CHICAGO AVENUE BRIDGE
Illinois & Michigan Canal National Heritage Corridor
Chicago Bridges Recording Project
Spanning North Branch of Chicago River at West Chicago Avenue
Chicago
Cook County
Illinois

HAER No. IL-144

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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
Washington, DC 20240

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Jet Lowe, photographer, summer 1999.

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HISTORIC AMERICAN ENGINEERING RECORD

CHICAGO AVENUE BRIDGE

HAER No. IL-144

Location:	Spanning the North Branch of the Chicago River at Chicago Avenue, Chicago, Cook County, Illinois.
Date of Construction:	1914
Designer:	City of Chicago
Builder:	Byrne Brothers Dredging and Engineering Company (substructure); Ketler & Elliot Company (superstructure)
Present Owner:	City of Chicago.
Present Use:	Vehicular bridge.
Significance:	The Chicago Avenue bascule belonged to a set of Chicago city bridges built between 1910 and 1915 that augured in this transition in design from an earlier strictly utilitarian approach to one influenced by aesthetic concerns. Its design also incorporated several innovations that became standard features of the next generation of the "Chicago type" bascule bridge.
Historian:	Matthew T. Sneddon, June 1999.
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.

Significance

Prior to the Civil War, commerce and travelers from west of Chicago could cross over a float bridge at Chicago Avenue to the northeast side of the city, an area separated from the emerging central business district by th2e river that served as the commercial lifeline of the burgeoning city. By 1914, three different types of movable bridges had spanned the Chicago River at this point, each type representing an important stage in the development of movable bridge technology in Chicago. Attendant with the technological changes from the first float bridge to the bascule bridge completed in 1914, a new conception of the bridges as contributors to the physical beauty of the city added an influential dimension to the city's plans for future bridges. The Chicago Avenue bascule belonged to a set of Chicago city bridges built between 1910 and 1915 that augured in this transition in design from an earlier strictly utilitarian approach to one influenced by aesthetic concerns. Its design also incorporated several innovations that became standard features of the next generation of the "Chicago type" bascule bridge.

Bridge History

"It is well known to everybody," began an 1898 study of obstructions to navigation on the Chicago River, "that the Chicago river has been and is of enormous value to the commerce of the city, through its large and extensive lake traffic, which compares favorably with that of any of the largest cities in the country... but it should be remembered that, in a place of such rapid growth and progress as Chicago, that which appears great and ample one day has generally proved small and insufficient the next."[1] Certainly the author, consulting engineer G. Liljencrantz, could well have had Chicago's movable bridges in mind when he referred to the effects of technological obsolescence. Bridge technology in Chicago during the nineteenth century had been hard pressed to keep pace with developments in transportation technologies, particularly in regard to the larger shipping vessels which supplied the city with the material for its prodigious growth. The original float bridges, with low clearances and slow, hand-pulled, chain-driven, opening mechanisms, hindered both river and surface traffic alike. As the city became increasingly involved in bridge building, considerable attention was given to the replacement of the slow-moving float bridges by the more quickly opened center-pier, pivot or swing type bridge. At Chicago Avenue, the city replaced the early float bridge with a new iron and wood swing bridge in 1867, which had to be rebuilt after it burned in the 1871 Chicago fire. In describing his design for these iron and wood trusses, J.K. Thompson, City Superintendent for the Board in charge of Streets, Bridges, Public Buildings, &c., modestly declared: "The Chicago pivot bridges, in convenience, and the facility with which they are handled, are believed to be

[1]G.A.M. Liljencrantz, "Obstructive Bridges and Docks in the Chicago River," *Journal of the Western Society of Engineers*, 3 (June 1898): 1056.

equal to any in our country. In no place are they so severely tested."[2] Unfortunately, the center-pier that served as the pivot point for the swing bridges also posed an obstacle to the increasingly larger boats that attempted to navigate the Chicago River. Despite attempts to adapt to the demands of both river and surface traffic, it was apparent to turn of the century observers such as Liljencrantz that the cycle of insufficiency had resurfaced on the river.

