CHICAGO & NORTH WESTERN RAILWAY, KINZIE STREET BRIDGE
Chicago Bridges Recording Project
Spanning N. Branch of Chicago River, S. of Kinzie St.
Chicago
Cook County
Illinois

HAER No. IL-142

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C St. NW
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CHICAGO & NORTH WESTERN RAILWAY, KINZIE STREET BRIDGE*

HAER No. IL-142

Location:	Spanning N. Branch of Chicago River, S. of Kinzie St., Chicago, Cook County, Illinois.
USGS Quadrangle:	Chicago Loop, Illinois (7.5-minute series).
UTM Coordinates:	16/446985/4637360
Dates of Construction:	1907-1908.
Designers:	William H. Finley, Assistant Chief Engineer of the Chicago & North Western Railway (Chicago), substructure; Strauss Bascule & Concrete Bridge Co. (Chicago), superstructure.
Fabricator:	Toledo-Massillon Bridge Co. (Toledo, Ohio).
Builders:	Great Lakes Dredge & Dock Co. (Chicago), substructure; Kelly-Atkinson Construction Co. (Chicago), superstructure.
Present Owner:	Union Pacific Railroad (Omaha, Nebraska).
Present Use:	Railroad bridge.
Significance:	The Kinzie Street Bridge occupies the site of Chicago's first railroad bridge (1852), and also the nation's first all-steel railroad bridge (1879). The line served Wells Street Station and industries in the Near North Side, contributing much to that area's development. The present structure is an overhead-counterweight bascule bridge based on the patents of Joseph B. Strauss, and was the world's longest and heaviest bascule leaf at the time of its completion. This is a particularly unusual example of its type because certain elements foreshadow Strauss' subsequent development of a heel-trunnion design for long bascule spans.
Historian:	Justin M. Spivey, January 2001.

* Throughout this report, "Kinzie Street Bridge" refers to the railroad bridge located just south of Kinzie Street, as opposed to the roadway bridge carrying Kinzie Street itself.

Project Description: The Chicago Bridges Recording Project was sponsored during the summer of 1999 by HABS/HAER under the general direction of E. Blaine Cliver, Chief; the City of Chicago, Richard M. Daley, Mayor; the Chicago Department of Transportation, Thomas R. Walker, Commissioner, and S. L. Kaderbek, Chief Engineer, Bureau of Bridges and Transit. The field work, measured drawings, historical reports, and photographs were prepared under the direction of Eric N. DeLony, Chief of HAER.

CHRONOLOGY

25 Oct. 1848	Galena & Chicago Union Railroad (G&CU) begins operating trains from station on west bank of North Branch of Chicago River.
1852	G&CU extends line eastward, crossing North Branch of Chicago River on pontoon bridge to serve new Wells Street Station on east bank.
1861	G&CU extends line further eastward, to Ogden Slip and North Pier.
1864	Chicago & North Western Railway (C&NW) absorbs G&CU.
1879	C&NW constructs a swing bridge, among the first all-steel spans in the U.S., at Kinzie Street crossing.
1897	U.S. Army Corps of Engineers survey of Chicago River notes that Kinzie Street Bridge is an obstacle to navigation.
14 Mar. 1898	Another swing bridge, replacing 1879 span, opens to traffic.
Circa 1905	U.S. Secretary of War orders removal of Kinzie Street Bridge.
11 Oct. 1906	U.S. Secretary of War approves new C&NW bridge at Kinzie Street.
17 Dec. 1906	City of Chicago approves new C&NW passenger terminal on west bank.
26 Dec. 1907	Construction begins on new Strauss overhead-counterweight bascule span at Kinzie Street.
19 Sep. 1908	C&NW places new Kinzie Street Bridge in service.
4 June 1911	First train arrives at new C&NW passenger terminal on west bank; Kinzie Street Bridge relegated to freight traffic.
1995	Union Pacific Railroad (UP) absorbs C&NW.

Introduction

If there is one continuous thread in the history of Chicago's Kinzie Street railroad bridge, it is William B. Ogden (1805-1877), an archetypical nineteenth-century "booster" and a recurring figure in the city's early history. Indeed, Ogden seems almost omnipresent in Chicago after his arrival in June 1835: selling real estate, contracting on the Illinois & Michigan Canal, presiding over the first successful railroad — not to mention serving as the city's first mayor. His ceaseless promotion of "public improvements" undoubtedly raised land values (among his own holdings if not elsewhere). One biography endows him with earth-moving omnipotence: "He made many rough places smooth, and the crooked ways straight."[1] Beyond city limits, Ogden's grandest achievements were in developing the transportation arteries that helped fuel Chicago's spectacular growth during the mid-nineteenth century.

Interestingly, Ogden was involved in the early stages of all three railroads that have crossed the North Branch of the Chicago River near Kinzie Street. He seemed to specialize in jump-starting projects that had stalled for lack of investment. After helping to bring into being the long-envisioned canal linking the Lake Michigan and Mississippi River watersheds, Ogden turned to promoting railroads. His first such project was a railroad that had been chartered in 1836 to connect Chicago with the Mississippi River through the lead-mining region around Galena. According to railroad historian H. Roger Grant, the Galena & Chicago Union Railroad (G&CU) "seemed destined to remain a 'paper' project" until Ogden became its president in the late 1840s.[2] Under Ogden's leadership, the railroad ran its first train in 1848. Although it never reached Galena, the G&CU did become a successful link between Chicago and its western hinterlands. The G&CU was acquired in 1864 by another Ogden-promoted project, the Chicago & North Western Railway (C&NW). The C&NW's predecessor company had declared bankruptcy in 1859 and was reorganized with Ogden in charge. He brought success to the C&NW, which soon became one of the country's largest and most prosperous.[3] A third and final consolidation occurred well after Ogden's lifetime, but nonetheless bears the mark of his influence. The Union Pacific Railroad (UP), which acquired the C&NW during a time of late twentieth-century railroad mergers, can attribute its early success to Ogden's presidency during 1862 and 1863. According to Grant, "his presence gave considerable prestige to the project."[4]

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[1] Isaac N. Arnold and J. Young Scammon, *William B. Ogden,* Fergus Historical Series No. 17 (Chicago: Fergus Printing Co., 1882), 46.

[2] H. Roger Grant, "William Butler Ogden," in Robert L. Frey, ed., *Encyclopedia of American Business History and Biography: Railroads in the Nineteenth Century* (New York: Facts on File, 1988), 292.

[3] H. Roger Grant, "Chicago & North Western Railway," in Frey, *Railroads in the Nineteenth Century*, 43. For an extremely thorough bibliography of the railroad's first hundred years, see Helen R. Richardson, comp., *Chicago and North Western Railway Company: A Centennial Bibliography* (Washington, D.C.: Bureau of Railway Economics Library, 1948), Reference Collection, Chicago Historical Society, Chicago, Ill.

[4] Grant, "William Butler Ogden," 293.

When the UP opened to through traffic in mid-1868, Chicago had a continuous railroad connection between Kinzie Street and the Pacific coast, with the C&NW carrying traffic as far as Omaha. Chicago, a small town with 1,500 residents upon Ogden's arrival, had become a city of 200,000 and the rail hub of the North American continent.[5]

Although the G&CU and its successors are best known for their westward expansion, the Kinzie Street Bridge is the result of a small but significant eastward extension. When the first train ran on the G&CU in 1848, it departed from a station at Kinzie Street on the west bank of the Chicago River's North Branch. Although the heart of the city was on the east bank of the South Branch, the omission of a railroad bridge was hardly fatal at that time. Federally sponsored improvements to the Chicago River's mouth allowed lake-going ships to enter the river and connect with the railroad terminal. Moreover, some of Chicago's industries, the lumber trade in particular, were already moving to less expensive land on the west bank.[6] At any rate, the fledgling G&CU may not have been able to afford the expense of bridging the North Branch. The railroad's financial situation soon improved, however, and in 1852 trains began crossing a new pontoon bridge to a station at Wells Street. Although closer than the old Kinzie Street Station, the Wells Street Station was still separated from the central business district by the Chicago River's Main Branch. Nonetheless, the railroad's passenger service became highly successful, requiring several expansions of the station during the nineteenth century.[7]

The Kinzie Street Bridge also carried freight trains, fueling development on the Near North Side. A small industrial district began developing along the G&CU's tracks east of the North Branch, including warehouses and grain elevators constructed by the railroad in 1854.[8] As other railroads entered Chicago, the G&CU built tracks for interchange traffic and spurs to serve industry. In 1861, the railroad's annual report mentioned "new tracks in Chicago ... to accommodate the business of certain lumber yards in the city."[9] The new tracks included another eastward extension of the main line, serving Ogden Slip and terminating at a pier reaching into Lake Michigan (a predecessor of the current Navy Pier). The Illinois Central Railroad added a bridge across the Chicago River's mouth in the late nineteenth century, but when this was

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[5] This was due to "Chicago's location at the breaking point between eastern and western rail networks"; see William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W. W. Norton & Co., 1991), 83.

[6] Cronon, *Nature's Metropolis*, 175.

[7] See F. W. Hillman, "North Western Stations," *Journal of the Western Society of Engineers* 42, No. 3 (June 1937).

[8] Galena & Chicago Union Railroad Co., *Seventh Annual Report of the Galena and Chicago Union Railroad Company* (Chicago: Daily Democrat, 1854), 10, Special Collections, Regenstein Library, Univ. of Chicago, Chicago, Ill.

