Historic Features Report

for

Bridge 2440 Rehabilitation Design (3rd Avenue Bridge), over the Mississippi River Minneapolis, Hennepin County, Minnesota

S.P. 2710-47 (TH 65)

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HNTB

Report Prepared for

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EXECUTIVE SUMMARY

The Minnesota Department of Transportation (MnDOT) is beginning a three-phase project to develop plans and specifications to rehabilitate the historic Third Avenue Bridge (Bridge 2440) in Minneapolis. Phase 1 of the project includes collecting and assembling information related to the history and condition of the bridge. After assessing information on the current field conditions and material properties, rehabilitation alternatives that meet the Secretary of the Interior's Standards for the Treatment of Historic Properties will be developed and evaluated. Phase 2 includes developing a geometric layout, assembling preliminary plans, and preparing a preliminary cost estimate based on the selected rehabilitation alternative. In Phase 3, final plans and specifications, suitable for bidding or coordination with a Construction Manager General Contractor, will be completed.

This Historic Features Report discusses the findings from a review of archival records, photographs, drawings, and other historical information about the bridge. It includes a description of the original construction of the bridge and changes that have taken place over the years from both a historian's and an engineer's perspective. It also contains an analysis of the significance of the bridge and its character-defining features. The information in this report will be used to develop a range of rehabilitation alternatives and to evaluate the impact of each of the alternatives on the historic integrity of the bridge.

The format of this report follows the outline of the 2012 MnDOT Historic Bridge Rehabilitation Study Format. Specifically, it contains content for Sections 2 and 3. It is anticipated that the content in this report will be incorporated in the Bridge Rehabilitation Alternatives Report to be assembled later in Phase 1.

The Third Avenue Bridge, which crosses the Mississippi River on the edge of downtown Minneapolis, opened on June 14, 1918. The structure's curved alignment was dictated by difficult foundation conditions at its location just upstream from Saint Anthony Falls. The monumental, reinforced-concrete, Melan-arch structure has five rib-arch main spans and two barrel-arch main spans. The original structure had four approach spans at each end, some cast-in-place reinforced-concrete beam spans and the rest steel beam spans; these were replaced by two spans for each approach in 1979.

The bridge is a contributing feature in the Saint Anthony Falls Historic District, which was listed in the National Register of Historic Places in 1971, and the bridge was previously determined individually eligible under Criterion C for its engineering significance. The following report examined other aspects of the bridge's history and recommends that it also qualifies for the National Register under Criterion A for its important role in the region's transportation network. The recommended period of significance begins in 1918, when the bridge was placed in service, and ends in 1941, adopting the ending date of the Saint Anthony Falls Historic District.

The bridge has experienced some changes over the course of time, including the beginning of streetcar service on tracks that were installed when the bridge was built, the removal of the tracks after service was discontinued in the 1950s, and major renovations in 1938-1939 and the 1970s.

Nevertheless, the bridge retains good integrity. Alterations in the 1930s, including the installation of metal railings, date from the period of significance.

Character-defining features include large-scale elements—the overall configuration and material of the seven main spans and related structure, incised linear detailing, and the observation platforms and cantilevered sidewalks—and noteworthy details such as the 1930s metal railings, the sidewalks, and the original light fixtures (no longer extant).

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2.0 BRIDGE HISTORICAL BACKGROUND

2.1 National Register of Historic Place Documentation

In the mid-nineteenth century, Euro-Americans established Saint Anthony on the East Bank of the Mississippi.[1] The town grew, catalyzed by commerce and by sawmills on the river, but it was soon overshadowed by Minneapolis, which appeared on the West Bank in the 1850s. In 1872, Saint Anthony merged with its younger rival.

The East Bank, though, retained a commercial core and sense of community that is still evident today. Its vitality was bolstered in the early twentieth century as the city's population boomed and the streetcar system encouraged real estate development to spread out from the river. Saint Anthony was connected in 1875 to Minneapolis's downtown core by the first streetcar line, which ran along Washington Avenue North to Hennepin Avenue, then across the river to East Hennepin Avenue and down Fourth Street Southeast.[2]

Lines connecting the east and west sides of the river were critical to the city's growth, but all of the lines had to run over the Hennepin Avenue Bridge, creating congestion at the bridgeheads, especially at the east end. Boosters on both sides of the river began a campaign for a new bridge at Third Avenue South around 1905. The plan was not popular with business owners along Hennepin, Nicollet, and East Hennepin Avenues, who feared a loss of customers. They questioned whether traffic demands required a new bridge, advocating instead for widening the Hennepin Avenue Bridge or rebuilding the 1872 Tenth Avenue Bridge, which connected the banks downstream from the Great Northern Railway's Stone Arch Bridge. Upgrading the aging Tenth Avenue crossing, however, was not an easy fix according to city engineer Andrew Rinker: "If that bridge were to be replaced by a modern structure, all of the steep grades to its approach should be eliminated, and the entire structure made to span the railroad bridges on this side of the river and the tracks on the other side at a high elevation. This would cost as much, if not more, than a new bridge at Third avenue south."[3]

Despite opposition, the idea of a new bridge took hold with supporters arguing that the new bridge would help expand the downtown core to include the Municipal Building (courthouse and city hall) and a new federal post office being constructed on Third Avenue South. William Henry Eustis, a former mayor, stated, "The people of the East Side are also entitled to a direct approach to such important centers as the Chamber of Commerce, the new union station, our great milling district, and the court house and city hall building." He continued, "the people of the East Side have the right to demand that they shall be given the most immediate access possible to the

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[1] The Mississippi River generally runs north to south. It alignment angles northwest-southeast in the vicinity of Saint Anthony Falls. Regardless, the two sides of the river are commonly known as the East Bank and West Bank, conforming to the directions that typically characterize the river. This standard nomenclature is adopted for this report.

[2] John W. Diers and Aaron Isaacs, *Twin Cities by Trolley: The Streetcar Era in Minneapolis and St. Paul* (Minneapolis: University of Minnesota Press, 2007), 25, 35.

[3] Rinker quote from "Petition: Paper Presented to City Council Friday Opposing Third Avenue Bridge," *Minneapolis Tribune*, February 10, 1906. See also Calvin F. Schmid, *Social Saga of Two Cities: An Ecological and Statistical Study of Social Trends in Minneapolis and St. Paul* (Minneapolis: Minneapolis Council of Social Agencies, 1937), 5-6.

federal building instead of reaching it by the present roundabout medium of the steel arch bridge and Hennepin avenue." Pressure for the bridge continued to grow over the next few years as the city's population also expanded. The Saint Anthony Commercial Club, a business organization on the east side of the river, was instrumental in publicizing the importance of a bridge.[4]

By 1912, opinion had been swayed and the Minneapolis City Council commissioned a design for a reinforced-concrete bridge from the Concrete-Steel Engineering Company in New York. It was a challenging site, just above Saint Anthony Falls. The falls, which had originally been located near what is now downtown Saint Paul, had worked its way northwest due to the geology beneath the Mississippi River. The top layer, limestone, rested on fragile beds of shale and sandstone. Backwash from the falls eroded the lower layers, creating limestone ledges that eventually collapsed from the force of the pounding water and caused the falls to move upstream. The limestone ledge ended near where the new bridge was proposed. If the ledge were lost, the falls would be as well, leaving rocky rapids. This had almost happened in the 1860s when a tunnel that was being burrowed under the river had collapsed, leading to years of failed remedies to stabilize the falls. Solutions finally came in the form of a subterranean dike, which controlled water seepage beneath the falls, and a series of aprons in wood, and then concrete, protecting the fragile limestone precipice.[5]

The Concrete-Steel Engineering Company did not respect the delicacy of the limestone riverbed in considering the design for the new bridge, particularly the location of the piers. Frederick W. Cappelen, who succeeded Rinker as city engineer, objected to the proposed plans because of the damage that would occur to the falls. The city council rejected the plans and instructed Cappelen to design a steel truss bridge. The resulting design had less impact on the riverbed and was approved by the council, but was not popular for aesthetic reasons. Given the prominence of the location, Cappelen tried again and came up with the solution that would ultimately be constructed. The reinforced-concrete bridge design was modified to curve like a reverse "S" so the pier locations avoided the limestone breaks in the river. Cappelen and city bridge engineer Kristoffer Oustad worked with Charles Bornefeld from the Concrete-Steel Engineering Company to modify the company's initial plans. Construction on the bridge, "the first of the graceful reinforced-concrete arch bridges in the Twin Cities," began in 1914.[6]

The chief designer for the Third Avenue Bridge was Frederick Cappelen, a Norwegian engineer educated in Sweden and Germany. He immigrated to the United States in 1880 and initially worked for the Northern Pacific Railway. In 1886, he was hired as a bridge engineer by the City of Minneapolis and designed the steel-arch Hennepin Avenue Bridge, completed between 1888 and 1890. In 1893, Cappelen was elected as the city engineer and held the position until 1898. He was reelected as city engineer in 1913, continuing in that role until his death in 1921. In 1914, Cappelen became the first president of the Minnesota Section of the American Society of Civil Engineers. He also made important contributions to the city and state as a sanitary

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[4] Quotes from "Third Avenue Bridge Said to Be Necessity," *Minneapolis Tribune*, March 3, 1907. See also "Business Men Want Third Avenue Bridge," *Minneapolis Tribune*, December 13, 1912.
[5] A. M. Richter, "A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve," *Engineering News* 74 (December 30, 1915): 1268-1270.
[6] Ibid., 1268-1270. Quote from Kenneth Bjork, *Saga in Steel and Concrete: Norwegian Engineers in America* (Northfield, Minn.: Norwegian-American Historical Association, 1947), 148.

engineer. Kristoffer Oustad, who collaborated with Cappelen on the Third Avenue Bridge, was another Norwegian engineer who immigrated to Minnesota and joined the city's engineering office in 1883. He worked his way up through the department and became the city's bridge engineer in 1893. Oustad would take over bridge design after Cappelen's death and would retire from the department in 1929.[7]

The design for the bridge utilized the Melan system of reinforcing the concrete arches of the seven main spans. For smaller structures, steel I-beams or railroad rails were curved to form the arch and covered with concrete. In larger structures, such as the Third Avenue Bridge, the "beams" were built-up from angles and lacing. In either case, the size, number, and spacing of the beams or trusses depended on the size and structural requirements of the bridge spans. The Melan concrete-arch system was introduced to the United States in 1894 by Frederick von Emperger at the annual meeting of the American Society of Civil Engineers. That same year, the country's first Melan concrete-arch bridge was built in Rock Rapids, Iowa. Emperger would design a larger bridge for a park in Cincinnati, Ohio, in 1895. In the early twentieth century, when concrete bridge construction was relatively rare, the Melan system gave engineers confidence to design the picturesque concrete-arch structures that were in high demand. The system used a large amount of fabricated steel, though, which made it expensive. More efficient systems of reinforcing would eventually make the Melan system obsolete.[8]

The construction of the bridge began with the footings for the piers in the river. Steel sheet coffer dams were constructed around the site of each pier and the silt cleared down to the limestone riverbed. Temporary timber towers measuring 165 tall were built on the east and west sides of the river. Steel cables running between the towers carried concrete and other materials over the water to the construction site. Work on the piers continued through the winter months. Falsework for the arches was started on April 19, 1915. Crews assembled the steel arches and poured concrete over the next three years. The bridge was opened on Flag Day, June 14, 1918, with a simple ceremony. The city council requested that every citizen cross the bridge sometime during Flag Day as a way of observing the holiday and the opening of the bridge.[9]

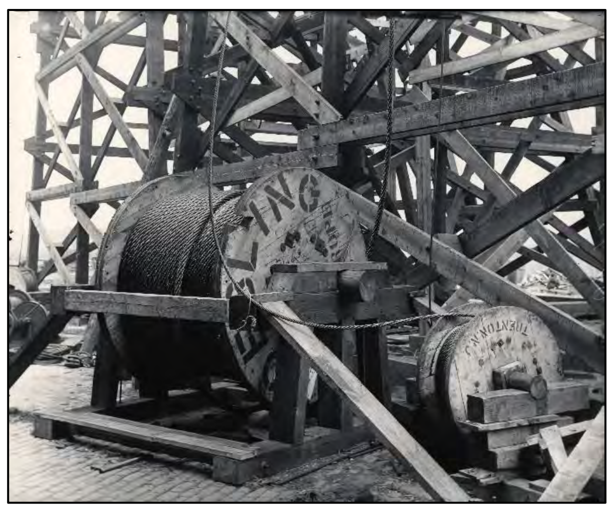

Figure 1. *Wire rope for the cableway was provided by the Roebling Company, New York, June 29, 1914 (City of Minneapolis)*

[7] Bjork, *Saga in Steel and Concrete*, 140-142, 146-147.
[8] Robert M. Frame III, "Reinforced-Concrete Highway Bridges in Minnesota," context developed from the National Register of Historic Places, Multiple Property Documentation Form, 1988, 12, available at the Minnesota Department of Transportation, Saint Paul; Juliet Landler, "Melan Arch Bridge, Addendum to Reinforced Concrete Arch Bridge," Historic American Engineering Record No. IA-15, 3-7; Frederick von Emperger, "A Melan Concrete Arch in Eden Park, Cincinnati, O.," *Engineering News* 34 (October 8, 1895): 214.
[9] Richter, "A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve," 1270-1271; "Preliminary Work Completed on New Third Avenue $650,000 Bridge," *Minneapolis Morning Tribune,* June 18, 1915; "Simple Ceremonies to Mark Completion of Third Ave. Structure," *Minneapolis Tribune*, June 14, 1918; "Third Av Bridge Is Mecca of Crowds Bent on Inspection," *Minneapolis Journal*, June 16, 1918.

Figure 2. *Construction Cableway Passengers, undated (City of Minneapolis)*

Before the bridge was completed, it was heralded as a sign of Minneapolis's growth. The *Minneapolis Sunday Tribune* reported that "this bridge will answer the ever-recurring demand for more convenient communication between the two banks of the river. It was the lack of such communication that so long kept St. Anthony the town, and Minneapolis but a field of undeveloped opportunities."[10] The bridge succeeded in connecting the city and making Central Avenue a prominent commercial strip.

The streetcar system was the primary public transit in the early twentieth century, and its ridership expanded rapidly, jumping from 31.2 million in 1900 to 87.4 million in 1910 and nearly 120 million by 1917. While a streetcar line was not immediately planned over the Third Avenue Bridge, the city engineer's office and the Minneapolis Street Railway had the foresight to install streetcar tracks as part of the original bridge construction. In 1920, with ridership at 138.6 million, the city council directed the Minneapolis Street Railway to route streetcars over the Third Avenue Bridge. The bridge soon carried the Bloomington-Columbia Heights line, the Grand and Monroe lines, and the Bryan and Johnson lines, and was "the keynote to the plan of rerouting and construction of new lines" to serve the city. The bridge, together with an expansion of the network of tracks through downtown Minneapolis, provided better service and relieved congestion.[11]

The bridge became part of U.S. Highway 8 in 1933 and U.S. Highway 65 in 1934. Even as it secured a prominent role in the state's transportation system, though, the bridge showed early signs of aging. By the 1930s, the sidewalks and concrete railings were deteriorating. The *Minneapolis Star* claimed that original railings were "built at the workhouse" and "merely set on the sidewalk." Using funds from the Public Works Administration (PWA), the city rehabilitated the bridge in 1938-1939. The concrete railings were completely removed and new Art Deco aluminum panels and concrete posts installed. The posts were tied into the deck structure with reinforcing rods. The *Minneapolis Tribune* reported that the new railings allowed the "opportunity for motorists and pedestrians alike to view the waters of the Mississippi far below." New sidewalks and curbs were poured. Space was reserved under the sidewalks to run conduit. Raised curbs with a steel pipe traffic barrier—to prevent "curb-vaulting motor vehicles"—were placed between the sidewalks and the roadway. The concrete light/streetcar poles were repaired

[10] "The Third Avenue Bridge," *Minneapolis Sunday Tribune*, July 18, 1915.

[11] Quote from "New Bridge Keynote of Trolley Line Plan," *Minneapolis Sunday Tribune*, February 15, 1920. See also "First Car over Third Avenue Bridge," *Minneapolis Tribune*, October 17, 1920; Schmid, *Social Saga of Two Cities*, 62.

and rewired for new light fixtures. Approximately 50 percent of the cantilevered portion of the spandrel columns was repaired.[12]

The Third Avenue Bridge had become the busiest bridge in the city by 1946, when a traffic study revealed that it carried "more traffic to and from the loop than any other artery." While the streetcar system remained in operation through the first half of the twentieth century, its primacy was eclipsed by the rise of the automobile. Buses had replaced streetcars on the routes over the bridge by 1954 and the streetcar tracks were covered by an overlay. In 1953, the city and the Minnesota Department of Highways executed an agreement to repair a failed concrete pier cap on the west end of the bridge. Additional agreements for repairs and maintenance were executed in the 1960s. Between 1958 and 1965, the concrete light poles that had served the bridge since 1918 were replaced with metal poles and mercury vapor lights. The approach spans to the bridge were reinforced in the 1960s with additional steel beams.[13]

In 1968, Howard, Needles, Tammen and Bergendoff (HNTB) completed a comprehensive study of the bridge, which provided a baseline of existing conditions to guide planning for an extensive repair program in the 1970s. In 1976, before the main project could begin, the Minnesota Department of Transportation (MnDOT), successor to the Department of Highways, removed a concrete spiral staircase at the east end of the bridge that led down to Main Street SE because of structural inadequacy. Two years later, a large-scale rehabilitation project began. When preparing for the project, MnDOT consulted with the State Historic Preservation Office (SHPO), the Minneapolis Heritage Preservation Commission (HPC), and other parties to ensure that repairs preserved the historic character of the bridge. The deck was removed, and the piers and arches were patched. The east and west approaches, including the spans, bents, abutments, and wing walls, were replaced. The existing retaining walls on the east side were repaired and extended upward. A new deck, spandrel cap beams, sidewalks, traffic barriers, and lights were installed. The Art Deco railings from 1938-1939 were preserved and reinstalled. The center of the bridge deck was raised approximately 5 feet, and the spandrel columns and piers were extended in height. A new spiral staircase was constructed on the east end of the bridge close to the location of the original staircase. The concrete on the bridge was coated with a Thoroseal cementitious mix to give the bridge a uniform appearance.[14]

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[12] Quotes from "Third Avenue Bridge to Get a New Railing," *Minneapolis Tribune*, December 7, 1938. See also *1934 Supplement to Mason's Minnesota Statutes 1927*, sec. 2554, 2557, and 2662-2½ (Citer-Digest Co. 1934); "Highways Will Get New Markers Friday," *Minneapolis Tribune,* May 3, 1934; Schmid, *Social Saga of Two Cities*, 65; F. T. Paul and E. G. L. Gorgenson, *Specifications for Third Avenue Bridge Repairs*, Minneapolis, Minnesota #1633-F, November 1938, S7-S8, S16, available from the Public Works Department, City of Minneapolis; Howard, Needles, Tammen and Bergendoff (HNTB), *Minnesota Department of Highways*: *Bridge Inspection Engineering Report Third Avenue Bridge,* November 1968, 1, 3.

[13] Quote from "Third Avenue Bridge Busiest," *Minneapolis Tribune*, July 4, 1946. See also Diers and Isaacs, *Twin Cities by Trolley,* 227, 230, 232; HNTB, *Bridge Inspection Engineering Report Third Avenue Bridge*, 3-4; State of Minnesota Department of Transportation Location/Design Study Report for State Project 2701-Bridge 2440, August 1978, 10; G. H. Kolstad, Minnesota Department of Transportation Office Memorandum, August 4, 1967, available from MnDOT; "A Brief History of MnDOT," Minnesota Department of Transportation, accessed June 5, 2017, http://www.dot.state.mn.us/information/history.html.

[14] Minnesota Department of Transportation, "The Third Avenue Bridge: Its History and Renovation," available at the Minnesota Department of Transportation Office, Saint Paul; "A Brief History of MnDOT."

In 1971, the Saint Anthony Falls Historic District was listed in the National Register of Historic Places. The Third Avenue Bridge is a contributing property to the district, which extends along both sides of the Mississippi River. Properties within the district are significant under National Register Criteria A, C, and D in several areas of significance. Under Criterion A, a property is associated with events that have made a significant contribution to the broad patterns of history. Properties significant under Criterion C embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value. Criterion D relates to archaeology and the potential for a property to yield information important in prehistory or history. The City of Minneapolis also designated the Saint Anthony Falls Historic District as a local district in 1971. When the district was first created, no period of significance was defined. Currently, both the SHPO and the HPC consider the period of significance to begin in 1858 and end in 1941.[15]

In 2006, the Third Avenue Bridge was evaluated for individual designation and found to be eligible for the National Register under Criterion C in the area of Engineering. For the present study, the bridge has been assessed under Criterion A in the area of Transportation, and it appears eligible in this context for its important role in the region's transportation network. Its significance was also considered using the multiple property documentation form for "Federal Relief Construction in Minnesota, 1933-1941." The bridge meets registration requirements 1 through 4. The bridge improvements were funded by the PWA (No. 1) and were completed before the end of 1941 (No. 2). The aluminum railings added during the 1938-1939 project incorporate distinctive materials and characteristics of the Art Deco style and are representative of the 1930s (No. 3). The bridge possesses the seven aspects of historic integrity: location, design, setting, materials, workmanship, feeling, and association (No. 4).[16]

As an individually eligible property, the period of significance for the bridge begins in 1918 when the original construction was completed and it was put into use. The period of significance ends in 1941, which is the end of the period of significance for the Saint Anthony Falls Historic District.

In a Programmatic Agreement executed in 2008, MnDOT, in cooperation with the SHPO and Federal Highway Administration (FHWA), committed to preserving selected historic bridges in Minnesota that are owned by the state and managed by MnDOT. Twenty-four bridges were selected as candidates for long-term preservation. Bridge 2440 was one of these bridges.

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[15] "St. Anthony Falls Historic District," National Register of Historic Places documentation, 1971-1991, available from the State Historic Preservation Office, Saint Paul; Minneapolis Heritage Preservation Commission, "St. Anthony Falls Historic District Design Guidelines," 2012, 19-27, available from the Minneapolis Heritage Preservation Commission, Minneapolis.

[16] Frame, "Reinforced-Concrete Highway Bridges in Minnesota," 4, 12; Rolf T. Anderson, "Federal Relief Construction in Minnesota, 1933-1941," National Register of Historic Places, Multiple Property Documentation Form, 1990, F36-F38, available at the State Historic Preservation Office, Saint Paul.

2.2 Sources of Bridge Records

2.2.1 MnDOT Records

Contains original correspondence and reports on the maintenance of the bridge. Includes some historic drawings and photographs. MnDOT records also cover more recent projects on the bridge such as replacement of bridge deck joints.

2.2.2 City of Minneapolis Records (Department of Public Works Bridge Office)

Contains original drawings, photographs, specifications, and maintenance agreements and records. The records also contain a significant number of accident reports.

2.2.3 Northwest Architectural Archives

A small number of original drawings donated by the City of Minneapolis.

2.2.4 Other Sources

Special Collections at the Hennepin County Library and the collections at the Minnesota Historical Society have historic photographs of the bridge.

2.2.5 Findings from Records Review

These sources provided information useful for understanding how the bridge was erected, subsequent repair and maintenance activities, and functional issues.

For the original design, surviving plans and specifications are invaluable sources about the overall structure as well as specific details. Large collections of photographs document the bridge as it was built, providing much information on staging and construction methods. Press coverage of the construction, particularly an in-depth article in *Engineering News* in December 1915, offers another useful perspective.

After the bridge was built, the documentation on physical modifications is not as thorough. Some information on alterations and maintenance work is provided by drawings and specifications, but there are many gaps. Reports, correspondence, photographs, newspaper articles, and other archival materials fill in some of the gaps. Together, for example, these records indicate that the bridge contains concrete from a number of different time periods, and also that these concretes may have had included admixtures such as calcium chloride as early as 1938. Coatings have been applied to the concrete surfaces as early as 1938.

Other resources offer insights on how the bridge functioned over time. In reviewing these materials, it is important to consider a variety of factors that might have influenced outcomes. The accident report data, for example, includes several accidents impacting the traffic barriers. With a large amount of traffic on the bridge and an S-curved alignment, accidents are to be expected. The setting of the bridge near Saint Anthony Falls, though, likely contributes to the accident history on the bridge. The extra moisture in the air from the cascading water probably leads to more frequent icing on the bridge deck.

The records review identified a rich trove of information that can help explain findings from physical investigations of the structure. At the same time, the physical investigations can corroborate incomplete archival data.