Maximizing the width available for navigation at the Chicago Avenue location was a vital concern for the various industries, commercial warehouses, and railroads that occupied the banks of the north branch of the Chicago River in the late nineteenth century. City engineers studied the problem presented by the swing bridges, and submitted a design for a "bascule" bridge, a name derived from the French word for teeter totter, that left a clear channel for river traffic. This original 1900 design consisted of two movable truss configured leaves that rotated on fixed axles, or trunnions. As the front portion of the span was balanced by weights rigidly attached to the rear, relatively little motive power was needed to raise or lower the leaves. This simple trunnion bascule design, which opened quickly and was well-suited to the pliable soil of the Chicago substratum, became the basis for the widely known "Chicago-type" bascule bridge. That the north branch received the first city-engineered bascule bridges testified to the importance of improving navigation on this gateway to a sizeable industrial district.

After congressional acts of 1890 and 1899 granted the War Department the authority to protect and preserve the nation's navigable waterways, shipping interests received a welcome ally in their campaign to clear the Chicago River of the center pier swing bridges. Shortly after 1900, Chicago became a primary testing ground of the new federal power. The Chicago Avenue swing bridge, located on a particularly difficult section of the north branch to navigate near "collision bend," was one of several bridges deemed an obstruction to navigation and ordered removed by the Secretary of War in the first decade of the twentieth century. While Chicago's city government labored to gain more time to work out a replacement schedule for the condemned bridges, the Division of Bridges and Harbors of the Chicago Department of Public Works began to work on plans for a bascule bridge at Chicago Avenue in 1911.[3]

The design for the Chicago Avenue bridge drew on several recent engineering and architectural developments in the city. Prominent Chicago architect Daniel Burnham and his assistant Edward Bennett had published their influential Chicago Plan just two years earlier in 1909, and its supporters convinced the city to implement elements of the plan's architectural recommendations on the bridge and surrounding approaches. Previously, little attention had been paid to the appearance of the bridges, particularly in regard to the operators' houses, which were typically simple, unadorned wooden box houses attached to one side of the bridge at the foundation abutments. Such utilitarian structures were a long way from the neoclassical, beaux arts bridges Burnham and Bennett imagined as the impressionable gateways to the city. The

[2] Chicago Board of Public Works, *Annual Report* (1868), 34.

[3] Chicago Department of Public Works, *Annual Report of the Chicago Department of Public Works* (1911), 232.

Chicago Plan envisioned the downtown sections of the city's waterways as not only a vital conduit for the city's commercial growth, but as a place to reflect a civic culture commensurate with the city's claims to greatness.

Burnham and Bennett were not the first to recognize the civic value of aesthetically pleasing bridges in the central business district. The Municipal Art League's initial attempts in 1902 to influence the architectural treatment of the bridges were rebuffed by the Division of Bridges. It is likely the meager funds budgeted for bridges in the first decade of the twentieth century discouraged the city engineers from considering architectural improvements. The financial footing of the Bridge Division in the first years of the twentieth century was less than stable: at the same time the Bridge Division faced orders from the Secretary of War to remove several swing bridges, it found the available monetary resources hardly sufficient to maintain the existing bridges. To City Engineer John Ericson, the situation was intolerable and dangerous. In the 1911 Chicago Department of Public Works annual report, he reported that it was impossible "to convey an idea of the impaired, almost disreputable, condition of the bridges, bridge piers and protections; the unprotected condition of the machinery and the deterioration of the machinery due to improper protection from rains and dirt."[4] According to one member of the Chicago Association of Commerce, the 35th Street bridge was in such a dangerous condition that "a friend of mine that lives in the vicinity never drives his automobile over. He gets out and walks over whenever he crosses this bridge. Tens of thousands of people pass over it daily."[5]

The answer the city formulated to the problem of funding was a proposed bond issue to support an ambitious new program of bascule bridge construction. Previously, appropriations for bridges had usually come from the city's general Corporate Fund, which left little for the Division of Bridges after monies were distributed to the police, fire department, city government salaries, Department of Sewers, Department of Water, and other public works. With the bridge bond, the city proposed a lump sum of $4,655,000 be earmarked specifically for the construction of several new bridges, contingent on voter approval. Recognizing the importance of the new bridges to the economic well-being of the city, the Chicago City Club and Association of Commerce organized a campaign in favor of the bonds. One effective technique placed "conspicuous signs" on the old center-pier swing bridges, advising passers-by "to tear this old bridge down" and "replace it with a modern structure by voting 'yes' on the bridge bond issue."[6] The bridge bonds passed by a wide margin in the April election of 1911.[7]

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[4] Chicago Department of Public Works, *Annual Report of the Chicago Department of Public Works* (1911), 23.