[9] Galena & Chicago Union Railroad Co., *Fifteenth Annual Report of the Galena and Chicago Union Railroad Company, Presented to the Stockholders for the Fiscal Year Ending December 31, 1861* (Chicago: Brewster, Pierce & Co., 1862), 18, Special Collections, Regenstein Library, Univ. of Chicago, Chicago, Ill.

demolished in 1904, the C&NW's Kinzie Street Bridge became once again the only railroad connection to the Near North Side.[10] By that time, the heavy demands placed on the Kinzie Street Bridge led the C&NW to re-design its entire Chicago terminal. A history of the Kinzie Street crossing will serve as an introduction to the current bridge, completed in 1908.

The Kinzie Street Crossing

The Kinzie Street crossing has been the site of many firsts. As Chicago expanded beyond the peninsula occupied by Fort Dearborn, the city constructed bridges over the Chicago River and its branches. According to the Chicago Department of Public Works, the first North Branch crossing was a pedestrian bridge constructed in 1832, "about where the present C. and N. W. Railway bridge is located, near Kinzie street."[11] Two decades later, the G&CU — Chicago's first railroad — crossed the North Branch on Chicago's first railroad bridge. Subsequent replacements of this structure included one of the nation's first all-steel railroad bridges in 1879, and the world's longest and heaviest bascule leaf at the time of its completion in 1908.

In its annual report of 1851, the G&CU's chief engineer reported that construction of a "Chicago extension" was in progress, including a drawbridge estimated to cost $20,000.[12] The line would cross the North Branch of the Chicago River to serve a new Wells Street Station closer to downtown. According to one company history, superintendent Jenks D. Perkins designed a "pontoon or floating bridge," completed in 1852.[13] This structure was not long-lived, however, if an 1857 map is to be believed. Cartographer James T. Palmatary's pictorial view of Chicago shows what is unmistakably a swing bridge at the Kinzie Street crossing.[14] Like contemporary bridges throughout Chicago and the nation, this swing span would have had wooden structural members, with iron used only for rails, fasteners, and perhaps tension rods.

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[10] The Illinois Central bridge's construction date could not be found; on its demolition, see U.S. Army, Corps of Engineers, *Annual Report of the Chief of Engineers to the Secretary of War for the Year 1905* (Washington, D.C.: U.S. Government Printing Office, 1906), 2:2072.

[11] Chicago Department of Public Works, *Seventh Annual Report* (1882), 41, Municipal Reference Collection, Chicago Public Library, Chicago, Ill.. This date is repeated in Alfred T. Andreas, *History of Chicago from the Earliest Period to the Present Time,* 3 vols. (Chicago: Alfred T. Andreas, 1884-86), 1:198. In their biography of Ogden, Arnold and Scammon noted, "He built, or caused to be, the first draw-bridge across the Chicago River...." Ogden did not arrive in Chicago until 1835, however, so this must refer to the Dearborn Street drawbridge; see Arnold and Scammon, *William B. Ogden,* 5, 44.

[12] Galena & Chicago Union Railroad Co., *Fourth Annual Report Read at the Annual Meeting of the Stockholders, June 4, 1851* (Chicago: Daily Democrat, 1851), 7-9, Special Collections, Regenstein Library, Univ. of Chicago, Chicago, Ill. The 1851 report was the first not to relegate the engineer's report to an appendix.

[13] W. H. Stennet, comp., *Yesterday and Today: A History of the Chicago and North Western Railway System*, 3rd ed. (Chicago: Winship Co., 1910), 35.

[14] James T. Palmatary, "[Map of] Chicago" (Chicago: Braunhold & Sonne, 1857), Geography and Map Division, Library of Congress, Washington, D.C.

Metal parts found greater use in the next railroad bridge at Kinzie Street, constructed by the C&NW in the spring of 1879. By that time, companies such as Phoenix Iron of Phoenixville, Pennsylvania, had developed standardized wrought-iron members for use in bridge and building structures. But the Kinzie Street bridge's members consisted exclusively of a modified Bessemer steel rather than wrought iron, making it among the first all-steel railroad bridges in the U.S. (along with the Glasgow Bridge across the Missouri River, built concurrently). Because wrought iron derives its strength from repeated heating and working, a process which was never entirely mechanized, mass production of metal structures demanded a less labor-intensive material. Henry Bessemer's process of converting iron to steel, developed in the mid-1850s, answered this need but produced a metal prone to brittle fracture under impact loading. As historian Thomas J. Misa explained in *A Nation of Steel,* his study of the American steel-making industry, Bessemer steel filled an enormous demand for railroad rails, but attempts to use it in railroad bridges were "experimental" and "unsatisfactory."[15] Particular results of the C&NW's experiment at Kinzie Street were reported to the Western Society of Engineers by Assistant Chief Engineer William H. Finley. Speaking in 1899 after the bridge was dismantled, Finley described numerous incidents of brittle cracking, and the difficulty of making repairs without causing even more cracks to appear. The metal used in the bridge was a Bessemer steel, modified by the Hay process of adding a special slag during smelting, and rolled at Carnegie Steel's Edgar Thompson works for the American Bridge Company. Instead of directly condemning the material, Finley presented a chemical analysis showing relatively high amounts of phosphorous and sulfur, both of which make steel brittle.[16] It was not until the advent of the basic open-hearth process in the late 1880s that U.S. steel-makers could remove these undesirable elements to mass-produce reliable structural steel.

Because of its metallurgical inadequacy, the 1879 bridge was deemed obsolete after just eighteen years of service. Its replacement, fabricated by the Lassig Bridge & Iron Works and erected in March 1898, incorporated several unusual features that merit brief description here.[17] The movable span was a triple-intersection riveted lattice truss, a type which has always been more popular in Europe than in America. In defending his choice of a riveted lattice design, Finley cited the greater structural redundancy which would help it to survive collisions with boats, evidently a common occurrence on Chicago's crowded rivers.[18] More unusual was the

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[15] Thomas J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925* (Baltimore: Johns Hopkins Univ. Press, 1995), 75 et passim.

[16] William H. Finley, "Rebuilding of the Kinzie Street Drawbridge of the Chicago & Northwestern Ry.," *Journal of the Western Society of Engineers* 4, No. 1 (Feb. 1899): 51-53.

[17] "Renewing a Bridge," *Railway Age and Northwestern Railroader* 25, No. 11 (18 Mar. 1898): 183.

[18] Finley, "Rebuilding of the Kinzie Street Drawbridge," 64. C&NW Bridge Engineer F. H. Bainbridge applied this same logic to a similar bridge over the Kinnickinnic River in 1901; see "Riveted Lattice Truss Drawbridge, Chicago and Northwestern Ry.," *Engineering News and American Railway Journal* 46, No. 6 (8 Aug. 1901): 84-85.

pivot point, located under the midpoint of the southern truss rather than in the center of the span. Furthermore, the span incorporated a special double-rack system, which allowed it to rotate 75.0 degrees over a roller nest covering only 37.5 degrees of arc.[19] Finley had improved upon a similar system installed on a nearby Chicago, Milwaukee & St. Paul Railway (Milwaukee Road) bridge. The Milwaukee Road then incorporated Finley's improvements into another bridge near Cortland Street the following year, demonstrating the sharing of information that occurred during the era of in-house swing bridge design.[20] With the turn of the twentieth century, however, this era drew to a close and patented designs began to supersede swing bridges in Chicago. It is an interesting coincidence that Joseph B. Strauss, an engineer at Lassig Bridge & Iron Works during the C&NW's bridge replacement in 1898, went on to develop the proprietary bascule form that replaced the Kinzie Street Bridge again a decade later.

A New Station, a New Bridge

The Wells Street Station's limited capacity became painfully evident by 1901, prompting C&NW President Marvin Hughitt to consider a total reconfiguration of the railroad's Chicago terminal.[21] Although the Kinzie Street Bridge did limit the number of trains entering and leaving, the station itself was constrained by a small site with no possibility of expansion.[22] Furthermore, the Main Branch of the Chicago River stood between the station and the Loop. Moving the station into the Loop was out of the question, but if the station could be located on the west bank of the South Branch, it would be no further away while eliminating the need for passenger trains to cross a bridge. In 1905, consulting engineer John F. Wallace proposed a new, much larger station fronting on Madison Street between Canal and Clinton streets and stretching for three blocks to the north. Tracks would approach the station on elevated viaducts, crossing over city streets and several complicated rail junctions. The viaducts would connect with existing elevated tracks west of Ashland Avenue and north of Chicago Avenue, which had been raised during the 1890s in response to city ordinances demanding the elimination of at-grade railroad crossings.[23] The terminal building on Madison Street, designed by Chicago architects Charles S. Frost and Alfred H. Granger, was estimated to handle five times as many passengers

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[19] Finley, "Rebuilding of the Kinzie Street Drawbridge," 58.

[20] See Justin M. Spivey, "Chicago, Milwaukee & St. Paul Railway, Bridge No. Z-6," HAER No. IL-162, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior.

[21] Timothy Barton, *Chicago and North Western Railway Terminal* (Chicago: Commission on Chicago Historical and Architectural Landmarks, 1981), 2.

[22] Harold M. Mayer, "The Railway Pattern of Metropolitan Chicago" (Ph.D. diss., Univ. of Chicago, 1943), 134.