2.3 Chronology of Bridge Milestones

1912 Minneapolis city planners sought designs for a concrete-arch bridge from the New York-based Concrete-Steel Engineering Company. The bridge was to be built above Saint Anthony Falls, but concerns were raised about the initial bridge plans due to the questionable stability of the stratum and possible impact on the falls. Minneapolis city engineer Frederick W. Cappelen proposed altering the location and building the bridge arches over the limestone breaks. The original design was further modified with deck girder approach spans so the bridge would clear railroad tracks on the east and west riverbanks.[17]

1914 Construction began on the Third Avenue Bridge.

1915 The first falsework on the bridge was constructed between April and June.[18]

1918 On June 14, the bridge opened to the public.[19]

1938-1939 The bridge underwent repairs under the PWA program. The railings, sidewalks, and curbs were replaced. The original light poles were repaired and rewired for new light fixtures. A new traffic barrier was installed between the sidewalk and the roadway. Approximately 50 percent of the cantilevered portion of the spandrel columns were repaired.[20]

1953 A series of memos between the City of Minneapolis and Minnesota Department of Highways documents the development of an extraordinary maintenance repair agreement to complete work on a failed concrete pier cap on the west end of the bridge.

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[17] "Civic Body Approves Third Avenue Bridge; Asks Railroad Space," *Minneapolis Tribune*, December 13, 1912; Kristen Zschomler, "Third Avenue Bridge," Minnesota Historic Property Record, HE-MPC-0165, 2; Kristen Zschomler, "Minnesota Department of Transportation Historic Bridge Management Plan, Bridge Number: 2440," June 2006.

[18] "Preliminary Work Completed on New Third Avenue $650,000 Bridge," *Minneapolis Morning Tribune,* June 18, 1915.

[19] HNTB, *Bridge Inspection Engineering Report Third Avenue Bridge*, 2; Zschomler, "Minnesota Department of Transportation Historic Bridge Management Plan; Zschomler, "Third Avenue Bridge," 2.

[20] Paul and Gorgenson, *Specifications for Third Avenue Bridge Repairs*; HNTB, *Bridge Inspection Engineering Report Third Avenue Bridge*, 3.

1964 On April 13, Director of Public Works Hugo G. Erickson submitted a plan to George Welch at the Department of Highways for a proposed extraordinary maintenance agreement to repair a concrete beam on the east approach to the bridge. The plan was carried out and "supplementary steel beams were added to the approach spans to insure structural safety."[21]

1967 An August 4 memo from G. H. Kolstad at the Department of Highways pointed out difficulties the City of Minneapolis was having with repairs on the bridge because "the deterioration appears to be more extensive than was first anticipated." The memo stated: "It now develops that there is a possibility of deterioration of the deck slab and the tops of the spandrel columns on the arches. It has also been found in sandblasting and cleaning the steel girders in preparation for repairs and painting that they are in a more critical condition."[22]

1968 A bridge inspection was completed and the resulting report recommended replacement of all approach spans, both abutments, the deck, and the caps and upper portion of the spandrels.[23]

1970-
1975 Various proposals for repairs to the bridge were discussed by MnDOT, HPC, and SHPO. Concern focused on a proposed railroad derailment barrier, the design of the east bent, retention of the 1939 bridge railings, and the stairway to Main Street SE.[24]

1978 MnDOT issued a scope of work to be completed for the bridge. This included coating the existing arch ribs, pier walls, spandrel columns, and exposed faces of the new concrete parapets and slab fascia with either shotcrete or a Thoroseal cementitious mix.[25]

1979 Repair work included a complete deck replacement that raised the roadway 5 feet at the middle of the bridge. The spandrel columns were lengthened to raise the deck. Both approaches were replaced. Cost: $9 million. New light standards were installed. New concrete railing posts were constructed and the 1939 Art Deco aluminum railings were cleaned and reinstalled.

1980 Repairs were completed.

2002 MnDOT completed a structure inventory on March 13, and issued a report titled "Recommendations for Bridge Improvement" on October 11.

2006 MnDOT completed a historic bridge management plan.

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[21] MnDOT, Location/Design Study Report for State Project 2701-Bridge 2440, August 1978, 10.
[22] Kolstad, Memorandum.
[23] MnDOT, Location/Design Study Report for State Project 2701-Bridge 2440, 11; HNTB, *Bridge Inspection Report Third Avenue Bridge*, 3-4.
[24] It appears that the derailment barrier was never constructed, or was removed after the railroad lines were converted to parkland.
[25] MnDOT, "Suggested Special Provisions 3rd Ave Bridge No. 2440," circa 1978, available from MnDOT.

Note: According to the 1968 inspection report, the dates for some renovations and repairs to the bridge are unknown. The HNTB report states that the date is unknown for installations of "mercury vapor lights using the same locations; and replacement of the creosoted paving blocks by an asphalt wearing course, covering the tracks and the cemented sand filler."[26] Based on historic photographs, it appears the change in lights occurred sometime between 1958 and 1968, but no additional information can be found in other sources.

[26] HNTB, *Bridge Inspection Engineering Report Third Avenue Bridge*, 3.

2.4 Photographic Chronology

The following historic photographs document the bridge's construction and subsequent evolution.

Figure 3. 1913 – Site of the Third Avenue Bridge, looking northeast from the west bank
(*City of Minneapolis*)

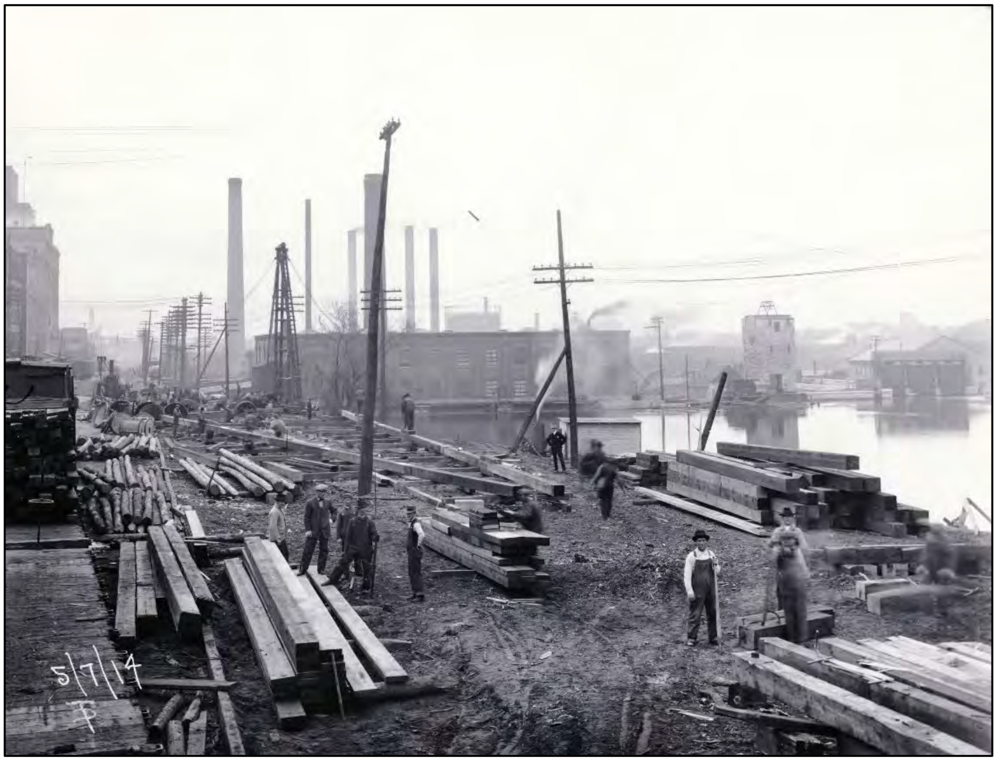


Figure 4. May 7, 1914 – Building the timber tower on the east bank, looking southeast
(*City of Minneapolis*)

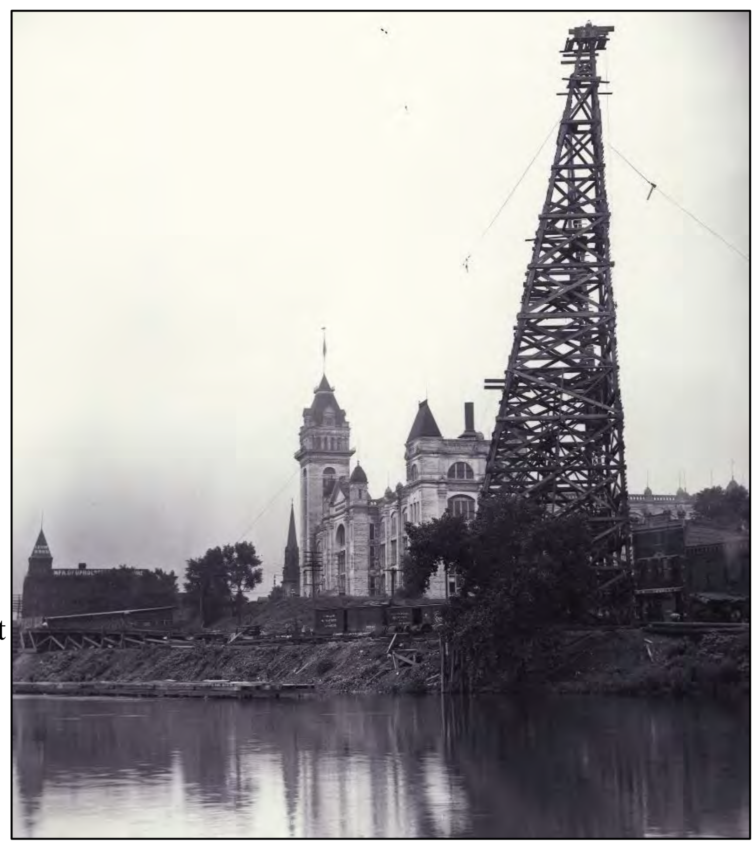


Figure 5. June 29, 1914 – Completed timber tower with part of the concrete plant visible, on the east bank, looking northwest
(*City of Minneapolis*)

Figure 6. September 2, 1914 – Concrete plant on the east bank, looking northwest
(*City of Minneapolis*)

Figure 7. September 2, 1914 – Concrete plant and tracks on the east bank, looking northwest
(*City of Minneapolis*)

Figure 8. c. 1914 – Completed timber tower on the west bank, looking southwest
(*City of Minneapolis*)

Figure 9. c. 1914 – Pier construction, looking northeast
(*Nicholas Acquard Photograph Album, Minnesota Historical Society*)

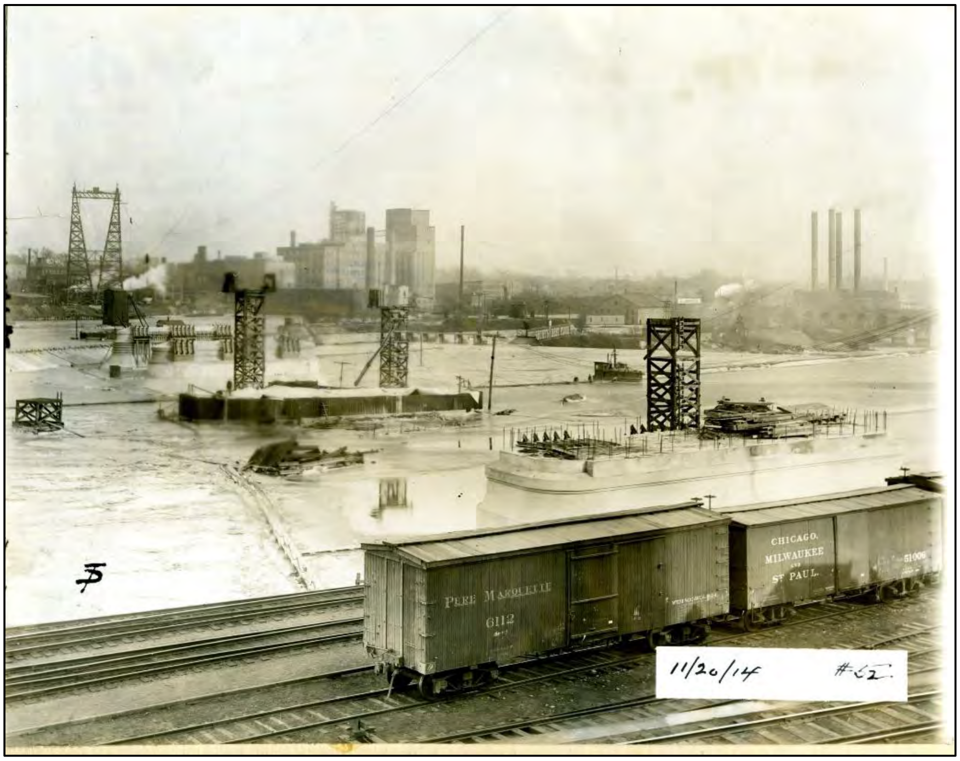


Figure 10. November 20, 1914 – Construction, looking northeast
(*City of Minneapolis*)

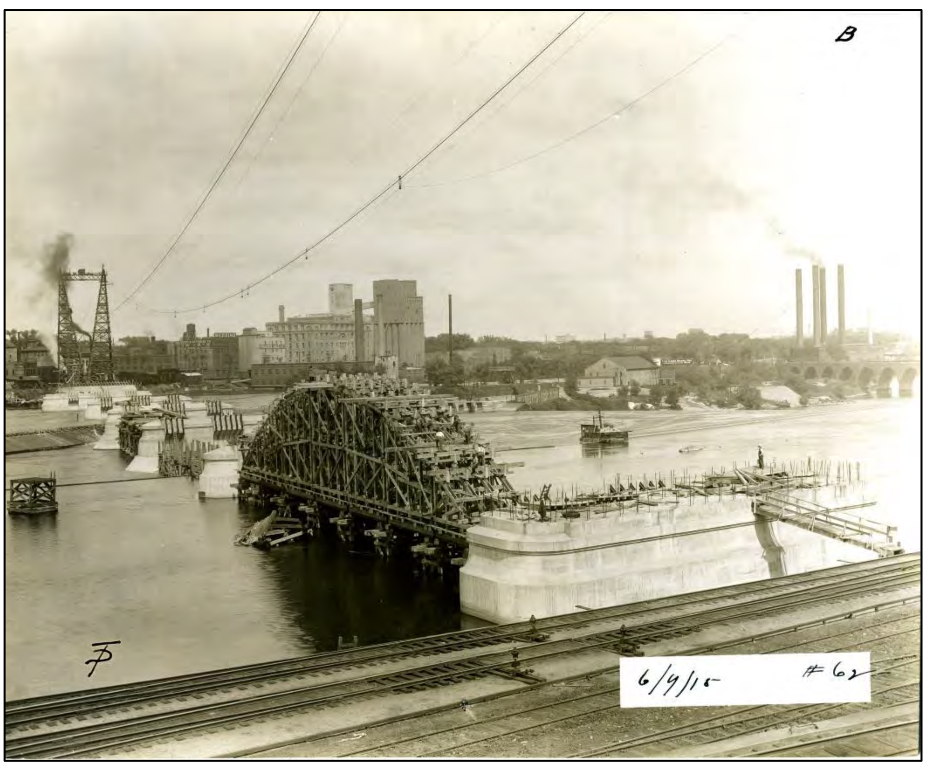


Figure 11. June 9, 1915 – Arch falsework, looking northeast
(*City of Minneapolis*)

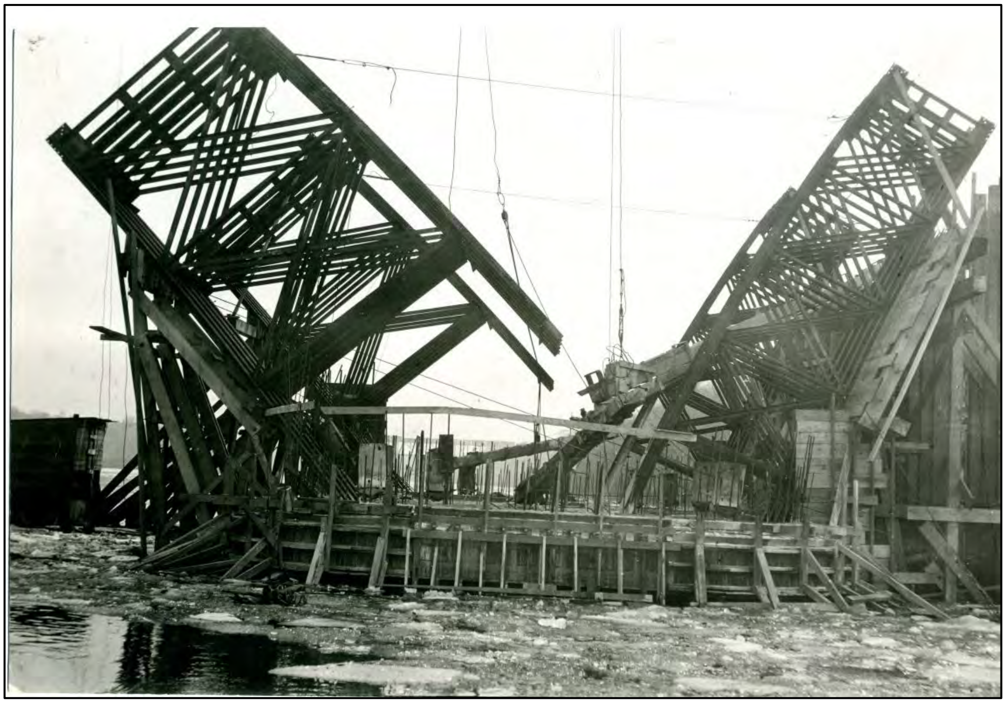


Figure 12. c. 1915 – Melan reinforcing for arch ribs
(*City of Minneapolis*)

Figure 13. June 30, 1915 – Arch construction, looking northeast
(*City of Minneapolis*)

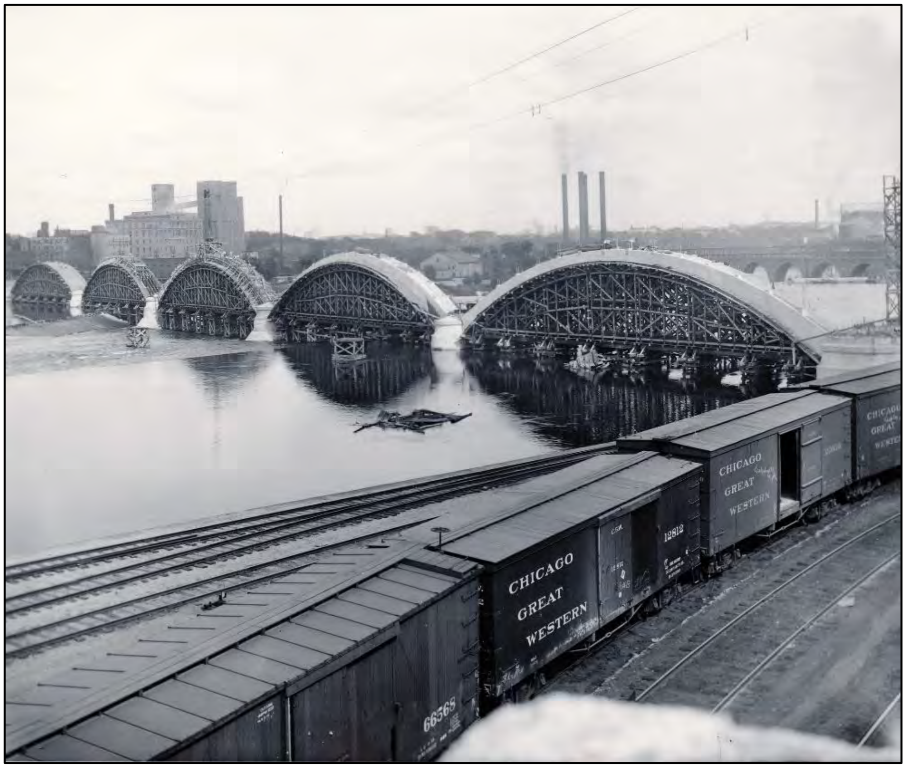


Figure 14. July 29, 1915 – Arch construction, looking northeast
(*City of Minneapolis*)

Figure 15. c. 1916 – Arch construction, looking west
(*City of Minneapolis*)

Figure 16. July 9, 1917 – Upstream elevation, looking northeast
(*City of Minneapolis*)

Figure 17. 1918 – Third Avenue Bridge with steel-girder west approach spans in foreground, looking northeast
(*City of Minneapolis*)

Figure 18. c. 1918 – Upstream elevation, looking south from the east bank
(*Minnesota Historical Society*)

Figure 19. c. 1918 – Staircase from bridge's east approach leading down to Main Street SE, looking northeast
(*City of Minneapolis*)

Figure 20. c. 1918 – Light poles, sidewalks, and railing, before streetcar service, looking northeast (*City of Minneapolis*)

Figure 21. 1920 – Detail of railings, looking northeast
(*Minnesota Historical Society*)

Figure 22. 1920s – Downstream elevation, looking north
(*Special Collections–Hennepin County Library*)

Figure 23. 1936 – Deck with streetcar line, looking northeast
(*Minnesota Historical Society*)

Figure 24. 1939 – New sidewalk, railing, and traffic barriers after renovation (*City of Minneapolis*)

Figure 25. c. 1940 – Deck after renovation, looking southwest
(*Minnesota Historical Society*)

Figure 26. 1948 – Deck with streetcar tracks, looking southwest
(*Minnesota Historical Society*)

Figure 27. 1940s – West approach, looking northeast
(*Special Collections–Hennepin County Library*)

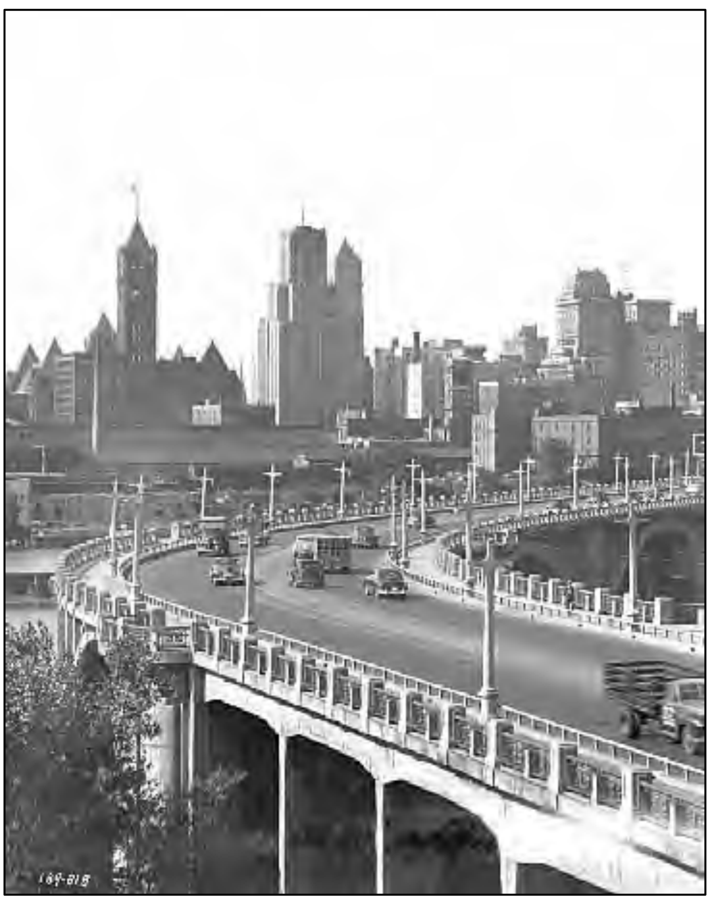


Figure 28. 1949 – East approach is in the foreground, looking west
(*Minnesota Historical Society*)

