WELDED BRIDGES

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(In Abstract)[1]

This paper reviews the welded bridges constructed in the United States, Canada and various foreign countries, and various practices in specifying steel materials, details of design, and method of construction; also the results of some German fatigue tests of welded beams, and some fatigue practices in girders and stringers of riveted bridges and the repairs that were made by welding.

Some 70 welded railway and highway bridges have been built in the United States and Canada from 1926 to date, several of them longer than 1,500 ft., involving fabricated plate girder and truss spans up to about 180 ft. between piers, and rigid frame spans of nearly 100 ft. Many smaller bridges have been welded. American railways as well as highway departments have used welding extensively in bridge repair and strengthening work, often under more difficult conditions than are encountered in new construction.

A recent tabulation of welded bridge projects on the Connecticut State highway system shows 17 welded bridges completed from 1939 through the first six months of 1948, four more under construction, and four other projects designed, making a total of 25 welded bridge projects, involving span lengths up to the 170-ft. middle span of the Jordan Lane viaduct. All of these structures are of girder or rigid-frame type construction.

It is reported that welded construction was adopted in Connecticut because of economic and architectural advantages, the latter being given special consideration by the bridge architect for the bridges on the Merritt and Wilbur Cross Parkways. Previous experience in constructing ten welded bridges in Connecticut had shown substantial savings. Systematic inspection of these structures, conducted over a period of nine years, has revealed no defects. Welding has provided a convenient solution to a good many special details arising from extreme skews, clearance requirements and superelevation on horizontal curves combined with vertical curvature.

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The State Highway Commission of Kansas has two welded, continuous, built-up girder bridges under construction as Federal Aid Projects, with middle spans of 108 ft.; and they have another welded girder bridge designed with 130-ft. spans. This state, like many others, such as Ohio and New York, has used welding extensively for details of continuous rolled beam spans and other types of steel bridges during the last 15 years, up to the time when federal aid could be applied to larger, all-welded, built-up girder bridges with welded field splices.

A list of some of the outstanding welded girder and truss type bridge projects in the United States, constructed from 1926 to 1941, may be found on pages 1288 and 1289 of the 1942 edition of the *Welding Handbook* of the *American Welding Society*. The longest all-welded truss span among these bridges is the 160-ft. span of the Riverside and Delanco, N. J. highway swing bridge built in 1935. There are also two bascule girder bridges, one built in 1935 at Jupiter, Florida, for main line traffic of the Florida East Coast R.R., and the other, a highway bridge between St. Petersburg, Florida, and Treasure Island, built in 1939.

An interesting bridge recently constructed at White City, Florida is a vertical lift span that carries highway traffic on State Route 71 across the Intracoastal Waterway.

The Public Roads Administration has now extended approval for welding in Federal aid bridge construction to include main members such as fabricated plate girders and shop and field splices in their elements.

Welded bridge construction has been extensively used in Europe, several hundred having been built in Germany alone. No difficulties have been reported for the bridges that have been built of their so-called "Martin" open-hearth, killed steel. In a few of the Belgian and German bridges built some ten years ago, the use of the then prevailing grade of Thomas (Bessemer type) steel, accompanied by some unfavorable details of design and construction procedures, resulted in serious difficulties. The Thomas

basic Bessemer steel that was used for some of the earlier welded bridges in Europe was frequently of the rimming type and of low notch toughness, and also susceptible to serious strain age embrittlement.

The causes of the difficulties, with respect to steel materials as well as details of design and workmanship, have been recognized and corrected through research and experience, and this work and study are reflected now in specification provisions.

The essential provisions of the American Welding Society specifications for welded bridges have been adopted widely by states and municipalities.

Welded girder bridges have now been built with individual span-lengths greater than 200 ft. Welded through-arch bridges have been built with spans up to 340 ft., welded deck-arches up to at least a 269 ft. span-length, and welded truss spans up to 438 ft. These bridges have made use of single thicknesses of material up to at least 3 in.

For the vast majority of bridges of the usual sizes and types as constructed for highway and railway service, welded construction has now been placed upon a basis of sound engineering control throughout most of the countries of the world, with a long background of experience, which enables such construction to be carried out in a satisfactory and economical manner.

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