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Experience obtained with Structures Executed in Austria.

Erfahrungen bei ausgeführten Bauwerken in Österreich.

Observations sur les ouvrages exécutés en Autriche.

Ing. F. Zelisko,
Ministerialrat, Wien.

An important development in the welding of steel structures has taken place in Austria during recent years. More particularly the scientific study of the most important welding problems proved to be a valuable help to the designing engineer and provided the necessary suppositions, to follow with sufficient accuracy the action of the forces, when calculating and designing such welded steel structures.

The earliest general directions referring to the calculation and erection of welded steel structures (Oenorm B 2332) were issued in Austria in 1934, establishing in the first place the permissible stresses in the original material and the weld, and settling many important details of design.

The results of applying these directions in actual building were carefully observed and tested and thus furnished the data for the immediate publication of new Standards for the calculation and erection of welded structures, and similarly for road bridges with welded web-plate girders. It can be expected that due to these standards, in which the new perceptions in all branches of welding are realised, the application of welding in structural steel — and bridge work will soon be pushing ahead in Austria, more particularly also on account of the frequently established economy of the new construction method. All approved types of welding are admitted, as well as most of the structural steel qualities manufactured in Austria. The structural steel qualities St 37.11 and St 37.12, so far in use, are supplemented by the structural steel qualities St 44.12 and St 55.12 (and by the commercial structural steel quality St 00. Ha for structures). The good results obtained, caused the permissible stresses to be considerably increased in comparison to those of the aforesaid "Directions". It may be mentioned, inter alia, that for bridges the permissible compressive stress of the welded seam has been raised to 1.00 σ_{zul}, and the corresponding permissible tensile stress to 0.80 σ_{zul}.

Strict rules and regulations concerning the structural arrangement, the workshop equipment, supervision of the welders and the welds, and examination of the welders are intending to eliminate all sources of uncertainty.

The following review illustrates the advancement of welding in the various types of steel structures in Austria.

The railway bridge for hauling service of the Elin. A.G. in Weiz, erected in 1929, ranks among the oldest welded steel structures in Austria, and it is also the oldest welded railway bridge in Europe (Fig. 1). The cross sectional design

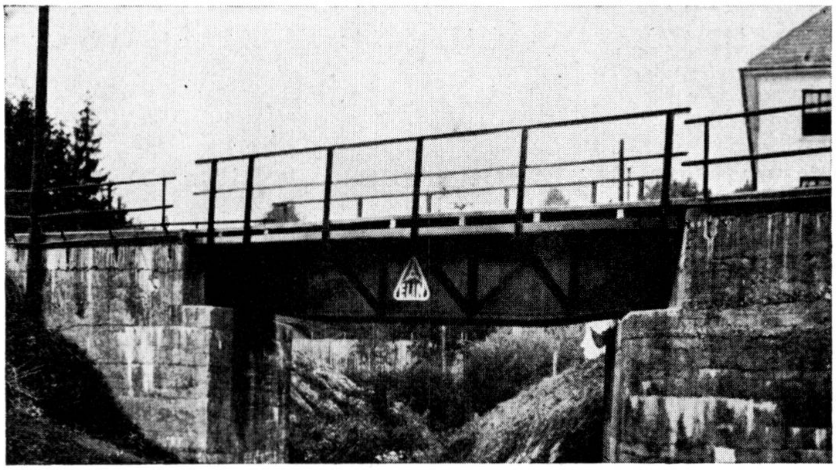

Fig. 1.
Electrically welded railway bridge at Weiz.

of the web-plate girders of 9.7 m span still remained exactly the same as that of the riveted plate girders. Rupture tests of an electrically welded plate girder of 4.80 m span and similar cross section as the main girder of the bridge (web-plate flange angle and flange plates), besides numerous tension-and bending tests, provided the Railway Authorities with the data for their specifications.

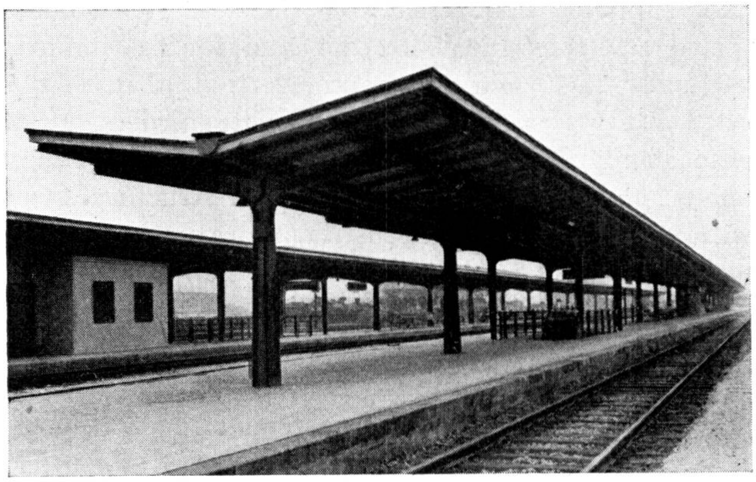

Fig. 2.
Platform roofs of the Graz Railway Station.