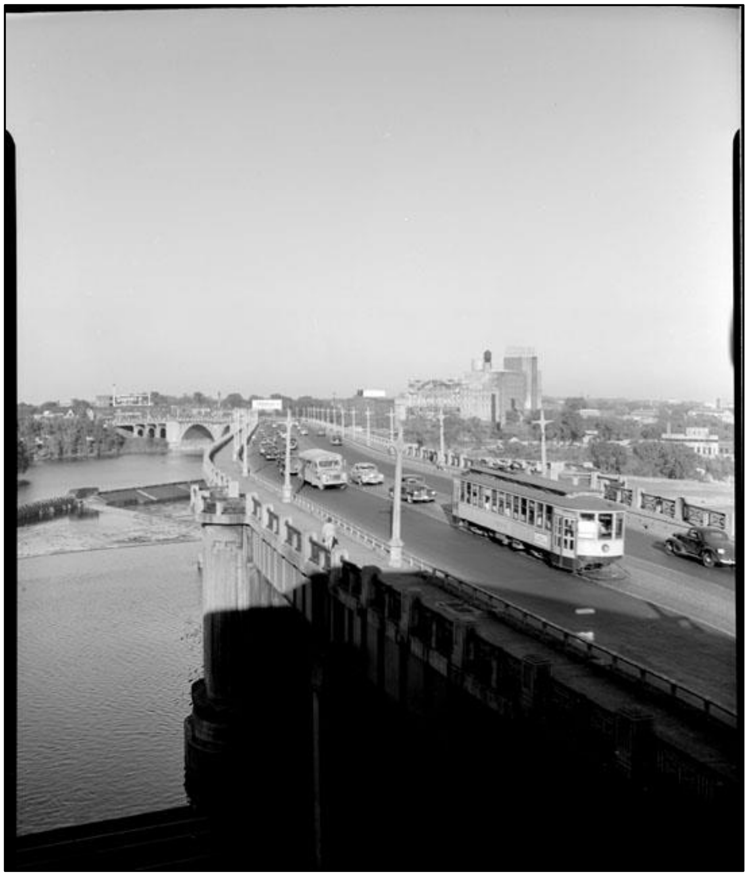


Figure 29. 1949 – Streetcar on west approach, looking east (*Minnesota Historical Society*)

Figure 30. c. 1950 – Third Avenue Bridge, looking southwest (*Minnesota Historical Society*)

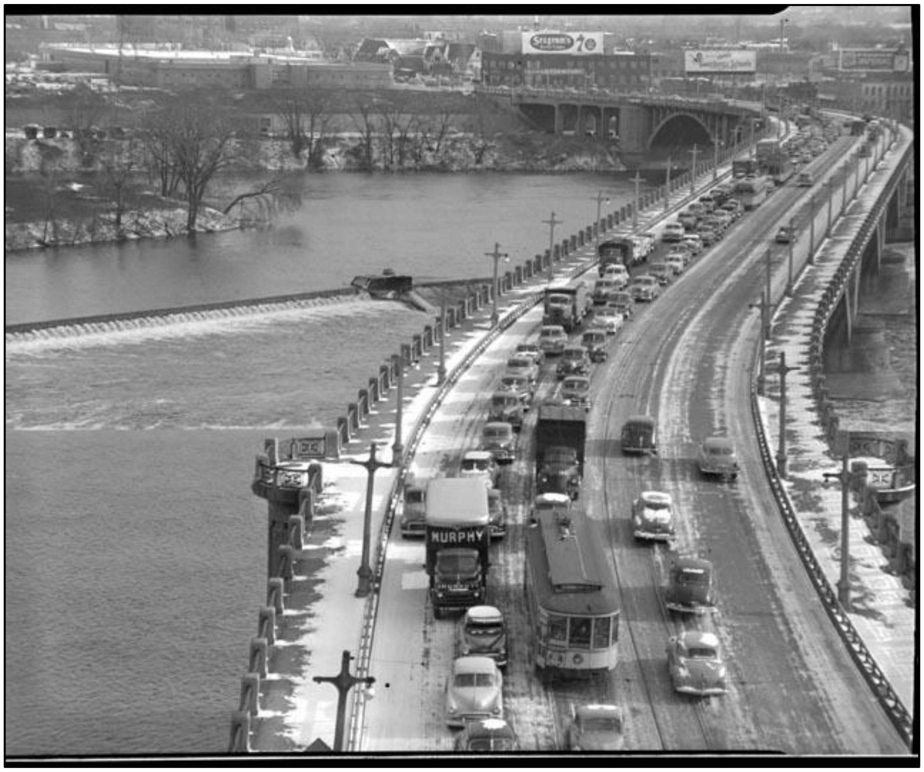


Figure 31. 1951 – Aerial, looking northeast
(*Minnesota Historical Society*)

Figure 32. 1952 – Upstream elevation, looking south
(*Minnesota Historical Society*)

Figure 33. c. 1955 – Aerial after streetcar line removed, looking southwest
(*City of Minneapolis*)

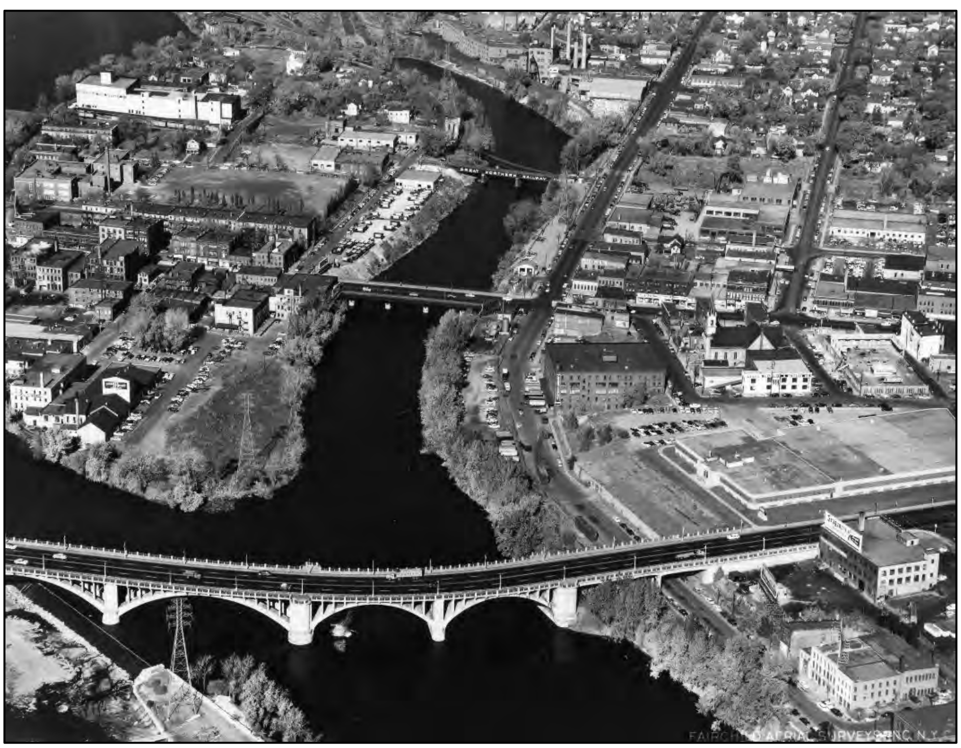


Figure 34. c. 1955 – Third Avenue Bridge, looking northwest
(*City of Minneapolis*)

Figure 35. c. 1965 – Third Avenue Bridge, looking west (*Minnesota Historical Society*)

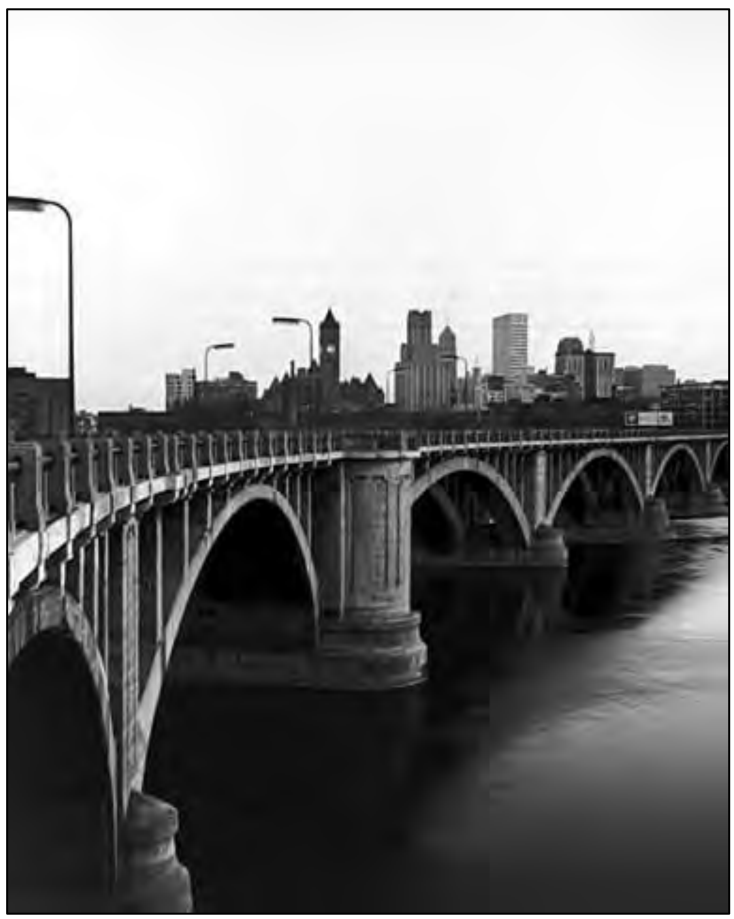


Figure 36. 1968 – Upstream elevation, looking southwest (*Minnesota Historical Society*)

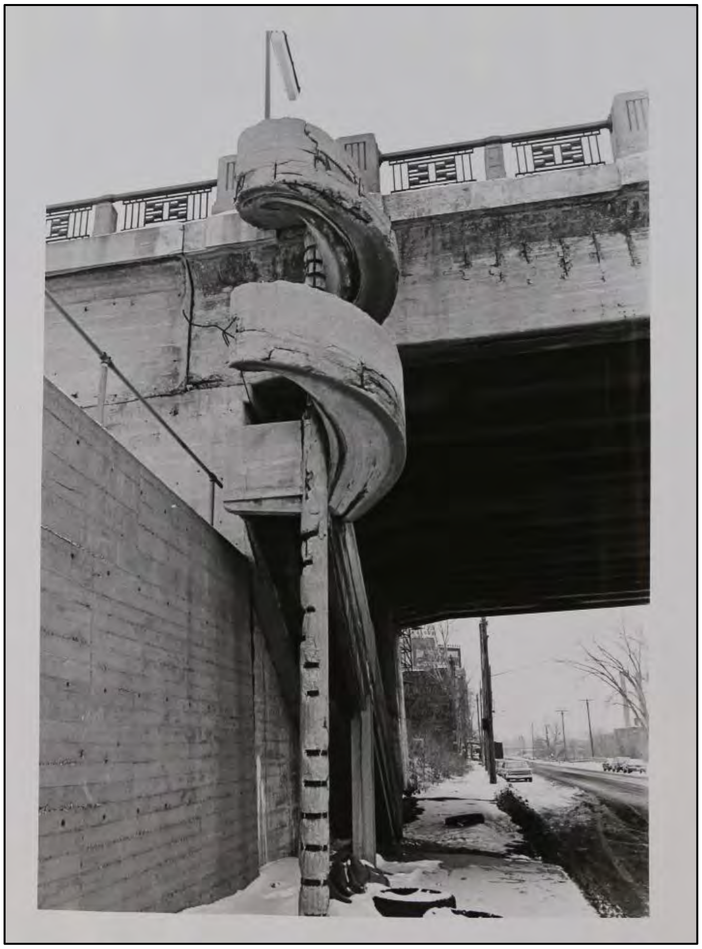
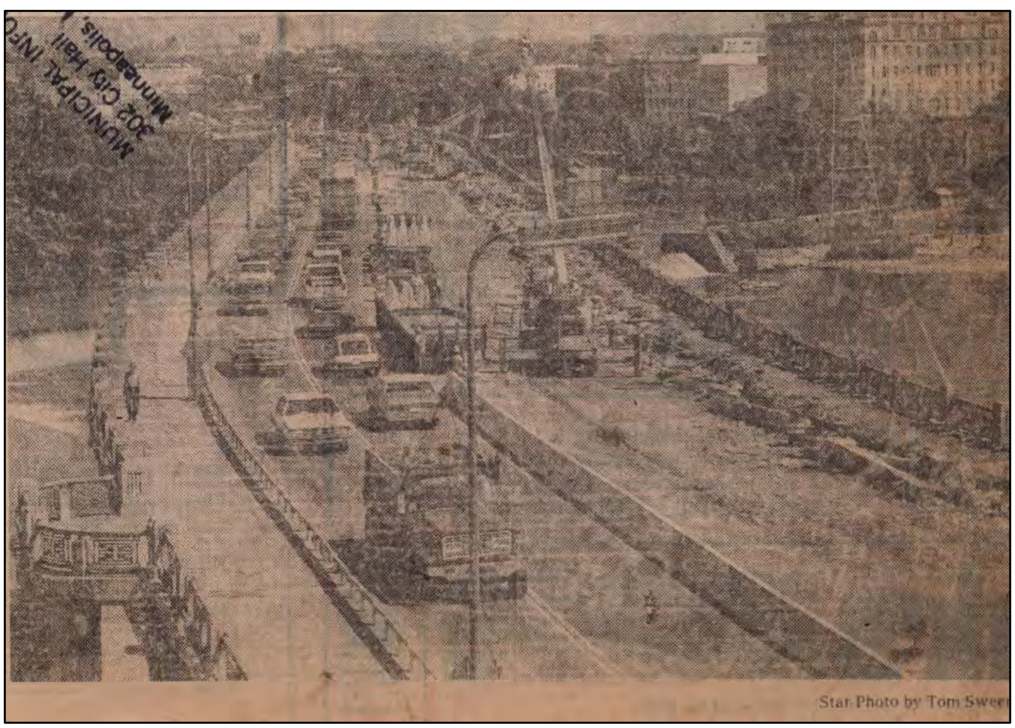


Figure 37. 1971 – Original spiral staircase at east approach, looking southeast (*Minnesota Historical Society*)

Figure 38. August 30, 1979 – Newspaper photo showing rehabilitation, looking northeast (*Minneapolis Star*, *Special Collections, Hennepin County Library*)



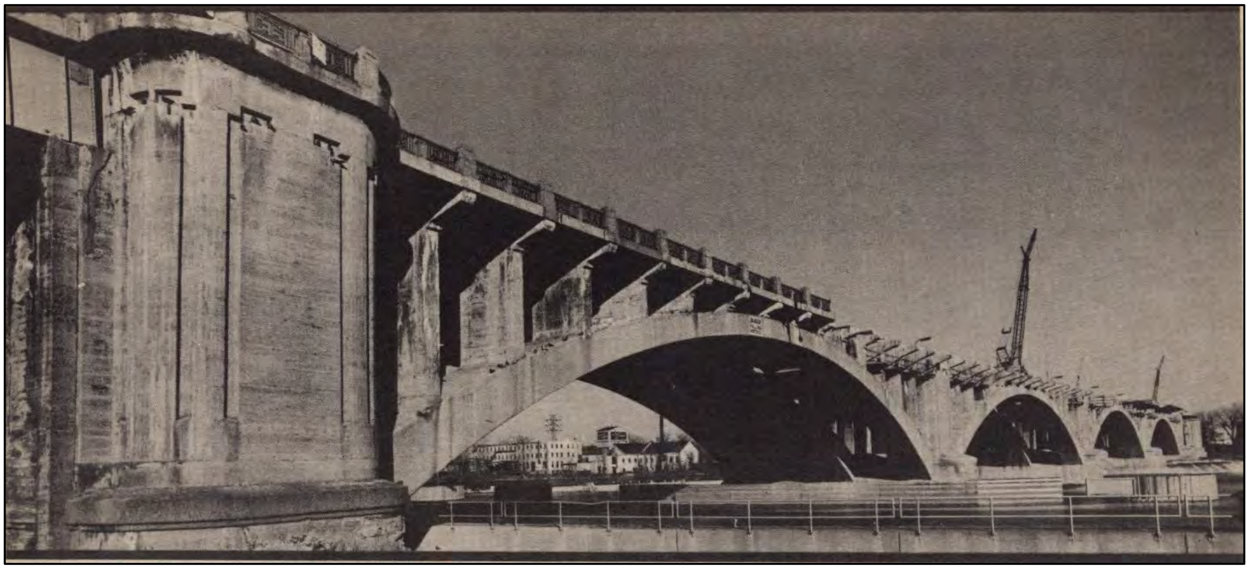


Figure 39. January 1980 – Downstream elevation during rehabilitation, looking north
(*Riverfront News*, *Special Collections, Hennepin County Library*)

2.5 Bridge Construction Activities

After the initial construction period of 1914 to 1918, the Third Avenue Bridge received major rehabilitation projects in 1938-1939 and in 1978-1980. These rehabilitation projects were associated with major changes to the bridge that included reducing the number of approach spans, changing the railing from concrete to metal, and substantial changes to the bridge profile and the bridge deck drainage system. In addition to the major construction events, the bridge also received smaller repairs. These small projects included the installation of steel support beams in the 1960s to strengthen the deteriorated concrete approach beams on the west, and the replacement or reconfiguration of light standards. The deck joints were replaced in 2003 and the foundations of Piers 1 and 5 were repaired in 2014.

For each of the major construction projects, the span arrangement, the deck configuration, the railing details, and the lighting details are provided. In each of the rehabilitation sections, a summary of the major alterations to the bridge are provided at the beginning to aid readers interested in the alterations in historic fabric. This section concludes with a summary of the engineering findings that may be significant as rehabilitation alternatives are developed. It should be noted that span numbers and pier numbers have changed over the years with the changing configuration and ownership of the bridge.

2.5.1 Original Construction 1914-1918

The original construction began in 1914 and was completed in 1918. At this time, the spans achievable with concrete-arch superstructures were significantly smaller than what was possible with steel truss spans. A straight alignment between the river banks was considered with a steel truss bridge. In the end, the reverse “S” alignment was selected to permit the bridge to span the smaller distance between defects in the limestone downstream. The bridge was designed to carry a significant trolley load in addition to a distributed live load.

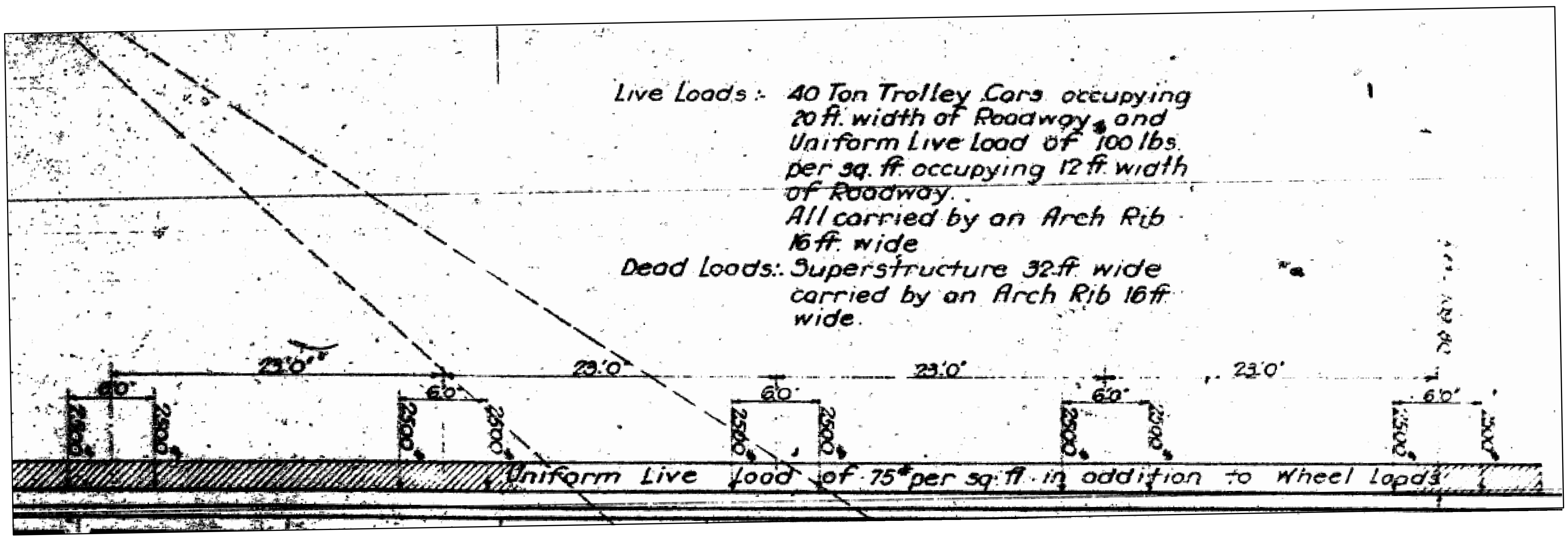


Figure 40. Loading information from the 1917 Plans

2.5.1.1 Span Arrangement

The bridge was constructed with four approach spans on each end of the bridge and seven arch spans over the river. Two types of open spandrel deck arches were used. The five arch spans on the west were rib arch spans and the two arch spans on the east were barrel arch spans. A figure in a 1915 *Engineering News* article illustrates the reverse "S" alignment of the arch span arrangement well. The same article stated that the bridge had an overall length of 2,223'.

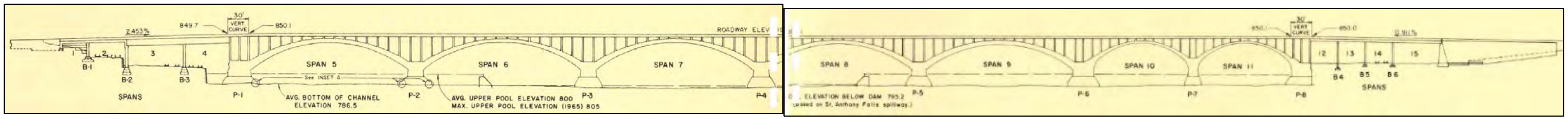


Figure 41. Original 1917 Bridge Elevation

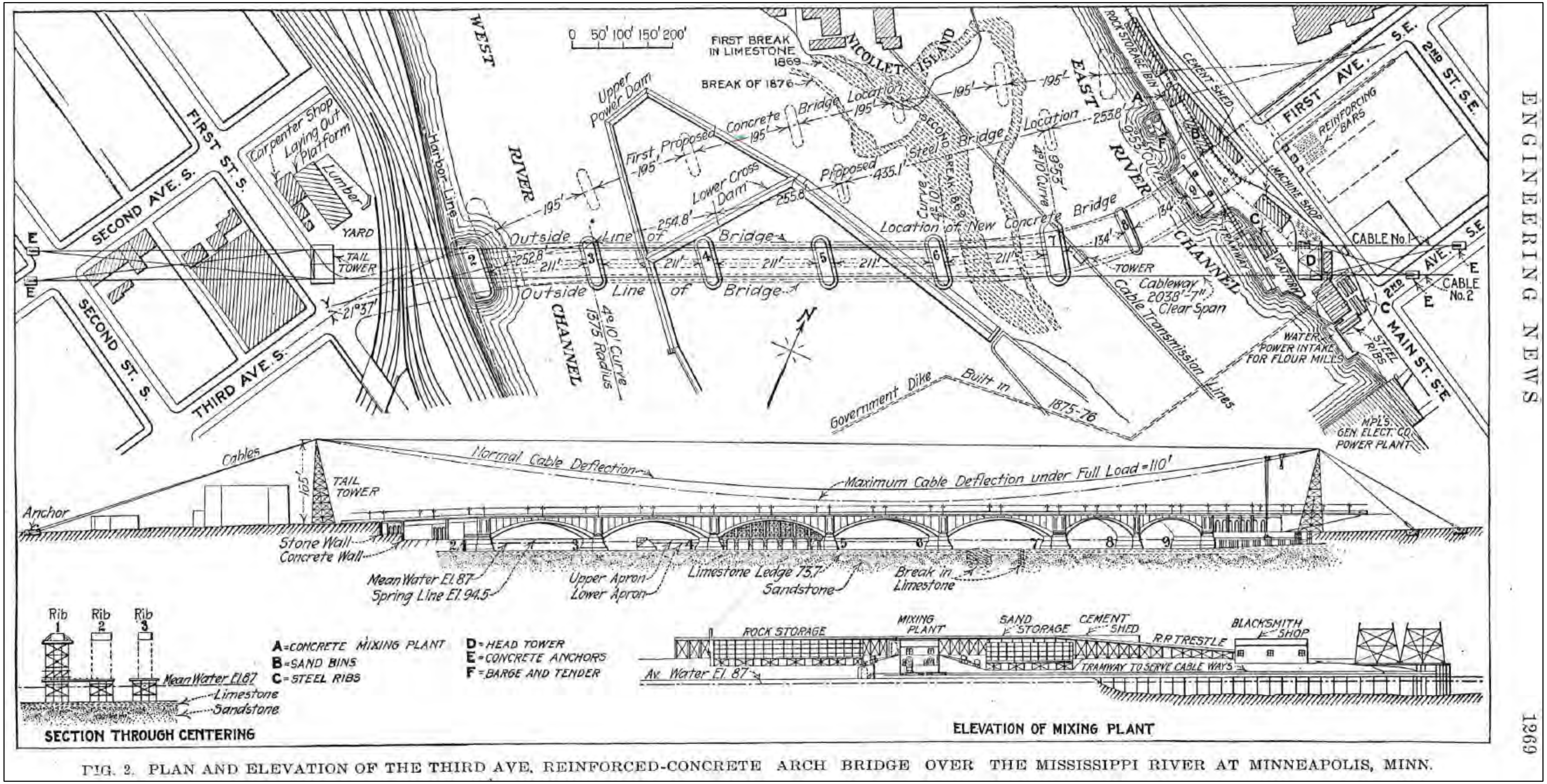


Figure 42. 1915 *Engineering News*

The approach spans also contained a mixture of superstructure types. The two westernmost and the four eastern approach spans used cast-in-place reinforced-concrete beams. The approach spans nearest the river on the west bank were built up steel beam spans. These longer steel spans provided fewer pier obstacles and provided additional horizontal clearance for the multiple tracks under the bridge on the west bank of the river.

