

## DANISH EXAMPLES OF IRON ARCHITECTURE AROUND THE MIDDLE OF THE CENTURY

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Let me begin with an apology, because in Denmark one basic assumption implied in this subject was absent almost completely, namely iron. This may require a more detailed explanation. In Denmark there has never been sufficient ore or energy for independent iron production. Both resources were available in Norway, a country with which Denmark was politically connected until 1814. This meant that the division of labour between the two countries made Norway the iron supplier and Denmark the granary. When the two countries were separated in 1814, Denmark lacked both iron and the possibility of iron working on a larger scale, and it took some decades for a domestic iron industry based on imported iron to be set up. Those were precisely the decades in which pioneering work on iron as a structural material was done in other countries, in Britain even earlier. This is the reason why iron had rather little significance in Danish architecture of the first half of the 19th century. Although the number of iron foundries increased considerably after 1840, they mainly turned out machine parts, ship equipment and military equipment.

Another reason for iron being rarely used as a structural material could perhaps be mentioned here. Approximately until 1840 Danish architecture was dominated by one man, Christian Frederik Hansen. He was born in 1756; in 1800 he was transferred from his post of Schleswig-Holstein State Architect to Copenhagen as Director of Building Activities, particularly in order to solve the urgent construction problems following two disastrous fires. Christiansborg Palace had burnt down in 1794, and a large fire had devastated Copenhagen in 1795. C.F.Hansen was a classicist of great ability, but he was in no way interested in the more recent trends, such as the Neo-Gothic or exotic styles of building, i.e., in areas in which iron would have been expected to be used as a structural or decorative material. He died as late as in 1845, much to the relief of a younger generation of architects.

For all these reasons I had to choose as the title for this lecture Danish examples around the middle of the century, instead of the first half of the century, so as to be able to include some first major architectural works in which iron played a main role.

First of all, let me show you some stove plates made in Norway in the 18th century, done in a style which is still customary in Denmark. Danish development proper began with the use of cast iron in structural components, i.e., special windows, loggias, consoles and various ornaments. These examples are details from facades of the Copenhagen courthouse and prison built by C.F.Hansen in 1805-15. On this rather small scale he did accept the possibilities offered by cast iron. Other examples are lunette windows in a mausoleum built by the German-born architect Gustav Hetsch and windows designed in the Neo-Gothic style in the medieval church of Horne, both built around 1825.

This leads back to the old ties to Norway. Heinrich Meldahl, who set up the first iron foundry in Denmark in 1811, had spent his apprenticeship at the Näs ironworks near Arendal and was financially supported by his Norwegian employer when he set up his own factory in Copenhagen. Meldahl left us some preliminary design drafts of cast iron grilles, lamp posts etc. His tombstone, of course made of cast iron, was designed by Gustav Hetsch in 1843. Incidentally, Meldahl's son Ferdinand became one of the leading architects of the

Beaux Arts style. After these beginnings cast iron was used for structural members, but outside grand architecture, a development culminating in the construction of the University Library of Copenhagen in the late 1850's. This building integrated design and decoration, one of the main objectives and ideals of Historism. In my paper I shall attempt to retrace the development from iron as a structural element to iron structures.

The Øregård estate north of Copenhagen was built by the French architect Joseph-Jacques Ramée in 1806. However, the loggia made of cast iron was not made at the same time, but probably some three decades later. The clear and slender forms of the loggia blend well with the architectural style of the house.

In 1842 an expensive project of a glass-covered shopping street in Copenhagen was designed. It was never implemented, which may be symptomatic of conditions at that time. It is ascribed to the architect H.C. Stilling. Stilling was also the first architect of the Copenhagen Tivoli entertainment park newly established in 1843. None of the original light pavilion buildings of Tivoli have been preserved, but it can be assumed that iron was used for their construction. A shop front built in Copenhagen in 1847 still exists completely unchanged; it was also designed by the architect Stilling. Its style is rather typical of that epoch of refined modesty, and decorative trends are still kept well under control.

The most original Danish architect of the turn of the century was Michael Gottlieb Bindesbøll, who had a relatively short career. He survived C.F. Hansen by only eleven years. He died in 1856 at the age of 56. His main work is the museum for the sculptor Thorvaldsen built in 1840-48. Although the museum was erected in the coach house of Christiansborg Palace, which had burnt down, it is a free, independent variation on the theme. The American architectural historian Henry-Russell Hitchcock even writes that, in this work, Bindesbøll "outschinkels" Schinkel, which is to say that he surpassed Schinkel's achievements in the latter's own field. However, the museum does not contain any features which could be called modern for the period. Fire protection was achieved by brick arches. Bindesbøll used very elementary, undecorated cast iron windows, probably for architectural reasons, in order to underline the contrast between opening and area.

The same characteristics are true of Bindesbøll's Agricultural College built in Copenhagen in the mid-1850's.

In the early fifties, cast iron was also used for components in the better residential buildings, e.g., for consoles of balconies or merely for decoration on balustrades and the like. A rather unobtrusive rear building on Pilestraede in Copenhagen perhaps constitutes an even more important beginning. It was built in 1844 and is the first house in Denmark to have a structure all of cast iron. However, the design is rather elementary. It consists of cast iron bars about 2 x 4 inches, both for the fascia pillars and the floor beams.

Much more impressive is the first iron bridge in Denmark built in the same year, 1844. Today it only carries pedestrians, but it was built to connect to the main road of the city of Odense on the Isle of Fyn. Odense at that time was the second largest city in Denmark and already had iron foundries able to solve these relatively difficult problems. The design concept is logical for an arched bridge, and so is the aesthetic style. The architect is unknown.