[23] W. C. Armstrong, "The New Passenger Terminal of the Chicago and North Western Railway," *Journal of the Western Society of Engineers* 16, No. 10 (Dec. 1911): 933-34.

as the old Wells Street Station.[24] After the new terminal opened, the C&NW would continue to use the Kinzie Street Bridge to serve freight customers on the Near North Side, for which it was perfectly adequate. Ground had yet to be broken on the station, however, when the railroad received a federal mandate for the bridge's removal. Construction of a replacement span occurred in 1907 and 1908, while the old Wells Street Station was still handling its full load of passenger traffic.

Demands for the bridge's replacement came from those Chicago industries dependent on river trade, which plied the city's waterways in ever-larger craft. As stated in an 1897 analysis of obstructions in the Chicago River, "The dimensions of the river some thirty years ago were ample for the commerce and traffic of that time.... Almost everything in the city [has] been 'kept up with the times' — except the river."[25] One diagram showed how three bridges at Kinzie Street — the city-owned span carrying Kinzie Street itself, the C&NW bridge to the south, and the Milwaukee Road bridge to the north — prevented the latest 432-foot ore boats from entering the North Branch.[26] The report, presented to the Western Society of Engineers in June 1898, carried the weight of more than opinion. The speaker was G. A. M. Liljencrantz of the Army Corps of Engineers' Chicago District, an arm of the U.S. War Department which had recently become the powerful federal ally of Chicago industries shipping on the river.

The Army Corps' role in Chicago River navigation increased throughout the nineteenth century. Although the Army began improving the Chicago River in 1833, when soldiers at Fort Dearborn first attempted to straighten the river where it entered Lake Michigan, it did not use federal appropriations for improvements beyond the river's mouth until 1896.[27] During this time the agency did exert some control over the river, although one annual report hints that the Chicago District had trouble enforcing a "mandate" regarding the city's Canal Street Bridge and laws against dumping in the river.[28] Toward the century's end, however, declining river trade highlighted the Chicago River's problems. The district engineer's recommendations against swing bridges with mid-channel piers appear to have effectively prevented their construction

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[24] "The New Chicago Station of the Chicago & North-Western Ry.," *Engineering Record* 61, No. 25 (18 June 1910): 774.

[25] G. A. M. Liljencrantz, "Obstructive Bridges and Docks in the Chicago River," *Journal of the Western Society of Engineers* 3, No. 3 (June 1898): 1056.

[26] Liljencrantz, "Obstructive Bridges and Docks," 1066.

[27] Congress first asked the Chicago District engineer to report on potential river improvements in 1892, and began to provide funding with the River and Harbor Act of 1894; see U.S. Army, Corps of Engineers, *Annual Report ... for the Year 1897* (Washington, D.C.: U.S. Government Printing Office, 1898), 2:2794. This money was not used until 1896, however; see ibid., *Annual Report ... for the Year 1901* (Washington, D.C.: U.S. Government Printing Office, 1902), 1:529.

[28] U.S. Army, Corps of Engineers, *Annual Report ... for the Year 1893* (Washington, D.C.: U.S. Government Printing Office, 1894), 4:2799.

after 1890.[29] The River and Harbor Act of 1899 gave the Secretary of War authority to order bridges removed, and imposed his approval as a necessary step in constructing bridges over navigable waterways.[30] The stage was set for the Army Corps to clear swing bridges from the river.

The order to remove the three Kinzie Street bridges came shortly thereafter. Echoing Liljencrantz's survey, the Army Corps' 1900 annual report complained that "the North Branch is throttled near the junction at Kinzie street by three obstructive bridges." Further justifying its position that these bridges should be removed, the District added, "The improvement of the North Branch of the river is simple and may readily be made for the largest vessels.... The tendency of commerce is already in the direction of the North Branch, and ... it may continue to develop in that direction."[31] Annual reports list bridge removal hearings on a sporadic basis, so the exact date of the Secretary of War's order could not be determined. Replacement plans were approved on 11 October 1906, however, with the city-owned and C&NW bridges considered together because of their proximity.[32]

When planning the Kinzie Street Bridge replacement in 1906, the C&NW's choice was more or less limited to the bascule type of bridge, where the span rotates about a horizontal axis. Neither a vertical-axis swing bridge nor a horizontally translating span would fit on the small site. Although J. A. L. Waddell had demonstrated his vertical-lift bridge on Chicago's South Halsted Street in 1893, no railroad was daring enough to use it until 1909.[33] A few folding spans had been constructed in Chicago and elsewhere, but these lacked the rigidity needed for railroad traffic. Waddell led the charge to condemn the "jack-knife" type as "a freak design."[34] After these choices had been eliminated, the bascule type was the only realistic option that remained. The city of Chicago had developed its own bascule design, which was used on the Kinzie Street roadway bridge.[35] The city's design was unavailable to the C&NW, and probably could not have been adapted to meet the railroad's needs anyway. Lacking the experience and resources to develop a single-leaf bascule bridge design in-house, the C&NW was left to choose among a

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[29] U.S. Army, Corps of Engineers, *Annual Report ... for the Year 1900* (Washington, D.C.: U.S. Government Printing Office, 1901), 5:3869.

[30] "An Act Making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," 3 Mar. 1899, *Statutes at Large* 30 (1899), 1121 et seq.

[31] U.S. Army, Corps of Engineers, *Annual Report ... for the Year 1900,* 5:3870.

[32] U.S. War Department, *List of Bridges over the Navigable Waters of the United States, Compiled in the Office of the Chief of Engineers, United States Army, 1935* (Washington, D.C.: U.S. Government Printing Office, 1936), 88.

[33] See Judith A. McGaw, "Hawthorne Bridge," HAER No. OR-20, 7-8.

[34] J. A. L. Waddell, *Bridge Engineering,* 2 vols. (New York: John Wiley & Sons, 1916), 1:668.

[35] Strauss later sued Chicago for patent infringement; see below.

number of patented forms. According to Finely, the railroad contracted with the Strauss Bascule & Concrete Bridge Company "after a careful comparison of the different types of bascule bridges."[36] This decision was based on certain functional and economic advantages unique to the Strauss type, to be discussed in detail below.

Early proposals for the Kinzie Street Bridge replacement show a scheme somewhat different from the one actually built, reflecting some uncertainty in planning the terminal reconfiguration. While the railroad began to acquire land for the new station and approaches in 1906, it had yet to receive the city's approval for the project. In order to cover the contingency that the new station could not be built, the C&NW obtained a War Department permit to build two double-track bascule bridges at Kinzie Street.[37] While this would not provide the same capacity as the proposed new station, it would increase the number of trains able to enter and leave the old Wells Street Station in case the latter had to be kept in service. The four-track idea persisted even after December 1906, when the City Council passed an ordinance authorizing the new station. In September 1908, two months before work began on the new station, *Engineering News* reported that the double-track bascule bridge just completed would be the first of two parallel spans.[38] The C&NW ultimately decided against building the twin span, evidently deeming it wasteful to improve the soon-to-be-abandoned Wells Street Station.[39] Passenger traffic shifted to the new station in June 1911, leaving the Kinzie Street Bridge's two tracks to carry only freight traffic.

Design and Construction: Substructure

Building the Kinzie Street Bridge's complex foundations, from December 1907 to May 1908, constituted a majority of the nine-month construction process. Assistant Chief Engineer Finley, while careful to credit his superiors, implied that he was the project's primary decision-maker in the articles that he wrote for engineering periodicals. He can be credited with designing the bridge's substructure, to which Chief Engineer E. C. Carter merely gave his approval. While the foundation plans were developed in-house, certain parameters were necessarily dictated by the superstructure design, which was contracted out to the Strauss Bascule & Concrete Bridge Company. The C&NW's use of a consulting engineer reflected a growing trend among American railroads in the early twentieth century, when in-house engineering staff could no

[36] William H. Finley, "Construction of the Kinzie St. Drawbridge (Chicago) and Its Deep Foundations: Chicago & Northwestern Ry.," *Engineering News* 64, No. 21 (24 Nov. 1910): 560.

[37] Chicago & North Western Railway Co., "Bridges over the North Branch of the Chicago River and Proposed Improvements in the Vicinity of Kinzie St.," Drawing No. 6087 (19 July 1906), Chicago Division Bridge No. N-1511, plan files, Union Pacific Railroad, Omaha, Neb.

[38] "A Trunnion Bascule Bridge," *Engineering News* 60, No. 13 (24 Sep. 1908): 349.

[39] The 1898 swing bridge was also a two-track span built under a four-track permit; see Finley, "Rebuilding of the Kinzie Street Drawbridge," 69.

longer keep up with the increasingly complex demands placed on movable bridges. Strauss' company and its proprietary bascule bridge design are discussed in separate sections below.

The Kinzie Street Bridge consists of two spans — a plate-girder span 25'-10" long on the west approach and the 170'-0" bascule span — supported by three piers. The western abutment is a 12'-0" by 35'-0" pier, skewed 15 degrees, on wooden piles driven 60'-0" below mean water level. The intermediate pier, on which the bascule leaf rests in its closed position, measures 12'-0" by 41'-6", and is likewise skewed and pile-supported. By far the largest pier is the eastern abutment, which carries the entire weight of the span and its counterweight in the open position. This was also the most difficult part to construct because, unlike the other two piers, the eastern abutment is carried by steel-lined concrete shafts driven to rock.[40] Six shafts, each 10'-0" in diameter and 65'-0" long, support a concrete-filled caisson. The caisson forms part of a large block of concrete, which continues upward for another 62'-0-5/8" to the base-of-rail level. This block is rectangular in plan, measuring 41'-8" by 49'-8", with the longer dimension parallel to the tracks. It is equipped with small cantilevered wings to support struts bracing the tower under the main trunnions.