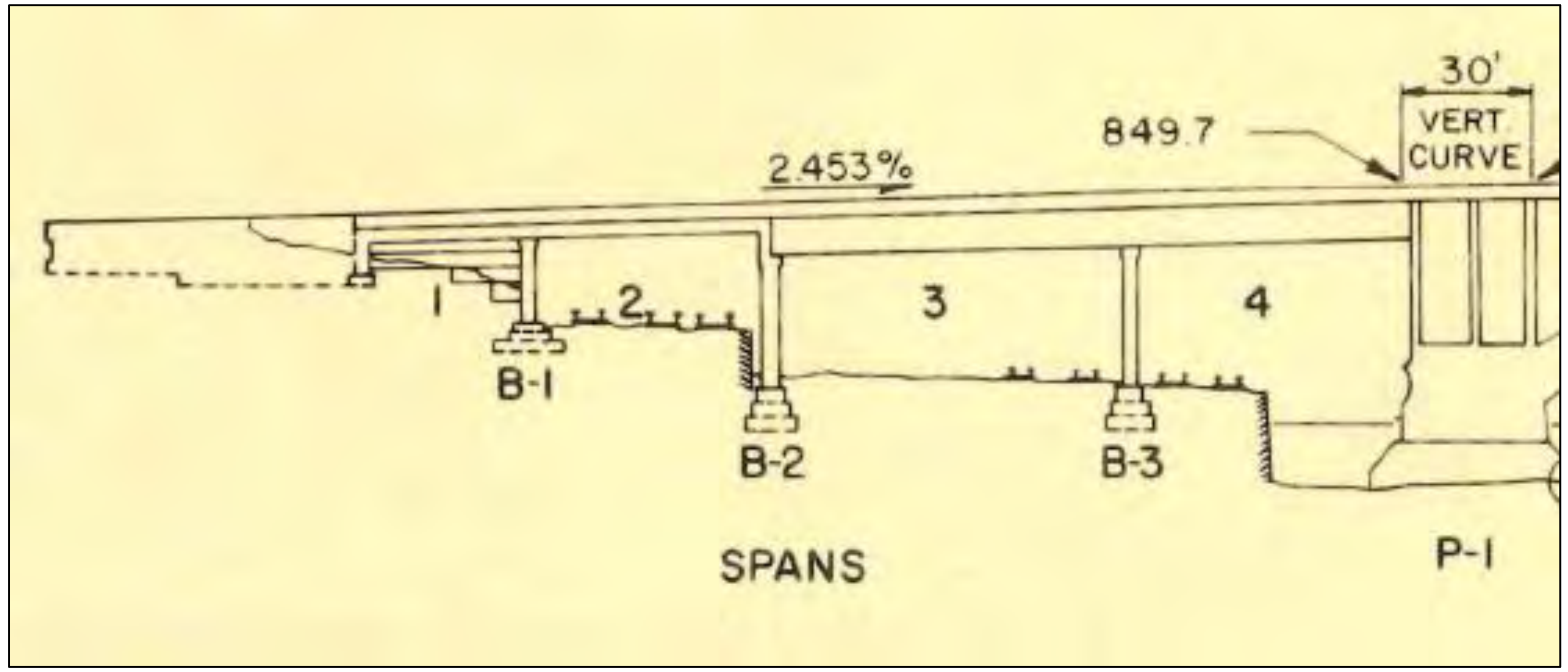
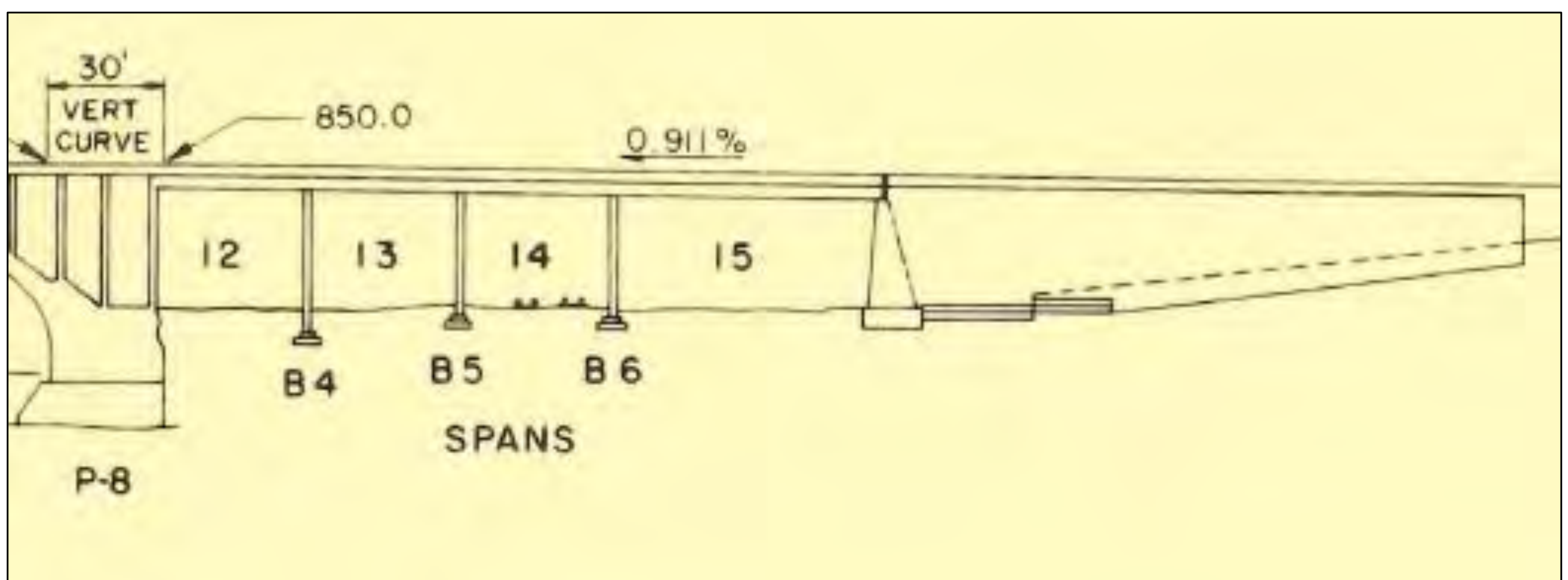


Figure 43. West Approach Span Layout

Figure 44. East Approach Span Layout



2.5.1.2 Deck Configuration

The deck configuration in 1918 consisted of two sidewalks, a pair of embedded streetcar rail lines and brick paving for a roadway surface. It should be noted that the cross section had a parabolic crown to direct drainage to the drain pipes below the catch basins embedded in the curb and gutter. The drainage pipes penetrated the arch ribs and allowed roadway drainage to fall directly into the river. The spandrel cap beams had arched soffits and utilities were placed under the sidewalk on both sides of the bridge. Each sidewalk was 12'-0" wide and the roadway was 56'-0" wide.

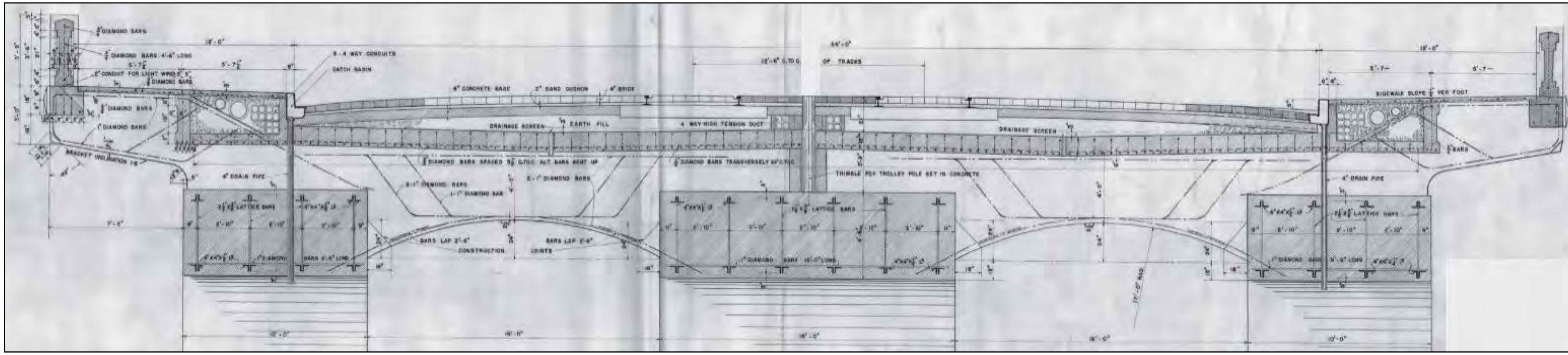


Figure 45. Original 1917 Bridge Section

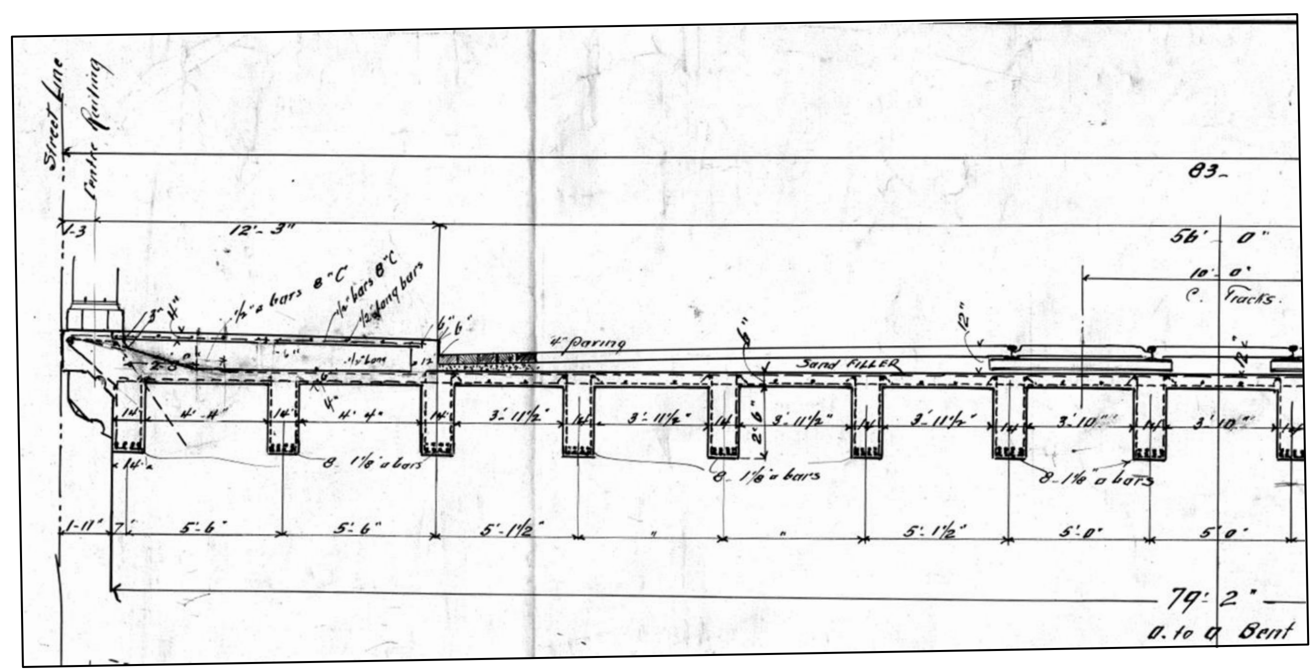
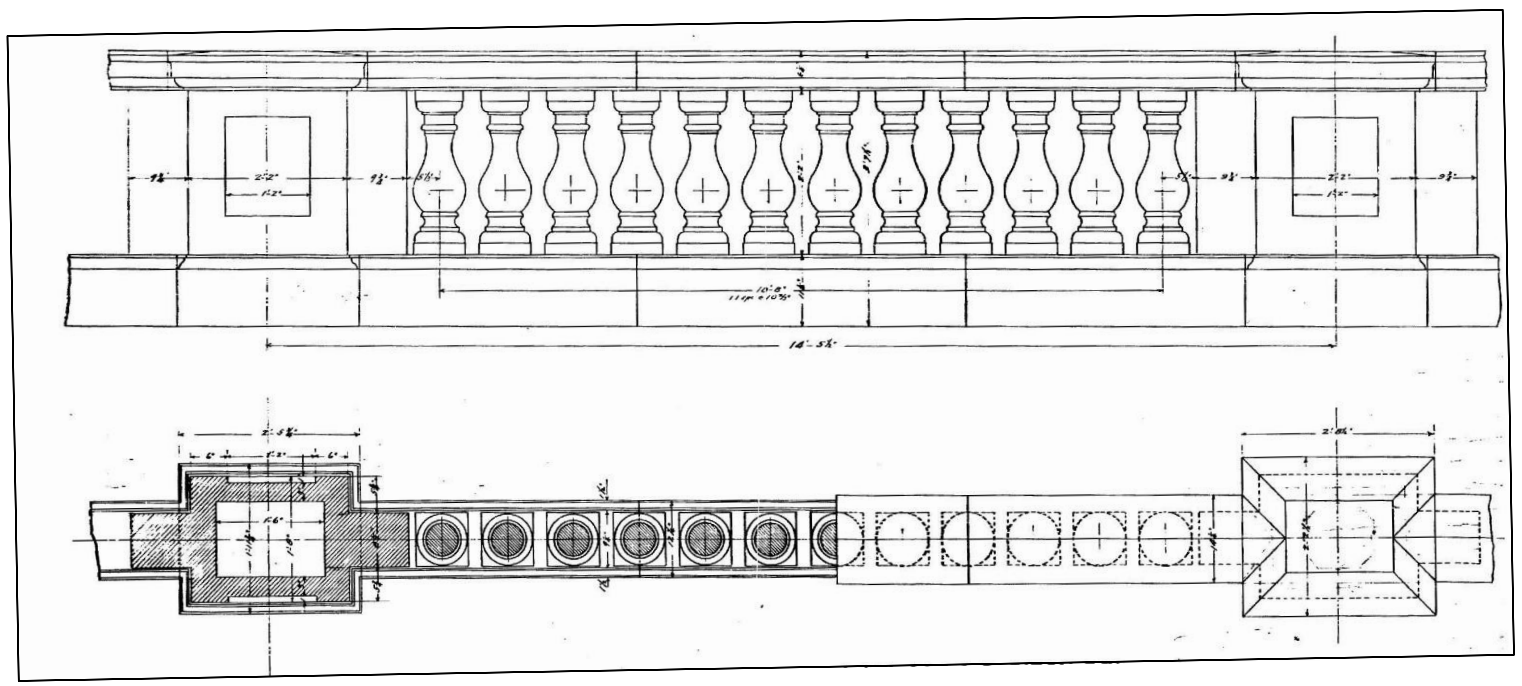


Figure 46. Half Section of 1917 Concrete Approach Spans

The cross section for the original concrete approach spans contained the same 56'-0" roadway width with the embedded streetcar rails.

2.5.1.3 Railing Details

The original railing was a concrete balustrade railing with a typical panel length of 14'-5½". It was 3'-7½" tall and had a uniform height over the length of each panel. The post elements contained rectangular voids. The balustrades had a maximum diameter of 8½" leaving what appeared to be a roughly 6"-wide opening between spindles near the top.



Figures 47 and 48. 1917 Concrete Balustrade Railing

Plans details on left and mockup on the right

2.5.1.4 Lighting Details

The original fifty-two light standards were placed on the sidewalk near the curb and gutter on both sides of the bridge. The spacing of the standards appears to be on the order of 75'. This allowed the lights to illuminate both the sidewalk and roadway. The light standards were large concrete elements that were cruciform shaped. The light fixtures appear to be from the Novalux Mazda series by the General Electric Company. Acorn-shaped glass globes were suspended on each of the horizontal arms of the standards. The incandescent bulbs were 200 watts and each had a candlepower of 160.

2.5.2 Major Rehabilitation 1938-1939

The 1938-1939 rehabilitation was focused on above-deck elements. The concrete sidewalk and railing elements had deteriorated and were in need of repair. A significant number of the fascia beams (assumed to be on the approach spans) were also repaired as part of this project.

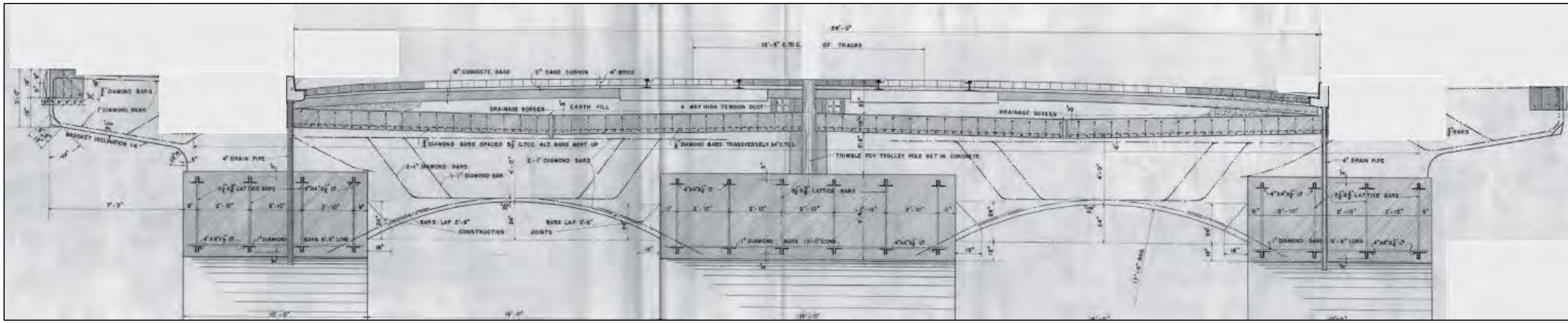


Figure 49. Removals during 1939 Rehabilitation

Removed concrete balustrade railing, curbing, and sidewalk.

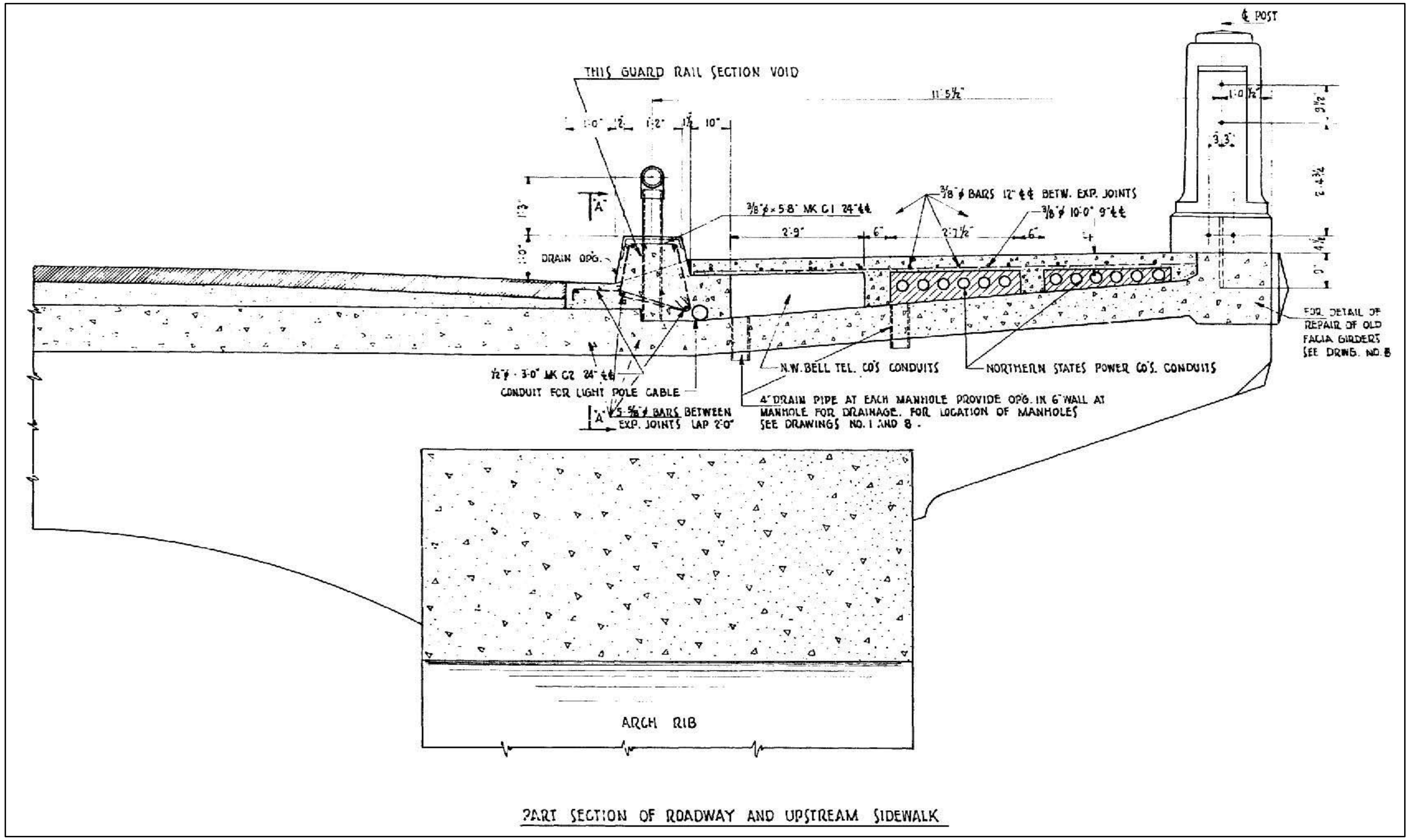


Figure 50. Completed 1939 Rehabilitation

Replaced concrete balustrade railing, curbing, and sidewalk

2.5.2.1 Alterations from the 1918 Configuration

The concrete balustrade railing was removed, the sidewalk was removed, and the utility chambers under each sidewalk were removed.

2.5.2.2 Span Arrangement

The span arrangement was not altered as part of the 1938-1939 rehabilitation.

2.5.2.3 Deck Configuration

The deck configuration was unchanged from gutter line to gutter line. An inner traffic barrier was provided over a new curb and gutter element to separate roadway traffic from pedestrians on the sidewalks. The utility chambers under each sidewalk were reconfigured from rectangular to triangular in shape. The bases for the original concrete light standards penetrated the arch ribs and as a result they possibly could have stayed in place as work was performed on the sidewalks and the utility chambers.

2.5.2.4 Railing Details

The new railing in 1938-1939 was unique in that it utilized ALCOA aluminum components. Similar to the original railing, the newer railing had concrete posts anchoring the railing, and the bridge contained overlooks at the major river pier locations.