[5] "Proposed Bond Issue for Bridges," *The City Club Bulletin* 4, no. 6 (12 April 1911): 60.

[6] Chicago Association of Commerce, "Bridge Bond Campaign" *Annual Reports of the Chicago Association of Commerce* (1911): 84.

[7] 211,751 for, 65,080 against. *Chicago Tribune* (5 April 1911): 1.

With an improved financial foundation now secure, the city moved forward with its plans to build several new bridges, including one at Chicago Avenue, and finish the bridge at Washington Street. The Washington Street Bridge marked the first success of the movement to gain "bridges of improved appearance" on the river. On this project, various civic and professional groups such as the Municipal Arts Committee, the Illinois Chapter of the American Institute of Architects, and the Chicago Plan Commission collaborated with the Division of Bridges, suggesting several changes to the bridge's approaches and operators' houses. City engineers found the new concern for aesthetics exacted certain sacrifices in terms of time and money. Washington Street, a key crossing point from the west side to the Loop, had been without a bridge for several years because the funds to build replacement bascules had been unavailable. Despite the pressing need to speed the Washington Street bascule to completion, the Bridge Division found construction delayed by their having spent considerable time incorporating the unusual architectural treatment and ornamentation submitted by the Chicago Plan Commission.[8] For a department that had just two years previously regarded the condition of the city's bridges as intolerable, the added expense and time of the new architectural treatment reflected the depth of the commitment to making the bridges adhere to the tenets of the city beautiful movement.

This commitment was also being carried out at Chicago Avenue, where despite the industrial character of the surrounding area, an area removed from the Loop by several blocks, Engineer of Bridge Design Alexander von Babo reported the new bridge would "be given a monumental appearance by the free use of concrete for the operating houses, enclosure walls and sidewalk railings, etc."[9] This first use of concrete rather than wood indicated the city was willing to incur the additional cost of presenting a more permanent, monumental structure, but only to a point. The city was reaching its limit on expenditures for the project, which ultimately cost $294,827 to build, well above the $250,000 initially allocated by the 1911 bond.[10] Rather than

[8] Chicago Department of Public Works, *Annual Report of the Chicago Department of Public Works* (1912), 245.

[9] Chicago Department of Public Works, *Annual Report*, 245.

[10] In the 1910 *Proceedings of the City Council*, the council allocated $250,000 for construction of a bridge at Chicago Avenue. "Proposed Bond Issue for Bridges," *The City Club Bulletin* 4, no.6 (12 April 1911): 1, also lists the figure of $250,000. A *Chicago Tribune* article listed the amount at $280,000, but it is likely this amount was either inflated, or subsequently reduced when the full value of the bond was not obtained. *Chicago Tribune* (5 April 1911): 2. Due to a legal technicality, the original bond issue in the amount of $4,655,000 was declared illegal, but it was re-submitted for a slightly less amount at the fall election and again passed by heavy majority vote in every ward. Chicago Association of Commerce, *Annual Report of the Chicago Association of Commerce* (1908), 61. The final cost of the bridge is listed in an unpublished table, in the archives of the Chicago Department of Transportation, Bureau of Bridges and Transit.

using more expensive stone facing, such as that used in London Bridge on the Thames River (a simple trunnion bascule completed in 1894), the city instead emulated stone with concrete, "so constructed as to present a granite texture on the exterior surfaces."[11] Unfortunately the operator's houses for the Chicago Avenue Bridge were monolithically cast, with insufficient provision for expansion. The structures aged poorly, making replacement rather than rehabilitation a likely course in the near future.

Although Edward Bennett, co-author of the Chicago Plan and architectural consultant to the CPC, was active in directing the future architecture of Chicago's public works, he was not the principal architect on the Chicago Avenue project. The extant original architectural drawings of the Chicago Avenue Bridge bear the title block of the CPC, but the 1912 Annual Report of the Chicago Department of Public Works cites George W. Maher and E.C. Jensen, members of the Illinois Chapter of the American Institute of Architects, as the delineators of much of the architectural work.[12] The rather austere, oval-shaped operator's houses roofed with vitrified tile were not typical of Bennett's bridge sketches in the Chicago Plan or future work with the city, and the Chicago Avenue Bridge was not among those listed by historian Joan Draper as bridges Bennett acted as consultant for. Nevertheless, the city was moving more toward the standard architectural treatment Bennett advocated. Whereas the operators' houses had formerly appeared as an appendage suspended from the side of the fixed part of the bridge, the Chicago Avenue design initiated the practice of integrating the operators' houses into the abutment masonry, where it blended more cohesively into the approaches and foundations. Bennett hoped that the CPC's involvement in these early bridges would help coordinate the development of a standard bascule type, cheaper to engineer and build, that would present the sort of harmonious architectural program outlined in his plan.