Because the Wells Street Station had to remain open during construction, the railroad took unusual steps to maintain traffic over the Kinzie Street Bridge. Early replacement plans show the reverse of the as-built configuration, with the largest pier on the west shore, where it could be constructed without interfering with the existing swing bridge. Finley noted that plans were changed because it was less risky to sink the caisson in the east channel, which was not usually used for navigation.[41] On the other hand, the east channel site was obstructed by the swing bridge whenever it opened, which was then thirty or forty times a day. To clear the way for foundation work, the railroad cut off one arm of the swing bridge and replaced it with an overhead counterweight on I September 1907. Just enough structure remained to support steel boxes filled with pig iron, effectively converting the span into a "bobtail" swing bridge.

Meanwhile, the Great Lakes Dredge & Dock Company was constructing the caisson for the eastern abutment pier. The company's successful bid on the substructure contract was no doubt aided by the proximity of its Chicago plant, located on Goose Island, about a mile upstream from the bridge. Photographs of the Kinzie Street Bridge's foundations appear in a 1912 company brochure, which describes the company's work as "heavy foundations, breakwaters, tunnels, docks, piers, lighthouses, bridges, and in fact, practically all branches of work employing marine methods." During its twenty-two years of operation to date, the company had purchased other engineering and contracting firms, resulting in "a Company operating in practically every harbor and river tributary to the Great Lakes," i.e., Chicago,

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[40] The C&NW's preference for cylindrical piers, which were then more popular in Europe than in America, was explained in a later article; see William H. Finley, "Cylinder-Pier Bridges of the Chicago and North Western Railway," *Engineering News* 68, No. 17 (24 Oct. 1912).

[41] Finley, "Construction of the Kinzie St. Drawbridge," 560.; cf. Chicago & North Western Railway Co., "Bridges over the North Branch."

Duluth, Cleveland, Buffalo, Sault Ste. Marie, and Amherstburg, Ontario.[42] The company also maintained a Boston office at that time, indicating a desire to expand onto the Atlantic coast.

Despite the brochure's promotional intent, the photographs and their captions contain significant data and dimensions, along with rare glimpses inside an early twentieth-century pneumatic caisson. The heavy timber caisson left the Goose Island yard on 23 November 1907, and reached the Kinzie Street site on 26 December.[43] Photographs of the caisson during excavation show air-locks for workers and materials (the latter is identified as a "Moran Material Lock" in one caption), and even a view inside the working chamber. The caisson's interior measured 41'-0" by 51'-0" in plan, and was lit by electric lighting during excavation.[44] Workers removed soil from within the caisson, allowing it to gradually descend until it came to rest at 50'-10" below the river's surface on 21 February 1908. At that point, a concrete mat was poured to seal the floor of the caisson, and work on the cylindrical shafts began. The first shaft reached bedrock on 9 March, and all had been filled with concrete by 3 April. The caisson and working shafts were then filled with concrete as well. On 17 May, the foundations were complete, and erection of the Strauss bascule bridge superstructure began.[45]

"Chiefly a Human Dynamo"

Biographies of Joseph Baermann Strauss focus on his five-foot height, as if a need to compensate for it motivated his mechanical ingenuity, ceaseless invention, and political acumen. On the fiftieth anniversary of San Francisco's Golden Gate Bridge, one publication directly linked his ineligibility for the University of Cincinnati football team to his desire "to build the biggest thing of its kind that a man could build."[46] But Strauss' success stems from his keen understanding of the kinematics of complex moving structures. About 150 patents, from window sashes to prison doors, and amusement rides to airplanes, attest to his obsession with movement and balance. Some of Strauss' patents cover the use of concrete in structures and vehicles,

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[42] Great Lakes Dredge & Dock Co., *A Few Views of Some of Our Work* (Chicago: Great Lakes Dredge & Dock Co., 1912), 3-4.

[43] Finley, "Construction of the Kinzie St. Drawbridge," 560.

[44] Great Lakes Dredge & Dock Co., *A Few Views*, 50-52. Exterior dimensions of 45'-2" by 53'-2" are given in Finley, "Construction of the Kinzie St. Drawbridge," 561.

[45] Finley, "Construction of the Kinzie St. Drawbridge," 560-62.

[46] Dixie W. Golden, "A Man and His Bridge," in *A Golden Gate Jubilee, 1937-1987* (Cincinnati: College of Engineering, Univ. of Cincinnati, 1987), 3, quoted in Henry Petroski, *Engineers of Dreams: Great Bridge Builders and the Spanning of America* (New York: Alfred A. Knopf, 1995), 274.

showing a facility with that material as well. These two interests came together in Strauss' work with bascule bridges, which started in Chicago and spread throughout the world.[47]

Born in Cincinnati on 7 January 1870, Joseph B. Strauss belonged to a talented family of musicians and artists. "In spite of his natural artistic and literary learnings," wrote one biographer, "Mr. Strauss early showed a strong bent for mechanics and the sciences."[48] Although this flattering quote appeared in a company brochure, there could be some truth to the author's assertion that Strauss' youth was spent observing mechanics and engineers at work. Strauss proceeded through public schools to the University of Cincinnati, where he took part in student activities both technical and literary. His years as Class President indicate an ego suited to politics; as Class Poet, a confidence in written and verbal expression. After presenting a thesis on bridging the Bering Strait, he received a civil engineering degree in 1892. These were the makings of the Golden Gate Bridge's Chief Engineer, a role which Strauss played as more of a promoter than a designer.[49]

Strauss' years between Cincinnati and San Francisco are of greater concern to this report. After graduating from college, he worked for two years with the New Jersey Bridge & Iron Company in Trenton, then returned to teach for one year at his alma mater. He must have arrived in Chicago with his new bride, college sweetheart May Van, around 1895. Employment at Lassig Bridge & Iron Works, then at the Chicago Sanitary District, led to work on movable bridges at Ralph Modjeski's engineering firm in 1899. According to engineering historian Henry Petroski, Strauss left because his ideas about concrete counterweights and trunnion bearings gained little acceptance there.[50]

Petroski implied that Strauss went directly to independent practice in 1902, but the Western Society of Engineers' member directories tell a different story. Strauss became a member of the society on 8 December 1899, and is listed as "Bridge Engineer, Monadnock Block" in its 1900 and 1901 directories. If he was then with Modjeski's firm, it seems odd that his employer's name was not mentioned. The next year, the listing changes to "Chief Engineer, Hall Bascule Bridge Co., 97 Washington St."[51] Departure from this firm, not Modjeski's, must

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[47] For example, a list of Strauss bridges under construction in June 1925 shows projects in the U.S., Canada, Egypt, and Japan. See A. B. Reeve, "The Story of Strauss Bridges," typescript (Chicago: Strauss Bascule Bridge Co., n.d.), 29, private collection of Eric N. DeLony.

[48] Reeve, "The Story of Strauss Bridges," 17.

[49] See Petroski, *Engineers of Dreams*, 272-85, for more about Strauss' work on the Golden Gate Bridge.

[50] Petroski, *Engineers of Dreams*, 275. Petroski evidently agreed with Strauss' critics, calling his overhead-counterweight Fourth Street Bridge (San Francisco, 1916) "nondescript if not downright ugly"; see ibid., 273.

[51] Western Society of Engineers, *Fifteenth List, Western Society of Engineers: Constitution, By-Laws, List of Officers and Members, June 1900* (Chicago: 1900), 33; ibid., *Sixteenth List ... August 1901* (Chicago: 1901), 32; ibid., *Seventeenth List ... July 1902* (Chicago: 1902), 40. "Hall" might be a misspelling of Rall Bascule Bridge Co., which held the patent for a rolling-lift design that receives some attention in Strauss' histories of bascule bridge design; see Joseph B. Strauss, "Bascule Bridges," in *Proceedings of the Second Pan-American Scientific Congress,*

be the basis for the 1902 date in Petroski's book, which also appears in Strauss company brochures. Strauss is listed as "Consulting Engineer, Opera House Block" in the 1903, 1904, and 1905 directories; the next year's issue contains the first mention of Strauss Bascule & Concrete Bridge Company (incorporated 1904). According to one company brochure, Strauss subsequently dropped "Concrete" from the name to reflect a focus on bascule spans. This occurred in 1910 or 1911, after the Kinzie Street Bridge was constructed.[52] By that time, Strauss' bascule bridge designs had earned six U.S. patents and attention in the national engineering press.

Strauss' engineering firm achieved financial success with a strong belief in intellectual property, reinforced by patents and defended by patent-infringement suits. Although bridge engineers had sought exclusive rights to their designs as early as 1841, when Squire Whipple was granted U.S. Patent No. 2,064 for "Construction of Iron-Truss Bridges," Strauss took it to new extremes. A Strauss Bascule Bridge Company brochure produced circa 1925 devoted three pages to the subject of patents, including a portrait of Donald M. Carter, the company's patent attorney.[53] Strauss' most well-known patent-infringement lawsuits were against the city of Chicago in 1913 and against Seattle in 1921. Strauss claimed that both cities had constructed bascule bridges with trunnion supports similar to his U.S. Patent No. 995,813, without paying royalties for using the design. The courts decided against Chicago, and Seattle settled out of court.[54] As the defensive tone of Strauss' brochure might indicate, the lawsuits earned him criticism from some fellow engineers, while others would have agreed with his desire to recoup the expense of a long-term effort to improve the bascule bridge.