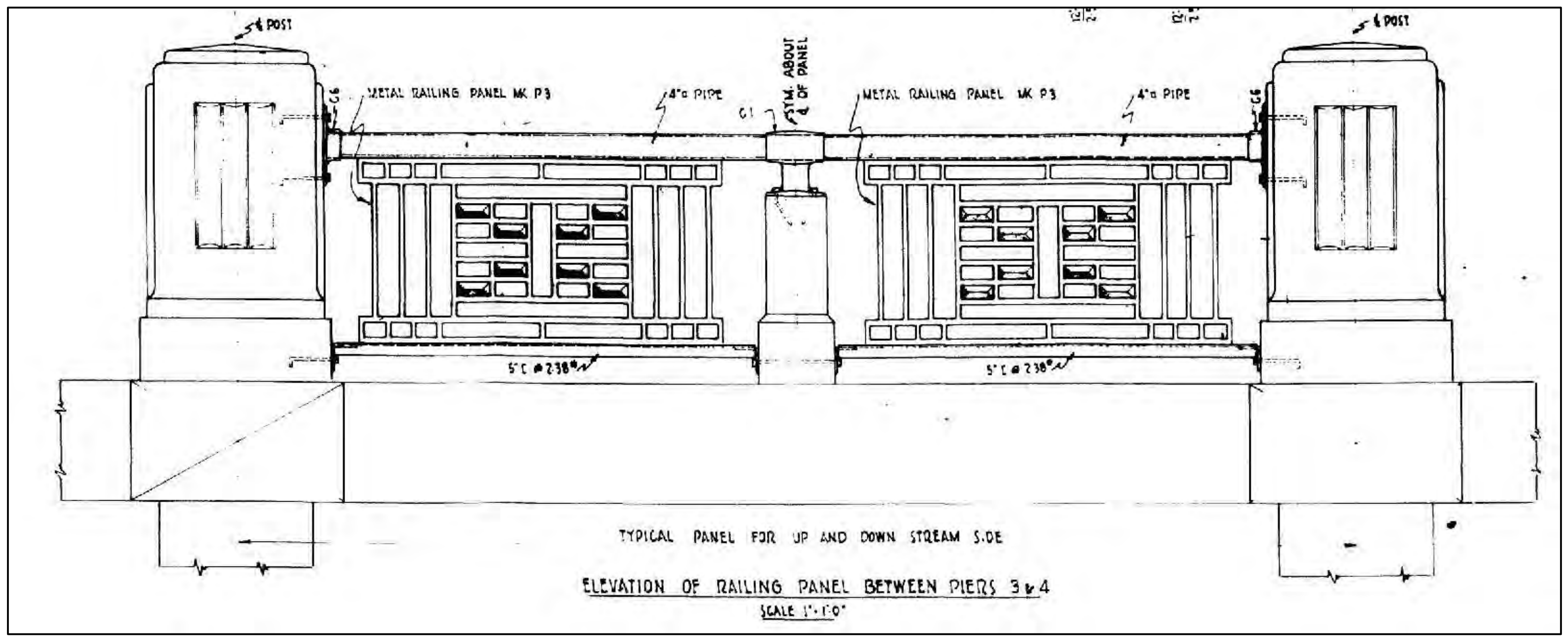


Figure 51. 1939 to Present Aluminum Railing with Concrete Pilasters

2.5.2.5 Lighting Details

As part of the 1938-1939 rehabilitation, the original concrete light standards were repaired and reinstalled. The original light fixtures were removed and new light fixtures installed on the horizontal arms overhanging the roadway. Detailed information on the fixtures, including wattage and candlepower has not been discovered. The light standards are visible in historic photographs of the bridge through the 1950s and appear to have been replaced sometime in the 1960s with steel light standards and mercury vapor fixtures.

2.5.3 Major Rehabilitation 1978-1980

Extraordinary maintenance agreements between MnDOT and the City of Minneapolis identified substantial deterioration of the bridge in the 1960s and 1970s. A significant number of repairs were made to concrete beams on the approach spans. In 1968, HNTB published their study of the current condition of the bridge. The bridge continued to deteriorate and in 1975, it was load posted to allow trucks no larger than eighteen tons and combination vehicles no larger than thirty tons.

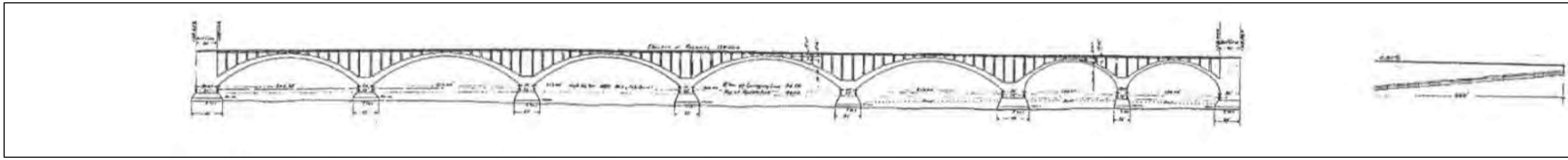


Figure 52. Span Removals During the 1979 Rehabilitation

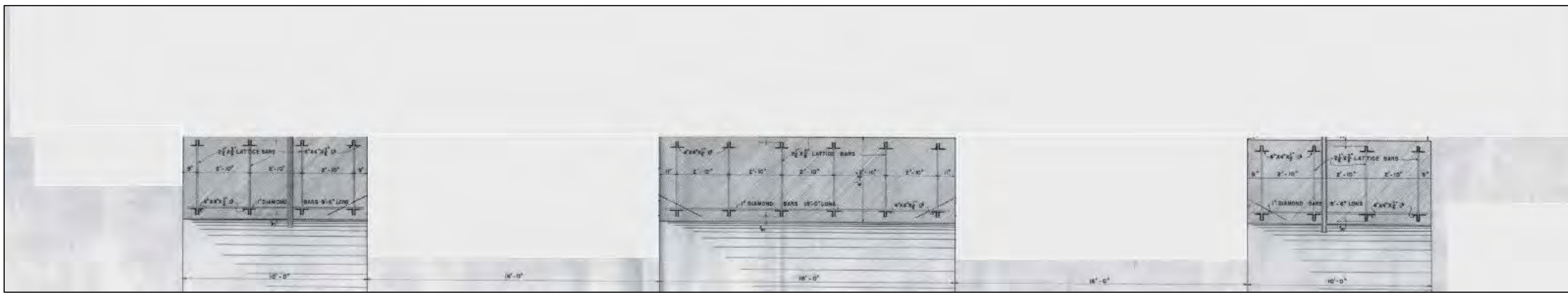


Figure 53. Removals During 1979 Rehabilitation

Removed concrete deck and cap beams. Top portions of spandrel columns and pier walls removed to varying elevations (not shown in section). Ornamental aluminum railing temporarily removed during work.

2.5.3.1 Alterations from the 1918 and 1938 Configurations

The comments in the 1988 bridge inspection (below) summarize the alterations as part of the project. The approach spans on both ends of the bridge were completely removed. The top portions of the spandrel columns and cap beams were removed. The deck, railing, and sidewalk were removed. The large piers associated with the arch spans were retained as were the arch ribs, the arch barrels, and portions of the spandrel columns and walls. Portions of the east approach retaining walls were also retained.

13. Comments Started Aug. 1979, Comp. Nov. 1980 Johnson Bros. Const. – $9,000,000 (complete deck removal, new lite standards, spandrel columns raised, roadway grade raised approx. 5', new approach pavs, 1939 railing cleaned and reinstalled, some pier repair)

Figure 54. 1988 Bridge Inspection Notes

2.5.3.2 Span Arrangement

The rehabilitated bridge contained four fewer approach spans. Two approach spans were removed from the east approach and two approach spans were removed from the west approach. The east approach superstructure was changed from cast-in-place concrete beams to prestressed concrete beams. The west approach spans were reconstructed with welded plate girders.

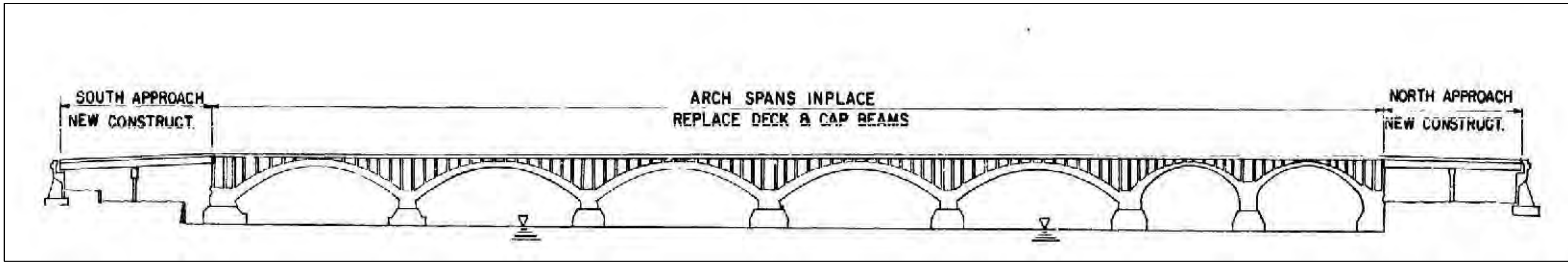


Figure 55. Completed 1979 Rehabilitation

Replaced west abutment, west approach spans, east approach spans, east abutment, top portion of spandrel columns, and deck. East retaining walls remained but not shown in view.
NOTE – These are elevation views of the bridge are generated from existing plans and only intended to show the major items of work. Lights, for example, are not shown on an existing drawing, see photos.

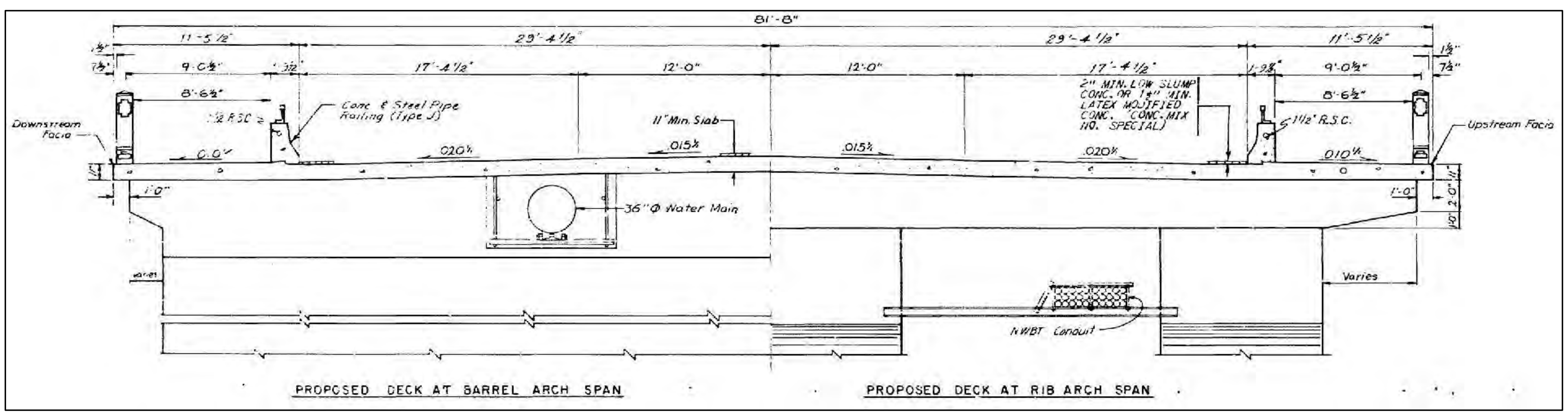


Figure 56. Completed 1979 Rehabilitation

Replaced concrete deck, cap beams and top portions of spandrel columns, and pier walls. Ornamental aluminum railing reinstalled. Grade raised (i.e. cap beams no longer extend below arch ribs).

2.5.3.3 Railing Details

The 1938-1939 aluminum railing was salvaged and reinstalled as part of the 1978-1980 project. New upper and lower rails were installed to hold the panels. The rails were rectangular, like the original rails. New concrete posts were constructed to support the metal railing. The design for the posts was similar to the original 1938-1939 posts, but with simplified detailing.

2.5.3.4 Lighting Details

New steel light standards were installed on the new concrete barriers between the sidewalks and the roadway. According to a MnDOT document, "The Third Avenue Bridge: Its History and Renovation," there were fifty-three "architectural-style units" installed. The number is similar to the original fifty-two light standards, and the placement of the standards appears to be close to the locations of the original light standards. The same MnDOT document describes the new light fixtures as "a modern unit that complimented the design of the deck and the railings."

2.6.1 Engineering Findings of Significance

The accident report data includes several accidents impacting the traffic barriers. With a large amount of traffic on the bridge and a reverse S-curved alignment a significant number of accidents are to be expected. The setting of the bridge near St Anthony Falls may in part contribute to the accident history on the bridge. The extra moisture in the air from water falling over the dam is believed to lead to more frequent icing on the bridge deck.

The bridge contains concrete from a number of different time periods. These concretes may have had admixtures such as calcium chloride added to the mixes as early as 1938-1939.

Mixing water shall not be heated beyond 130° F. 2% Calcium Chloride or high early strength cement may be used with the permission of the Engineer. After the concrete is deposited, it shall be suitably protected to prevent freezing. At temperatures below 25° F, the Contractor shall secure the written permission of the Engineer before any concrete is placed. Frozen concrete will be rejected as not complying with the specifications and shall be promptly removed and replaced.

Figure 57. 1938 Specification Language

Coatings have been applied to the concrete surfaces as early as 1938-1939. The coating was a mixture of cement and water for the top of the rail posts to provide a uniform color and texture. The fascia girders received a coating of Billings-Chapin Driwall which was intended to be a waterproof barrier.

Figure 58. Billings-Chapin Company ad

The 1978-1980 rehabilitation included a pay item for a special surface finish for the bridge. The special surface finish has historically been a mixture of acrylic paint and cement.

3.0 CHARACTER DEFINING FEATURES AND BRIDGE INTEGRITY

3.1 Character-Defining Features

For a monumental structure like the Third Avenue Bridge, character-defining features can be considered at two levels: 1) large scale, and 2) details.

Significant large-scale characteristics include:

- The overall configuration and material of the seven main spans and related piers and columns (S-curve, reinforced concrete, three arch ribs, barrel arches).
- The incised linear detailing on the pier and the projecting bands at the bases of the piers.
- The observation platforms and cantilevered sidewalks, which extend outward and highlight the edge of the deck.

Noteworthy details include:

- Railings: The aluminum panels are historic, and the newer concrete posts are complimentary. The railings contribute to the historic integrity of the bridge.
- Sidewalks: The sidewalks have always flanked the roadway and maintaining the symmetry of sidewalks on both sides of the bridge is important to the historic integrity. The relationship between the sidewalks and the historic railing panels should be maintained. If the sidewalks are raised or lowered, the spaces between the railings and the sidewalks should be maintained.
- Light fixtures: The modern light fixtures do not complement the bridge's historic character. The original light fixtures, as modified in 1938-1939, represent the period of significance. Historic photographs and drawings, included above, provide detailed information on the historic light fixtures.

While the approaches and abutments are not original, they maintain the bridge's function and are important for that purpose. Their design is utilitarian and similar to the historic approaches and abutments. The existing features do not draw attention away from the historic main spans.

3.2 Bridge Integrity

Properties listed in the National Register of Historic Places must have physical integrity that conveys their historic significance. The National Register guidelines state that the evaluation of integrity is "grounded in an understanding of a property's physical features and how they relate to its significance."[27] The National Register recognizes seven aspects of integrity: location, design, setting,

[27] National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation (Washington, D.C.: National Park Service, 1997), 44.

materials, workmanship, feeling, and association. To retain historic integrity, the Third Avenue Bridge must possess most of these aspects.

Location is the place where a historic property was constructed or where a historic event occurred. The Third Avenue Bridge has occupied the same location since it was built. The importance of connecting Third Avenue South and Central Avenue SE was the reason the bridge was constructed. The location influenced the design for the bridge. The reverse "S" plan was required to avoid breaks in the limestone riverbed under the bridge.

Design is the combination of elements that create the plan and structure of the bridge. The original design for the seven main spans has been maintained. The deck-girder approach spans were replaced in 1978-1980. The new spans are also deck girders and the designs respect the original intent. The deck was completely replaced in the late 1970s but the design for the new deck recreated key design elements of the original deck. Sidewalks were maintained on both sides of the roadway. Historic railing panels were preserved and reinstalled on the bridge. Where design features were replaced because of changes to standards, the new designs were mostly complimentary. A taller traffic barrier and new lights were installed, which affected the historic character but these were required by contemporary standards. The historic spiral staircase on the east end was replaced with a new concrete spiral staircase that met standards.

Setting is the character of the physical environment surrounding a historic property. The setting around the Third Avenue Bridge has continuously been dominated by the Mississippi River and the Falls of Saint Anthony. The horseshoe dam under three spans of the bridge has existed since the nineteenth century. Although the dam has been modified, it maintains the same basic form. The bridge continues to connect Third Avenue South on the west side of the river to Central Avenue SE on the east side. Railroad tracks ran under the east end of the bridge along Main Street SE. The tracks were removed in the late twentieth century and a linear park with bicycle and pedestrian trails now runs along Main Street SE and under the bridge. On the west side, a similar linear park and West River Parkway replaced railroad tracks that ran under the west approach span. The bridge was historically flanked by three other bridges—the steel Hennepin Avenue Bridge was upstream and the Stone Arch Bridge and the old Tenth Avenue Bridge were downstream. The previous Hennepin Avenue Bridge was replaced with the current suspension bridge in 1990. The Stone Arch Bridge is still extant and the old Tenth Avenue Bridge was removed during World War II. The upstream entrance to the Upper Saint Anthony Lock and Dam, which was completed in 1963 is under the west end of the bridge. While the lock was constructed after the period of significance, walls along the riverbank and the channel to the lock may be older. Buildings on the riverbanks have changed over time, but the dense urban character of the city has been maintained.

The **materials** used in the bridge are important for revealing construction preferences from the period of significance. The property must retain key materials and if it has been rehabilitated, then "the historic materials and significant features must have been preserved."[28] The Third Avenue Bridge has been repaired multiple times, including a major rehabilitation in 1978-1980. The deck and top sections of the spandrels were replaced. The abutments were also rebuilt, although parts of the original east retaining walls remain. The current deck and approach spans were built after the period of significance, but the original main spans, which form the majority of the superstructure, are intact. Repairs to the historic concrete have used concrete and other cementitious products. On the bridge deck, the retention of the historic aluminum bridge railings panels preserves an important material from the period of significance. The top and bottom rails were replaced, but essentially in kind. The concrete railing posts were also replaced but the new posts have a similar form and configuration to the historic posts.

Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history. Signs of workmanship are not clearly visible on the reinforced-concrete superstructure of the bridge. It has endured almost one hundred years and its longevity is the strongest indication of the workmanship that went into the original construction.

Feeling is a property's expression of the aesthetic or historic sense of a particular period of time. **Association** is the direct link between a property and an important historic event. The physical features of the Third Avenue Bridge give it the feeling and association of a bridge from the early twentieth century, and it continues to carry vehicles and pedestrian traffic. The bridge was built as an important connector between the east and west sides of Minneapolis, and it continues to be associated with transportation as a vital corridor within the city.

3.3 Site Visit Description

A collaborative site visit was held at the bridge on the morning of April 13, 2017. Personnel from MnDOT, the City of Minneapolis, Hess Roise and Company, Olson and Nesvold Engineers, Wiss Janney Elstner Associates, and HNTB participated in the site visit. Engineers and historians walked below both approaches, and on the upstream and downstream sidewalks of both approaches and the main spans. Discussion topics included deck width, lighting standards, the period of significance, and the condition of the traffic barriers. The rotation of the east abutment retaining walls was reviewed as were the condition of the main river piers near each bank of the river.

[28] Ibid., 45.

3.4 Preservation Priority Roster

The MnDOT Bridge Office has expressed interest in a summary spreadsheet identifying character-defining features of the bridge and the pertinent considerations associated with each of the features. The initial preservation roster was assembled just prior to the Site Visit. Subsequent to the site visit it was updated at a historic collaboration meeting. A copy of the updated roster is provided below:

3rd Avenue Bridge/Site Element Notes Regarding Preservation

Item	Item Name	Discussion	Field Notes
1	Above Deck Lighting	What is or is not important from a preservation perspective for roadway and sidewalk lighting? Which lighting standards are appropriate?	If the period of significance is complete after the 1938 rehab, the existing lights (installed as part of the last rehab) are not important bridge elements
2	Sidewalk Barrier/Railing	Current aluminum railing or original balustrade?	Again, if the 1938 aluminum railing is in fair to good condition no need to consider the original concrete railing, some sections of the 1938 railing may need repair.
3	Traffic Barrier / Median	What details are most acceptable for traffic barriers and a median	Low profile barrier would be a preference of the public
4	Roadway/sidewalks	Concrete pavements are expected for both elements	Detail to prevent over the side drainage may be possible with a full deck replacement. Overlooks are a key detail to retain. Desire to remove many of the deck joints to limit the intrusion of salty water into the bridge.
5	Stairway at the NW corner	Should the 1980 stairway be retained? If not what access is most appropriate from a preservation perspective?	This is somewhat tied to the period of significance discussion
6	Below deck elements Main Street	Slope protection or sidewalk details of concern?	Removal of the non-permitted building at the abutment breastwall is likely. Lots of festivals use the area under the bridge. Rip rap is a sensitive issue at this location. The City has spent funds to improve the site.
7	Below deck elements River Road	Slope protection or sidewalk details of concern?	Retention of the wall near the old rail bed on the north side of the post office would be a preference
8	North Approach spans	If the deck is replaced are their details to modify on the spans above the beams?	Topic felt to be premature to discuss at the site visit
9	Downtown Approach spans	If the deck is replaced are their details to modify on the spans above the beams?	Topic felt to be premature to discuss at the site visit
10	Reconstruction of the NE retaining wall	What is or is not an appropriate design style for reconstruction of retaining wall?	Beyond the building the distortion appears related to the elevated portion of the retaining wall. Aluminum railing is distorted.
11	Utilities	Likely little change will be possible with the utilities. However, what changes, "other than removal" would be considered improvements?	City Water likes to self-perform work so if they do work they would need to coordinate with the DOT's contractor. Some utilities are a concern to WJE. There is a need to identify all utility owners on the bridge. Severe deck spalling at manholes
12	Review spandrel column and wall details including caps	If portions of these elements are reconstructed, are they preferences on what the details should look like?	The amount of reconstruction will guide the appropriate cap details. If only select caps are replaced, then the replacements will match the current details. If all are replaced, there will need to be additional conversations about cap beam details
13	River Piers	Repairs on the outside face are necessary in many locations due to over the side drainage of salty water.	A variety of repairs have been performed in the past. Concrete elements are coated.
14	Arch ribs	No major changes are expected from a geometric perspective. Encasement of an arch rib near a pier would be the largest potential impact	The arches may be in better condition than people think, inspection and material testing will confirm. Lower portions could be in worse condition
15	Barrel arch	No major changes are expected from a geometric perspective.	The arches may be in better condition than people think, inspection and material testing will confirm. Lower portions could be in worse condition

Appendix A – 2006/2014 Historic Bridge Management Report

Minnesota Department of Transportation (Mn/DOT)
Historic Bridge Management Plan

Bridge Number: 2440

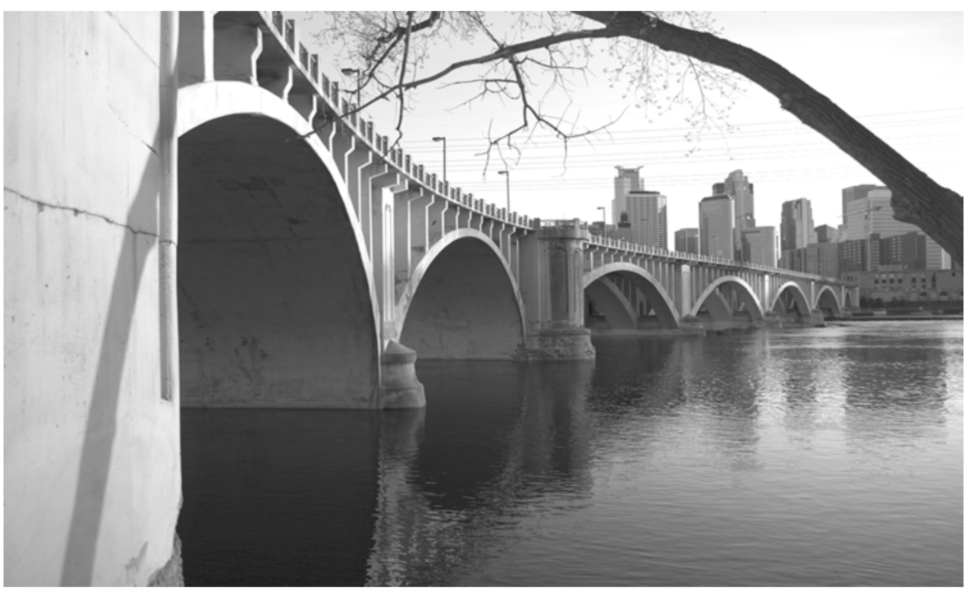
Executive Summary

Bridge 2440 (Third Avenue Bridge) was completed in 1917 to carry Trunk Highway 65 (Third Avenue) over the Mississippi River just above St. Anthony Falls in Minneapolis, Hennepin County. It has an overall structure length on 1,887.8 feet and an out-out width of approximately 82 feet (wider over some piers). It has seven reinforced-concrete main spans, including five open-spandrel, rib-arch spans of 211 feet each, and two open-spandrel, barrel-arch spans of 131 feet each. There are two steel-beam approach spans on the south, and two prestressed I-beam approach spans on the north. The significant design features are the use of the Melan system of steel reinforcing in the main spans and the reverse S-curve of the alignment. The unusual geologic structure of the riverbed necessitated pier placements that resulted in the S-curve. The bridge features Classical Revival detailing, including an ornamental metal and concrete railing added in 1939. A major rehabilitation in 1979-80 resulted in complete deck removal and replacement with reinstallation of the 1939 railing.

