Gustav Lindenthal

By Frank Griggs, Jr., Ph.D., P.E., P.L.S.

Gustav Lindenthal.

Gustav Lindenthal was one of the premier bridge builders in the United States between 1877 and 1935. He was born in Bruun, Austria May 24, 1850 and attended classes at the Provincial College of Brunn and the polytechnical schools of Brunn and Vienna before beginning his engineering career on the Austrian Empress Elizabeth Railroad in 1870. He moved to Vienna in 1872 as an Assistant Engineer for the Union-Baugesellschaft. He immigrated to the United States in 1874, where he anticipated greater opportunities. Finding no work in New York, he went to Philadelphia looking for a job in the construction of buildings for the Centennial Exposition. After working as a mason, he was moved up to draftsman and later engineer on design and construction of several of the main buildings.

He then went to Pittsburgh where he worked for three years with the Keystone Bridge Company. In 1879, he started a two-year employment with the Atlantic and Great Western Railroad. One of his biographies indicates that he "reconstructed or strengthened some hundred old bridges and built at least a half a hundred new iron bridges throughout the Middle West."

In 1881, Lindenthal went into business on his own as a consulting engineer in the Pittsburgh area. He built four major bridges in the area over the next several years. The Herr's Island, 30th Street, Bridge was his first chance to apply the continuous bridge principle. He next replaced John A. Roebling's Smithfield Street Suspension Bridge over the Monongahela River. For his channel spans, Gustav chose Pauli (lenticular) Trusses. This was the first long span bridge of this type built in the United States. His bridge opened in 1883 and still spans the Monongahela River. A parallel span was added, with a new portal, in 1891.

He next showed his versatility in building a suspension bridge over the Youghiogheny River at McKeesport (1883). The Seventh Avenue Bridge that opened in 1884 over the Allegheny River was an eye bar braced chain bridge over three river piers, with the two central spans being 330 feet.

In 1885, he was asked to prepare a plan to carry Pennsylvania Railroad tracks across the Hudson River from New Jersey into lower Manhattan. Lindenthal surveyed the river and later wrote, "The great railroad bridge over the Firth of Forth in Scotland was then under construction. The question was, could a similar bridge be built over the Hudson River?" In 1886, he presented a proposal for a four-track suspension bridge with a 3,000-foot central span. He estimated his bridge and Manhattan Terminal would cost approximately $22,000,000. The cost of his project was more than the Pennsylvania Railroad could support.

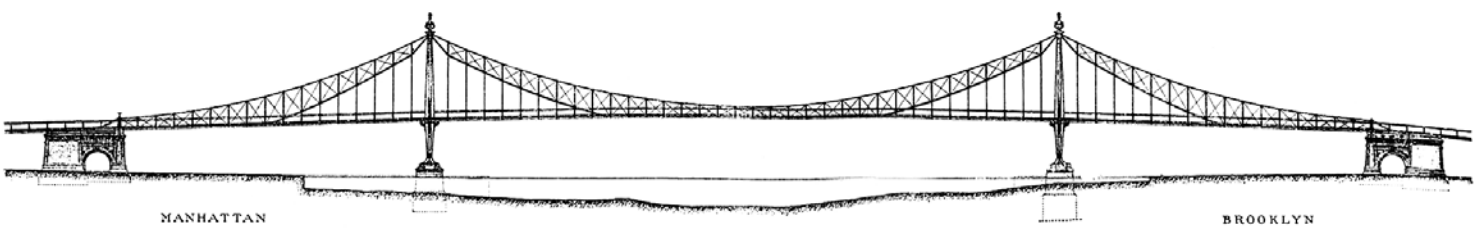
The *Engineering News* noted, "there is probably no one on either side of the ocean who could be counted on more confidently to deal successfully with the intricate engineering problems involved than Mr. Lindenthal. Certainly, no one of the eminent engineers who have already constructed great long span bridges could have been justly regarded as better equipped for his work at its inception." Lack of funding delayed the start of construction for another several years. Then the financial panic of 1893 to about 1900 and the bankruptcy of several railroads that signed onto the bridge, caused further delay.