In the following year the Austrian State Railways constructed *the platform roofs at the main station in Graz* (Fig. 2) as welded steel structures, exhibiting already all the features of recent welding technique. The frames, mostly single-pillared, composed of plates and flange plates, carry rolled joist purlins.

The same can be said of the *Opera garage in Graz,* the roof trusses of which consist of electrically welded plate girders (Fig. 3).

Fig. 3.
Opera House Garage in Graz.

The large tank for molasses of the distillery and refinery of Messrs. G. & W. Löw at Angern near Vienna, erected also in 1930, arc welded in its essential parts, ranked, at the time, among the most important welded tanks so far

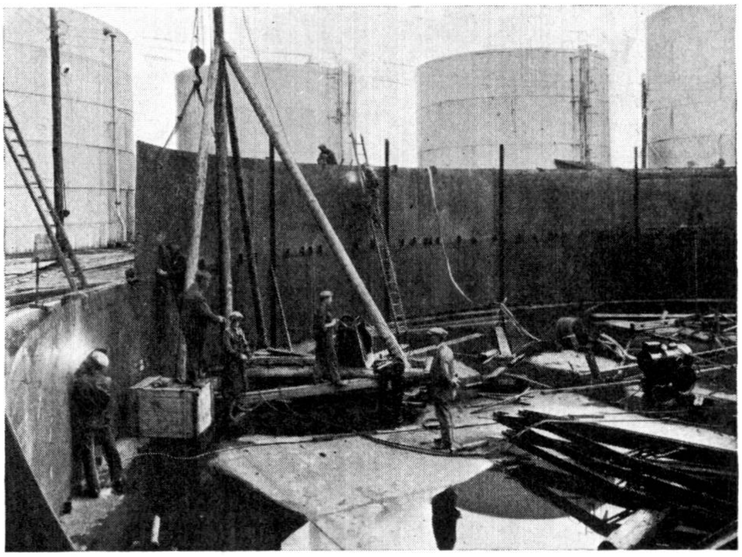

Fig. 4.
Molasses-Container of the Refinery and Spirit Factory G. and W. Löw at Angern near Vienna.

constructed (Fig. 4). Its diameter is 28.5 m, its cylindric height 11,17 m and its capacity 7.100 m³. This structure is interesting in many respects. The carrying capacity of the ground being small — the safe ground pressure amounting to barely 1 kg/cm² — local settlement had to be expected. The top layer of soil, to a depth of 2 m, was removed and the tank set up on a concrete base, 22 cm thick, made waterproof with asphalt board. This concrete slab was merely intended to prevent the soil moisture from reaching the steel floor. In spite of the very bad condition of the ground, a stronger foundation was unnecessary, because the tank is capable of standing, without risk, any additional stresses which are liable to result from irregular settlement. The vertical