With adequate roadway width and load capacity, and FHWA-compliant railings, Bridge 2440 serves as a major thoroughfare over the Mississippi River in downtown Minneapolis. However, deteriorated below deck concrete components in the main arch spans require extensive rehabilitation.

The recommended future use of the bridge is rehabilitation for continued vehicular use on-site. The bridge should be rehabilitated based on the Secretary of the Interior's Standards for Rehabilitation (Standards) [36 CFR Part 67] and Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards (Guidelines).

Until the Federal Highway Administration (FHWA), State Historic Preservation Office (SHPO) and Minnesota Department of Transportation (Mn/DOT) have signed a historic bridge Programmatic Agreement, all proposed work on this bridge (including maintenance, preservation and stabilization activities) needs to be sent to the Mn/DOT Cultural Resources Unit (CRU) for formal review.



Minnesota Department of Transportation (Mn/DOT)
Historic Bridge Management Plan

Bridge Number: 2440

Table of Contents

The Minnesota Department of Transportation (Mn/DOT), in cooperation with the Minnesota State Historic Preservation Office (SHPO) and Federal Highway Administration (FHWA), has committed to preserve selected historic bridges in Minnesota that are owned by the state and managed by Mn/DOT. In consultation with SHPO and FHWA, Mn/DOT selected 24 bridges as candidates for long-term preservation. Mn/DOT's objective was to preserve the structural and historic integrity and serviceability of these bridges following the Secretary of the Interior's Standards for the Treatment of Historic Properties (Standards) [36 CFR Part 68], and their adaptation for historic bridges by the Virginia Transportation Research Council as Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards (Guidelines). The character-defining features of each bridge received special attention. Mn/DOT also hopes to encourage other owners of historic bridges to follow its model for preservation.

The Glossary in the Appendix explains historic preservation terms used in this plan, such as historic integrity and character-defining features, and engineering terms, such as serviceability and deficiency.

Mn/DOT's ongoing efforts to manage historic bridges are intended to comply with Section 106 of the National Historic Preservation Act of 1966, as amended, and Section 4(f) of the U.S. Department of Transportation Act of 1966. This effort began with Robert M. Frame's 1985 study and list of significant and endangered bridges in Minnesota and incorporates Jeffrey A. Hess's 1995 survey and inventory of historic bridges in Minnesota that were built before 1956. That inventory identified the subject bridge as eligible for listing in the National Register of Historic Places. Using the results of the 1995 study, Mn/DOT selected individual historic bridges for long-term preservation.

To achieve its preservation objectives, Mn/DOT retained the consultant team of Mead & Hunt and HNTB to develop management plans for 22 of the 24 selected bridges. The remaining two bridges have been addressed through separate projects.

Mn/DOT requested that the team consider a full range of options for each bridge and present the option that the team judged to be best for long-term preservation with due consideration given to transportation needs and reasonable costs. For example, if two options are explored that both result in an equivalent level of preservation for the bridge (e.g., retention of historically significant features and projected life span), but one option costs significantly more than the other, the less costly option will be recommended. In cases where one option results in a significantly better level of preservation than any other reasonable options but costs more, it will be the recommended action.

Preservation objectives call for conservation of as much of the existing historic fabric of the bridge as possible. However, safety, performance and practical considerations may have dictated replacement of historic fabric, especially of a minor feature, if such action improved the overall life expectancy of a bridge.

Options that were considered for the 22 historic bridges, listed from most to least preferred, are:
1. Rehabilitation for continued vehicular use on-site
2. Rehabilitation for less-demanding use on-site, such as one-way vehicular or pedestrian/bicycle traffic
3. Relocation and rehabilitation for less-demanding use
4. Closure and stabilization following construction of bypass structure
5. Partial reconstruction while preserving substantial historic fabric

A recommended option was selected for each bridge through consultation among the consultant team, Mn/DOT and SHPO. Within the recommended option, the plan identifies stabilization, preservation and maintenance activities. Stabilization activities address immediate needs in order to maintain a bridge's structural and historic integrity and serviceability. Preservation activities are near-term or long-term steps that need to be taken to maintain a bridge's structural and historic integrity and serviceability for the foreseeable future. Preservation activities may include rehabilitation and replacement of components, as needed, and remedial activities to address a deficiency. Maintenance activities, along with regular structural inspections and anticipated bridge component replacement activities, are routine practices directed toward continued serviceability. Mn/DOT is responsible for final decisions concerning activities recommended in the plan.

Recommendations are intended to be consistent with the Standards. The Standards are ten basic principles created to help preserve the distinctive character of a historic property and its site, while allowing for reasonable change to meet new needs. They recommend repairing, rather than replacing, deteriorated features when possible. The Standards were developed to apply to historic properties of all periods, styles, types, materials, and sizes. They also encompass the property's site and environment as well as attached, adjacent, or related new construction.

Because the Standards cannot be easily applied to historic bridges, the Virginia Transportation Research Council prepared Guidelines, which adapted the Standards to address the special requirements of historic bridges. The Guidelines, published in the Council's 2001 Final Report: A Management Plan for Historic Bridges in Virginia, provide useful direction for undertaking historic bridge preservation and are included in the Appendix to this plan.

The individual bridge management plan draws from several existing data sources including: PONTIS, a bridge management system used by the Mn/DOT Bridge Office to manage its inventory of bridges statewide; the current Mn/DOT Structure Inventory Report and Mn/DOT Bridge Inspection Report for each bridge (the complete reports are included in the Appendix); database and inventory forms resulting from the 1995 statewide historic bridge inventory; past maintenance reports (if available, copy included in the Appendix); and other information provided by Mn/DOT. Because PONTIS uses System International (metric) units, data extracted from PONTIS are displayed in metric units.

The plan is based on information obtained from Mn/DOT in 2005, limited field examinations completed in 2005 for the purpose of making a qualitative assessment of the condition of the bridge, and current bridge design standards. Design exceptions are recommended where appropriate based on safety and traffic volume. The condition of a bridge and applicable design standards may change prior to plan implementation.

This plan includes a maintenance implementation summary at the end. This summary can be provided as a separate, stand-alone document for use by maintenance staff responsible for the bridge.

The plan for this individual bridge is part of a comprehensive effort led by Mn/DOT to manage the statewide population of historic bridges. The products of this management effort include:
1. Minnesota Historic Bridge Management Plan
2. Individual management plans for 22 bridges
3. National Register of Historic Places (NRHP) nomination forms for 2 bridges
4. Minnesota Historical Property Record (MHPR) documentation for 46 bridges

The first product, the Minnesota Historic Bridge Management Plan, is a general statewide management plan for historic bridges in Minnesota that are owned by the state, local governments or private parties. It is intended to be a single-source planning tool that will help bridge owners make management and preservation decisions relating to historic bridges. Approximately 240 historic bridges owned by parties other than Mn/DOT survive in the state as of 2005. Mn/DOT is developing this product to encourage owners of historic bridges to commit to their long-term preservation and offer guidance.

This individual plan represents the second product. The third and fourth products will be prepared as stand-alone documents.

Date of Construction	1917		
SHPO Inventory Number	HE-MPC-0165		
Common Name (if any)	Third Avenue Bridge		

Location

Feature Carried:		TH 65 (Third Avenue S.)	
Feature Crossed:		Mississippi River, railroad, and city streets	
Descriptive Location:		0.3 Miles Northeast of Jct. TH 952A	
UTM Zone:	15	NAD:	1983
Easting:	4981072	Northing:	479448
USGS Quad Name:		Minneapolis South	
Town or City:		Minneapolis	
County:		Hennepin	

Structure Data

Main Span Type:	111	Concrete Arch - Deck	Total Length: 1888

Descriptive Information (or narrative as available)

Superstructure:

Substructure:

Floor/Deck:

Other Features:

Narrative:

The Third Avenue Bridge is the last major reinforced-concrete bridge constructed in the Twin Cities using Melan ribs (Westbrook 1983:18). As explained by Condit (1982:174-175):

"In the Melan system, the reinforcing consisted of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose."

A detailed bridge description was presented in a 1915 article in Engineering News:

"There are five 211-ft. concrete arch spans with piers 20-ft. wide at the springing line and two 131-ft. spans with an intermediate pier 13.79-ft. wide. The two end, or abutment, piers and the pier between the 211-ft. and 134-ft. spans are 30-ft. wide. The approaches are steel girder spans on thin piers. All the river piers are skew to the center line. The 211-ft. spans are on the tangent of the 4? curves and the 134-ft. spans are on the 10? curves.

"Each of the 211-ft. spans is carried by three arched ribs of 36-ft. rise. The outside ribs are 12-ft. wide in the two end spans and 10 ft. in the intermediate spans, while all center ribs are 16 ft. wide. The reinforcing is of the Melan type, consisting of ribs of 4 x 4 x ½-in. angles laced with 3 x 3 x 5/16-in.

angles (at haunches) and 2½ x -in. bars. There are six of these ribs in each 16-ft. arch rib, five in the 12-ft. and four in the 10-ft. ribs. They are braced every 30 ft. with 3 x 3 x 5/16-in. angles.

"The two 134-ft. spans over the east channel are full-barrel arches with Melan ribs of 3 x 3 x 5/16-in. angles laced with 2½ x ¼-in. bars. These are spaced 34 in. center to center and cross-braced every 30 ft. with 3 x 3 x 3/8-in. angles.

"Carrying the floor system from the ribs are transverse walls and girders supporting the floor slab and brackets supporting the sidewalk slabs and parapet-wall beam.

"The piers were constructed in open coffer-dams of Lackawanna steel sheeting, some of the sheeting being used three and four times. The coffer-dam dimensions were as follows: Pier No. 2, 46 x 121-ft.; Nos. 3 to 6, inclusive, 37 x 113-ft.; No. 8, 24 x 101.5-ft.; No. 7 (between the larger and smaller arches), 46 x 131-ft.; east abutment pier, 42 x 110-ft.

"The construction of pier No. 2 is described in what follows and is typical of all the work. After placing the underbracing for the coffer-dam, the sheetpiling was driven. On this pier (also No. 3) it was necessary at the upstream end of the coffer-dam, because of the strong current, to anchor 15-in. I-beam sills to the rock bottom with 2-in. rods to hold the lower end of the sheeting in place.

"The steel sheeting was very tight and was made entirely water-tight by a filling of coal dust and fine cinders. Sandbags were placed around the bottom of the sheeting and then pumping was started. If water came in through fissures in the rock, pumping was stopped and the bottom curse of the concrete, 5 to 6 ft. think, was placed under water. After this had set, the coffer-dam was pumped out and the remainder of the work placed dry. This was done on piers Nos. 2, 6 and 8 and partly on No. 3. Excavating for piers Nos. 6 and 8 was done entirely with orange-peel buckets. The rock in those coffer-dams was cleaned by divers with water jets. The other foundations were place dry, but always in sections, and generally four sections to each coffer-dam.

"After the footings were completed, the piers were concreted in forms which were used over and over again. The first section above the footing was carried above water level, generally leaving a center space considerable below water level to receive the ends of the steel ribs. Finally this part of the pier containing the ribs was cast in one continuous pouring. This amounted to about 7,000 yd. on piers Nos. 3, 4, 5, and 6; 1,266 yd. on Nos. 7 and 9; and 750 yd. on pier No. 8. The record run was 1,000 yd. in 22 hr.

"Pier construction was carried on through the winter except when the temperature was below zero, special precautions being taken against freezing. The forms were entirely inclosed [sic] with tarpaulins and heated with coke stoves. The sand and rock bins were supplied with heaters, and when necessary the cableway buckets for handling concrete were dipped in hot-water tanks on shore. Careful records were kept of temperatures of materials at deposit points. As a result, there was no trouble from frozen concrete.

"Concrete deposited under the water was 1:2:4 mixture. All other concrete in the piers was 1:3:6. It was mixed in batches of about 1yd. (24 ft. of stone, 12 of sand and 4 sacks of cement), two batches to each bucket. The stone was mostly traprock from Dresser Junction, Wis., crushed to a maximum size of 3 ½ in. The sand was a Minnesota product. A timber tower about 50 ft. high, with crib bottom for anchorage, was placed adjacent to the pier, standing on the river bottom. The tower had a hopper near the top, with a chute to the forms. The cableway buckets delivered concrete to the hopper, where a man regulated the discharge to the chute. The towers were picked up bodily by the cableway and moved from place to place.

"The first coffer-dam (pier No. 2) was begun Aug. 2, 1914, and the pier work was finished June 28, 1915. The river froze solid early in December, and the ice left the west channel in March and the east channel in April. Between the dates mention, 27,000 yd. of concrete was laid in pier construction.

"Falsework for the arches was begun Apr. 19, after the ice was out. One set of falsework was designed for the center ribs for the five 211-ft. spans. It was made in seven sections per span, supported by 24-in. 70-lb. I-beams, 28 ft. long on the inside sections and 26 ft. on the two end sections. The I-beams were supported on cribs made of eight 10 x 10-in. posts braced and capped and having open plank bottoms for loading with sandbags to sink them into place. These cribs were placed 28 ft. 11 in. c. to c.

"The falsework to carry the ribs was of 8 x 8-in. posts braced with 2 x 10-in. planks. The bents were capped and furnished with wedges under caps supporting the joists which carried the lagging and the framework for the rib. The lagging and side forms were 1-in. tongued-and-grooved plank, the forms being supported by 4 x 4-in. posts and 4 x 6-in. longitudinal timbers.

"The I-beams rested on 8-in. blocking, so that when the centering had been used for one rib, the entire falsework could be moved into place for the next rib by replacing the blocking with rollers. This falsework was placed in position for the upstream rib first and cribs were place also for the center ribs at the same time. Trouble was experienced in placing them because of high water and because several cribs were located on the roll dams and aprons. The use of the 24-in. I-beams of 26- and 28-ft. length was decided upon in order to utilize the material for the floor spans of the approaches.

"The first arch rib, between piers Nos. 2 and 3, was poured July 8, 1915; 240 yd. of concrete was handled on one cableway in 11 hr. over the center section of the rib. The steel ribs were then riveted at the haunches during the next night and the two end sections poured simultaneously the following day, both cableways being used for 9 hr. to handle 340 yd. of concrete. The last upstream rib was poured Aug. 5. Two days later the centering was struck under the first rib and the falsework rolled over by means of a crab on pier No. 2, with block and tackle hitched to each section. The whole centering for one span was thus moved in one day.

"On Aug. 16 the centering for the next span was moved into position and on Aug. 19 and 21 the center rib was poured – 768 yd. in 24 hr. A record run was made on the center rib finished Aug. 28, when 450 yd. was poured in 7½ hr. with both cableways, or one bucket every 2 min., at a distance of 1,600 ft. from the mixers. The concrete for the ribs is a 1:2:4 mix, using ¼ to 1½-in. stone.

"The program for the rest of the work provided for pouring one rib a week until all 15 were completed. The cribs for the upstream ribs were moved and used again for the third ribs on the downstream side. The centering of the last rib was moved over into place in 2 hr. 40 min.

"In October, 1915, the timber for the first three 211-ft. spans was moved over to the 134-ft. spans in order to finished the arches before cold weather sets in. The transverse walls are being put in, and only the floor proper will remain to be put in next spring. It is expected that the new bridge will be opened to travel not later than June1, 1916.

"The alignment of the bridge and skew of the piers necessitated an elaborate system of location. The triangulation had for its base the center tangent line of the bridge. A series of large triangles was laid out on either side of this base line, regard being given to prominent points as targets for the apices of the triangles.

"A secondary triangulation system was calculated, with proper attention to balancing errors for the location of the instrument platforms. Upon this the intersection points of pier, transverse center lines and base line of platforms were accurately established. These intersections were established with ordinary transits reading to 30 sec. Seconds were interpolated on the platforms by means of thread intersections; the minute next great and that next smaller to the actual triangle calculated to the nearest second were ready by the instrument man and recorded on the platform. Actual measurements show a maximum error of ¼-in. in 211 ft."

The bridge had ornamental railing installed in 1939, and was remodeled in 1979-1980. The rehabilitation consisted of complete deck removal; new light standards; raising of the spandrel columns; raising of the roadway grade by 5 feet; new approach pads; removal, cleaning and reinstallation of the 1939 railing; and pier repair.

Roadway Function:	Mainline
Ownership:	State
Custodian/Maint. Agency:	State

Contractor Unknown

Designer/Engineer Frederick W. Capellen

Significance Statement

The Third Avenue Bridge is individually eligible under Criterion C for its engineering significance and under Criterion A as a contributing element to the St. Anthony Falls Industrial Historic District.

The Third Avenue Bridge is an example of Melan arch construction. In 1894, Viennese engineer Josef Melan received an American patent for his innovative reinforcing system. It consisted "of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose" (Frame 1988:3). The first American bridge to embody the Melan system reportedly was a small highway span designed by German-born engineer Fritz von Emperger and built by William S. Hewett at Rock Rapids, Iowa, the same year as the patent. Several small but early Melan bridges were built and designed by Hewett in Minneapolis and Saint Paul for the Twin Cities Rapid Transit and survive today as park structures (Frame 1988:3). The Third Avenue Bridge is significant because it reflects the design and engineering of Josef Melan's reinforcing system.

In 1912, Minneapolis planners solicited designs for a concrete-arch bridge from a New York-based company, the Concrete-Steel Engineering Co. The Third Avenue Bridge was to be constructed just above the St. Anthony Falls, originally planned to be to the north of the final location. The proposal, which called for sinking piers into the weak stratum that had caused the collapse of the Eastman Tunnel in the 1860s, was not well received by the public or the power companies (since a collapse of the falls would impact its power capabilities).

Frederick W. Capellen, Minneapolis city engineer, devised a solution by altering the bridge location and leapfrogging the bridge arches over the dangerous limestone breaks (Westbrook 1983:18). As described by A. M. Richter in an Engineering News article from 1915 (pp. 1269-1270):

"While bridge engineer for the city in previous years, Capellen had built six bridges across the Mississippi River and acquired a thorough knowledge of river conditions. He refused to approve the proposed location. The City Council then rejected the plans and instructed him to design a steel bridge that could be constructed without endangering the falls or affecting water-power-rights.

"His proposed location is shown on the plan, and his design included one span of 434 feet to clear entirely the area of the limestone breaks. The trusses were to be of the parabolic through-truss type. In the face of many objections (based mainly on aesthetic considerations), the City Council approved the plans and directed the engineer to proceed with construction."

At this time, however, Mr. Cappelen conceived the idea that by adopting a curved location for the line of the bridge, a design satisfactory to all parties might be worked out. On investigation it was found that at one point the limestone break could be spanned by a concrete arch of 211-foot clear-span. A revised plan for the desired ornamental structure was then presented. This proved satisfactory to all parties and was finally adopted."

Construction began on the Third Avenue Bridge in 1914, and the total project cost was $862,254.00.

Historic Context Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945

National Register Criteria A, C

References

Bridge Inventory Files, Bridge no. 2440, Minnesota Department of Transportation Office; Condit, C.W. " Reinforced Concrete: Buildings and Bridges," in American Building: Materials and Techniques from the First Colonial Settlements to the Present, 2d ed. Chicago and London: University of Chicago Press, 1982; Frame, Robert M. "Reinforced-Concrete Highway Bridges of Minnesota," National Register of Historic Places Multiple Property Documentation Form, Sec. F, 8, 1988, in files of State Historic Preservation Office, Minnesota Historical Society, St. Paul, Minnesota; Richter, A.M. "A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve," Engineering News 74, no. 27 (1915):1268-1273, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota; Westbrook, N., ed. A Guide to the Industrial Archaeology of the Twin Cities. 1982, prepared for the Twelfth Annual Conference of the Society for Industrial Archaeology, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota.

Character-Defining Features

Character-defining features are prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include materials, engineering design, and structural and decorative details.

Feature 1. Melan-system reinforced-concrete arches. The Melan system, patented in 1894, uses steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The Third Avenue Bridge has seven large Melan arches, including two barrel arches and five three-rib arches, including the example in this photograph. It is considered to be the last major reinforced-concrete bridge constructed in the Twin Cities using the Melan system.

Feature 2. Reverse S-curve alignment. The bridge location lies in an area of the Mississippi River between Nicollet Island and St. Anthony Falls that has an irregular limestone base. The placement of piers and engineering of the spans required considerable engineering analysis to avoid unstable areas. The final plan resulted in a reverse S-curve alignment, which spanned the poor foundation sections and produced an aesthetic form that added to the bridge's overall image as a gateway to downtown Minneapolis.

Feature 3. Classical Revival aesthetic treatment. A gateway structure, the Third Avenue Bridge received a Classical Revival aesthetic treatment. Classical elements include piers and the projecting pedestrian bays, which were restored or reconstructed in the 1979-80 deck-replacement project, and the 1939 ornamental railing.

Feature 4. St. Anthony Falls setting. The Third Avenue Bridge is located just above the falls, as visible in this photograph. It spans elements of the V-shaped, upper-dam system that channeled water into east and west mill ponds on the east and west sides of the falls. The ponds provided water to the waterpower canals for the flour-milling district. The bridge is within the St. Anthony Falls Historic District (National Register of Historic Places).

Inspection Date	9/16/2004	*(Inspection and inventory data in this section was provided for this project by Mn/DOT in May 2005)*
Sufficiency Rating [1]	80.3	
Operating Rating [1,2]	31.75	
Inventory Rating [1,2]	18.14	
Posted Load [1]	0	
Design Load [1]	6	
Deficiency Rating Status [1]	S	
Condition Codes		
Deck:	6	
Superstructure:	6	
Substructure:	5	
Channel and Prot.:	6	
Culvert:	N	
Appraisal Ratings		
Struct. Eval.:	5	
Deck Geometery:	5	
Underclearances:	9	
Waterway Adequacy:	N	
Appr. Alignment:	8	
Smart Flag Data [1]	☐	*(A check indicates data items are listed on the Bridge Inspection Report)*
Fracture Critical [1]	N	
Last Inspection Date		
Waterway Data		
Scour Code [1]:	A scour evaluation has been completed for Bridge 2440 and determined that it has a low risk of scour failure.	
Roadway Data		
ADT Total:	18500	
Truck ADT Percentage:	2	
Bypass Detour Length [2]:	1.6093	
Roadway Clearances		
Roadway Width [2]:	17.89176	
Vert. Clearance Over Rdwy [2]:	99.99	
Vert. Clearance Under Rdwy [2]:	7.3152	
Lat. Under Clearance Right [2]:	4.572	
Lat. Under Clearance Left [2]:		
Geometry Characteristics		
Skew:	0	
Structure Flared:	0	

[1] These items are defined in the glossary in Appendix A. [2] These items are provided in metric units.

Roadway Characteristics

Floodplain Data

Available data indicates that Bridge 2440 will not inundate during a Q100 flood event.

Accident Data

The Mn/DOT Accident Database reports 76 accidents associated with this bridge for the 15-year period of 1990-2004.

43 – Property Damage – No Apparent Injury accidents
17 – Injury – Possible Injury accidents
13 – Injury – Non-incapacitating Injury accidents
2 – Injury –Incapacitating Injury accidents
1 – Fatality accident

Location of Plans

Bridge Office

Existing Conditions

Available information was reviewed prior to assessing the various options for preservation of Bridge 2440 and visiting the bridge site. This information is cited in the Project Introduction section of this plan. A site visit was conducted to qualitatively establish the following:

1. General condition of structural members
2. Conformation to available extant plans
3. Roadway geometry and alignment
4. Bridge geometry and clearances

Serviceability Observations:

Bridge 2440 has a roadway width of 58.7 feet which is adequate for a four-lane structure with an ADT of 15,500 (2004).

The load ratings (based on a 1980 analysis) are adequate with an inventory rating of HS20 and an operating rating of HS35.

The inventory report identifies the vehicular railings as FHWA-compliant.

The posted speed limit on the bridge is 30 mph.

Structural Condition Observations:

Deck and Sidewalk Observations
The inspection report states that 43 strip-seal expansion joints were replaced or installed in the deck in 2003. The report also states that they require continual repair.

Checker plates over the sidewalk expansion joints were not extended to the end of the joint.

There is cracking in the deck on the west shoulder of the bridge. Localized ponding of water was visible in isolated locations on the east sidewalk during the site visit.

The top surface of the west sidewalk has popouts and minor cracking.

The soffit of the deck on the north approach spans has cracks with efflorescence.