In 1890, Gustav moved his office to New York City. In 1894-95, when the New York and New Jersey Bridge Company was proposing a competing 2,000-foot span cantilever bridge, and later a 3,000-foot span suspension bridge by T. C. Clarke and Charles Macdonald across the Hudson River, he revived interest in his bridge. Neither bridge company was able to raise funds to build their bridges during the economic downturn that took place between 1893 and 1900.

In 1898, he was asked by the Phoenix Bridge Company to prepare an estimate and design for a wire link, braced chain suspension bridge for the proposed Quebec Bridge across the St. Lawrence River. Theodore Cooper was selected to review the plans. Cooper met with Lindenthal and John Sterling Deans, Chief Engineer of the Phoenix Bridge Company, to discuss Lindenthal's/Phoenix Bridge's suspension bridge design. Cooper indicated, "he would not give Mr. Lindenthal's plan careful and detailed consideration due his estimated cost." Cooper recommended the cantilever proposal of the Phoenix Bridge Company "as the 'best and cheapest' plan and proposal of those submitted to me..." Construction started in July 1905. The bridge collapsed during construction on August 28, 1907, killing 75 men.

In 1902, Lindenthal was appointed New York City Bridge Commissioner. At that time the Williamsburg Bridge was under construction, the foundations were under contract on the Blackwell's Island Bridge and the design of the Manhattan Bridge was well along. The next two years were tumultuous ones for Lindenthal, as he was at odds with Leffert L. Buck, Richard S. Buck, O. F. Nichols, Wilhelm Hildenbrand, Washington and Charles Roebling, etc.

He greatly modified the design of the Blackwell's Island Bridge, changing it from a conventional cantilever with suspended spans to one with no suspended spans making it fully continuous under live loads. The Mayor called in a special panel of engineers to report on his proposed changes. The panel compared the earlier design of R. S. Buck and Lindenthal's, and came up with a design of its own which was accepted. The bridge opened in 1909 after many delays.



Lindenthal's Manhattan Bridge Design.

When Lindenthal came into office, the Manhattan Bridge had been designed and was under construction. However, he determined "the original design made by the department engineers was unattractive in appearance, and devoid of a definite outline and expression of purpose." Lindenthal changed the towers from three-dimensional to ones pinned at the base, changed the anchorages and substituted a chain of nickel steel eye bars for the wire cables of Buck.

Mayor Seth Low called in a panel of prominent engineers to report on the changes. The panel made its final report on June 29, 1903. It determined that the "design contains three features which, though not properly novel, are departures from the common practices with suspension bridges; they are the cables, the stiffening trusses and the metal towers, each of which may be considered by itself" and approved all three. Despite support of Mayor Low the necessary funds were not approved by the Board of Aldermen. He also attempted to modify the design of L. L. Buck's Williamsburg Bridge, but was not successful.

In January 1904, Gustav returned as Consulting Engineer and Architect to the Pennsylvania Railroad and a plan for the New York Connecting Railroad to link New York City and the Pennsylvania Railroads with New England via the New York, New Haven & Hartford Railroad. While working on this project, he also designed the replacement bridge for C. Shaler Smith's Kentucky High Bridge originally built in 1877. The railroad was looking for a bridge to go across the Kentucky River with two tracks on a much higher elevation than existed. His replacement bridge, built around Smith's bridge, was constructed in 1910-1911 without stopping traffic on the old bridge.

While working on the Kentucky River Bridge, Lindenthal continued work on the New York Connecting Railroad. The largest of three bridges on the connection was the Hell Gate Bridge. He looked into several designs before arriving at the style he considered most economical for the site, finally choosing a spandrel arch. In June 1907 *Scientific American* was running articles on the bridge with the headline "The Largest Arch Bridge in the World." *The Engineering Record* wrote, "Besides planning a bridge of ample strength, the company has endeavored to make it a thing of beauty…Mr. Lindenthal's conception is that of an imposing portal, or gateway…just as the Brooklyn Bridge forms a gateway from the harbor." His design made it the longest and most heavily loaded railroad bridge in the world when it opened in 1916.

