtsmanship as distinct from architectural draughtsmanship. The bare structure became the centre of interest, and the construction draughtsmanship matured to become the engineer's own way of describing his technical design (Fig.9).

Last but not least, another construction technique was used which was unusual not only in Berlin and Prussia. Each of the wrought iron tie rods, which were decisive for the load-bearing capacity of the bowstring girders and which were used throughout the northern wing, was tested in a hydraulic press before leaving Borsig's factory. There was a well organised system of quality control, a method whose first systematic use historians have normally attributed to Fox Henderson's construction of the London Crystal Palace - although that building was built a full seven years after the Neues Museum.

Thus without even having taken a look at the structure itself it is obvious that the methods used to design and execute the Neues Museum alone provide unique evidence of nineteenth century changes in design and construction in building technology.

The building product

Like the building process, the building itself had little to do with traditional construction, whatever its outward appearance might suggest. To understand why Stüler and Hoffmann developed and realised such an unusual concept it is worth listing the essential aspects of the brief and the peculiarities of the site:

- the extremely poor foundation conditions on this island in the River Spree, situated in what was once part of the prehistoric Berlin-Warsaw river valley. The subsoil is characterised by unstable Holocene incursions in the firm Pleistocene layer, creating crater-like sheer drops throughout the firm bearing stratum, especially in the area of the Neues Museum. Beneath the museum, from the southeast to the northwest corner, the level of the firm soil layer falls to almost 25 metres below the undersurface of the building's foundation;
- the resulting need to reduce the dead load of each part of the building's structure as far as possible; the minimisation of the weight and thickness of the walls, and the design of bracing to take account of differential settlement in the structure;
- the design of floor structures with a span of about 10 metres, which had to be as light as the walls, but fireproof. The aim was for the floors to be as thin as possible, allowing for the installation of three storeys within the limits of the overall building height, which was defined by the height of the neighbouring two storey Altes Museum;
- and, last but not least, the need to complete the basic construction works as quickly as possible to allow the museum to open at an early date!

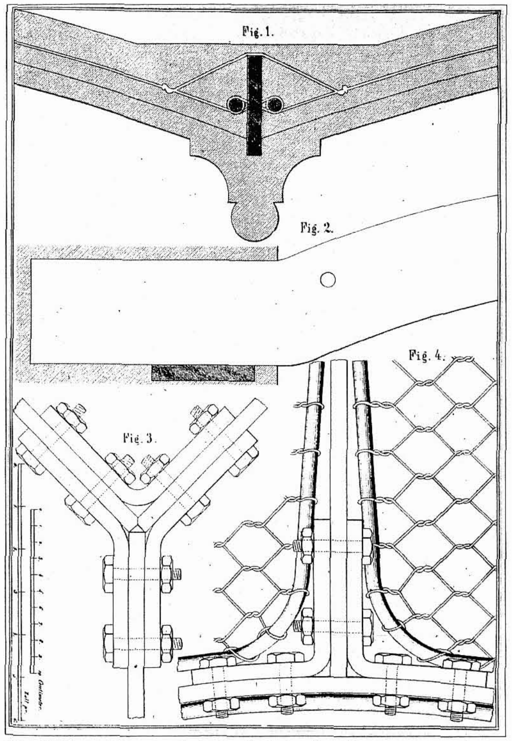

Fig. 10 Neues Museum, Gotischer Saal, details of iron structure and wire stucco ceiling, published in Breymann, *Allgemeine Bau-Constructions-Lehre*, 1854.

This short list of the essential requirements shows clearly that it was impossible for Stüler and his engineers to create a building like this using a traditional structural concept. They had to find other ways and means, and they found them in the new concept of building with iron. The use of iron, the integration of a multitude of often hidden cast and wrought iron structural elements, became the inevitable condition, the *conditio sine qua non*, for the execution of this ambitious architectural design. For the first time, a monumental and prestigious building was erected in Prussia, the design of which evolved directly from industrialised methods.

