3. Gerhard Grosch, Friedrich Ritter von Hessing. In: Neue Deutsche Biographie, Berlin 1972, Vol.9, page 25.
4. Exhibition catalogue, Architektur des 19. Jahrhunderts in Augsburg. Augsburg 1979, page 56.
5. Hans-Christoph Hoffmann, Die Theaterbauten von Fellner und Helmer, Munich 1966, page 22.
6. Das Kurhaustheater Augsburg-Göggingen. Arbeitshefte des Bayerischen Landesamtes für Denkmalpflege München, Munich 1981. Contributions by Astrid Debold-Kritter, Dagmar Dietrich, Lothar Schätzl, Ruth-Maria Ullrich.
7. Georg Kohl, Barna von Sartory, Das Glashaus, Munich 1981, page 68.
8. Exhibition catalogue Augsburg 1979, ibid. Fig. XI.
9. Kurhaus Göggingen. Studie des Kontaktkreises des Augsburger Architektenverbandes BAB, BAI, BDA, BDB, VFA, Augsburg, no year.

RAILWAY BRIDGES OVER THE MOSELLE AND RHINE (1857-1879). TWENTY YEARS OF BRIDGE CONSTRUCTION HISTORY IN KOBLENZ

Udo Liessem

On account of its topographical situation at the confluence of two important, also strategically significant rivers, Koblenz has been a bridge city from earliest recorded history: Two permanent Roman bridges, one across the Rhine (about 50 A.D.), the other across the Moselle (2nd or 3rd century A.D., with earlier, as yet unproven predecessors) were at the beginning. Whereas the former was abandoned with the fall of the limes (about 260 A.D.) and there was no further permanent Rhine bridge for more than 1500 years, the Roman Moselle bridge had a successor in the Balduin bridge (construction begin about 1332) which was for the most part only destroyed in its historical substance by planning mistakes in the 1960's and '70's.

The following four bridges, which all still exist today, admittedly only with the pillar construction or abutments from the original structures, were built within a little more than two decades (1857-1879). All four are railway bridges, with the Pfaffendorf bridge being used exclusively by road traffic since 1899.
Unfortunately, apart from commemorative publications at the time of the opening and mention in specialist literature, there is no thorough account of the structures and certainly no monograph. Even if the iron constructions have had to make way for modern structures in tune with traffic technical requirements, it is nonetheless incomprehensible why the stone components should also be destroyed and why these remains - imposing enough - still have not been protected as ancient monuments.
It is interesting to observe the very rapid changes in attitude towards the Koblenz bridges. In 1875, the art historian Wilhelm Lübke (1826-1893) listed the "lattice bridges in Dirschau, Marienburg, Cologne and Koblenz" as being equally important and adds that they would rank "on a par with the greatest works of wonder of all times". However, in his "History of German Art" (1890), the same author does not mention a single bridge structure, and F. Haack, who compiled "The Art of the Nineteenth Century" edited by W. Lübke, does not mention the bridges at all (1912/18). On the other hand, the in its time widely used "Illustrated Building Lexicon" by O. Mothes (1874) praises the Pfaffendorf bridge and reproduces two drawings of it. F.M. Feldhaus expresses similar praise in his lexicon "Technology" (1914). In more recent times, G. Drebusch accorded the Pfaffendorf bridge an appropriate place in his work "Industrial Architecture" (1976). If one disregards the brief mention in Lübke's work, the aesthetic-art historical dimension is never brought to the fore, just the technical one. But both should be taken into account if justice is to be done to the bridges.
The Koblenz bridges came into being as a result of the rapid expansion of the Prussian railway network; apart from economic aspects, it was the strategic ones which were decisive. The Moselle bridge was built in the course of the construction of the main north-south trunk route, as part of the section from Rolandseck to Bingerbrück. At the same time, however, a Rhine bridge was planned in order to be able to provide the link to the line running along the right bank of the Rhine. - The two other bridges, the Moselle bridge at Güls and the Rhine bridge at Horchheim, were planned as part of the Berlin-Metz route. In this case it was solely strategic reasons which played a decisive role, something which was also clearly observed in