The engineering profession's debate over proprietary designs neither began nor ended with Strauss' bascule bridges. As early as 1902, discussions in the American Society of Civil Engineers' *Transactions* pitted pro-patent engineers against those who felt that the existence of proprietary designs "lowers the dignity of the profession."[55] Citing the medical profession's ethical restriction on patenting medical instruments, opponents claimed that engineering patents impeded progress toward public good. Another important point of dispute was whether

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ed. Glen L. Swiggett (Washington, D.C.: U.S. Government Printing Office, 1917), 6:309-10; ibid., "The Bascule Bridge in Chicago," in John H. Jones and Fred A. Britten, ed., *A Half-Century of Chicago Building* (Chicago: 1910), 92.

[52] Reeve, "The Story of Strauss Bridges," 18. "Strauss Bascule Bridge Co." first appears in Western Society of Engineers, *Twenty-Eighth List ... 1911* (Chicago: 1911), 57.

[53] Reeve, "The Story of Strauss Bridges," 54-56.

[54] "Chicago Settles with Strauss for Infringing Bridge Patent," *Engineering News-Record* 85, No. 24 (9 Dec. 1920): 1158; "Eight Years of Litigation over Seattle Bascule Bridges," *Engineering News-Record* 103 (19 Dec. 1929): 968.

[55] James Owen, discussion following Archibald R. Eldridge, "Is It Unprofessional for an Engineer to Be a Patentee?," *Transactions of the American Society of Civil Engineers* 48 (1902), 325.

engineers made unfair gains by charging royalties for proprietary designs. A powerful counter-argument, in the words of engineer S. Whinery, was that engineers "must have some assurance that, after they have spent large sums for the development and introduction of the invention, they will be able to prevent competitors from robbing them of the reward."[56] Undoubtedly, Strauss' continual improvement of the bascule bridge was financed by the dozens of clients who chose to pay for his proprietary design. As stated in Strauss' brochure, clients chose patented designs in an open market, therefore "the only hope for a patented product lies in its ability to do things at less cost or to do them better."[57]

The Evolving Strauss Bascule Bridge

Although the Kinzie Street Bridge is an early example of a Strauss bascule span, it either includes or foreshadows many of the features found in the mature design. The engineer himself recognized that the Kinzie Street Bridge represented an important developmental step on the way to the heel-trunnion bascule that became his most recognizable movable bridge design. In Strauss' 1925 brochure, a photograph of the Kinzie Street Bridge is identified as the "Second Step in Strauss Bascule Bridges."[58]

Before describing the process of development, however, a basic identification of design issues is necessary. A bascule bridge is defined by a movable span, or leaf, rotating about a horizontal axis. Usually the work of rotation is made easier by balancing the leaf with a counterweight on the other side of the axis. The axis can be either stationary, where the leaf rotates about a fixed trunnion, or moving, where the leaf rocks or rolls along a track. Almost all of Strauss' bascule bridges have fixed trunnions, where the structure's weight is always delivered to the foundation at the same point. Strauss was granted a patent for an electromagnet-driven rolling bascule bridge in 1908, but no such spans were ever constructed.[59] For the most part, Strauss recognized and avoided the troublesome situation of a rolling leaf imposing a moving load on its foundation. Another major variable in bascule bridge design is the connection between the leaf and its counterweight. If rigidly attached, the counterweight must descend while the leaf ascends, requiring a pit below the roadway level. To reduce the pit's depth, the counterweight arm can be made shorter, but then the counterweight must be proportionately heavier. This is because balance is dictated by not only weight, but also the distance at which the weight is located from the axis of rotation. As an alternative to rigid attachment, the counterweight could be connected to the leaf by mechanical links and kept above the roadway level. Without the restrictions of a pit, the counterweight could be made any size, a significant

[56] S. Whinery, discussion following Eldridge, "Is It Unprofessional?," 323.

[57] Reeve, "The Story of Strauss Bridges," 55.

[58] Reeve, "The Story of Strauss Bridges," 15.

[59] Joseph B. Strauss, "Bascule Bridge," U.S. Patent No. 894,239, 28 July 1908.

improvement because concrete is significantly less expensive — but significantly less dense — than steel or pig iron.

The idea of a separate counterweight did not originate with Strauss, but he did make significant advances in the design of mechanical links, both before and after the Kinzie Street Bridge. In essays on the history of bascule bridges, Strauss and his contemporaries listed numerous means of ensuring that the counterweight balanced the leaf throughout its range of motion. These included weights rolling down sinusoidally curved tracks, suspended from ropes wound around spiral drums, or divided into segments and dropped in sequence.[60] Strauss' early schemes were no less inventive. In 1901, he patented a bascule bridge with counterweights that descended in the river as the span opened, so their downward pull was reduced by buoyant force.[61] This impractical design was never built, but he soon hit upon the parallel-link concept that made him famous. Strauss freely acknowledged a basic similarity between his bascule designs and nineteenth-century Dutch bridges, both of which included a parallelogram-shaped configuration of links.[62] He claimed originality, however, in configuring the movable truss and the trunnion supports so that the counterweight could occupy most of the span's width and yet pass beneath the trunnions during rotation. This arrangement permitted a large (i.e., concrete) counterweight with a minimum of pit excavation. Although Strauss' infringement suits were based on a 1911 patent, this same feature also appears in a patent issued eight years earlier.

As with many design patents, the text of U.S. Patent No. 738,954 makes vague claims with the hope of protecting the widest possible range of designs. The drawings, of bascule leaves with counterweights below deck, do not even show the classic Strauss parallelogram of counterweight links. The configuration is more accurately described as a quadrilateral that collapses into a triangle when the bridge is fully open.[63] Even so, the links force the counterweight to remain vertical, using the full effect of its weight to balance the leaf in any position. By the time that Strauss had constructed his first bascule bridge for the Wheeling & Lake Erie Railroad (W&LE) in Cleveland, he had adopted the parallel arrangement of links to support an overhead counterweight. Demonstrating the flexibility of his patent's claims, Strauss implied that it protected the W&LE bridge. "Although thus first applied in the overhead type of bridge in 1904," he wrote, "the pin-connected concrete counterweight was originally proposed by the writer for the underneath counterweight type of bascule in 1901 in a series of plans ... later embodied in patent application No. 738,954."[64] The Kinzie Street Bridge's design can also be

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[60] H. S. Prichard et al., "Lift Bridges — a Discussion," *Proceedings of the Engineers' Society of Western Pennsylvania* 25, No. 1 (Feb. 1909): 20 et seq.; Joseph B. Strauss, "Bascule Bridges," 6:304 et seq.

[61] Joseph B. Strauss, "Bridge," U.S. Patent No. 668,232, 19 Feb. 1901.

[62] Strauss, "Bascule Bridges," 6:305, 314.

[63] Joseph B. Strauss, "Bridge," U.S. Patent No. 738,954, 15 Sep. 1903.

[64] Strauss, "Bascule Bridges," 6:313. U.S. Patent No. 995,813 bears an even stronger resemblance to the W&LE bridge; Strauss filed the application on 18 Dec. 1905, but it was not issued until 20 June 1911.

considered as a descendant of this patent, even though the trunnion sits above the leaf rather than below it. Interestingly, the C&NW's application for a War Department permit shows a bascule span remarkably similar to Patent No. 738,954, even though the Kinzie Street Bridge turned out much different in form.[65] Strauss applied for a patent to protect the overhead-trunnion version of his design in March 1908, but it was not issued until August 1915.[66] By that time, the Strauss bascule bridge had evolved once more to the heel-trunnion type.

As the "Second Step in Strauss Bascule Bridges," the Kinzie Street Bridge improved upon the W&LE bridge's shortcomings, and anticipated the mature (i.e., heel-trunnion) Strauss bascule form. Figure 1 shows the Kinzie Street Bridge in three positions: closed, open halfway, and at its maximum inclination of 85 degrees to the horizontal.

[65] Chicago & North Western Railway Co., "Bridges over the North Branch."

[66] Joseph B. Strauss, "Bascule Bridge," U.S. Patent No. 1,150,643, 17 Aug. 1915.