Unfortunately, a considerable number of the unusual construction techniques that were used can now no longer be seen because of wartime damage. Thus we must mourn the loss of the wonderful light structure of the 'Gothic' vault in the former Gotischer Saal. This had wrought iron ribs, screwed together with simple angle pieces, supporting a wire stucco ceiling (Fig.10). The ceiling was the first of its type in Berlin and one of the first examples of its kind anywhere; a construction type that was later to become one of the classic lightweight

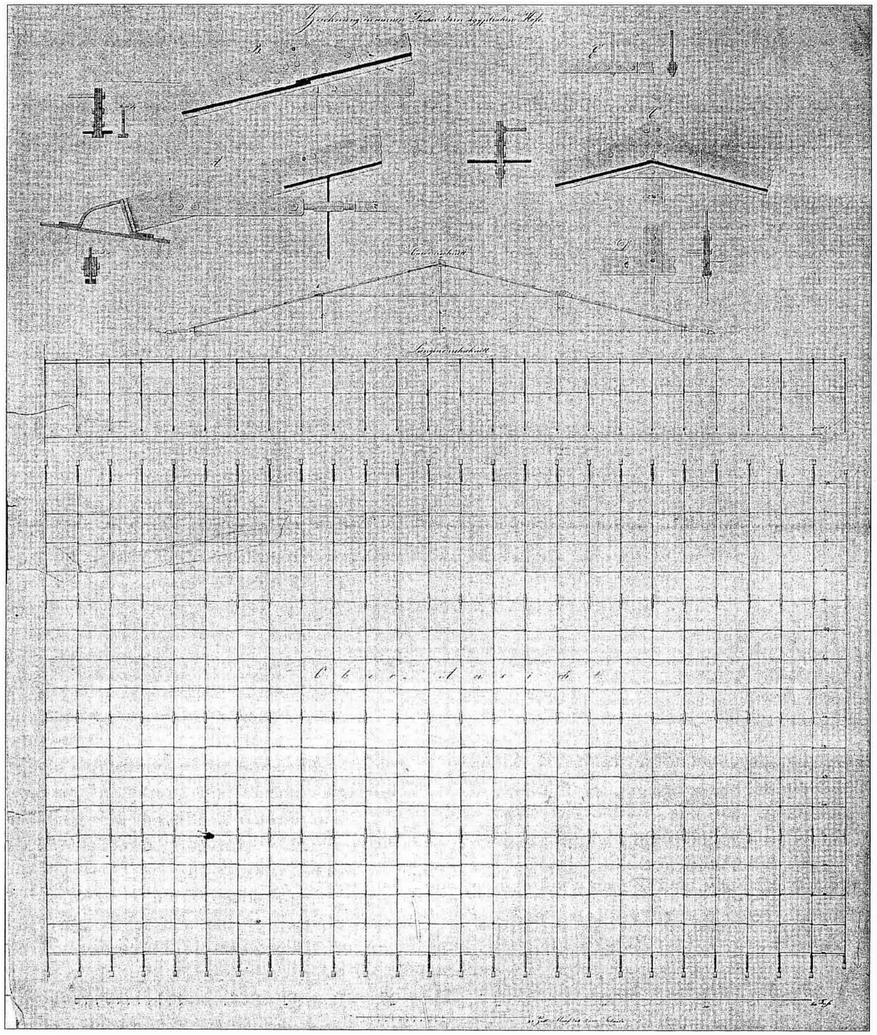

Fig. 11 Neues Museum, wrought iron hanging trusses for the glass roof covering the Egyptian Court (working drawing c 1845, from the Plansammlung der Staatlichen Museen zu Berlin Preußischer Kulturbesitz).

structures and is still used today in a modified form. The little vault of wrought iron, wire and stucco gave the illusion of a real Gothic vault without allowing its horizontal thrust to endanger the outer walls, which had been built very thinly due to the weak subsoil.

A number of other interesting structural features are lost today, among them the glass roof covering the Egyptian Court, which was supported by 26 wrought iron hanging trusses with a clear span of about 15 metres(Fig.11). But there are, nonetheless, many remarkable structural elements still in existence, in whole or in part.

