IRON AS CONSTRUCTION MATERIAL IN BUILDING CONSTRUCTION IN AUSTRIA IN THE SECOND HALF OF THE NINETEENTH CENTURY

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This present study deals principally with the material iron as an auxiliary building material, or, to put it more simply, those iron constructions which are not normally exposed to public view. The late start made with the use of iron construction in building construction in Austria is best illustrated by a decree issued by the Court Chancellery in 1845, in which it is explicitly stated that there are no objections on the part of the authorities to the use of iron arched girders, however, "every care must be taken in connection with gaining a preliminary conviction that those iron girders have the requisite load-bearing capacity." One of the earliest applications of iron girders in Austria is to be found in the extension to the swimming pool of the Sophienbad in Vienna which was begun in 1865 by the architects August Sicardsburg and Eduard von der Mill. The ceiling (3) consisted of riveted box girders of approx. 32 mm thick iron sheet, with a curved lower flange and a polygonally-formed upper flange; the smallest cross section - for a clear span of no less than 17.7 m - was 265 x 2270 mm. It is also worth mentioning that the two architects also had iron vault girders incorporated into a side room, without calculating them - and immediately ran into difficulties. (4)

In 1856, during the construction of the offices for the First Danube Steamship Company in Vienna, the rolled I-girders were obtained from a British company. But it was still not possible to produce them in Austria (5). In 1862, the iron works of the Klein family were the only ones in Austria producing such beams. (6) Significantly enough, it was one of its directors of that company, Albert von Klein, who had one of the first town mansions erected on the Ringstrasse, in the immediate vicinity of the opera, to the design of the architect Ludwig Förster, and here deliberately requested the use of iron girders. (7) Even in 1866, I-girders could only be supplied to special order by the majority of factories, so that the Austrian Engineers' and Architects' Association formed a committee of its own, which in 1865 drew up a list of ten sizes of I-girders, with heights ranging from 105 mm to 336 mm, which the steel mills were recommended to produce and stock. (8) Sixteen years later, in 1881, the position was somewhat different; there were 62 different riveted sections available on the Austrian market, and the afore-mentioned association now felt constrained to publish a recommendation for the reduction of the number of types. (9) The major iron companies of the period were already offering riveted girders as prefabrication components: for instance, a catalogue from the Ignaz Gridl company from 1883 included I-girders and bow girders in heights ranging from 158 to 1,111 mm. (10)

The majority of rolled girders were used in crown ceilings, that is, ceiling vaulting constructed with bricks set between the girders, which were given the nickname "Mozart Platte" (Viennese biscuits) in Austria because they were so widely used in the capital. It was possible to construct these ceilings using simple templates, thus making them cheaply and initially they were especially as fire-proof ceilings over cellars, ground floors and uppermost storeys - in keeping with building regulation requirements. Probably the cheapest dwelling house in Vienna to have such ceilings on all floors was again - characteristically - a house for the afore-mentioned industrialist, Albert von Klein, at Dr. Karl Lueger-Platz 2, built by the architect Karl Tietz between 1867 and 1869. (11) However, the use of these ceilings was by no means restricted to tenement houses, in which, for obvious reasons, there had to be economies, they are also to be found in the majority of monumental constructions: thus, for instance, almost all the rooms in the Vienna City Hall, erected between 1872 and 1883 to the plans of the architect Friedrich von Schmidt, have such ceilings. They were, however, only left bare in the rarest cases, for the most part they served as bearing constructions, from which the ceilings proper were suspended.

An obvious further development of this type of ceiling - influenced not least by the then widely held opinion that iron provided a great degree of fire safety - were the so-called calotte ceilings. In this system, iron plates with concave indentation pointing upwards were riveted in between the iron girders. Hasenauer, for instance, had such ceilings constructed above the main staircases of the Natural History and Fine Arts Museums in Vienna. (12) The "carruraged iron girder" represented an even simpler system which could be spanned from one impost to the next. The underlying principle of these sectional plates lay in the fact that the corrugations were higher than they were wide, resulting in a straight section between the peak and valley of the corrugation, something of considerable importance for the ability to bear loads. The afore-mentioned Gridl company, for instance, had an imperial charter on this construction system; admittedly, we no longer know the date of the original invention, the charter for an improved version was granted in 1875. (13) The problem of suspended ceilings mentioned above was often solved by means of what are called "agraffe constructions". They came - just like the word "agraffe", meaning "hook" or "clasp" - directly from France, and were also known as "Vaux Constructions" from the name of a Parisian firm. The principle of these constructions is best shown by a study paper, unfortunately neither dated nor signed, from the former Polytechnical Institute in Vienna; (14) flat-iron bars, arranged as far as possible between a bearing system of appropriately dimensioned iron sections, form a net which is bricked over with hollow bricks. A plan for the construction of the Natural History Museum in Vienna from 1877 shows such a ceiling, which obviously was too complicated - and for the observer almost incredible - there are agraffe constructions over the entrance halls of both the Natural History Museum and the Fine Arts Museum. The ceiling of the former is 15.76 m, appears to be supported on the massive buttresses on the one and, by a stone ring in the middle on the other, through which it is possible to see the cupola above.