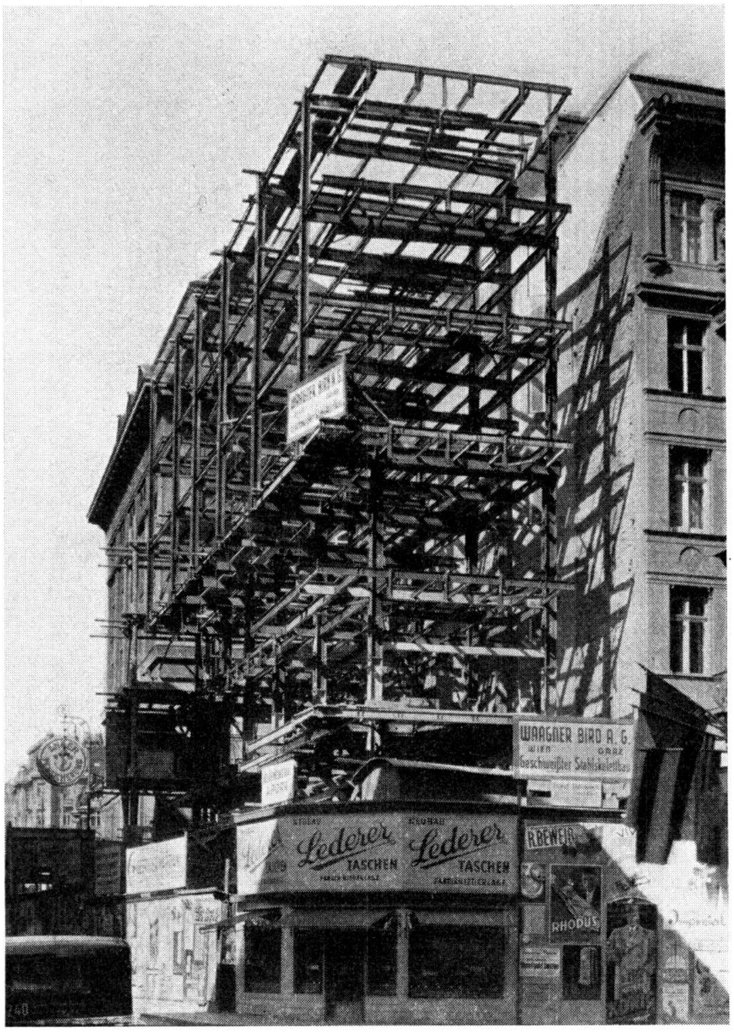

Fig. 5.
Steel skeleton construction at the Lichtensteg in Vienna.

seams of the casing were of the "V" type, the root side being cleared and covered with a strip. Numerous, carefully performed resistance tests showed this type of welding joint to be stronger than others. The choice of this joint, instead of uncovered "V"seams enabled the casing to be constructed of thinner plates, representing a saving of 12 per cent in weight, as compared with butt-welded plates. The tightness tests on the finished tank turned out very well. The work, including designing, preliminary tests und the supply of material, took only 3 months to complete, so that in the case of this large tank, welding proved to be of the greatest advantage, not only with respect to economy but also as regards rapidity of construction.

The first all welded hight-storied steel framework in Austria was erected in autumn 1935 in the Rotenturmstrasse — Lichtensteg — Rothgasse block, Vienna I (Fig. 5). The economical use of the building site (4.8 × 24.0 m), narrowed to an unusual extent by the prescribed street frontage line, could be effected only by using steel. The four lower stories (intended for commercial premises) have an effective depth (from front to back) of 4.8 m, the three upper (residential) stories overhang the building line on the long side of the building by about 2.0 m. The steel skeleton consists of 6 stiff frames which also have to take the wind load. The transoms are passed through the verticals, which are formed of two channel sections, and fixed by inserting steel wedges. The wall girders and floor joists are bolted to these frames in the usual way. The hourdis plates laid on the floor joists are secured against slipping by a layer of concrete, 3 cm thick. The construction and assembly of all detail parts is thoroughly up-to-date. The erection of the whole seven-story steel framework was completed in less than 3 weeks, in spite of the unfavourable and cramped conditions at the building site. The work was designed by Baurat h. c. Dr.-Ing. Friedrich Bleich and carried out by the Waagner-Biro A.G.

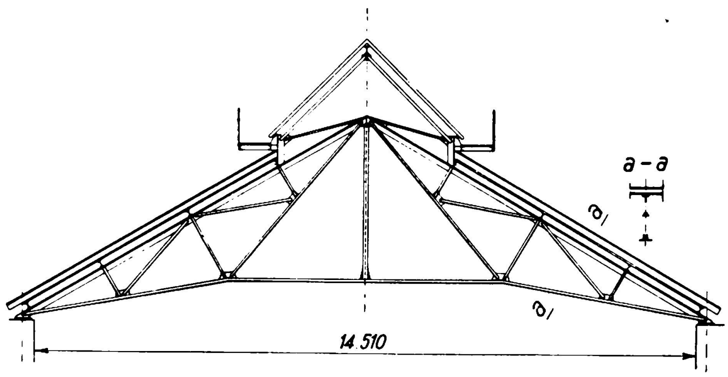

Fig. 6.
Roof construction for the Power Station Engerthstrasse of the Municipal Electric Works, Vienna.

Roof trusses of halls have been welded also. At the *construction of a roof for the Engerthstrasse Power-house* for the Vienna Municipal Electricity Works triple Wiegmann-Polonceau roof trusses of about 15 m span were used, the compression booms of which consist of halved broad flange I beams, the other members of angle-iron. Gusset plates serve to connect the angle braces to the lower booms (Fig. 6).