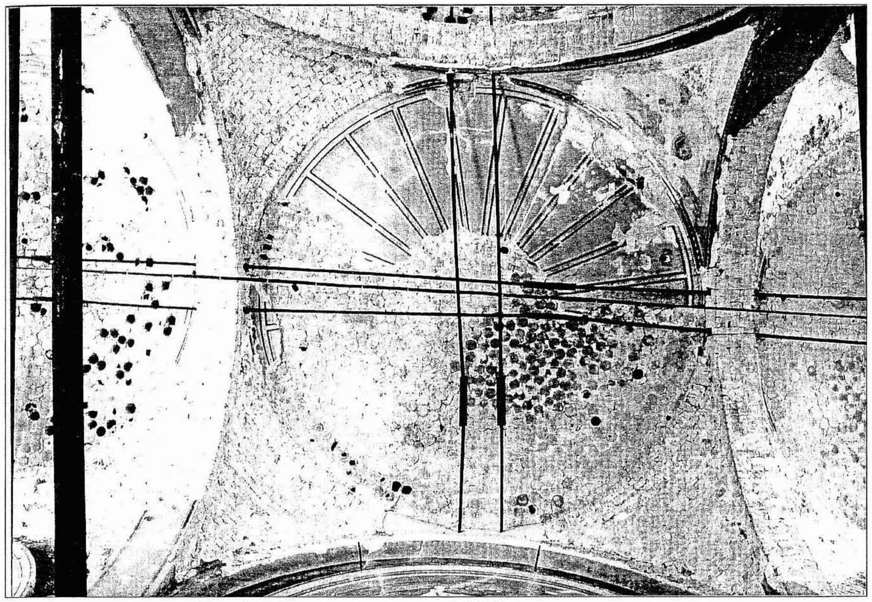

Fig. 12 Neues Museum, vaulting with hollow clay pots (photograph 1995).

The first of these is the 'fireproof' ceiling construction composed of prefabricated cast iron beams and massive vaults, which can be found on all floors in a great variety of different designs. This type of ceiling, later in Germany called Preußische Kappe, which had first been developed for industrial purposes in English and Scottish mills and warehouses around 1800, was used here in Berlin on this scale for the first time. The most interesting aspect of these ceilings are the vaults, which consist of various lightweight bricks or hollow clay pots (Fig.12). These pots, produced in various nearby factories, illustrate very clearly the builder's aim to minimise the dead load of every part of the structure as well as of the building as a whole. The idea of integrating clay pots into the load-bearing structure is a throwback to early Christian construction (as, for example, at San Vitale in Ravenna or Santo Stefano Rotondo in Rome) where clay tubes were often used for the vaults, though in a different way. It is not known whether Stüler or Hoffmann knew about these precursors, but obviously they knew about their revival in England and France at the end of the eighteenth century. Around 1800 they are found - partly connected with wrought iron beams - in 'fireproof' ceilings in Parisian dwelling-houses; also in English factory buildings, for example in sections of the arched floors in the mills at Derby (1792) and Milford (1793). They had also been employed in more prominent buildings such as the reconstruction of the Paris Theatre au Palais Royal (Victor Louis, c 1786) and the Bank of England (John Soane, c 1818).

The cast iron frames are also notable; arched beams combined with very thin cylindrical columns, which dominate the upper floors of the museum's southern wing. These supported a variety of vaults, tunnel vaults as well as pendentive cupolas. Fig.13, which is taken from the architect's description of the museum in a publication of 1862, provides an example of the final shape and decoration of these skeletal structures as used in the Room of the Majolicas. Fig.9 shows the working drawings for the cast iron structure in the same area, and Fig.14 illustrates its present-day state.

Perhaps the most impressive structural elements, however, are the bowstring girders which were