While working on the Connecting Railroad and its bridges, Lindenthal designed the Sciotoville Bridge over the Ohio River. He looked at all types of bridges that had been used to carry heavy railroad loadings over long spans. He determined that a continuous truss with two spans of 775 feet best met the site conditions. With the help of Ammann and D. B. Steinman it was, in 1916 when opened, the longest continuous riveted span in the United States. It continues to serve the Chesapeake and Ohio Railroad.

Sciotoville Bridge.

In 1920, Gustav revived the North River Bridge Company and, with the assistance of his longtime assistant Othmar Amman, he designed a massive suspension bridge at 57th Street in Manhattan. His new bridge carried 16 lanes of traffic, four rapid transit lines on the top deck and two promenades. The lower deck had 12 tracks for railroads and rapid transit.

The bridge maintained its 3,240-foot central span, with flanking spans of 1,590 feet and 825-foot tall towers. He estimated the project could be built for $100,000,000. Once again, he did not get the backing of the railroads or city officials to build his bridge.

In 1922-23, Lindenthal was called to the Portland, Oregon area to review designs of the Sellwood, Ross Island and Burnside Bridges. He modified the designs of all three bridges, making the first two continuous trusses. Ammann was Lindenthal's chief assistant on these bridges. For the Sellwood Bridge over the Willamette River, he used 246-foot spans flanking 300-foot central spans. The bridge opened December 15, 1925. The Ross Island Bridge also spanning the Willamette River, was significantly different than the Sellwood Bridge. The central span was 535 feet with the two flanking spans of 321 feet. It opened December 1, 1926. The Burnside Bridge had two 268-foot steel flanking spans and a 252-foot double-leaf Strauss bascule draw span. It opened May 28, 1926 and is currently undergoing restoration.

Ammann returned to New York in early 1923 and sensed Lindenthal's insistence on a North River Bridge of his design, especially with a large commitment to the railroads, was placing the entire project in jeopardy. After unsuccessfully urging Lindenthal to scale back his project, Ammann decided to prepare a design of his own and submit it to the Governor of New Jersey. The Governor submitted it to *The Engineering Record*, which published it with a small drawing and brief description in the January 3, 1924 issue. The article mentioned the drawings were by Ammann and the bridge was estimated to cost $30,000,000. Ammann's George Washington Bridge was completed and opened October 24, 1931 in a grand ceremony, with Lindenthal riding in the dedication parade with Ammann.

Lindenthal was awarded the first Thomas Fitch Rowland Prize by ASCE in 1883 for his paper on the Monongahela Bridge replacement and again in 1922 for his paper on the Sciotoville Bridge. He was made an honorary member of ASCE in 1929. His memoir in the *Transactions of the ASCE* stated:

"It was often said of Mr. Lindenthal, during his lifetime and with truth, that he never built two bridges alike…An innate love of beauty in engineering works went hand in hand with this seeking for the structurally best form. In part it seemed to spring from a conviction that a form satisfying the eye will also satisfy the demands of strength…"

He was described as "big and broad-shouldered with deep-set, blue twinkling eyes and iron gray hair and bushy beard. He is genial and good tempered in his moments of relaxation from the tremendous problems he wraps himself up in." He died July 31, 1935 at the age of 86 at his Metuchen, New Jersey home.▪

Dr. Griggs specializes in the restoration of historic bridges, having restored many 19th Century cast and wrought iron bridges. He was formerly Director of Historic Bridge Programs for Clough, Harbour & Associates LLP in Albany NY, and is now an independent Consulting Engineer. Dr. Griggs can be reached via email at ***fgriggs@nycap.rr.com****.*