contemporary reports: "And may this Berlin-Metz railway line which has now been opened - and which has often been called a military railway - serve for the welfare and victory of the peaceful development of our German fatherland" wrote the local press (17.5.1879) at the time of the railway's opening. One day earlier, the strategic character was emphasised even more clearly - "to increase the Empire's power of defence".
The Koblenz railway bridge across the Moselle is among the earliest (major) Prussian railway bridges. One could mention as predecessors the Vistula bridge at Dirschau (1850/57) and the bridge alongside Cologne Cathedral (1855/59); the Koblenz bridge was also a lattice structure. The extraordinarily short period of construction is impressive even by today's standards: 10.8.1857 beginning of the building works, 11.11.1857, festive foundation stone ceremony, 11.11. 1858 the opening, accompanied by a great ceremonial act. "The bridge (...) has four spans of 44 m clear width each with six additional openings of 15.7 m clear width for flood waters. The total width of clear span is 270.2 m. The tracks on the bridge are 12.6 m above the lowest water level. The four river spans are by an iron parallel lattice bridge, the six spans for flood waters, on the other hand, are vaulted stone arches. At either end of the river spans there were fortified tower piers. The track bed itself was for two tracks without a dividing central lattice. The main lattice trusses differed from those usually used at that time in that sturdy t-irons were selected for the truss bars (...). State surveyor Hartwich, the director of building works of the Rhenish Railway Company, was in overall charge of construction." . In 1908 the bridge was widened to take a further two tracks: "For this purpose the piers had to be extended and new stone arches for flood waters where constructed. Semi-bowstring girders were chosen for the spans over the river proper." Further rebuilding took place in 1911, 1918, 1927, 1931 and 1975.
The fortified tower piers had not yet been completed at the time of the opening, they were added later. Their design was in accordance with the structures of the Prussian fortifications in Koblenz, in particular the transverse tower (1831) on the Balduin bridge and the bridge gateway there (completed in 1834).
The Pfaffendorf Rhine bridge was technically much more complicated than the Moselle bridge and was an aesthetically extremely satisfying structure. Whereas the lattice construction of the Moselle bridge is probably best judged from the purely functional aspect, in the case of the Rhine bridge, deliberate account was taken of the landscape, and in place of the horizontal structure, a (triple)arched bridge was chosen. Additional expense did not play any role here.

"The bridge over the river (...) had (...) the following dimensions: The distance between the tower end piers, which were designed as fortified bridge heads, was 307 m. This was divided into three equal spans of 97 m each and two piers in mid-stream of 8 m each, apart from this, the foreland on the left bank was bridged by a roughly 10 m high vaulted arch, so that the new flood profile created by the bridge was completely adequate for flood waters and ice floes (...). What was decisive for the width of the bridge was the fact it was decided not to build an additional bridge for road traffic, provision being made for road traffic, although road traffic was only allowed across the bridge when it was not possible to use the pontoon bridge. The track bed was accordingly wide enough to accomodate a twin-tracked railway (...). An arched construction was chosen for the superstructure which fitted into the romantic surroundings of Koblenz and which detracted less from the charming views to be had everywhere than high, straight