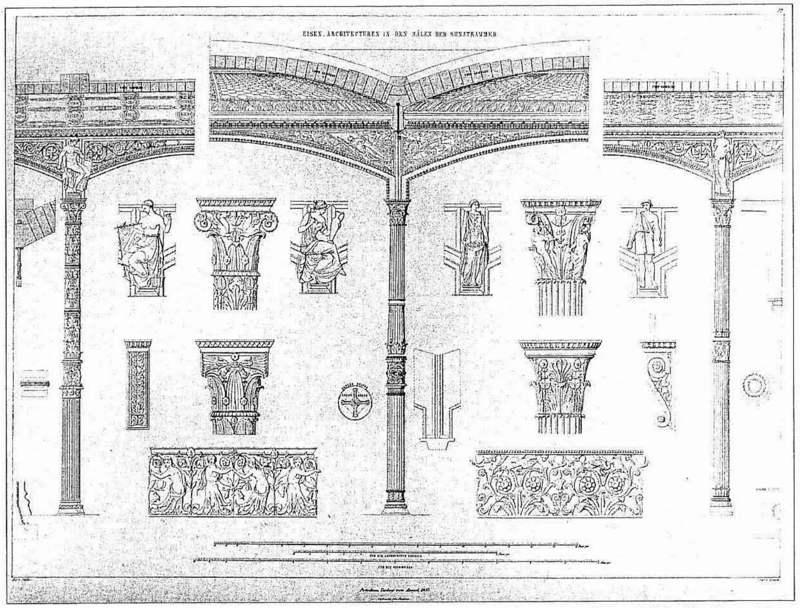

Fig. 13 Neues Museum, Room of the Majolicas, details of iron structure and zinc decoration, published by the architect (from A. Stüler, *Das Neue Museum in Berlin*, 1862).

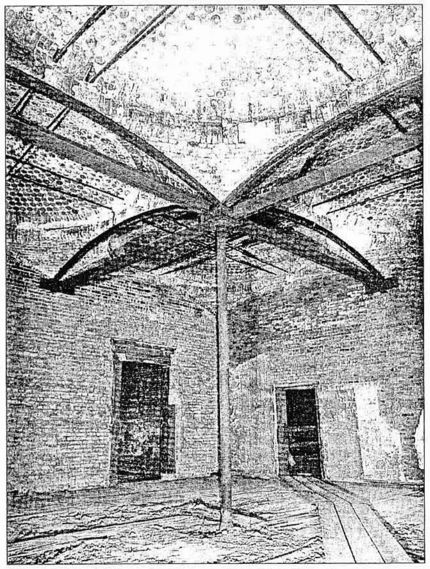

Fig. 14 Neues Museum, Room of the Majolicas, iron structure: the horizontal beams help stabilise the structure (photograph 1993).

used in almost all of the exhibition rooms of the northern wing, with a span of about ten metres (Fig.15 & 16). There are still bowstring girders in three of the principal rooms; the ones in best condition are in the Room of the Niobides on the first floor (Fig.17). Each of these girders consists of a cast iron arch, normally prefabricated in two parts, and a pair of wrought iron tie rods, forged together and rolled out to a diameter of 2 1/3 inches using different single rods of best Scottish Low Moor iron. The design embodies a well graded structural concept which places different demands on the different structural elements. The well-designed detail of the connection between the tie rods and the arch demonstrates the high level of fabricating skill which Prussia's engineers had reached, trying to catch up on the lead of their British and French counterparts (Fig.18).

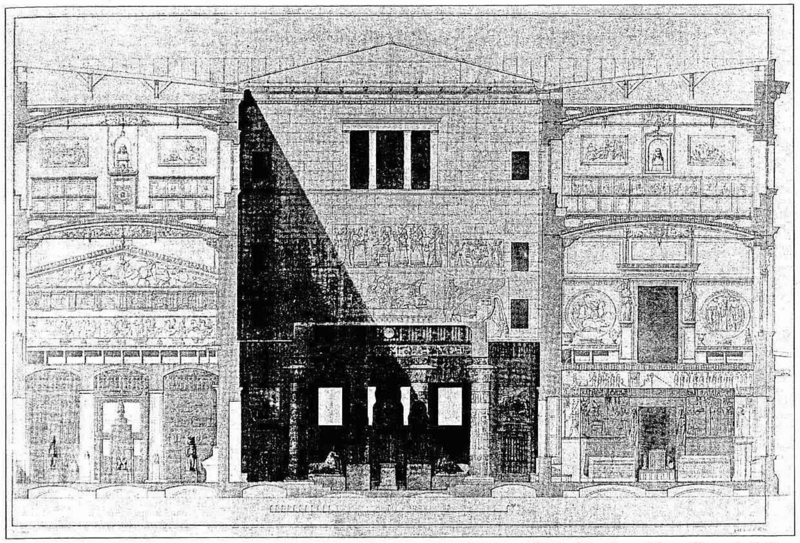

Fig. 15 Neues Museum, northern wing, cross section with bowstring girders, published by the architect (from A. Stüler, *Das Neue Museum in Berlin*, 1862).