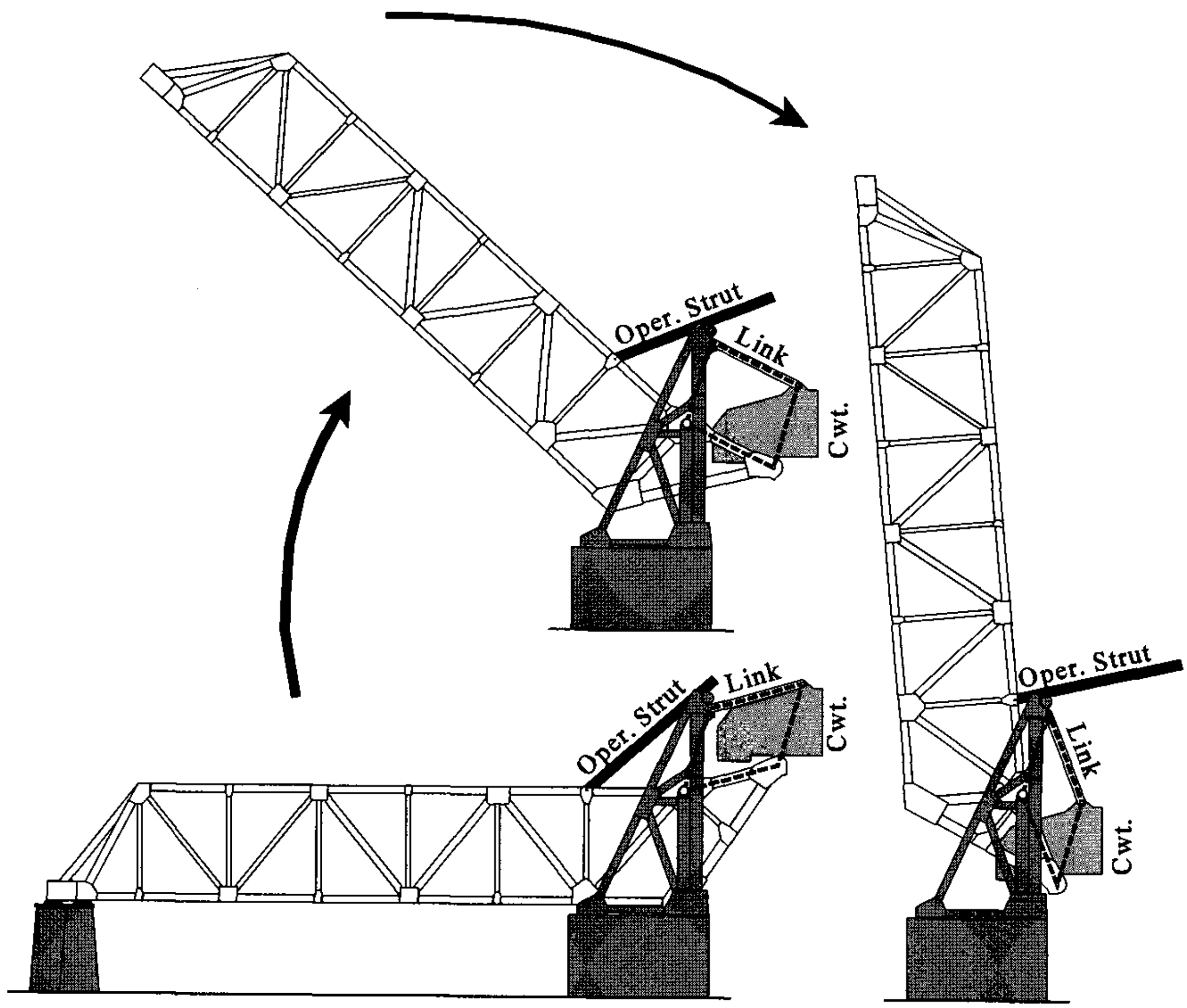

Figure 1. Schematic of Kinzie Street Bridge (not to scale), with stationary parts in grey tone. Sketch by author.

As shown in the figure, the structure consists of three main parts, a fixed tower, a rotating bascule leaf, and a concrete counterweight rotating independently from the leaf. The leaf's axis of rotation, the main trunnion, is located about halfway up the tower. Note that the main trunnion is located in the truss' upper chord. Extending through the tower, the truss has an inclined rear arm to support the counterweight. Parallel to this, a link beam connects the top of the counterweight to the tower. These two elements remain parallel throughout the span's rotation, as is shown by the bold parallelogram. As the span reaches its fully open position, the counterweight passes between the rear arms of the truss, a compact arrangement that does not require a tail pit. To prevent the span from opening further than 85 degrees, the rear arms of the truss engage a wooden bumper on the tower. Motive power is provided by a pinion at the top of the tower, which engages a rack on the operating strut to raise or lower the leaf.

The Kinzie Street Bridge differs from the W&LE bridge in three major aspects. Most noticeably, Strauss moved the main trunnion from the lower chord to the upper chord. This allowed the leaf to support the counterweight directly in the Kinzie Street Bridge, simplifying the system of links and making the parallelogram more compact. Another result was the change from a rectangular tower on the W&LE bridge to a more efficient triangular one on the Kinzie Street and subsequent bridges. The third and most subtle change was the provision of a separate support for the Kinzie Street Bridge's main trunnion. Looking carefully at Figure 1, one notices that the tower's vertical leg actually consists of two members, one supporting the operating machinery and counterweight link trunnion, the other supporting the main trunnion. The W&LE bridge's main trunnion, in contrast, was supported by girders spanning between the front legs of the tower. This change made little difference in the operation of the bridge, but it does signify that Strauss was beginning to recognize the inefficiency of concentrating the entire load of leaf and counterweight at a single point.

After the Kinzie Street Bridge, the next step in the evolution of Strauss bascule bridges was to separate the leaf and counterweight loads to opposite sides of the tower. Strauss also moved the leaf out in front of the tower, with the end of its lower chord pivoting on a main trunnion which sat directly on the foundation. In the analogy of a tapping foot, the trunnion occurs at the heel, so this new form was called a heel-trunnion bascule bridge. This helped to remedy a deficiency shared by the W&LE and Kinzie Street bridges: their leaf and tower trusses did not lie in the same plane.[67] Because the leaf truss had to pass through the tower, it was offset from the tower trusses on either side, subjecting the trunnions to a high shearing force. With the trusses co-planar and the counterweight load supported elsewhere, the heel-trunnion bascule bridge required main trunnions proportionately smaller than its predecessors. Although the Kinzie Street Bridge had the world's longest and heaviest bascule leaf at the time of its construction, Strauss' heel-trunnion design shattered the record again and again.[68] As Strauss' brochure confirmed, the Kinzie Street Bridge was an important step along the way.

Design and Construction: Superstructure

One additional advantage of the Strauss bascule form was that it could be erected in an upright position, with a minimum of interference to traffic on the river below. This worked particularly well on the cramped Kinzie Street site, where the existing swing bridge had to continue operating throughout the construction sequence. The majority of erection work therefore took place on the river's east bank, where contractors had to work around the C&NW's busy Wells Street Station yard.

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[67] Strauss, "Bascule Bridges," 6:314.

[68] For an example in Chicago, see Justin M. Spivey, "St. Charles Air Line Bridge," HAER No. IL-157.

The low bidders on the Kinzie Street Bridge superstructure were names that appeared time and again throughout the flurry of bridge replacements in Chicago during the first decades of the twentieth century. The erection contract went to the Kelly-Atkinson Company, which, like Great Lakes Dredge & Dock, also maintained headquarters in Chicago. The pair worked together on Strauss heel trunnion bridges elsewhere, for the Chicago & Western Indiana Railroad over the Calumet River in 1912, and for the C&NW over the North Branch at Deering in 1916.[69] Despite its distant fabricating plant, the Toledo-Massillon Bridge Company of Toledo, Ohio, was not unfamiliar with Chicago's rivers, having fabricated bridges in the city since at least 1881.[70]

The Kinzie Street Bridge's bascule leaf weighs about 800 tons and consists of two Warren through trusses with verticals, of unequal length, spaced 29'-10" on center.[71] As shown in Figure 2, both trusses measure 30'-2" deep between center-lines of their upper and lower chords. Lateral bracing in the upper and lower planes forms an "X" in each panel, except U7-U8, where it would interfere with the counterweight. Proceeding west from the main trunnion at U7, the north truss has one panel 26'-0" long followed by six panels each 24'-0" long, for a total of 170'-0", the dimension usually cited as the bridge's length. The south truss, however, has one panel 26'-0" long, then five panels 24'-0" long, with the seventh panel of 16'-0" resulting in a 15-degree skew on the west end. Clipping the last panel of the south truss may represent an effort to reduce span weight rather than a true accommodation of the crossing's skew alignment. Given that the axis of rotation must be perpendicular to the bridge's axis, bascule bridges cannot be skewed more than a few degrees. (Note that the Kinzie Street Bridge's east end is square.) Although an asymmetrical distribution of weight between the trusses produces uneven loads on the trunnions when the span is open, Strauss must have considered the difference minor compared to the overall reduction in weight.[72] Typical of early twentieth-century truss construction, all steel members in the Kinzie Street Bridge are built up from rolled sections such

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[69] C. H. Norwood, "Electrical Equipment for a Bascule Bridge," *Railway Age Gazette* 53, No. 13 (27 Sep. 1912): 575-76.; O. F. Dalstrom, "The 186 Foot Bascule Bridge of the C. & N. W. Ry., over the North Branch of the Chicago River at Deering,"*Journal of the Western Society of Engineers* 22, No. 7 (Sep. 1917): 453-78.

[70] Although Finley, in "Construction of the Kinzie St. Drawbridge," 563, placed Toledo-Massillon Bridge Co. in Cleveland, this error was corrected in "Notes and Queries,"*Engineering News* 64, No. 22 (1 Dec. 1910): 602. In 1881, Massillon Bridge Co. constructed a bridge at Kedzie Avenue over the West Fork of the South Branch of the Chicago River; see Chicago Department of Public Works, *Sixth Annual Report* (1881), 78, Municipal Reference Collection, Chicago Public Library, Chicago, Ill.

[71] All dimensions in this section come from Strauss Bascule & Concrete Bridge Co., "Strauss Trunnion Bascule Bridge for C. & N. W. Ry. Co. over North Branch Chicago River near Kinzie St., Chicago, Illinois," drawings (9 May 1907), Chicago Division Bridge No. N-1511, plan files, Union Pacific Railroad, Omaha, Neb.; except weights from Finley, "Construction of the Kinzie St. Drawbridge," 562.