structural sides. In order to attain greater rigidity at the sides, there were three instead of two main trusses in each span and wrought iron was selected as building material.
In the calculation and design, the following basic principles were applied: The greatest loading of the wrought iron should not be more than 730 kg per sgm/cm and that with a maximum load of 3200 kg per metre length. However, the greatest axle loading on the track from the driving wheel of a locomotive was taken to be 8250 kg. The modulus of elasticity was presumed to be 1 310 000 kg.
The ribs of the main girders were composed of plates and angles set together in upper and lower members. The arches were 3.14 m in height and their pier height was 9.10 m. The supports on the abutments of the land-based piers were 1.24 m above ground level and 3.14 m above the tow path. The underside of the arch at the centre was 15 m above normal water level, while the railway track was 62 cm higher, so that a considerable part of the curve of the arches extended above the railway tracks.
The upper and lower members were connected by a system of double-diagonal t-girders and vertical plates reinforced with angle irons. The divisions in this system coincided with the divisions of the cross girders so that in each case the connection with the cross girders, where they were within the ribs, was made by such a plate. On the other hand, where the cross girders with the track bed lay above the upper member, vertical plates of similar construction formed the supports for the transverse girders and track beds. Vertical, horizontal and diagonal cross girders served to safeguard against lateral swaying.
The track bed is formed by iron transverse sleepers supporting longitudinal sleepers on which the rails were laid and which were placed through the transverse girders. In this way it was possible to attain as low a height as possible for the track bed above the lower member at its apex.
The arch ribs had very powerful wrought-iron plates, reinforced by angle irons at their ends, they rested on steel wedges on the cast plates mounted onto the abutments. By tightening up the central wedges, the arches were supposed to retain an elastic flexibility.
(...)
The plan for this magnificent structure came from the senior government architect Hartwich and the former Prussian state architect Sternberg who was later to become government architect in Baden and professor at the Baden Polytechnic in Karlsruhe. The construction work itself was under the direction of the departmental architect Schwarz." The construction time was again remarkably short: The foundation works began in summer 1862, the foundation stone was laid on the 11.11.1862, the opening - celebrated at anormous expense for the cereomonies - was on the 9.5.1864.
"For its time the bridge represented a work of technology which by virtue of the boldness of the project as also its execution outshone all other Rhine bridges, both the Cologne truss bridge and the Mainz bridge constructed with so-called fish-belly girders. Above all it excelled by its architectural beauty."
The fortifications at the bridge heads were considerable, culminating in 10 m high bomb-proof towers, closing gates and extending roller bridges. The design of the towers was similar to that for the Moselle bridge.
The Pfaffendorf bridge was rebuilt in 1933/34 and 1950/53; like all other Koblenz bridges it too was destroyed in 1944/45.

Chronologically, the next bridge is the Güls railway bridge over the Moselle. It was built as part of the Berlin-Metz railway between April 1877 and October 1878. "The Moselle was not crossed at right angles to the river, but at an angle of 80°, determined by the existence of a suitable site for constructing a permanent bridge at a very favourable point. The total clear opening of the bridge was originally 226 m and was made up of three main spans of 64 m each, crossed by iron arches, and an arched span of 17 m clear width on each bank. The passage profile based on the highest recorded flood level of 1845 was 1557 sqm. (...) The structure itself was designed to take two tracks with a distance of 3.50 m between the track centres. The track bed was supported by two beams with a distance of 5 m between their axes and which were beneath the outer rails. These main beams consisted of two upper and lower members, braced by a double diagonal system, the upper one of which was on a horizontal plane whereas the lower traced a parabola. The rise of the parabola measured 7 m."
On account of an intervention by the Koblenz district council and by the villages of Güls and Moselweiss, both now part of Koblenz, and by Bassenheim, the railway bridge was equipped with an iron footbridge on either side. Once again the bridge heads were defended by towers, similar to those described before. The Güls bridge underwent reconstruction in 1925 and after the war, when as the least badly damaged of the Koblenz bridges it was quickly rebuilt.
Horchheim railway bridge, the most recent of the Koblenz bridges presented here, was, however, the most complex as far as the architectural design was concerned. This went beyond the purely functional; the defensive aspect now had somewhat accessory character, it became almost purely representational architecture. The forms used have close affinities to the towers of the older Cologne Cathedral bridge, but in particular they follow neo-Gothic architecture used along the middle Rhine; we would point as examples to the tunnel entrances on the railways along both banks of the Rhine. Stolzenfels Castle, which can be seen from the bridge, had the greatest influence. Construction of the bridge began in June 1876. On the 6.12.1877 topping out and completion was on the 15.5.1879.