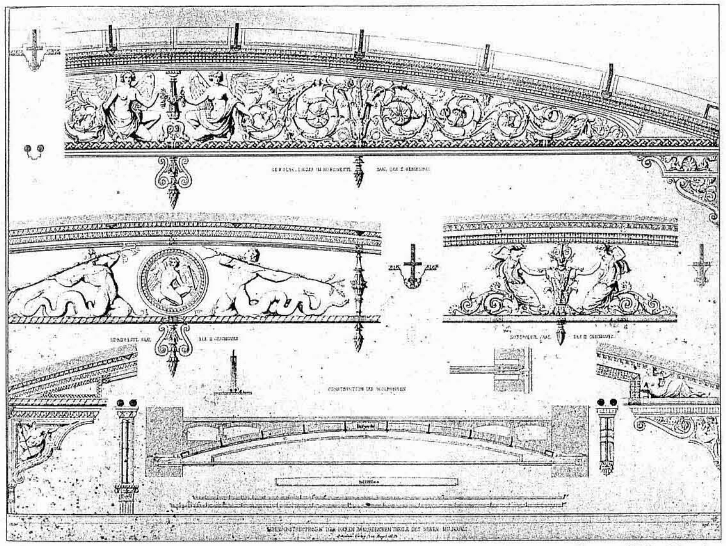

Fig. 16 Neues Museum, bowstring girders, details of iron structure and zinc decoration, published by the architect (from A. Stüler, *Das Neue Museum in Berlin*, 1862).

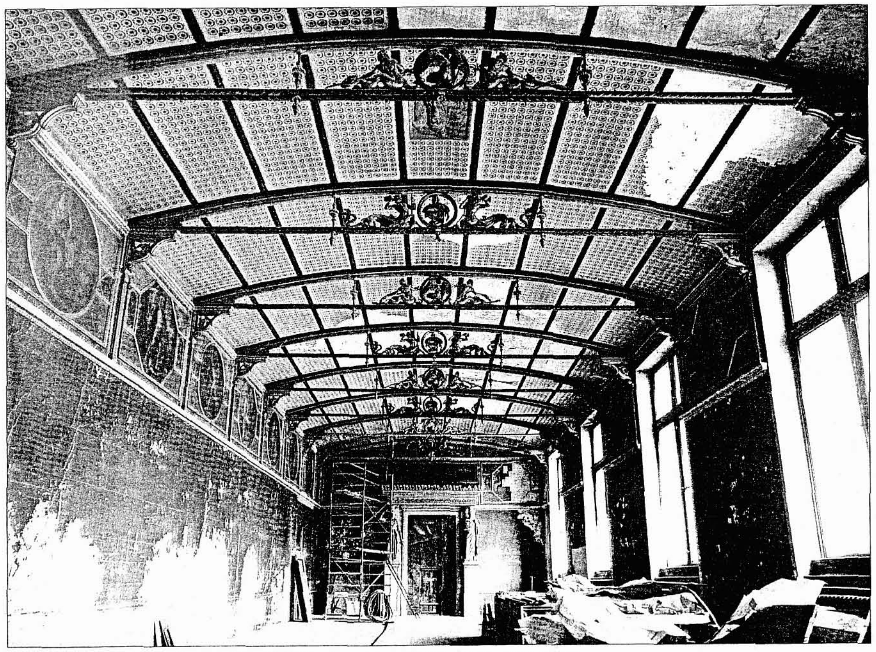

Fig. 17 Neues Museum, Room of the Niobides, bowstring girders (photograph 1993).