As a matter of fact, however, the bearing ceiling consists of truss-like corbels arranged in circular pattern, from which the vaulting is suspended, the so-called agraffe constructions constituting an essential element: a sort of small iron bridge construction from which wide spanning, straight trusses could be suspended. So came directly to Austria from France; evidence for this is to be found in various papers in the first volumes of the Allgemeine Bauzeitung reporting on these "strange constructions", (17) with which in Paris the whole ground floor area of buildings was opened up for shops and cafes facing out onto the newly-created boulevards.
building periodical (21) since 1836, had made numerous study tours and knew the comparable English examples.

The transition from cast-iron to wrought-iron construction took place in Vienna, by the way, in general between 1850 and 1860. The so-called Bank and Stock Exchange building built by Heinrich Perzler from 1856 to 1859, already had iron roof frames over the clerestories in the passageway area and the covered inner courtyards, but still in part with brick and stone corbeled up in the upper corners.

Something which is characteristic for the transition from cast-iron construction is the difference in material between the design and the execution stages, something which can be observed repeatedly. The plan submitted in 1860 by Theophil Hansen for the construction of the Protestant School still shows cast-iron construction over the courtyard (23); the project was carried out in 1862 using wrought-iron. From this is a draft design for the Stock exchange building by the government architect Paul Sprenger, dated April 15th 1851, which also shows a massive cast-iron roof frame. (24) In the course of the construction of the Stock Exchange which, however, took place much later, from 1871 to 1877, under the architect Theophil Hansen, a wrought-iron roof frame was included, on the other hand, as a matter of course.

A decisive point in the development of iron roof frames comes with the roof over the main nave of the Votivkirche in Vienna which was constructed in 1865/66. There is a plan still in existence from the Allhusen Engineering Works (22), the execution of which would certainly not have been possible for statical reasons. Apparently at the same time, or perhaps a little earlier, a design has been preserved which the English engineer Joseph Paxton (25) envisaged a cast-iron construction with simple tension bracing. The interesting point here is that the contract was not, it is true, ever executed. But the principle enunciated by Paxton, clearly to be found again in the structure erected in 1870, to the designs of the engineer Eduard Leyser and produced by the G. Sigl Engineering Works (22), is among the most impressive iron constructions from the Historicism period in Vienna. It has an icosahedronal ground plan, with a support width of about 34.5 meters.

A few years after the completion of the church, Friedrich Schmidt once again had occasion to deal very intensively with the problem of engineering works, with the construction of the City Hall in Vienna. In close cooperation with the companies involved in the building, the architect developed seventeen different constructions for this building along which were executed in 1876/79. The city and construction plan still in existence (29) here provide an almost specific insight into the practical planning procedure: the architect first developed a construction system, in accordance with his own ideas, which was then revised by the company carrying out the work, in this case once again, the Ignaz Gr Admission company. Firstly, a larger scale system sketch was prepared, with the help of which the statical checks were made, and then the detailed drawings were produced. The statical checks on much, in part, extremely complicated wrought work were conducted by the way, almost exclusively using graphic methods, as is generally known, by Carl Culmann, and which had also spread rapidly in Austria with the publication of his main work "Graphical Statics" in 1865. (20)
Even more interesting than the examples quoted up to now are those buildings, or parts of buildings, in which whole steel skeleton constructions were carefully concealed behind plaster and stucco work. Here the lower part of the daylighting on the roof of the Opera House and Burgtheater. The ceilings of the dress circles and the boxes in the opera house were in agraffe construction, resting on solid cast-iron pillars. (31) The pillars were rectangular in section, measuring 53 x 126 mm. Every pillar had a head plate and a base plate incorporated as part of the casting, measuring 316 x 210 mm. It was possible to bolt both iron girders of the ceiling construction and the base plate of the next gallery pillar up into a specially formed head piece. The pillars were partially concealed in the corridor walls, and partially in the partitions between the boxes. It was certainly not possible to see the auditorium that it was for the most part made up of iron constructions.

The auditorium in the Burgtheater was constructed in a very similar fashion. (32) However, here the ceilings were formed by a close network of 1-girders with corrugated iron girders in between; box girders of 145 x 283 mm cross section, made of wrought-iron and rolled-iron sections, were used as supports.