Construction was complicated by the fact that the Berlin-Metz railway had to be led over the southern tip of Oberwerth island meaning that the Rhine arm on the left was closed off by an earth embankments and the right side was given a different flood profile.
"The total clear width of the bridge, which was to span the main stream, was calculated at 312 m, with a clear passage opening of 2967 sqm at the highest flood water level. The river itself was spanned by two wrought iron arches of 106 m clear span each, adjoined by four stone archways with 25 m span each at the sides. Arched girders were chosen for the main opening in order not to detract from the extraordinarily beautiful, romantic landscape in the immediate vicinity of Koblenz by the construction of systems of less satisfactory aesthetic aspect. The lowest point of the abutments of the main girders was set at 0.14 m above the highest flood water mark of 1845. The width chosen for the bridge was sufficient to accomodate two main tracks. The arch girders were made of welded iron. The total weight of the iron construction was 1196 tons."

The plans were produced by government architect Hilff of the Prussian Railways regional administration in Wiesbaden, and the inspector of railway construction Altenloh, who was in charge of the construction work. The architectural design was probably by O. Sarrazin who was later to become government architect. Reinforcement and reconstruction works were carried out in 1901/02, 1933/34, 1946/47 and 1961.
All four Koblenz bridges, if they are taken together, were structures of the greatest technical precision with roughly the same period of construction and employing the same building material - namely iron - as factors linking them together. If one disregards the varying nature of the construction, they do share in common the successful synthesis of functional technology, an aesthetic desire to create and incorporate into the landscape by means of employing forms related to the landscape. Their successors, constructed between the 1950's and 1970's are, for all their praiseworthy functionalism, soulless alien bodies in a delightful landscape.

Notes

1. On the Roman Moselle bridge: H. Eiden, Zehn Jahre Ausgrabung am Mittelrhein und Mosel, Koblenz, 2. edition, 1977, pp. 55 ff. - On the Roman Rhine bridge: H. Fehr, Eine Rheinbrücke zwischen Koblenz und Ehrenbreitstein aus der Regierungszeit des Claudius. In: Bonner Jahrbücher, Vol. 181, Cologne 1981, pp. 287 ff.
2. U. Liessem: Neues zur Kunstgeschichte der Balduinbrücke. In: Koblenz Stadt der Brücken (= Dokumentationen der Stadt Koblenz 4), Koblenz 1975, pp. 69-73.
3. F. Michel: Die Kunstdenkmäler der Stadt Koblenz. Die profanen Denkmäler und die Vororte (= Vol. 1 Kunstdenkmäler von Rheinland-Pfalz) Munich, Berlin 1954, p. 145/6. - H. Bellinghausen: Alte und neue Rhein- und Moselbrücken bei Koblenz. In: Festschrift zur Einweihung der Pfaffendorfer Brücke, Koblenz 1953. - E. Franke: Geschichte der Koblenzer Brücken. In: Koblenz Stadt der Brücken, pp. 14-63. - By far the best survey is provided by the festschrift published by the City of Koblenz on the occasion of the completion of the Adolf-Hitler-Brücke and the reconstruction of the Pfaffendorf bridge, Koblenz 1934. In this work the Chief City Architect, Neumann and City Architect Mohaupt write about the four Koblenz railway bridges on pp. 29-52. All dates and construction descriptions quoted here have been taken from this work unless otherwise stated.
4. W. Lübke : Geschichte der Architektur, Leipzig, 5.edition,1875, p. 828.
5. - idem - Geschichte der deutschen Kunst, Stuttgart 1890.
6. F. Haack: Die Kunst des 19. Jahrhunderts (= Vol. 5 Grundriss der Kunstgeschichte, ed. by W. Lübke), Esslingen, 4.edition, 1912, 5. edition 1918.
7. O. Mothes (Ed.): Illustriertes Bau-Lexikon, Leipzig, Berlin, 3. edition, 1874, Vol. 1: The article on bridges by Mothes, pp. 495-539, Figs. 774-925, in particular p. 507 and figs. 831/32.
8. F.M. Feldhaus: Die Technik. Ein Lexikon (1914), Reprint,Wiesbaden 1970, pp. 138/50.
9. G. Drebusch: Industrie-Architektur (= Heyne-Stilkunde 6), Heyne Vol. 4511, Munich 1976, p. 107.
10. An exception to this is: U. Liessem: Bögen, Türme, Zinnen. Zur Bau- und Kunstgeschichte der Horchheimer Brücke. In: Kirmes-Magazin, Horchheim 79, pp. 57/58.
11. H.J. Schmidt: 1879-1979 Ein Jahrhundert Horchheimer Eisenbahnbrücke. In: Kirmes-Magazin Horchheim 79, pp. 32/35, 46/47, here p. 32

