

The Whipple Truss and the Wrought Iron Bridge Company

The Whipple Truss: In 1847, the Whipple truss was patented by Squire Whipple, a prominent 19th century civil engineer and inventor from Worcester County, Massachusetts. Whipple built some of the earliest all-iron bridges in the Nation over the Erie Canal, in New York State. He also did design work for several early railroads, where he encountered a key problem – how to design long span iron bridges that could support the heavy live loads imposed by steam locomotives. He solved the problem with the invention of a new truss that was named after him.

The Whipple truss was one of many design configurations for all-metal bridges that emerged during the course of the 19th century. Previously in the 18th century, cast iron as a structural material came into general use, and by the end of the century, wrought iron was also being used in structural applications. In the early 19th century, engineers began to design and build bridges with various combinations of iron and wood, as well as both cast and wrought iron. These advancements led to the development of new bridge superstructure configurations, of which the Pratt truss, patented in 1844, was the most important.

Squire Whipple's new truss was a modification of the Pratt truss. Also known as the Double Intersection Pratt truss, its diagonal tension members crossed two panels, while those of a Pratt truss crossed one panel only. This allowed a bridge's trusses to be higher while maintaining the rigidity of its individual panels, thus increasing load bearing capacity and span length. The Whipple truss was improved in 1863 by John W. Murphy, Chief Engineer of the Lehigh Valley Railroad, who modified Whipple's configuration through the addition of crossed diagonals.



Pratt Truss



Double Intersection Pratt Truss

(Source: PHMC and PennDOT 1986)

Whipple trusses immediately became popular for long-span railroad bridges, as Squire Whipple had intended. In 1852, Whipple himself erected the first truss that bears his name for the Rensselaer & Saratoga Railroad, which ran from Troy to Ballston Spa in upstate New York. Soon, Whipple trusses were also being used for long-span highway bridges. Most commonly, they were built in the trapezoidal configuration with straight top and bottom chords, and with odd numbers of panels. One highly unusual variation was the “Triple Whipple”, with diagonal members that crossed three panels rather than two.

During the latter half of the 19th century, Whipple truss railroad and highway bridges were erected throughout the United States and Canada. However, it was the railroads that built its most impressive examples, crossing the great rivers of the continent's interior. An example was the Blair Crossing Bridge over the Missouri River in Blair, Nebraska. Built in 1883 by the Sioux City & Pacific Railroad, the Blair Bridge was composed of three 330 foot Whipple trusses supported 50 feet above the river on massive stone masonry piers and abutments. In Canada, the Prince of Wales Bridge carried the Canadian Pacific Railroad over the Ottawa River. It was composed of 13 Whipple trusses and was 2,225 feet long.



Blair Railroad Bridge (Source: HAER, NE-7-1)

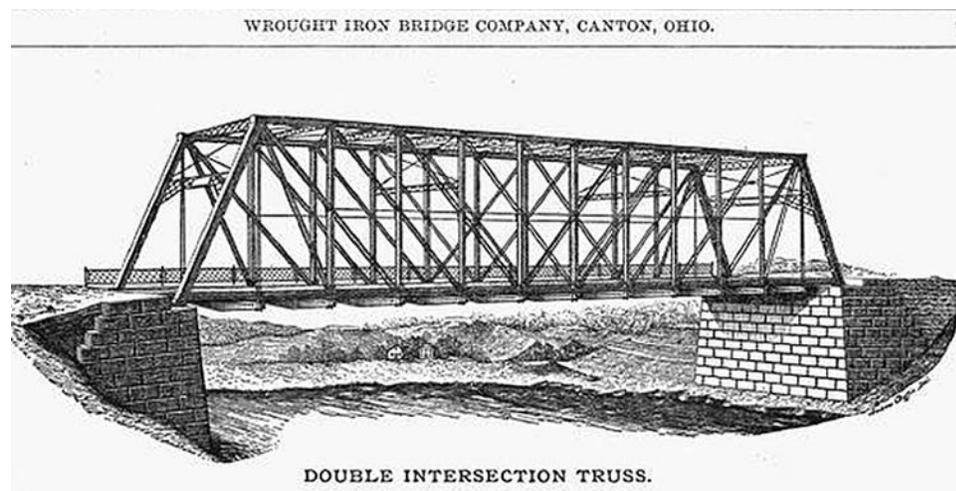
But as the end of the 19th century approached, the Whipple truss gradually fell out of use as other modified Pratt truss designs, including the Baltimore and Pennsylvania (Petit), were developed. By the second decade of the 20th century, the design was effectively obsolete.