One construction which appears especially curious to the modern observer was erected about 1910 in the first storey of the central part of the Neue Hofburg. (33) The room involved has a cruciform ground plan, over the crossing is a higher calotte-form cupola, apparently resting on pillars and pilasters, while on the side walls of the room there is a semicircular barrel vaulting. In fact, the whole load-bearing system is made of iron, the vaulting being formed in aggregate, cupola, and the bearing support of the cupola also consist of riveted iron sections. The whole iron frame was covered and decorated with an elaborate stucco decor, with bases and capitals for the surrounding pillars. Nowadays, the corresponding iron construction are bare in the roof area, so that there can be no doubt about the realisation of the detailed plans which are still in existence.

The examples quoted, which have been taken from a comprehensive research project (34) and could be added to at will, do permit some generally valid conclusions—at least as far as Austria is concerned:

1. Iron became an accepted building material, also actually used in practice in building construction, at a relatively late date, namely not until the second half of the nineteenth century.

2. The introduction of iron in building construction was not dependent on the development of statics and material mechanics, but more on the economic and building organisational advantages which the "new" building material had over traditional materials.

3. Iron constructions developed in the second half of the nineteenth century for the most part independently of the architectural appearance; the historicizing building forms were just put on over the technical structure, much as one might put on a shirt.

Notes


4. Vienna, Department of plans and documents, No. E2 1089/III, sheets 6/1-2, decision of the city authorities dated the 17th August 1846.


18. Vienna, Archive of the Gebäudeverwaltung des Österreichischen Bundestheaterverbandes, Plan No. 136, dated 20.1.1876, signed lg. Gridi, and 9.3.1876, "seen Hasenauer".


IRON ARCHITECTURE IN THE BOHEMIAN LANDS FROM THE MID-NINETEENTH CENTURY UNTIL ART NOUVEAU

Dobroslav Libal

The Bohemian lands had already been on the forefront in iron production in central Europe for some centuries. Production in the modern period, however, has a long tradition in the past. Already by the end of the first quarter of the nineteenth century, iron architecture was beginning to influence the appearance of our countryside. It was first represented by several suspension bridges. Their main planner, the engineer Friedrich Schönhäubl, built the first chain bridge over a side arm of the Morava close to the town of Strašnice in south-east Moravia in 1823-24. It was the earliest chain suspension bridge on the European continent, with a span of nearly 30 m.

Only one of these chain bridges has survived down to the present. It was built by Friedrich Schönhäubl to provide a bridge across the Vitava (Moldau) for the Tabor-Pisek road in 1868-69. The bridge was disassembled in 1960. The granite blocks and iron components were transported into the nearby valley of the Lužnice, where the bridge was reconstructed in 1975. It was classified as a historical monument and is used as the river crossing of a minor road in this picturesque landscape.

By the period shortly before the middle of the last century, iron architecture had developed within the framework of late, Gothic-inspired Historicism. Direct English influence played a decisive role here.

In the Liechtensteins' castle at Lednice (Siegfried) on the Moravian-Austrian border, the iron glasshouse or palmhouse was erected in 1843-44 to the design of the English architect P.H. Desvignes. The cast-iron construction was supplied by the Klein Brothers' Iron Works in Sobotín in northern Moravia. In an exact parallel to this is the iron orangery erected by the engineer Damian Devorecký, following English designs, in the Schwarzenberg's south Bohemian castle of Mšovské.

By 1870, the technique of iron statue casting had been highly developed. The centre for this were the Salmische Eisenwerke foundry in Blansko to the north of Brno (Brünn), which was also called the “School of the Moravian Foundry Industry”. Sculptures, monuments and reliefs were cast there with the greatest skill and to high artistic standards.

Already from the eighteen-twenties on, cast iron had made its breakthrough as a material for architectural details, mainly for staircases and railings in general. We could take as an example the stair hand-rail on the magnificent stairway in the town mansion No. 1025-II in the New Town in Prague, opposite the new railway station. The mansion was built by the architect J.O. Kramper in 1845-44 for Albert Klein, a member of the afore-mentioned iron-founding and railway-building family. The renowned Viennese architect, Ludwig von Förster, built a town mansion for the Klein brothers on the main square in Brno (Brünn). The building, which was erected in 1846, was intended to represent the products of the Kleins' iron foundries in Sobotín. Within the framework of the late-Classicist façade composition, Förster employed very original and striking cast-iron architectural elements. On both sides of the frontage of the house, two two-storey high bay windows project out, each richly decorated with figures and ornaments. Cast-iron details were also particularly developed for the windows and on the main cornice. In the case of some components, the decorative function played a more important role than the structural one. The whole frontage of Förster's mansion was an interesting