12. ibid. p. 46.
13. Neumann/Mohaupt p. 29.
14. Die Pfaffendorfer Brücke 1864 (nach Quellen im Landeshauptarchiv Koblenz). In: Pfaffendorfer Kirmes-Zeitung, 27 (1977), p. 1 ff.
15. Neumann/Mohaupt pp. 34/35.
16. ibid. p. 38. The "bridge which is so characterised by its light and pleasing form" was praised by contemporaries. cf. J. Wegeler: Beiträge zur Geschichte der Stadt Coblenz, Koblenz, 2.edition, 1882, p. 193.
17. ibid. p. 49.
18. K. Hoppstädter: Die Eisenbahn im Moseltal nach den Akten des Staatsarchivs Koblenz, published by the Bundesbahndirektion Saarbrücken 1973, p. 47/48.
19. The only photograph showing the towers is to be found in: K. Möhlig: Der Alt-Koblenzer Osterspaziergang. In: Mitteilungen des Heimatkündlichen Arbeitskreises Güls/Mosel 4, Güls 1969, illustration on p. 13.
20. As Note 10.
21. Neumann/Mohaupt, p. 46.
22. As Note 10.

IRON FURNITURE

Georg Himmelheber

Surrounded by all those giants of iron architecture to which the papers in this colloquium are primarily devoted, pieces of furniture do not only appear small and modest, but perhaps also out of place. However, I am very pleased to have the opportunity here of pursuing this subject further, because from time immemorial, the art of furniture construction has been very closely linked with architecture. Perhaps this symposium may help to throw light on the extent to which this opinion of mine is also indeed applicable in the case of iron furniture - assuming that it is possible for any conclusions at all to be drawn at the present stage of investigations, because I must admit that my own research in this field is still very new. My comments are in effect a commissioned work without any preliminary work, either by other researchers or by me myself. In the extensive range of literature on iron - including also what has been appearing recently and has also been dealing increasingly with the decorative parts of iron architecture - furniture is never touched.
I can thus only give a preliminary survey, which means that I can also not just restrict myself to the second half of the nineteenth century - although the greater part of the furniture to be covered dates from this second half.

Firstly the question arises: Why is there such a thing as iron furniture? How did the manufacture of iron furniture come about?
A decisive incentive for the manufacture of iron furniture is fear, namely fear in three forms:

1. fear of theft and fire,
2. fear of bugs and
3. fear of bad weather.

That is, of course, just one aspect which leaves out other motives, such as questions of skil, craftsman's pride, the pleasure in strange things which also induce the artist-craftsman to produce iron furniture. Nevertheless, I should like to keep to the three "categories of fear", because they do permit a certain degree of classification of the material.
Fear of fire and theft led to the production of iron receptacles as items of furniture, starting out from the iron chests of the Middle Ages down to modern safes.
Fear of bugsled to the production of iron beds which - something we tend to forget nowadays - were so widely spread and in general use in the nineteenth century, that the reintroduction of wooden bedsteads was only achieved with difficulty.
Finally, fear of bad weather led to the manufacture of iron garden furniture, the most extensive and widely spread form of iron furniture.

The first pieces of iron furniture we know of were, admittedly, produced for artistic reasons, for the sheer pleasure of using an unusual material for furniture. One of the most magnificent pieces of iron furniture in existence was produced in Augsburg in 1574 by the master cutler and instrument-maker Thomas Rucker, and was intended as a gift by the City of Augsburg to Emperor Maximilian II.(1) This elaborate piece of furniture is, of course, itself part of a tradition. Its cross members forming the seat proper and continuing up to form the back and arms are a development of the