Superstructure Observations
The prestressed concrete beams supporting the north approach spans appear in good condition.

The weathering steel girders on the south approach spans are staining the substructure units, with the heaviest staining under the fascias.

Substructure Observations
Vines cover the west face of the north abutment. A large portion of the breastwall over the building attached to the north abutment has been painted gray, most likely to cover graffiti.

Without access to the river spans (below the deck) during our site visit it is impossible to estimate the amount of deterioration in the arch spans. Photos taken from the river banks indicate that spandrel column deterioration may be widespread. The inspection report notes that multiple spandrel columns near mid-span of the arches have sheared at the top just below the deck. In addition, pier elements below the spring line of the arches generally appear deteriorated.

The west and east faces of the south river pier have been repaired and appear to be in better condition than adjacent pier elements.

The inspection report indicates that an underwater inspection of the foundations found that several piers have exposed and/or undermined foundations.

There is a substantial amount of graffiti on the inner walls of the pier on the north bank of the river. There are also several vertical cracks over the access openings. Shotcrete repairs on the west face of the pier have failed. During the site visit, water was visibly draining out of the pier in the spalled region.

The inspection report notes that bearings for the south approach spans have been damaged due to movement of the south abutment northward, locking the beams against the first arch pier.

The top of the concrete retaining wall supporting the embankment on the southwest corner of the bridge (along West River Road Parkway) appears to be tilting north.

Railing Observations

Metal railing components on the vehicular railing are rusting near “sharp” edges of components and staining the concrete below.

The west vehicular railing at the north expansion joint has a vertical offset over the paving block.

The metal pedestrian railing appears to be in fair to good condition.

A significant spall (2’ x 3’) with exposed rebar is present on the east face of the east vehicular railing 25 feet north of a missing roadway light.

In several locations on the east and west vehicular railings the expansion joints and internal joints show significant distress. There is a 2”+ vertical offset of the metal railing on the northern end of the east vehicular railing. The offset must have been present prior to the expansion joint work, because concrete elements do not have a similar offset.

One segment of the east vehicular railing has rotated (top to the east) along the north approach. A horizontal offset of 1-2” is noted at the height of the metal railing.

Non-Structural Observations:

Roadway Approach Observations

The north approach roadway pavement is bituminous and has extensive cracking. The pavement is in poor condition next to the north expansion joint.

The northwest approach sidewalk near the modern stairs has settled and has been repaired with bituminous patches.

The bituminous approach for the south end of the bridge has also cracked extensively and appears heavily worn with minor rutting.

Lighting Observations

On the bridge, modern roadway lighting is attached to the top of the vehicular railings. The lighting components are not compatible with the historic features of the bridge. Roadway lights are missing in several locations. Wires for the lights are exposed at these locations. In other locations, anchorage details appear corroded.

Substandard electrical wiring is displayed on the south end of the east vehicular railing. A gray cable exits a partially closed junction box and is attached to the metal vehicular railing with zip ties until it reaches the next light, roughly 20 to 25 feet away.

Miscellaneous Observations

Weeds are growing in the joints between concrete components

The 30-mph speed limit sign on the west pedestrian railing is attached with only a clamp and wire. Likewise, a small white sign is attached to a concrete post at the south end of the west pedestrian railing with 2 metal bands . The metal bands have stretched, leaving the sign tilting west.

Many utilities are carried by the bridge, with most under the deck just inside the outer arch ribs.

Date of Site Visit

October 5, 2005

Figure 1. Looking north at the bridge from the south approach. The vehicle barriers are not symmetrical on the south end. A low profile barrier is provided on the east and a taller barrier is provided on the west. The approach roadway pavement is deteriorated and has extensive cracking.

Figure 2. Looking south along the west side of the bridge from the west sidewalk. Stained, deteriorated concrete on the pier below the overlook is visible.

Figure 3. Looking north at the north end of the east sidewalk. Localized ponding adjacent to a reconstructed sidewalk expansion joint is visible. Staining on the vehicle barrier from the metal railing components and anchorages is typical.

Figure 4. Looking north at the east vehicular railing on the north approach. Settlement has led to shifting of the barrier both vertically and laterally.

Figure 5. Looking east at the southernmost river pier. Deteriorated concrete is visible in many locations, primarily near the water line. The weathering steel beams supporting the south approach spans are also visible.

Figure 6. Looking northwest at the north abutment. A recently installed stairway of modern design to access the west sidewalk on the bridge is visible just to left of the building attached to the abutment.

Figure 7. Staining and concrete spalls are visible on the north face of the west end of the pier between the barrel and rib arches.

Figure 8. Looking east at the northernmost river pier. Shotcrete repairs to the pier have failed. Large spalled regions, with water draining out of the deteriorated area, were visible during the site visit.

Overall Recommendations

With a sufficiency rating just over 80, Bridge 2440 is in fair condition.

Bridge 2440 has characteristics (adequate roadway width, load capacity, and FHWA compliant railings) that will permit it to function as part of the trunk highway system for the 20-year planning window of this management plan. Extensive rehabilitation will be necessary to reach the end of the planning window without significant loss of historic fabric. Other less desirable preservation options were not considered.

Recommended Future Use:

Rehabilitation for continued vehicular use on-site.

Recommended Stabilization Activities:

1. Repair the exposed and undermined regions of the foundations for the river piers utilizing standard Mn/DOT procedures.

2. Inspect and test the drainage features on the bridge to confirm they are properly conveying water. Identify the source of water leaking out of the north river-bank pier to prevent additional deterioration.

3. The shearing of spandrel column tops and the continual repair of expansion joints indicate that the bridge is moving in unanticipated directions. The movement patterns are likely complicated by the reverse curve alignment and the translation of the south approach spans north. Develop and implement a plan to monitor and collect the geometry of the bridge's superstructure and substructure as it moves with changes in temperature for a period of at least two years.

Recommended Preservation Activities:

1. Conduct a concrete material testing program. Through the use of sounding, mini-cores, and chloride sampling, determine the condition and chloride contamination of concrete components. Test original and reconstructed components. Delineate the location and size of deteriorated regions for future rehabilitation efforts.

2. Assemble a three-dimensional structural analysis model of the bridge. Utilizing the field-collected temperature movement data, calibrate the boundary conditions of the analysis model.

3. Load rate the bridge utilizing the calibrated three-dimensional analysis model, which should be based on the condition (section loss) of the concrete components and their material properties.

4. Seal cracks in the deck and sidewalks utilizing standard Mn/DOT procedures.

5. Clean and paint the metal components of the vehicular railings. Utilize Mn/DOT standard procedures and match the existing paint color on the pedestrian railing.

6. Replace missing roadway lights and properly wire fixtures. If feasible, paint the roadway light standards to match the color of the metal railing components. When the vehicular railing requires replacement, install a roadway lighting system with more historically appropriate light standards and fixtures. Select the new lighting in consultation with CRU and the Bridge Office.

7. Remove the bituminous approach panels. Contingent upon the location of utilities, excavate the approach backfill behind the abutments down to the level of the footings. To minimize future movements and settlements, rebuild the approach fills utilizing select granular material placed in layers with

geotextile fabric to reinforce and contain the backfill. Install new concrete approach panels.

8. Remove graffiti on the substructure units utilizing standard Mn/DOT procedures.

9. Remove the vegetation growing in the various joints on the bridge.

10. Based on the results of the concrete testing program, identify appropriate repairs for deteriorated regions. Repair deteriorated concrete components subsequent to any electrochemical chloride extraction rehabilitation. Conduct concrete repair using standard Mn/DOT repair methods and in compliance with National Park Service Preservation Bulletin 15 – Preservation of Historic Concrete. Consult with Mn/DOT's Office of Bridges and Structures before making final determination of the means and methods of concrete repairs. Apply Mn/DOT special surface finish to exposed concrete subsequent to the repairs. Apply anti-graffiti coating to the areas of the concrete susceptible to graffiti.

11. Attach signage to the bridge utilizing base plates and inserts in the sidewalk concrete. Take care not to damage pedestrian railing components.

Projected Inspections to Monitor Bridge Condition

Routine:

1. Routine annual inspections are recommended. Perform recommended maintenance activities identified as part of the inspection within a 12-month period.

2. Conduct in-depth, arm's length inspections on an interval not to exceed 4 years. Conduct maintenance and repair activities identified as part of the in-depth inspection within 24 months.

Special:

Conduct underwater inspections at 5-year intervals. Implement resulting recommended maintenance or repair efforts within a 24-month period.

Recommended Maintenance Activities

1. Flush the deck, railings, sidewalks, and fascia components with water annually.

2. Seal cracks in the deck and sidewalks on a 5-year cycle utilizing standard Mn/DOT procedures.

3. Spot paint metal railing components on a 5-year cycle utilizing standard Mn/DOT procedures.

4. Repaint metal railing components on a 40-year cycle utilizing standard Mn/DOT procedures.

5. Confirm that all strip-seal glands are in good working during routine inspections. Replace damaged glands utilizing standard Mn/DOT procedures.

VI - Projected Agency Costs — Bridge Number: 2440

Qualifier Statement

The opinions of probable costs provided below are in 2006 dollars. The costs were developed without benefit of preliminary plans and are based on the above identified tasks using engineering judgment and/or gross estimates of quantities and historic unit prices and are intended to provide a programming level of estimated costs. Refinement of the probable costs is recommended once preliminary plans have been developed. The estimated preservation costs include a 20% contingency and 5% mobilization allowance of the preservation activities, excluding soft costs (see Appendix D, Cost Detail, Item 5: Other). Actual costs may vary significantly from those opinions of cost provided herein.

For itemized activity listing and costs, see Appendix D.

Summarized Costs

Maintenance costs: $45,300 annualized

Stabilization activities
Superstructure: $0
Substructure: $400,000
Railing: $0
Deck: $40,000
Other: $75,000
Total: $515,000

Preservation activities
Superstructure: $2,000,000
Substructure: $8,000,000
Railing: $250,000
Deck: $180,000
Other: $1,667,000
Contingency: $2,608,000
Total: $14,705,000

Applicable Funding

The majority of funding for the rehabilitation and reuse of historic bridges in the state of Minnesota is available through federal funding programs. The legislation authorizing the various federal funding programs is the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).

SAFETEA-LU programs include the Transportation Enhancement (TE) Fund, the Surface Transportation Program (STP), the Highway Bridge Replacement and Rehabilitation Program (HBRRP), National Highway System Funds, and the National Historic Covered-Bridge Preservation Program. A program not covered by SAFETEA-LU, the Save America's Treasures Program, is also available for rehabilitation and reuse of historic bridges that have national significance.

Other than the Save America's Treasures Program, the federal funds listed above are passed through Mn/DOT for purposes of funding eligible activities. While the criteria for determining eligible activities are determined largely by federal guidelines, Mn/DOT has more discretion in determining eligible activities under the TE fund.

The federal funding programs typically provide 80-percent federal funding and require a 20-percent state/local match. Typical eligible activities associated with these funds include replacement or rehabilitation of structurally deficient or functionally obsolete bridges for vehicular and, non-vehicular uses, painting, seismic retrofit, and preventive maintenance. If a historic bridge is relocated, the estimated cost of demolition can be applied to its rehabilitation at a new site. It should be noted that the federal funds available for non-vehicular uses are limited to this estimated cost of demolition. However, TE funds can be applied to bridge rehabilitation for non-vehicular use.

State or federal bridge bond funds are available for eligible rehabilitation or reconstruction work on any publicly owned bridge or culvert longer than 20 feet. State bridge bond funds are available for up to 100 percent of the "abutment to abutment" cost for bridges or culverts longer than 10 feet that meet eligibility criteria.

A more in-depth discussion regarding funding can be found in the Minnesota Historic Bridge Management Plan.

Special Funding Note

N/A

Appendix A. Glossary of Preservation and Engineering Terms

Glossary

Appraisal ratings – Five National Bridge Inventory (NBI) inspection ratings (structural evaluation, deck geometry, under-clearances, waterway adequacy, and approach alignment, as defined below), collectively called appraisal ratings, are used to evaluate a bridge's overall structural condition and load-carrying capacity. The evaluated bridge is compared with a new bridge built to current design standards. Ratings range from a low of 0 (closed bridge) to a high of 9 (superior). Any appraisal item not applicable to a specific bridge it is coded N.

Approach alignment – One of five NBI inspection ratings. This rating appraises a bridge's functionality based on the alignment of its approaches. It incorporates a typical motorist's speed reduction because of the horizontal or vertical alignment of the approach.

Character-defining features – Prominent or distinctive aspects, qualities, or characteristics of a historic property that contribute significantly to its physical character. Features may include structural or decorative details and materials.

Condition rating – Level of deterioration of bridge components and elements expressed on a numerical scale according to the NBI system. Components include the substructure, superstructure, deck, channel, and culvert. Elements are subsets of components, e.g., piers and abutments are elements of the component substructure. The evaluated bridge is compared with a new bridge built to current design standards. Component ratings range from 0 (failure) to 9 (new); element ratings range from 1 (poor) to 3 (good). In rating a bridge's condition, Mn/DOT pairs the NBI system with the newer and more sophisticated Pontis element inspection information, which quantifies bridge elements in different condition states and is the basis for subsequent economic analysis.

Deck geometry – One of five NBI inspection ratings. This rating appraises the functionality of a bridge's roadway width and vertical clearance, taking into account the type of roadway, number of lanes, and Average Daily Traffic (ADT).

Deficiency – The inadequacy of a bridge in terms of structure, serviceability, and/or function. Structural deficiency is determined through periodic inspections and is reflected in the ratings that are assigned to a bridge. Service deficiency is determined by comparing the facilities a bridge provides for vehicular, bicycle, and pedestrian traffic with those that are desired. Functional deficiency is another term for functionally obsolete (see below). Remedial activities may be needed to address any or all of these deficiencies.

Deficiency rating – A nonnumeric code indicating a bridge's status as structurally deficient (SD) or functionally obsolete (FO). See below for the definitions of SD and FO. The deficiency rating status may be used as a basis for establishing a bridge's eligibility and priority for replacement or rehabilitation.

Design exception – A deviation from standard bridge design practices that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design exception is used for federally funded projects where federal standards are not met. Approval requires appropriate justification and documentation that concerns for safety, durability, and economy of maintenance have been met.

Design load – The usable live-load capacity that a bridge was designed to carry, expressed in metric tons according to the allowable stress, load factor, or load resistance factor rating methods. An additional code was recently added to assess design load by a rating factor instead of tons. This code is used to determine if a bridge has sufficient strength to accommodate traffic demands. A bridge that is posted for load restrictions may not be adequate to accommodate present or expected truck traffic.

Fracture critical – Classification of a bridge having primary superstructure or substructure components subject to tension stresses and which are non-redundant. A failure of one of these components could lead to collapse of a span or the bridge. Tension members of truss bridges are often fracture critical. The associated inspection date is a numerical code that includes frequency of inspection in months, followed by year, and month of last inspection.

Functionally obsolete (FO) – The FHWA classification of a bridge that cannot meet current or projected traffic needs because of inadequate horizontal or vertical clearance, inadequate load-carrying capacity, and/or insufficient opening to accommodate water flow under the bridge.

Historic fabric – The material in a bridge that was part of original construction or a subsequent alteration within the historic period (e.g., more than 50 years old) that has significance in and of itself. Historic fabric includes both character-defining and minor features. Minor features have less importance and may be replaced more readily.

Historic bridge – A bridge that is listed in, or eligible for listing in, the National Register of Historic Places.

Historic integrity – The authenticity of a bridge's historic identity, evidenced by the survival and/or restoration of physical characteristics that existed during the bridge's historic period. A bridge may have integrity of location, design, setting, materials, workmanship, feeling, and association.

Inspections – Periodic field assessments and subsequent consideration of the fitness of a structure and the associated approaches and amenities to continue to function safely.

Inventory rating – The load level a bridge can safely carry for an indefinite amount of time expressed in metric tons or by the rating factor described in design load (see above). Inventory rating values typically correspond to the original design load for a bridge without deterioration.

Maintenance – Work of a routine nature to prevent or control the process of deterioration of a bridge.

Minnesota Historical Property Record (MHPR) – A documentary record of an important architectural, engineering, or industrial site, maintained by the MHS as part of the state's commitment to historic preservation. MHPR typically includes large-format photographs and written history, and may also include historic photographs, drawings, and/or plans. This state-level documentation program is modeled after a federal program known as the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER).

National Bridge Inventory – Bridge inventory and appraisal data collected by the FHWA to fulfill the requirements of the National Bridge Inspection Standards (NBIS). Each state maintains an inventory of its bridges subject to NBIS and sends an annual update to the FHWA.

National Bridge Inspection Standards – Federal requirements for procedures and frequency of inspections, qualifications of personnel, inspection reports, and preparation and maintenance of state bridge inventories. NBIS applies to bridges located on public roads.

National Register of Historic Places – The official inventory of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, and culture, which is maintained by the Secretary of the Interior under the authority of the National Historic Preservation Act of 1966 (as amended).

Non-vehicular traffic – Pedestrians, non-motorized recreational vehicles, and small motorized recreational vehicles moving along a transportation route that does not serve automobiles and trucks. Includes bicycles and snowmobiles.

Operating rating – Maximum permissible load level to which a bridge may be subjected based on a specific vehicle type, expressed in metric tons or by the rating factor described in design load (see above).

Posted load – Legal live-load capacity for a bridge usually associated with the operating or inventory ratings as determined by a state transportation agency. A bridge posted for load restrictions may be inadequate for truck traffic.

Pontis – Computer-based bridge management system to store inventory and inspection data and assist in other bridge data management tasks.

Preservation – Preservation, as used in this report, refers to historic preservation that is consistent with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*. Historic preservation means saving from destruction or deterioration old and historic buildings, sites, structures, and objects, and providing for their continued use by means of restoration, rehabilitation, or adaptive reuse. It is the act or process of applying measures to sustain the existing form, integrity, and material of a historic building or structure, and its site and setting. Mn/DOT's *Bridge Preservation, Improvement and Replacement Guidelines* (BPIRG) describe preservation differently, focusing on repairing or delaying the deterioration of a bridge without significantly improving its function and without considerations for its historic integrity.

Preventive maintenance – The planned strategy of cost-effective treatments that preserve a bridge, retard future deterioration, and maintain or improve its functional condition without increasing structural capacity.

Reconstruction – The act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location. Activities should be consistent with the Secretary of the Interior's *Standards for the Treatment of Historic Properties.*

Rehabilitation – The act or process of returning a historic property to a state of utility through repair or alteration which makes possible an efficient contemporary use, while preserving those portions or features of the property that are significant to its historical, architectural, and cultural values. Historic rehabilitation, as used in this report, refers to implementing activities that are consistent with the Secretary of the Interior's *Standards for the Treatment of Historic Properties*. As such, rehabilitation retains historic fabric and is different from replacement. However, Mn/DOT's *Bridge Preservation, Improvement and Replacement Guidelines* (BPIRG) describe rehabilitation and replacement in similar terms.

Restoration – The act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time. Activities should be consistent with the Secretary of the Interior's *Standards for the Treatment of Historic Properties.*

Scour – Removal of material from a river's bed or bank by flowing water, compromising the strength, stability, and serviceability of a bridge.

Scour critical rating – A measure of bridge's vulnerability to scour (see above), ranging from 0 (scour critical, failed, and closed to traffic) to 9 (foundations are on dry land well above flood water elevations). This code can also be expressed as U (unknown), N (bridge is not over a waterway), or T (bridge is over tidal waters and considered low risk).

Serviceability – Level of facilities a bridge provides for vehicular, bicycle, and pedestrian traffic, compared with current design standards.

Smart flag – Special Pontis inspection element used to report the condition assessment of a deficiency that cannot be modeled, such as cracks, section loss, and steel fatigue.

Stabilization – The act or process of sustaining a bridge by means of making minor repairs until a more permanent repair or rehabilitation can be completed.

Structurally deficient – Classification indicating NBI condition rating of 4 or less for any of the following: deck condition, superstructure condition, substructure condition, or culvert condition. A structurally deficient bridge is restricted to lightweight vehicles; requires immediate rehabilitation to remain open to traffic; or requires maintenance, rehabilitation, or replacement.

Structural evaluation – Condition of a bridge designed to carry vehicular loads, expressed as a numeric value and based on the condition of the superstructure and substructure, the inventory load rating, and the ADT.

Sufficiency rating – Rating of a bridge's structural adequacy and safety for public use, and its serviceability and function, expressed on a numeric scale ranging from a low of 0 to a high of 100. It is a relative measure of a bridge's deterioration, load capacity deficiency, or functional obsolescence. Mn/DOT may use the rating as a basis for establishing eligibility and priority for replacement or rehabilitation. Typically, bridges rated between 50 and 80 are eligible for rehabilitation and those rated 50 and below are eligible for replacement.

Under-clearances – One of five NBI inspection ratings. This rating appraises the suitability of the horizontal and vertical clearances of a grade-separation structure, taking into account whether traffic beneath the structure is one- or two-way.

***Variance* -** A deviation from standard bridge design practices that takes into account environmental, scenic, aesthetic, historic, and community factors that may have bearing upon a transportation project. A design variance is used for projects using state aid funds. Approval requires appropriate justification and documentation that concerns for safety, durability and economy of maintenance have been met.

Vehicular traffic – The passage of automobiles and trucks along a transportation route.

Waterway adequacy – One of five NBI inspection ratings. This rating appraises a bridge's waterway opening and passage of flow through the bridge, frequency of roadway overtopping, and typical duration of an overtopping event.

Appendix B. Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards

Guidelines for Bridge Maintenance and Rehabilitation Based on the Secretary of the Interior's Standards

1. The original character-defining qualities or elements of a bridge, its site, and its environment should be respected. The removal, concealment, or alteration of any historic material or distinctive engineering or architectural feature should be avoided.
2. All bridges shall be recognized as products of their own time. Alterations that have no historical basis and that seek to create a false historical appearance shall not be undertaken.
3. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.
4. Distinctive engineering and stylistic features, finishes, and construction techniques or examples of craftsmanship that characterize an historic property shall be preserved.
5. Deteriorated structural members and architectural features shall be retained and repaired, rather than replaced. Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
6. Chemical and physical treatments that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the most environmentally sensitive means possible.
7. Significant archaeological and cultural resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.
8. New additions, exterior alterations, structural reinforcements, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.
9. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Source: Ann Miller, et al. *A Management Plan for Historic Bridges in Virginia*. Charlottesville, Va.: Virginia Transportation Research Council, 2001.

Appendix C. Current Mn/DOT Structure Inventory Report

Current Mn/DOT Bridge Inspection Report

Past Maintenance Reports (if available)

Other Reports (if available)

Mn/DOT STRUCTURE INVENTORY REPORT

Bridge ID: 2440 **TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No. (6206) (RS 1) - 1
District 05 **Maint. Area** 5A
County 27 HENNEPIN (53)
City 2585 MINNEAPOLIS
Township
Placecode 43000
Desc. Loc. 0.3 MI NE OF JCT TH 952A
Sect. 23 **Tnsp.** 029N **Range** 24W
Lat. 44d 59m 00s **UTM-Y** 4981147.56
Long. 93d 15m 13s **UTM-X** 479988.03
Toll Bridge (Road) NO
Custodian STATE
Owner STATE
Inspector METRO DISTRICT
BMU Agreement No
Year Built 1917 **Yr Fed Rehab**
Year Remod. 1980
Temp.
Skew 0 **Plan Avail.** CENTRAL

* STRUCTURE DATA *

Service On HWY;PED
Service Under HWY;RR;STREAM
MN Main Span 112 CONCR/ARCH
MN MSpn Det Def OPEN SPANDREL ARCH
MN Appr. Span 401 STLCNT/BM SPAN
MN ASpn Det Def
Culvert Type
Barrel Length
No. Main Spans 7 **No. Appr.Span** 4
Total Spans 11 **NBI Len. (?)** YES
Main Span Length 236.7 ft
Structure Length 1,887.8 ft
Abut. Mat'l. CONCRETE
Abut. Fnd. Type FTNG/PILE
Pier Mat'l. CONCRETE
Pier Fnd. Type SPRD/ROCK
Deck Width 81.6 ft
Deck Material CIP CONC
Wear Surf. Type LO SLP CON
Wear Surf. Inst. Yr. 1980
Wr. Crs/Fill Depth 0.17 ft
Deck Membrane NONE
Deck Rebars EPOXY REBAR
Deck Rebars Inst. Yr. 1980
Structure Area 154,044 sq ft
Roadway Area 110,815 sq ft
Swk Width L/R 8.0 ft 8.0 ft
Curb Ht. L/R 0.3 ft 0.3 ft
Rail L/R/FHWA 23 23 YES
Ped. Fencing
Hist. Significance NATL REGISTER
Bird Nests (?) NO

* ROADWAY DATA *

Route System (Fed) MNTH
Mn. Route System MNTH
Route Number 65
Roadway Name TH 65 (3RD AVE S)
Roadway Function MAINLINE
Roadway Type 2 WAY TRAF
Control Section 2710
BDG. Reference Point 001+00.716
Date Opened to Traffic 10-01-1980
Detour Length 1 mi
Lanes 4 ON BRIDGE (1)
ADT 15,500 **HCADT** 310
ADT Year 2004
Functional Class URB/MINOR ART
Nat'l. Hwy. System NOT NHS
STRAHNET NOT STRAHNET
Truck Net NOT TRUCKNET
Fed. Lands Hwy. N/A
OnBaseNet NOT BASENET

* ROADWAY CLEARANCES *

	If Divided	NB-EB	SB-WB
Rdwy. Wid. Rd 1/Rd 2		58.7 ft	
Vrt. Clr. Ovr. Rd 1/Rd 2			
Max Vert Clr Rd 1/ Rd 2			
Horz U/Clr - Rd 1/Rd 2		327.8 ft	
Lat UndClr Left/Right			
RR UndClr Vert/Lat		27.0 ft	12.0 ft
Appr. Surface Width		64.0 ft	
Median Width			

* ROADWAY TIS DATA *

	TIS 1st KEY	TIS 2nd KEY
Route System	03	
Route Number	00000065	
High End	944	
Low End	944	
Direction	N	
Reference Pt.	001+00.716	
Interchg. Elem.		