The Wrought Iron Bridge Company: As the Whipple truss was gaining popularity, bridge building companies multiplied and expanded their operations. One such was the Wrought Iron Bridge Company of Canton, Ohio. The company was founded in 1864 by David Hammond, and was incorporated in 1871. Although one of the largest, the company was but one of dozens of such firms that capitalized on the market for replacing the country's many deteriorating wooden highway bridges, and for building new ones for the ever expanding highway and railroad networks. A Wrought Iron Bridge Company catalogue of highway bridge offerings published in 1882 indicated that the firm had by that date produced nearly 4800 spans ranging in length from 20 to 300 feet. They also pioneered materials testing to determine the strength and quality of the components used in their bridges, and manufactured bridge components in their factory using high-quality wrought iron. Once the parts were manufactured, they were transported by rail to

the site where trained bridge builders erected the structures. Their 1882 catalogue offered numerous highway bridge engineering designs and a number of options on transport, assembly, and painting.

Whipple trusses figured prominently in the Wrought Iron Bridge Company's 1882 catalogue. Describing their illustrated "Double Intersection Truss", they wrote:

This plan is designed for spans of 135 to 276 feet, and is also specially adapted to spans of 100 to 135 feet with wide or double roadways for heavy traffic where deep girders are desirable to avoid a squatty end view. We have built over three hundred spans on this plan over the past nine years, for every kind of highway and railway work, and can guarantee satisfaction with it in every requirement of a first-class highway bridge.



Wrought Iron Bridge Company Illustration (Source: Stewart 1882)

Interestingly, the cover of their 1882 catalogue illustrates a "Triple Whipple" truss highway bridge over Laughery Creek near Aurora, Indiana. Of this bridge type, they wrote:

For spans of 275 to 325 feet, we build the Triple Intersection Truss, an example of which is shown on page 1, which was built by us in 1878, and is the *longest Highway truss span* in the United States, and unequalled in strength, stiffness, and economy of construction.

The Wrought Iron Bridge Company's Laughery Creek "Triple Whipple" is still standing, now renovated for pedestrian use. It is listed in the National Register of Historic Places, and is the only example of its type still in existence.



Laughery Creek Highway Bridge (Source: HAER, IN-16-2)

The Cast Iron Bridge Company also built Whipple truss highway bridges in Pennsylvania. Notable among these was the Emlenton Bridge across Allegheny River in Emlenton Borough, Venango County. The company erected this two span 225 foot long Whipple truss bridge in 1883. It was featured in the Pennsylvania Historical and Museum Commission's 1986 *Historic Highway Bridges in Pennsylvania*, but was demolished and replaced in 1988. Another notable Pennsylvania Whipple truss highway bridge is the Millers Station Bridge in Rockdale Township, Crawford County. This 136 foot span crosses French Creek, and was erected by the Wrought Iron Bridge Company in 1887. It was listed in the National Register in 1988.



Millers Station Highway Bridge (Source: A&HC 2010)

At the time of Pennsylvania's historic bridge survey in 1999, only ten Whipple truss highway bridges were still standing within the borders of the Commonwealth. Of these, three were built by the Wrought Iron Bridge Company, more than any other builder. One of the three Wrought Iron Bridge Company Whipple trusses was the above mentioned Millers Station Bridge. Another was the 153 foot single span Kralltown Road Bridge over Bermudian Creek in Washington Township, York County, built in 1884. Like the Millers Station Bridge, the Kralltown Road Bridge was listed in the National Register in 1988. The third surviving Wrought Iron Bridge Company Whipple truss was the 186 foot long bridge that carries Sheep Bridge Road over Conewago Creek in Newberry Township, York County, which they erected in 1889. This bridge was determined to be eligible for listing in the National Register in 2001.

Like the Whipple truss, wrought iron bridges soon became obsolete. In the 1890s, bridge companies increasingly constructed bridges of steel. Although they were by then building steel bridges, the Wrought Iron Bridge Company retained its original name until 1900, when it was purchased along with 27 other major iron and steel construction companies and consolidated into the American Bridge Company. The deal was master-minded by J. P. Morgan. In 1901, the American Bridge Company became a subsidiary of the newly-formed national trust, U.S. Steel, where it remained for most of the remainder of the 20th century.

Today, 19th century through truss metal bridges are becoming increasingly rare, as deterioration and obsolescence take their toll. Of the three Wrought Iron Bridge Company Whipple truss highway bridges that still remained within Pennsylvania's borders in 1999, one (the Krallton Road Bridge) has been demolished and replaced, another (Sheep Bridge Road over Conewago Creek) has been rehabilitated and remains in service, while the third (the Millers Station Bridge) is open to traffic but is scheduled for demolition and replacement in 2011. The seven other Whipple truss bridges that were then extant have fared little better. Five are still in service but are in poor structural condition, two have been bypassed and are permanently closed to traffic, and one is closed to traffic and scheduled for demolition and replacement.

Although they are deteriorating and most, in all likelihood, will eventually be lost, Pennsylvania's wrought iron Whipple truss highway bridges have served the traveling public for nearly a century and a half. They stand witness to the durability of wrought iron as a structural material, and to the ingenuity and dedication of the men who designed and built them.

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