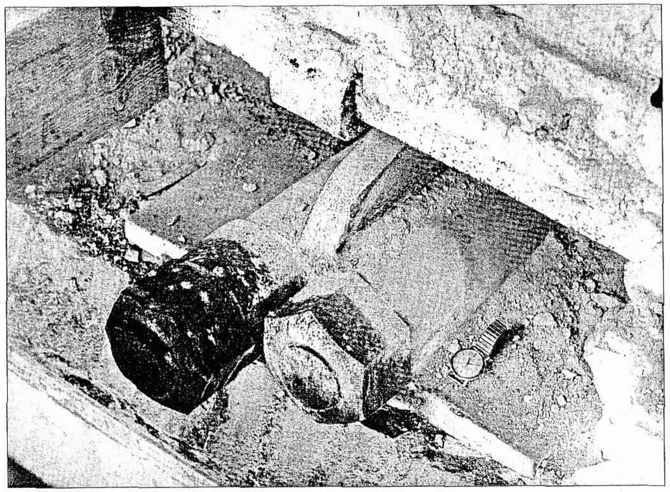

Fig. 18 Neues Museum, Room of the Niobides, end of bowstring girder, connection between wrought iron tie rods and cast iron arch (photograph 1993, W. Lorenz)

This short survey of only some structural elements serves to illustrate that the innovations in Stüler and Hoffmann's design for the Neues Museum, by integrating cast iron and wrought iron elements, were distinguished for their details as well as for the overall concept. The result was a complicated, three storey building consisting of various structural forms and room shapes encased in extremely light surrounding walls. The builder's architectural gesture was multilayered and full of different meanings. Nonetheless, it underlined unambiguously that Prussia's building technology had reached the age of industrialisation.

Summary

In many respects, the Neues Museum is a unique testimony to the Prussian art of construction in the age of industrialisation and classicism. It testifies to a deep change that was taking place in the understanding of how to design and build a major monument. Industrialisation generated new building practices and also produced a new type of builder - the engineering contractor. In addition, the Neues Museum testifies to the evolution of a new kind of structure, one characterised by the unerring use of the potential inherent in iron. It would have been impossible for its builders to execute the architectural and functional concept without the integration of a wide range of cast and wrought iron structural elements. The use of these elements presented an architectural challenge - an aspect which cannot be discussed fully here. Suffice it to say that the Neues Museum embodied a new architectural theory, developed for the era of industrialisation; a very tectonic theory, that enabled its builders to combine classic ideals with new construction methods.

Today, the Neues Museum in its badly damaged state is the only 'iron' monumental building of its date in Berlin and Prussia that still survives. It is a unique monument, the historical importance of which - technical as well as architectural - can hardly be overestimated. First steps toward stabilisation of the fabric, including new underpinning, were initiated in the late 1980s. Meanwhile, the building has been the object of extensive structural analysis, including mathematical simulation and computer modelling. 150 years after its completion, its restorers face a new architectonic and technical challenge. The surviving torso calls for a treatment which respects its detail and the courage of its original builders, but which is also a contemporary solution to the problems which we now face.

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Sources

1. C.W. Hoffmann, 'Notizen über die bei dem Grundbau des neuen Museums gebrauchten Transportmittel (...)', *Notizblatt des Architektenvereins zu Berlin* (1842), pp. 57-69.
2. C.W. Hoffmann, 'Nachricht über die beim Bau des neuen Museums angewendete Vorrichtung zum Auffahren der Materialien', *Notizblatt des Architektenvereins zu Berlin* (1843), pp. 89-91.
3. C.W. Hoffmann, 'Die feuerfesten Decken des neuen Museums hierselbst', *Notizblatt des Architektenvereins zu Berlin* (1845), pp. 167-177.
4. F. Adler, 'Das Neue Museum in Berlin', *Zeitschrift für Bauwesen* (1853), pp. 23-xx, 571-86.
5. A. Stüler, *Das Neue Museum in Berlin* (Berlin, 1862).
6. D. Vorsteher, *Borsig - Eisengießerei und Maschinenbauanstalt zu Berlin* (Berlin, 1983).
7. W. Lorenz, '150 Jahre Borsig - Beitrag zur Technikgeschichte des frühen Eisenbaus', *Bauingenieur* (1988), pp. 375-84.
8. W. Lorenz, 'Stüler's Neues Museum', in *Berlins Museen - Geschichte und Zukunft* (Munich and Berlin, 1994), pp. 99-112.
9. W. Lorenz, *Konstruktion als Kunstwerk* (Berlin, 1995).
10. W. Lorenz, 'The Berlin Neues Museum - a microcosm of Prussian building technology against the background of beginning industrialisation', in C.A. Brebbia, ed. *Structural Studies, Repairs and Maintenance of Historical Buildings VI,* (Southampton and Boston, 1999), pp. 389-98.