[72] On a similarly skewed Strauss bascule bridge at Deering Station in Chicago, two counterweights were used, with a more dense concrete mix balancing the heavier truss; see "Weight of Counterweight Concrete Varied by Changing Mix," *Engineering News-Record* 80, No. 1 (3 Jan. 1918): 32.

as angles, channels, lacing, and plates. All connections are riveted together with gusset plates, with particularly heavy reinforcement around the rotating joints.

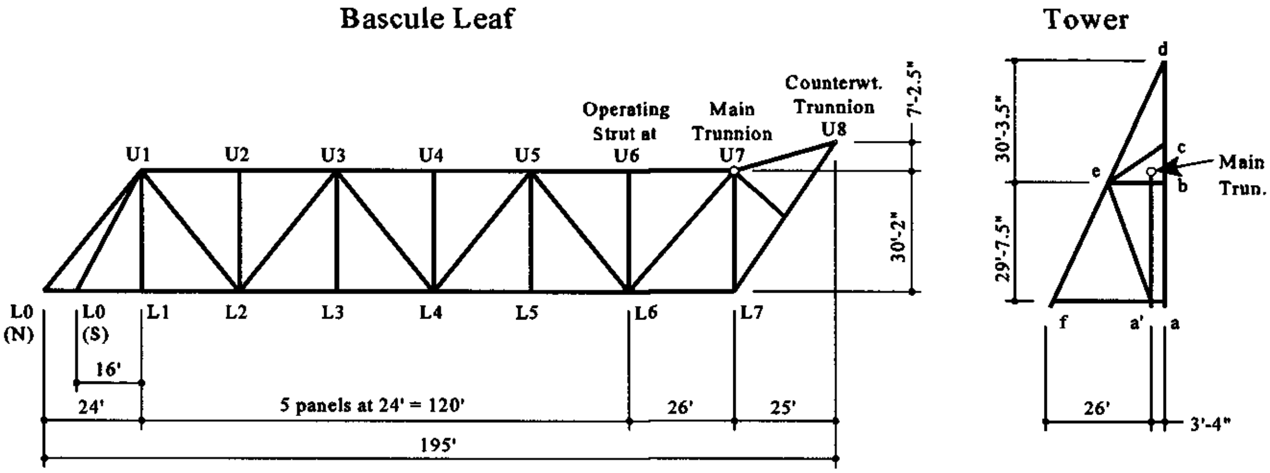

Figure 2. South elevation of Kinzie Street Bridge leaf and tower trusses (not to scale). Sketch by author.

The leaf rotates about 23-3/4"-diameter main trunnions at U7, which are supported on separate posts offset 3'-4" from the tower's rear legs. These posts were filled with concrete to increase their strength.[73] Each truss' top chord extends 25'-0" beyond the main trunnion, rising 7'-2-1/2" to meet a 12"-diameter counterweight pin at U8. A counterweight link, not shown in Figure 2, is parallel to member U7-U8 and keeps the counterweight in a vertical position. The link is attached to the tower just below point "d," and to the top of the counterweight, with 7"-diameter pins at each location. The counterweight itself weighs about 1,247 tons and is concrete reinforced with old rails, on a structural steel frame. Truss member U7-U8, counterweight, link, and tower form the parallelogram characteristic of Strauss' bascule bridge designs.

Attesting to the near-perfect balance between leaf and counterweight, relatively little power is needed to operate the span. This was originally supplied by two 50-horsepower direct-current electric motors located in a reinforced concrete machinery house at the top of the tower. (Repair records do not indicate whether these were later replaced with alternating-current equipment.[74]) Through a series of reduction gears, the motors turn the two pinions that engage racks on the operating struts attached to the leaf at panel point U6. To lift the span, the motors need only overcome friction in the trunnions, plus the additional weight of water, dirt, or snow that might have accumulated on the span. Each pinion is kept in contact with the rack by a triangular harness that rolls along the top flange of the operating strut, pulling the pinion against

[73] Strauss Bascule & Concrete Bridge Co., "Strauss Trunnion Bascule Bridge for C. & N. W. Ry. Co.," sheet 1.

[74] Card file information supplied by Mike Bruckner, Structural Designer for Union Pacific Railroad, in letter to author, 24 July 1999.

the rack on the bottom flange. A "spur gear equalizer," or differential, distributes torque between the two motors and the two pinions so that they turn at equal rates. According to an article in *Iron Age,* the Kinzie Street Bridge had not only two sources of electrical power in its original configuration, but also "an air motor" and provision for manual operation. An equal number of braking mechanisms were provided: a solenoid brake on each motor, a hand brake, and a brake automatically engaged by limit switches as the bridge approached its fully open or closed position.[75] Except for the solenoid brakes, the braking mechanisms act on the drive train. Braking the drive train was not particularly safe and risked burning out the motors, so Strauss subsequently devised brakes that acted on the operating struts.[76]

The machinery is controlled from an operator's house, which is cantilevered out from the north side of the tower above point "e" in Figure 2. Like the machinery house above point "f," the operator's house is constructed of reinforced concrete panels in a steel frame. This is a significant feature found on few Strauss bascule bridges. Even the C&NW's bridge at Deering Station, a Strauss heel-trunnion bascule completed in 1916, has a steel frame with wood infill.[77] In addition to the drive machinery and brakes, the bridge operator must also control two locking mechanisms. The first is a wedge driven to latch the tip of the leaf (panel point L0) down to the rest pier. Because the leaf is almost perfectly balanced, this is a necessary precaution against it rising off the rest pier while a train is on the span. A second wedge beneath panel point L7, which Strauss' drawings call the "front support," transmits the weight of passing trains directly to the abutment.[78] Both sets of wedges were originally driven by a 3-horsepower motor located at mid-span. Without the front support, the cyclic loading of passing trains would be carried up to the trunnions, causing them to wear out quickly. Even so, C&NW repair records indicate that the leaf was propped up on falsework to replace the trunnion bushings in early 1918.[79] Their short life may be related to a failure of the front support to perform its intended function. Although the operating and locking machinery has been updated, the reinforced concrete houses more or less intact.

Conclusion

Once erection was complete, the Kinzie Street Bridge was lowered into its closed position. Almost right away, on 19 September 1908, trains began running across the new span. The old swing bridge remained in service long enough to reconfigure the tracks serving Wells

[75] "A Heavy Strauss Bascule Bridge," *Iron Age* 82, No. 25 (17 Dec. 1908): 1179.

[76] Strauss, "Bascule Bridges," 6:315.

[77] Dalstrom, "The 186 Foot Bascule Bridge," 466.

[78] Strauss Bascule & Concrete Bridge Co., "Strauss Trunnion Bascule Bridge for C. & N. W. Ry. Co.," sheet 1.

[79] Card file information supplied by Bruckner in letter to author, 24 July 1999.

Street Station, after which the C&NW relocated it to span the Kinnickinnic River near Milwaukee.[80] The new Strauss bascule bridge carried a full load of passenger trains for less than three years, after which the new C&NW terminal opened and the Kinzie Street line was relegated to freight service. In contrast to the sudden drop in traffic on the bridge, the number of boats passing on the river declined more slowly. C&NW correspondence reports 16,608 bridge openings in 1915 and 9,587 in 1922, with an average time of just over 3 minutes each.[81]

As the twentieth century progressed, freight traffic declined on river and railroad alike. This can be attributed to the disappearance of industry from Chicago in general, and from along the C&NW's tracks through the Near North Side in particular. Land along the Main Branch of the Chicago River became too valuable for industrial uses; those that remained through the Great Depression were replaced with office buildings during the post-World War II boom. One notable exception was the gargantuan Merchandise Mart trading center constructed on the Wells Street Station site in 1930. At present, the former C&NW tracks run beneath this and other buildings to serve one remaining freight customer: the Chicago *Sun-Times*. The Kinzie Street Bridge remains in the open position almost all of the time, closing only to allow the occasional paper train to cross. Even the *Sun-Times* has plans to move its printing plant away from the Loop, to Damen Avenue and 39th Street, after which UP will abandon the Kinzie Street Bridge.[82]

Once abandoned, contemporary criticism of Strauss bridges' aesthetics will probably work against the Kinzie Street Bridge's survival. During the early twentieth century, the towering raised leaf and complex counterweight links might have evoked feelings of wonder and awe. The bridge's record-breaking length, a fact inevitably mentioned on postcards, was a mark of pride for the city.[83] Now that Chicago's role as a financial center has surpassed its industrial prowess, however, the Kinzie Street Bridge's imposing mass of flat-black steel looks out of place against the shiny skyscraper core. To some modern observers, Strauss bascule bridges even resemble "giant cockroaches." (The St. Charles Air Line Bridge, a heel-trunnion span across the South Branch at 16th Street, is perhaps more deserving of the remark because of its thin "wing"-shaped counterweights.) Between aesthetic objections, safety concerns, and the high value of recycled steel, there will be reason enough to scrap the Kinzie Street Bridge. When that occurs, no physical evidence will remain of this important "second step" in the development of the Strauss bascule bridge.

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[80] Finley, "Construction of the Kinzie St. Drawbridge," 560, 563; this is a different Kinnickinnic River bridge than the one described in "Riveted Lattice Truss Drawbridge," 84-85.

[81] William H. Finley, Chief Engineer of Chicago & North Western Railway, letter to Joseph B. Strauss, 24 Dec. 1915, files, Green Bay Department of Public Works, Green Bay, Wis.; F. L. Wells, Supervisor of Signals for Chicago & Northwestern Railway, letter to J. S. Robinson, Division Engineer, 21 Oct. 1922, archives, Chicago & North Western Historical Society, Chicago, Ill.