In the building of transmission lines, important steel structures, such as the 18.5 m high *suspension and angle masts at Ebenfurth*, have likewise been welded. The separate latticed lengths of mast were welded at the workshop and bolted together at the site.

In the erection of open-air stations the opportunity of welding the necessary frames has also been afforded.

Not only in structural work, but also in bridge building, welding was successfully introduced in 1930.

Six identical bridges of 21.0 m span with welded web-plate girders and roadway on bottom boom, cross the head water channel of the *Mixnitz power-house on the Mur in Styria.* The main girders consist solely of web-and flange plates; the skeleton of the roadway is built of rolled joists. The joints are covered by welded butt straps.

The road bridge over the Mur at Kalsdorf, finished last year, seems worthy of special mention (Fig. 7); its attractive appearance can be attributed not only

Fig. 7.
Road bridge over the Mur near Kalsdorf.

to the use of continuous girders (over two spans of 38.5 m each), but especially also to the use of welding.

In distinction to this bridge, which, for a width between parapets of 7.20 m, has only two main girders, *the road bridge over the Kainach at Zwaring* (built in 1936), with a span of 31.0 m and a width between parapets of only 6.0 m. has five welded main girders. This type of structure was influenced by the very low structural height, which amounted to only 0.8 m above the abutments and 1.1 m at the centre of the bridge.

The Maut bridge at Aussee, likewise a welded plain-web girder bridge, with a span of 22.0 m, roadway above, and a width between parapets of 7.9 m, has six welded main girders. The permissible girder depth above the abutments was only 0.51 m and that at the centre of the bridge only 0.76 m.

Mention may finally be made of three more large road bridges which are still under construction at present. Design and erection are already arranged for in accordance with the Standards soon to be published.

The road bridge over the Murz at Wartberg will consist of curved booms with plain-web stiffening girders. The span measures 44.4 m and the working

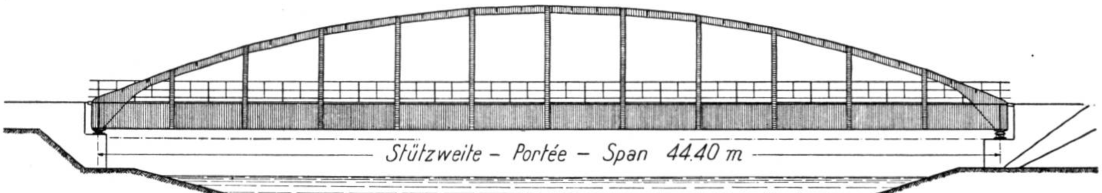

Fig. 8.
Road bridge over the Mürz in Wartberg.

width 8.5 m (Fig. 8). The main and transverse girders are welded throughout; the roadway is carried by longitudinal rolled beams.

The road bridge over the Traun at Steeg (Fig. 9) will be constructed of welded plain-web girders, continuous over 3 spans (36.0 m + 42.0 m + 36.0 m, width between parapets 6.5 m).

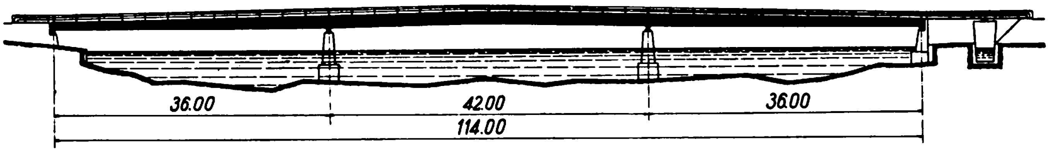

Fig. 9.
Road bridge over the Traun in Steeg.

The Hundsdorf bridge will cross the *Casteiner Ache* at an angle of 71^0 and with a span of 24.0 m. The five main girders are to be delivered, thoroughly welded, at the site and placed there with a spacing of 1.5 m apart. The cross bracings will be attached by riveting.

The bridges mentioned testify to the rapid development of welding in the construction of road bridges, and the increasing confidence in this method of construction.

Accordingly, welded-steel construction in Austria is now competing seriously with riveted work. Which method of construction is to be considered in any given case must, as a rule, be decided upon from the standpoint of economy.

The application of welding in steel construction work will be greatly promoted by the provision of sections, specially adapted for welding. Arc-welding for highly stressed steel structures also requires specially adapted welding wire, as a condition precedent. It is still imperative that all welding work, so far as possible, be carried out in the workshop, and welding at the site be restricted to the limit of absolute necessity.

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