Slightly later, in 1850, the first suspension bridge was built in Denmark. It is made of cast iron and chains and can be found on Brahesborg Estate on the Isle of Fyn. It is not quite clear for what

purpose that bridge had been built; probably it is just a park folly without any importance for traffic. (As you can see, the bridge is almost impossible to photograph). But the history of this bridge is very different from that of Odense Bridge. The owner of Brahesborg, W.F. Treschow, was also the owner of the Fritzøe ironworks near Larvik in Norway, where the bridge was manufactured and shipped to Denmark. Around 1850 Fritzøe were the leading Norwegian ironworks, but already in 1868 production was stopped, after more than 200 years of activity, as a consequence of the international economic situation.

Let me briefly mention a bridge built in the 1850's, the so-called Frederik VII Bridge in Copenhagen which, unlike the others, was made of forged iron. Originally it had been built to bridge the gap in the wall systems created as a consequence of the demolition of the gate buildings of the city of Copenhagen. It is said that the rather eccentric King did not want to interrupt his rides on horseback along the walls of the city. The bridge was later set up in the neighbouring park.

Danish buildings did not contain more sophisticated iron structures until the second half of the 1850's. However, by that time the predominance of cast iron had almost come to an end, because rolled iron sections soon replaced cast iron as horizontal girders. This means that floor girders made of cast iron are very rare in Denmark. The first waterworks run on steam were built in Copenhagen in 1857 from plans by the Danish architect N.S. Nebelong and the English engineer James Simpson. The building and the machine facilities are largely integrated in that the machine hall is subdivided by a floor with cast iron downstand beams which, at the same time, are components of the steam engine. The I-beam sections contain the upper main bearings of the machines and are more complicated in shape than would be possible for rolled sections.

Both the building and one of the three original English steam engines are still in existence, but unfortunately they have been removed from their original site. The house is empty and unused, and the machine is set up at Denmark's Technical Museum. It is really debatable whether such unique monuments of industrial architecture should not be preserved in situ. The main work of Danish iron architecture dating from the middle of the last century is undoubtedly the University Library of Copenhagen built 1857-60 by the architect J.D. Herholdt following a competition in 1856. In the rules of that competition it had been demanded that the library be built of "iron and stone." Fire safety at that time was a rather recent consideration; we know that too much confidence was put in unencased iron structures. By that time, some rather bad experience had been made in Britain with so-called fire-proof structures, a fact which does not seem to have been known in Copenhagen: the inner structure is completely exposed. However, the building has never been endangered by fire.

The University Library not only represents the first deliberate architectural design of a large cast iron structure in Denmark, but also includes characteristics of the so-called Nordic-Italian trend in Historism which was to be very popular in Denmark right up to the turn of the century. Another remarkable feature is the great importance attached to material and craftsmanship, which is almost inconceivable without Pugin and Ruskin. Moreover Herholdt, who had formerly worked with Bindesbøll, undoubtedly had been influenced by Henry Labrousse's Bibliothèque Ste. Geneviève.

The main hall of the Library is almost structured like a three-nave church. On each side of the nave, which ends in a semicircular arch made of riveted iron panels at the top, there are open galleries with

bookshelves. Spans are 18 - 12 - 18 feet in the transverse direction and 9 - 9 - double pillar - 9 - 9 feet etc. in the longitudinal direction. The outer walls made of brick are load bearing walls, but the whole inner structure of pillars and downstand beams is made of cast iron. Between the downstand beams there are flat arches of brickwork, a design also found in British factory buildings. This type of design was introduced in Denmark in the University Library.

Some of Herholdt's original drawings are preserved by the Academy of Arts of Copenhagen. They are characterized by a very tender and delicate graphic style reminiscent of the interior designs actually implemented. It is part of the architectural character of the Library that ceilings and structural elements were decorated by the painter and decorator Georg Hilker. Hilker was much older than Herholdt, representing late Classicism rather than early Historism. His style was even called "Pompeian." It has been said that Hilker's Pompeian decorations did not fit in these historicist surroundings. I do not think this criticism is justified, because also Herholdt, although working in a different style, used classicistic discipline and precision. The decline and deterioration both of classicism and the Romanesque style did not show until the second half of the 19th century. Also Hilker's design drafts are now preserved by the Academy of Arts.

In yet another respect the University Library building may be regarded as a breakthrough. It is a symptom of Danish iron foundries having reached a stage of maturity by the late 1850's. The whole structure was made by the iron foundry and machine shops of Gamst & Lund of Copenhagen. An important man in this connection was the owner and technical director of the company, P.J. Winstrup, one of the earliest graduates of the Danish Polytechnic Institute founded in 1829. After some delay in the early years, development proceeded rather rapidly after 1860. Soon, as mentioned above, the new rolled iron sections could be found in industrial building construction. A pioneer in introducing modern building techniques in Denmark was J.C. Jacobsen, founder of the well-known Carlsberg brewery. For an industrialist, Jacobsen was more than normally involved in architecture, the arts and modern technology. Some parts of his brewery and his own residence, now a residence of honour, whose large hall is covered by a semi-circular arch made of iron and glass, were designed by himself. His plant buildings, which were not covered by insurance, burnt down in 1867. As a consequence, he developed an understandable interest in fireproof designs and, at the same time, became one of the most ardent promoters of the Copenhagen Fire Insurance Company.