If the Chicago Avenue Bridge represented a step toward a more cohesive, elaborate architectural treatment of the Chicago bascules, similarly, it incorporated recent engineering features that became commonly used in later bridges. In the same year plans for the Chicago Avenue bridge were finalized, the Bridge Division prepared a set of "General Specifications" that covered the design and detailing of the structural parts and machinery used in the city's movable bridges and simplified calculations.[13] One of the most significant aspects of the new design was the internal rack patented by the city's Engineer of Bridge Design, Alexander von Babo. Von Babo explained in his patent application that a rack contained internally within the trusses, used in conjunction with a transverse trunnion girder to support the trunnions, allowed space for a larger dimension counterweight of more inexpensive material and permitted placement of the operating machinery and gear trains directly alongside the movable truss. In

[11] Chicago Department of Public Works, *Annual Report* (1914), 155.

[12] Chicago Department of Public Works, *Annual Report* (1912), 245.

[13] Chicago Department of Public Works, *Annual Report,* 241.

addition, it "avoided use of unsightly circular racks above the top chords or beneath the bottom chords."[14]

Two prior attempts to circumvent the large through trusses associated with external racks produced interesting precursors to the internal rack. In 1910, the Bridge Division completed a bridge at West Erie Street supported by two "pony" trusses instead of the standard three through-trusses used in earlier Chicago bascules. Since the "pony"-type truss extended half-way above and half-way below the deck, the truss ends did not afford the radius needed for an external rack of conventional design. Instead, von Babo and Engineer in charge of Bridges Thomas Pihlfeldt constructed a complex opening mechanism actuated by an operating strut, located under the roadway, which raised and lowered the bridge. Although this bridge operated until its removal in 1970, the arrangement was never used again. At Polk Street, another two-pony truss type bascule of much different design, was completed in 1910. Here, a unique situation developed. For undisclosed reasons, the Bridge Division opted to build a bridge designed by Chicago's Strauss Bascule Bridge Company (later the Strauss Engineering Corporation), specialists in movable bridge engineering, that mounted a curved rack externally, but underneath rather than atop the main trusses.[15] For the first and last time until the late 1970s, the city's Bridge Division erected a bridge not of its own design. In its undermounted, external rack design, the Polk Street bascule was similar to bascules built earlier in Milwaukee, Wisconsin, and illustrated one method of how the trusses might be lowered and the truss end, circular external racks dispensed with. Von Babo's insight led him to invert the rack from its external mounting to one contained within the truss, so that the machinery and trusses could be lowered and obscured from view. Nearly all subsequent bascules built by the city's Bureau of Bridges were opened by internal racks, and bridges in other cities such as Seattle, Washington, borrowed the design as well.

In the group of double-leaf, single deck, bascule bridges built between 1912 and 1915, several aspects of design were standardized in conjunction with this early use of the internal rack. The Chicago Avenue, Washington Street, 92nd Avenue, and Indiana Street (Grand Avenue) bridges shared gearing, including rack dimensions, pitch radius, distance from trunnion to pinion, and gear sizes, as well as motor and drive train arrangements at the rear end of the truss, with unconnected units mounted on each truss of the leaf, either unit able to fully operate the leaf in the event one of the units failed. Although the distance of bridge spans and leaf weights differed, all were driven by direct current motors that ranged from forty to fifty horse power each.[16]

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[14] U.S. Patent No. 1,001,800, received 29 August 1911, Alexander F. L. von Babo, 1.

[15] It is possible that the Division of Bridges was under some pressure to open the bidding for design of the city's bridges to outside competition.

[16] First mentioned in connection with 92nd Avenue bridge, Chicago Department of Public Works, *Annual Report of the Chicago Department of Public Works* (1909), 139.