[82] Tom Zappler of Union Pacific Railroad, telephone conversation with author, 11 June 1999.

[83] Postcards in the private collection of Eric N. DeLony.

SOURCES CONSULTED

Published

Andreas, Alfred T. *History of Chicago from the Earliest Period to the Present Time.* 3 vols. Chicago: Alfred T. Andreas, 1884-86.

Armstrong, W. C. "The New Passenger Terminal of the Chicago and North Western Railway." *Journal of the Western Society of Engineers* 16, No. 10 (Dec. 1911): 933-1004.

Arnold, Isaac N., and J. Young Scammon. *William B. Ogden.* Fergus Historical Series, No. 17. Chicago: Fergus Printing Co., 1882.

Barton, Timothy. *Chicago and North Western Railway Terminal.* Chicago: Commission on Chicago Historical and Architectural Landmarks, 1981.

Casey, Robert J., and W. A. S. Douglas. *Pioneer Railroad: The Story of the Chicago and North Western System.* New York: Whittlesey House, 1948.

Chicago Department of Public Works. *Annual Report.* Municipal Reference Collection, Chicago Public Library, Chicago, Ill.

"Chicago Settles with Strauss for Infringing Bridge Patent." *Engineering News-Record* 85, No. 24 (9 Dec. 1920): 1158-59.

Cronon, William. *Nature's Metropolis: Chicago and the Great West.* New York: W. W. Norton & Co., 1991.

Dalstrom, O. F. "The 186 Foot Bascule Bridge of the C. & N. W. Ry., over the North Branch of the Chicago River at Deering." *Journal of the Western Society of Engineers* 22, No. 7 (Sep. 1917): 453-78.

"Eight Years of Litigation over Seattle Bascule Bridges." *Engineering News-Record* 103 (19 Dec. 1929): 968-69.

Eldridge, Archibald R. "Is It Unprofessional for an Engineer to Be a Patentee?" *Transactions of the American Society of Civil Engineers* 48 (1902): 314-26.

Finley, William H. "Construction of the Kinzie St. Drawbridge (Chicago) and Its Deep Foundations: Chicago & Northwestern Ry." *Engineering News* 64, No. 21 (24 Nov. 1910): 560-63.

______. "Cylinder-Pier Bridges of the Chicago and North Western Railway." *Engineering News* 68, No. 17 (24 Oct. 1912): 748-52.

______. "Rebuilding of the Kinzie Street Drawbridge of the Chicago & Northwestern Ry." *Journal of the Western Society of Engineers* 4, No. 1 (Feb. 1899): 51-72.

Frey, Robert L., ed. *Encyclopedia of American Business History and Biography: Railroads in the Nineteenth Century.* New York: Facts on File, 1988.

Galena & Chicago Union Railroad Co. *Fifteenth Annual Report of the Galena and Chicago Union Railroad Company, Presented to the Stockholders for the Fiscal Year Ending December 31, 1861.* Chicago: Brewster, Pierce & Co., 1862.

______. *Fourth Annual Report Read at the Annual Meeting of the Stockholders, June 4, 1851.* Chicago: Daily Democrat, 1851.

______. *Seventh Annual Report of the Galena and Chicago Union Railroad Company.* Chicago: Daily Democrat, 1854.

Gilbert, Paul T. *Chicago and Its Makers.* Chicago: Felix Mendelsohn, 1929.

Grant, H. Roger. *The North Western: A History of the Chicago & North Western Railway System.* DeKalb, Ill.: Northern Illinois Univ. Press, 1996.

Great Lakes Dredge & Dock Co. *A Few Views of Some of Our Work.* Chicago: Great Lakes Dredge & Dock Co., 1912.

"A Heavy Strauss Bascule Bridge." *Iron Age* 82, No. 25 (17 Dec. 1908): 1779-80.

Hillman, F. W. "North Western Stations." *Journal of the Western Society of Engineers* 42, No. 3 (June 1937): 127-32.

Liljencrantz, G. A. M. "Obstructive Bridges and Docks in the Chicago River." *Journal of the Western Society of Engineers* 3, No. 3 (June 1898): 1056-97.

Misa, Thomas J. *A Nation of Steel: The Making of Modern America, 1865-1925.* Baltimore: Johns Hopkins Univ. Press, 1995.

"The New Chicago Station of the Chicago & North-Western Ry." *Engineering Record* 61, No. 25 (18 June 1910): 774-78.

Norwood, C. H. "Electrical Equipment for a Bascule Bridge." *Railway Age Gazette* 53, No. 13 (27 Sep. 1912): 575-76.

"Notes and Queries." *Engineering News* 64, No. 22 (1 Dec. 1910): 602.

Petroski, Henry. *Engineers of Dreams: Great Bridge Builders and the Spanning of America.* New York: Alfred A. Knopf, 1995.

Prichard, H. S., et al. "Lift Bridges — a Discussion." *Proceedings of the Engineers' Society of Western Pennsylvania* 25, No. 1 (Feb. 1909): 11-75.

"Renewing a Bridge." *Railway Age and Northwestern Railroader* 25, No. 11 (18 Mar. 1898): 183.

Richardson, Helen R., comp. *Chicago and North Western Railway Company: A Centennial Bibliography.* Washington, D.C.: Bureau of Railway Economics Library, 1948.

"Riveted Lattice Truss Drawbridge, Chicago and Northwestern Ry." *Engineering News and American Railway Journal* 46, No. 6 (8 Aug. 1901): 84-85.

Statutes at Large.

Stennet, W. H., comp. *Yesterday and Today: A History of the Chicago and North Western Railway System.* 3rd ed. Chicago: Winship Co., 1910.

Strauss, Joseph B. "Bascule Bridge." U.S. Patent No. 894,239, 28 July 1908.

______. "Bascule Bridges." In *Proceedings of the Second Pan American Scientific Congress,* edited by Glen L. Swiggett, 6:304-23. Washington, D.C.: U.S. Government Printing Office, 1917.

______. "The Bascule Bridge in Chicago." In *A Half Century of Chicago Building,* edited by John H. Jones and Fred A. Britten. Chicago: 1910.

______. "Bridge." U.S. Patent No. 668,232, 19 Feb. 1901.

______. "Bridge." U.S. Patent No. 738,954, 15 Sep. 1903.

______. "Bascule Bridge." U.S. Patent No. 894,239, 28 July 1908.

______. "Bridge." U.S. Patent No. 974,538, 1 Nov. 1910.

______. "Bridge." U.S. Patent No. 995,813, 20 June 1911.

______. "Bascule Bridge." U.S. Patent No. 1,150,643, 17 Aug. 1915.

"A Trunnion Bascule Bridge." *Engineering News* 60, No. 13 (24 Sep. 1908): 349.

U.S. Army. Corps of Engineers. *Annual Report of the Chief of Engineers to the Secretary of War for the Year....* Washington, D.C.: U.S. Government Printing Office, 1876-1906.

U.S. War Department. *List of Bridges over the Navigable Waters of the United States, Compiled in the Office of the Chief of Engineers, United States Army, 1935.* Washington, D.C.: U.S. Government Printing Office, 1936.

Waddell, J. A. L. *Bridge Engineering.* 2 vols. New York: John Wiley & Sons, 1916.

"Weight of Counterweight Concrete Varied by Changing Mix." *Engineering News-Record* 80, No. 1 (3 Jan. 1918): 32.

Western Society of Engineers. *Constitution, By-Laws, List of Officers and Members....* Chicago: Western Society of Engineers, 1900 et seq.

Unpublished

Bruckner, Mike, Structural Designer for Union Pacific Railroad. Letter to author. 24 July 1999.

Chicago & North Western Railway Co. "Bridges over the North Branch of the Chicago River and Proposed Improvements in the Vicinity of Kinzie St." Drawing No. 6087 (19 July 1906). Chicago Division Bridge No. N-1511, plan files, Union Pacific Railroad, Omaha, Neb.

Finley, William H., Chief Engineer of Chicago & North Western Railway. Letter to Joseph B. Strauss. 24 Dec. 1915. Files, Green Bay Department of Public Works, Green Bay, Wis.

Mayer, Harold M. "The Railway Pattern of Metropolitan Chicago." Ph.D. diss., Univ. of Chicago, 1943.

McGaw, Judith A. "Hawthorne Bridge." HAER No. OR-20. Historic American Engineering Record, National Park Service, U.S. Department of the Interior.

Palmatary, James T. "[Map of] Chicago." Chicago: Braunhold & Sonne, 1857. Geography and Map Division, Library of Congress, Washington, D.C.

Reeve, A. B. "The Story of Strauss Bridges." Typescript, Chicago: Strauss Bascule Bridge Co., n.d. Private collection of Eric N. DeLony.

Strauss Bascule & Concrete Bridge Co. "Strauss Trunnion Bascule Bridge for C. & N. W. Ry. Co. over North Branch Chicago River near Kinzie St., Chicago, Illinois," drawings (9 May 1907). Chicago Division Bridge No. N-1511, plan files, Union Pacific Railroad, Omaha, Neb.

Wells, F. L., Supervisor of Signals for Chicago & North Western Railway. Letter to J. S. Robinson, Division Engineer, 21 Oct. 1922. Archives, Chicago & Northwestern Historical Society, Chicago, Ill.

Zappler, Tom, of Union Pacific Railroad. Telephone conversation with author. 11 June 1999.