Another feature of bridge design standardized by the end of the decade was the use of two trusses instead of three to support the bridge decking, and the positioning of the center of gravity in the movable leaves. The 1910 Erie Street Bridge demonstrated the switch from three supporting trusses to two worked well and saved money, materials, and time. Chicago Avenue Bridge, and nearly all other single-deck, double leaf bascules built by the city after 1910, used two trusses to support each leaf. Ideally, the front and rear portions of a bascule leaf balanced perfectly around the trunnion, and required only the motive force needed to overcome friction to open and close. In early practice, the City Engineer John Ericson feared a perfectly balanced bridge might become unbalanced on hot days when the timber decking dried out and raise unexpectedly. To avoid this possibility, the first bascules had their center of gravity just ahead of the trunnions, and had to be raised fourteen inches before they became balanced. Since this required heavier motors and more substantial front piers for the trusses, Thomas G. Pihlfeldt, Engineer in Charge of Bridges, convinced Ericson that the structure could be exactly balanced by building pockets into the counterweight into which cast iron or lead plates could be placed to account for weight changes caused by the weather.[17] Bridges built after 1910 incorporated Pihlfeldt's counterweight pockets, which also served as a means to re-balance the bridge in later years, when more durable concrete and steel grid decks replaced the original wood ones.

Clearly many aspects of the Chicago Avenue Bridge were typical of the generation of Chicago bascules built just prior to World War I, but important differences lay beneath the surface. A sewer tunnel crossed the river at Chicago Avenue, and the city hoped a subway would eventually run under the bridge. Subsurface conditions such as tunnels or nearby foundations required unique solutions. In this case, the city engineers had recently encountered similar problem at Washington Street. Here, reinforced concrete shafts that straddled the existing streetcar and pedestrian tunnel were sunk below the concrete piles to support the counterweight pit. The Chicago Avenue Bridge used the same sort of foundational supports, with forty feet of space between the shafts to allow for the future subway tunnel. Atop the counterweight pit, two longitudinal girders that extended from the front wall (river pier) to the back wall (anchor pier) of the pit provided support for the outside trunnion bearings. Supporting the trunnion bearings was a special concern, because not only was the entire weight of the leaf was concentrated on the two bearings as it opened, but the supports had to allow space for the path of the large counterweight rigidly fixed to the rear end of the truss. This outer longitudinal girder, first used at West Erie Street, was characteristic of most later superstructure supports. Curiously, the inner trunnion supports at Chicago Avenue copied an older arrangement used at West Erie Street instead of the transverse or "cross" girder specified as a key component of the internal rack design. The inner support consisted of a quadrilateral, longitudinal truss extended from the front wall to the back wall of the pit. Because the cross girder became the focus of a patent infringement suit brought against the city by the Strauss Bascule Bridge Company in 1913, the city engineers may have tried to avoid the complications its use may have brought; however, several bridges built during the lengthy period of litigation that lasted until 1920 employed the cross girder design.

[17] *Chicago Daily News* (15 October 1936), 21.

Epilogue

The deck and roadway of the Chicago Avenue Bridge was designed to support primarily horse-drawn transport and light automobile traffic. Like many bridges built before the automobile gained widespread use, the maintenance section of the Bridge Division updated the Chicago Avenue Bridge with a more durable deck and roadway surface. The new deck, completed in 1932, required the addition of fifty tons of counterweights to balance the heavier retrofit. Despite the decline of shipping on the north branch of the river, the bridge still opens infrequently, largely for recreational river traffic. Another re-decking and major repairs to the bridge in 1968,1969 and 1992 have kept the bridge operational to this date.

To Donald Becker, former Engineer of Bridge Design with the city, the years during which the Chicago Avenue Bridge was designed and built constituted an "improvement period" of the Chicago type.[18] Indeed, a certain continuity underlay the transition from the first Cortland Street bascule built by the city in 1902 to the Chicago Avenue Bridge completed over a decade later. In principle, the two bridges shared the basic simple trunnion design with rigidly attached, below-deck counterweights, as well as certain details such as deck framing, paved surfaces, and center lock devices. Yet aspects of the Chicago Avenue design, including the patented internal rack and pinion system, the shift to a two pony-truss leaf configuration, and unusual foundational supports, separated this next generation from the precedent set at Cortland Street, illustrating some of the limits of conceptualizing an archetypal "Chicago-type" bascule design.

[18] Donald N. Becker, "Development of the Chicago Type Bascule Bridge" *Proceedings of the American Society of Civil Engineers* LXIX (February 1943): 279.

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