* MISC. BRIDGE DATA *

Struct. Flared
Parallel Struct. NONE
Field Conn. ID BOLTED
Cantilever ID
Permit Code A 1
Permit Code B 1
Permit Code C 1
Permit Code Fut.

* BRIDGE SIGNS *

Posted Load NO SIGNS
Traffic NO SIGNS
Horizontal NO SIGNS
Vertical NO SIGNS

Def. Status ADEQ **Suff. Rating** 80.3

* WATERWAY DATA *

Drng. Area
Wtrwy. Opening 99,999 sq ft
Navigation Control NO PERM REQD
Nav. Vert./Hrz Clr.
Nav. Vert. Lift Clr.
MN Scour Code L-STBL;LOW RISK
Scour Eval. Year 1993

* INSPECTION DATA *

Inspection Date 05-19-2005 (YGIH)
Inspection Frequency 24
Inspector METRO

Condition Codes		Appraisal Ratings	
Deck	6	**Struct. Eval.**	5
Superstruct.	6	**Deck Geometry**	5
Substruct.	5	**Underclearances**	9
Chan. & Prot.	6	**Waterway Adeq'cy**	N
Culvert	N	**Appr. Alignment**	8

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	1
Pier Protection		**Appr. Guardrail**	0
Scour Critical	8	**Appr. Trans.**	0
Deck Pct. Unsnd.	2 %	**Appr. Term.**	N

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical			
Pinned Asbly.			
Underwater	Y	60	02/2004
Spec. Feat.			

* PAINT DATA *

Year Painted 1980 **Pct.Unsound**
Total Painted Area
Primer Type 3309 UNPAINTED
Finish Type 3309 UNPAINTED

* CAPACITY RATINGS *

Design Load HS20MOD
MN
Operating Rating HS 35.0
Inventory Rating HS 20.0
Posting Veh: Semi: Dbl:
Rtg Date 04-01-1980

* IMPROVEMENT DATA *

Prop. Work REHAB DET
Work By CONTRACT
Prop. Structure BRIDGE
Length 1,886.5 ft **Width** 49.2 ft
Appr. Rdwy. Work
Bridge Cost 8,155,000
Approach Cost 100,000
Project Cost 1,500,000
Data - Year/Method 2003 COMPUTER

Mn/DOT STRUCTURE INVENTORY REPORT

Bridge ID: 2440 **TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No.	(6206) (RS 2) - A
District	05
Maint. Area	5A
County	27 HENNEPIN (53)
City	2585 MINNEAPOLIS
Township	
Placecode	43000
Desc. Loc.	0.3 MI NE OF JCT TH 952A
Sect.	23
Tnsp.	029N
Range	24W
Lat.	44d 59m 00s
UTM-Y	4981147.56
Long.	93d 15m 13s
UTM-X	479988.03
Toll Bridge (Road)	NO
Custodian	STATE
Owner	STATE
Inspector	METRO DISTRICT
BMU Agreement No	
Year Built	1917
Yr Fed Rehab	
Year Remod.	1980
Temp.	
Skew	0
Plan Avail.	CENTRAL

* STRUCTURE DATA *

Service On	HWY;PED
Service Under	HWY;RR;STREAM
MN Main Span	112 CONCR/ARCH
MN MSpn Det Def	OPEN SPANDREL ARCH
MN Appr. Span	401 STLCNT/BM SPAN
MN ASpn Det Def	
Culvert Type	
Barrel Length	
No. Main Spans	7
No. Appr.Span	4
Total Spans	11
NBI Len. (?)	YES
Main Span Length	236.7 ft
Structure Length	1,887.8 ft
Abut. Mat'l.	CONCRETE
Abut. Fnd. Type	FTNG/PILE
Pier Mat'l.	CONCRETE
Pier Fnd. Type	SPRD/ROCK
Deck Width	81.6 ft
Deck Material	CIP CONC
Wear Surf. Type	LO SLP CON
Wear Surf. Inst. Yr.	1980
Wr. Crs/Fill Depth	0.17 ft
Deck Membrane	NONE
Deck Rebars	EPOXY REBAR
Deck Rebars Inst. Yr.	1980
Structure Area	154,044 sq ft
Roadway Area	110,815 sq ft
Swk Width L/R	8.0 ft 8.0 ft
Curb Ht. L/R	0.3 ft 0.3 ft
Rail L/R/FHWA	23 23 YES
Ped. Fencing	
Hist. Significance	NATL REGISTER
Bird Nests (?)	NO

* ROADWAY DATA *

Route System (Fed)	CITY
Mn. Route System	MUN
Route Number	699
Roadway Name	MAIN ST SE
Roadway Function	MAINLINE
Roadway Type	2 WAY TRAF
Control Section	
BDG. Reference Point	
Date Opened to Traffic	10-01-1980
Detour Length	1 mi
Lanes	4 UNDER BRIDGE (A)
ADT	2,100
HCADT	
ADT Year	1995
Functional Class	URB COLL
Nat'l. Hwy. System	NOT NHS
STRAHNET	NOT STRAHNET
Truck Net	NOT TRUCKNET
Fed. Lands Hwy.	N/A
OnBaseNet	NOT BASENET

* ROADWAY CLEARANCES *

	If Divided	NB-EB	SB-WB
Rdwy. Wid. Rd 1/Rd 2		50.0 ft	
Vrt. Clr. Ovr. Rd 1/Rd 2		24.0 ft	
Max Vert Clr Rd 1/ Rd 2		24.0 ft	
Horz U/Clr - Rd 1/Rd 2		327.8 ft	
Lat UndClr Left/Right			15.0 ft
RR UndClr Vert/Lat			12.0 ft
Appr. Surface Width		53.0 ft	
Median Width			

* ROADWAY TIS DATA *

	TIS 1st KEY	TIS 2nd KEY
Route System	10	
Route Number	25850699	
High End	944	
Low End	944	
Direction		
Reference Pt.	000+00.210	
Interchg. Elem.		

* MISC. BRIDGE DATA *

Struct. Flared	
Parallel Struct.	NONE
Field Conn. ID	BOLTED
Cantilever ID	
Permit Code A	1
Permit Code B	1
Permit Code C	1
Permit Code Fut.	

* BRIDGE SIGNS *

Posted Load	NO SIGNS
Traffic	NO SIGNS
Horizontal	NO SIGNS
Vertical	NO SIGNS

Def. Status	ADEQ
Suff. Rating	80.3

* WATERWAY DATA *

Drng. Area	
Wtrwy. Opening	99,999 sq ft
Navigation Control	NO PERM REQD
Nav. Vert./Hrz Clr.	
Nav. Vert. Lift Clr.	
MN Scour Code	L-STBL;LOW RISK
Scour Eval. Year	1993

* INSPECTION DATA *

Inspection Date	05-19-2005 (YGIH)
Inspection Frequency	24
Inspector	METRO

Condition Codes		Appraisal Ratings	
Deck	6	**Struct. Eval.**	5
Superstruct.	6	**Deck Geometry**	5
Substruct.	5	**Underclearances**	9
Chan. & Prot.	6	**Waterway Adeq'cy**	N
Culvert	N	**Appr. Alignment**	8

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	1
Pier Protection		**Appr. Guardrail**	0
Scour Critical	8	**Appr. Trans.**	0
Deck Pct. Unsnd.	2 %	**Appr. Term.**	N

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical			
Pinned Asbly.			
Underwater	Y	60	02/2004
Spec. Feat.			

* PAINT DATA *

Year Painted	1980
Pct.Unsound	
Total Painted Area	
Primer Type	3309 UNPAINTED
Finish Type	3309 UNPAINTED

* CAPACITY RATINGS *

Design Load	HS20MOD
	MN
Operating Rating	HS 35.0
Inventory Rating	HS 20.0
Posting	Veh: Semi: Dbl:
Rtg Date	04-01-1980

* IMPROVEMENT DATA *

Prop. Work	REHAB DET
Work By	CONTRACT
Prop. Structure	BRIDGE
Length	1,886.5 ft
Width	49.2 ft
Appr. Rdwy. Work	
Bridge Cost	8,155,000
Approach Cost	100,000
Project Cost	1,500,000
Data - Year/Method	2003 COMPUTER

Mn/DOT STRUCTURE INVENTORY REPORT

Bridge ID: 2440 **TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS** Date: 01/04/2006

* IDENTIFICATION *

Agency Br. No.	(6206) (RS 3) - B
District	05
Maint. Area	5A
County	27 HENNEPIN (53)
City	2585 MINNEAPOLIS
Township	
Placecode	43000
Desc. Loc.	0.3 MI NE OF JCT TH 952A
Sect.	23
Tnsp.	029N
Range	24W
Lat.	44d 59m 00s
UTM-Y	4981147.56
Long.	93d 15m 13s
UTM-X	479988.03
Toll Bridge (Road)	NO
Custodian	STATE
Owner	STATE
Inspector	METRO DISTRICT
BMU Agreement No	
Year Built	1917
Yr Fed Rehab	
Year Remod.	1980
Temp.	
Skew	0
Plan Avail.	CENTRAL

* STRUCTURE DATA *

Service On	HWY;PED
Service Under	HWY;RR;STREAM
MN Main Span	112 CONCR/ARCH
MN MSpn Det Def	OPEN SPANDREL ARCH
MN Appr. Span	401 STLCNT/BM SPAN
MN ASpn Det Def	
Culvert Type	
Barrel Length	
No. Main Spans	7
No. Appr.Span	4
Total Spans	11
NBI Len. (?)	YES
Main Span Length	236.7 ft
Structure Length	1,887.8 ft
Abut. Mat'l.	CONCRETE
Abut. Fnd. Type	FTNG/PILE
Pier Mat'l.	CONCRETE
Pier Fnd. Type	SPRD/ROCK
Deck Width	81.6 ft
Deck Material	CIP CONC
Wear Surf. Type	LO SLP CON
Wear Surf. Inst. Yr.	1980
Wr. Crs/Fill Depth	0.17 ft
Deck Membrane	NONE
Deck Rebars	EPOXY REBAR
Deck Rebars Inst. Yr.	1980
Structure Area	154,044 sq ft
Roadway Area	110,815 sq ft
Swk Width L/R	8.0 ft 8.0 ft
Curb Ht. L/R	0.3 ft 0.3 ft
Rail L/R/FHWA	23 23 YES
Ped. Fencing	
Hist. Significance	NATL REGISTER
Bird Nests (?)	NO

* ROADWAY DATA *

Route System (Fed)	CITY
Mn. Route System	MUN
Route Number	
Roadway Name	WEST RIVER PKWY
Roadway Function	MAINLINE
Roadway Type	2 WAY TRAF
Control Section	
BDG. Reference Point	
Date Opened to Traffic	01-01-1993
Detour Length	1 mi
Lanes	2 UNDER BRIDGE (B)
ADT	500
HCADT	
ADT Year	1993
Functional Class	URB COLL
Nat'l. Hwy. System	NOT NHS
STRAHNET	NOT STRAHNET
Truck Net	NOT TRUCKNET
Fed. Lands Hwy.	N/A
OnBaseNet	NOT BASENET

* ROADWAY CLEARANCES *

	If Divided	NB-EB	SB-WB
Rdwy. Wid. Rd 1/Rd 2		14.0 ft	14.0 ft
Vrt. Clr. Ovr. Rd 1/Rd 2		30.0 ft	30.0 ft
Max Vert Clr Rd 1/ Rd 2		30.0 ft	30.0 ft
Horz U/Clr - Rd 1/Rd 2		24.0 ft	24.0 ft
Lat UndClr Left/Right		2.0 ft	12.0 ft
RR UndClr Vert/Lat			12.0 ft
Appr. Surface Width		38.0 ft	
Median Width		10.0 ft	

* ROADWAY TIS DATA *

	TIS 1st KEY	TIS 2nd KEY
Route System		
Route Number		
High End		
Low End		
Direction		
Reference Pt.		
Interchg. Elem.		

* MISC. BRIDGE DATA *

Struct. Flared	
Parallel Struct.	NONE
Field Conn. ID	BOLTED
Cantilever ID	
Permit Code A	1
Permit Code B	1
Permit Code C	1
Permit Code Fut.	

* BRIDGE SIGNS *

Posted Load	NO SIGNS
Traffic	NO SIGNS
Horizontal	NO SIGNS
Vertical	NO SIGNS

Def. Status ADEQ **Suff. Rating** 80.3

* WATERWAY DATA *

Drng. Area	
Wtrwy. Opening	99,999 sq ft
Navigation Control	NO PERM REQD
Nav. Vert./Hrz Clr.	
Nav. Vert. Lift Clr.	
MN Scour Code	L-STBL;LOW RISK
Scour Eval. Year	1993

* INSPECTION DATA *

Inspection Date	05-19-2005 (YGIH)
Inspection Frequency	24
Inspector	METRO

Condition Codes		**Appraisal Ratings**	
Deck	6	**Struct. Eval.**	5
Superstruct.	6	**Deck Geometry**	5
Substruct.	5	**Underclearances**	9
Chan. & Prot.	6	**Waterway Adeq'cy**	N
Culvert	N	**Appr. Alignment**	8

Other Inspection Codes

Open, Posted, Clsd.	A	**Rail Rating**	1
Pier Protection		**Appr. Guardrail**	0
Scour Critical	8	**Appr. Trans.**	0
Deck Pct. Unsnd.	2 %	**Appr. Term.**	N

In Depth Inspections

	Y/N	Freq.	Last Insp.
Frac. Critical			
Pinned Asbly.			
Underwater	Y	60	02/2004
Spec. Feat.			

* PAINT DATA *

Year Painted	1980
Pct.Unsound	
Total Painted Area	
Primer Type	3309 UNPAINTED
Finish Type	3309 UNPAINTED

* CAPACITY RATINGS *

Design Load	HS20MOD MN
Operating Rating	HS 35.0
Inventory Rating	HS 20.0
Posting	Veh: Semi: Dbl:
Rtg Date	04-01-1980

* IMPROVEMENT DATA *

Prop. Work	REHAB DET
Work By	CONTRACT
Prop. Structure	BRIDGE
Length	1,886.5 ft
Width	49.2 ft
Appr. Rdwy. Work	
Bridge Cost	8,155,000
Approach Cost	100,000
Project Cost	1,500,000
Data - Year/Method	2003 COMPUTER

Crew Number: 7627
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 2440 TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS INSP. DATE: 05-19-2005

County: HENNEPIN | Location: 0.3 MI NE OF JCT TH 952A | Length: 1,887.8 ft
City: MINNEAPOLIS | Route: MNTH 65 Ref. Pt.: 001+00.716 | Deck Width: 81.6 ft
Township: | Control Section: 2710 Maint. Area: 5A | Rdwy. Area / Pct. Unsnd: 110,814 sq ft 2 %
Section: 23 Township: 029N Range: 24W | Local Agency Bridge Nbr: 6206 | Paint Area / Pct. Unsnd:
Span Type: CONCR / ARCH
NBI Deck: 6 Super: 6 Sub: 5 Chan: 6 Culv: N | Open, Posted, Closed: OPEN
Appraisal Ratings - Approach: 8 Waterway: N | MN Scour Code: L-STBL;LOW RISK | Def. Stat: ADEQ Suff. Rate: 80.3
Load Posting: NO SIGNS Traffic Signs: NO SIGNS Horiz. Cntl. Signs: NO SIGNS Vert. Cntl. Signs:

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
377	CONC DECK-EPOXY&LSCO	0	2	05-19-2005	30,937 SF	0	30,937	0	0	0
				09-16-2004	30,937 SF	0	30,937	0	0	0
	Notes: [2003] Type 1 & 3 deck repair, seal deck cracks. Two approach spans at each end. [1980] New deck (7" deep) with 2" low slump overlay (only top mat has epoxy rebar).									
378	CONC SLAB-EPOXY&LSCO	0	2	05-19-2005	123,107 SF	0	123,107	0	0	0
				09-16-2004	123,107 SF	0	123,107	0	0	0
	Notes: 7 arch spans. [2003] Type 1 & 3 deck repair, seal deck cracks. [1980] New slab (9" deep) with 2" low slump overlay (only top mat has epoxy rebar). [83/2000] Extensive conc patches along poured jts (continual repairs required). [2004] 2% deck unsound.									
300	STRIP SEAL JOINT	0	2	05-19-2005	2,982 LF	2,982	0	0	N/A	N/A
				09-16-2004	2,982 LF	2,982	0	0	N/A	N/A
	Notes: 300) [2003] 43 Strip seal joints replaced at abutments, arch piers & spans.									
301	POURED DECK JOINT	0	2	05-19-2005	496 LF	496	0	0	N/A	N/A
				09-16-2004	496 LF	496	0	0	N/A	N/A
	Notes: [2003] Pourable joints replaced at sidewalk & pier bent 2 (north approach).									
320	CONC APPR SLAB-BITOL	0	2	05-19-2005	2 EA	0	2	0	0	N/A
				09-16-2004	2 EA	0	2	0	0	N/A
	Notes: Both approaches are bituminous. [97/2004] Each approach has longitudinal cracking, with 100 SF bituminous patches along abutment end block.									
333	RAILING - OTHER	0	2	05-19-2005	4,091 LF	1,546	2,045	500	N/A	N/A
				09-16-2004	4,091 LF	1,546	2,045	500	N/A	N/A
	Notes: [2003] Special surface finish on railing. [1980] Roadway rail code 23 (J-rail with line pipe). [1983/88] Rail base has moderate scale & 600 LF of vertical cracks. [1997] Metal pipe has extensive corrosion, 2 sections on SE approach radius are bent (traffic impact).									
334	METAL RAIL-COATED	0	2	05-19-2005	4,086 LF	2,043	2,043	0	0	0
				09-16-2004	4,086 LF	2,043	2,043	0	0	0
	Notes: Pedestrian ornamental metal rail with concrete posts - metal railings are original (refurbished in 1980). [1997] Metal portions have minor corrosion.									
106	UNPNTD STEEL GIRDER	0	2	05-19-2005	1,856 LF	1,556	300	0	0	N/A
				09-16-2004	1,856 LF	1,556	300	0	0	N/A
	Notes: [1980] S approach spans reconstructed (36"-56" deep welded beams - unpainted weathering steel). [1991/99] Beam ends at N end have no room for expansion (contacting parapet on arch pier 1). As a result, fixed bearings at S abut have been damaged (anchor bolts bent southward).									
109	P/S CONCRETE GIRDER	0	2	05-19-2005	1,828 LF	1,828	0	0	0	N/A
				09-16-2004	1,828 LF	1,828	0	0	0	N/A
	Notes: [1980] North approach spans reconstructed (54" deep pre-stressed beams).									
144	CONCRETE ARCH	0	2	05-19-2005	3,812 LF	0	3,312	500	0	N/A
				09-16-2004	3,812 LF	0	3,312	500	0	N/A

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 2440 TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS INSP. DATE: 05-19-2005

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
	Notes: Spans 1 - 5 have 3 arch ribs, spans 6 & 7 have a solid arch barrel (all are original 1917 construction). [1980] Repair patches along arch edges. [1994/98] Arch barrels have minor longitudinal cracking, arch ribs have map cracking & spalling along edges.									
385	CONC SPANDREL COLUMN	0	2	05-19-2005	230 EA	0	115	115	0	N/A
				09-16-2004	230 EA	0	115	115	0	N/A
	Notes: Spans 1 - 5 have spandrel columns, spans 6 & 7 have spandrel walls. [1980] Upper portions reconstructed (lower portions original 1917 construction). [94/2000] Shear cracks have developed in column stubs near center of arch spans (some have cracked through & shifted up to 1/4"), several spandel columns have cracking & delam. Spandrel walls have cracking at horiz'l exp jts (some minor spalling), some areas of cracking, delam, and spalls.									
380	SECONDARY ELEMENTS	0	1	05-19-2005	1 EA	1	0	0	0	N/A
				09-16-2004	1 EA	1	0	0	0	N/A
	Notes: 380) Stairway at west side north end.									
310	ELASTOMERIC BEARING	0	2	05-19-2005	48 EA	47	1	0	N/A	N/A
				09-16-2004	48 EA	47	1	0	N/A	N/A
	Notes: Bent 1, south face arch pier 1, north face arch pier 8 & bent 2.									
313	FIXED BEARING	0	2	05-19-2005	20 EA	10	10	0	N/A	N/A
				09-16-2004	20 EA	10	10	0	N/A	N/A
	Notes: Fixed bearings at abutments. The anchor bolts bent southward at the south abutment.									
205	CONCRETE COLUMN	0	2	05-19-2005	9 EA	9	0	0	0	N/A
				09-16-2004	9 EA	9	0	0	0	N/A
	Notes: [1980] Bents 1 & 2 on approach spans.									
210	CONCRETE PIER WALL	0	2	05-19-2005	720 LF	0	520	200	0	N/A
				09-16-2004	720 LF	0	520	200	0	N/A
	Notes: Element includes arch piers (both the footings & upper portions) - with the exception of far upper sections, all are orig 1917 construction. [1984] Arch pier footings have severe spalling (up to 8" deep) below deck drains. [1996] Underwater insp found severe scale along waterline (all piers), with "voids" at upstream ends of piers 1 & 5. [1992/97] Pier 8: upper portion of pier wall (curved E end) has a severe vert crack (3/4" wide) severe spalling (4" deep). The curved W end has similar cracking, but not as severe. [2003] Good condition pier footings, inspected by construction inspector Tom Waks during low water.									
215	CONCRETE ABUTMENT	0	2	05-19-2005	168 LF	168	0	0	0	N/A
				09-16-2004	168 LF	168	0	0	0	N/A
	Notes: < none >									
234	CONCRETE CAF	0	2	05-19-2005	6,320 LF	2,860	3,160	300	0	N/A
				09-16-2004	6,320 LF	2,860	3,160	300	0	N/A
	Notes: Element includes the spandrel caps (spans #1 - 5),& appr span pier caps. [1980] All spandrel caps & pier caps reconstructed. [1994] Some spandrel caps (mainly near center of arch spans) have severe shear cracks at column connections. [1997] Spandrel caps located below poured deck jts have rust stains, horizl cracking & delam, some areas of severe spall.									
387	CONCRETE WINGWALL	0	2	05-19-2005	4 EA	2	1	1	0	N/A
				09-16-2004	4 EA	2	1	1	0	N/A
	Notes: < none >									
358	CONC DECK CRACKING	0	2	05-19-2005	1 EA	0	0	1	0	N/A
				09-16-2004	1 EA	0	0	1	0	N/A
	Notes: 358) [1983/84] Overlay (arch spans) has extensive map cracking, with 2,500 LF of longitudinal cracks. South approach spans have some transverse cracking.									
359	CONC DECK UNDERSIDE	0	2	05-19-2005	1 EA	0	0	0	1	0
				09-16-2004	1 EA	0	0	0	1	0

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 2440 TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS INSP. DATE: 05-19-2005

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5

Notes: Arch spans. [2003] Conc repaired at old pourable jt locations. [97/2000] Underside of slab has some longtdl leaching cracks (rust stains & delam). Slab is deteriorating along spandrel caps (below poured jts) water sat, delam, spalling & exp rebar. S appr spans. [1991] Underside of deck has 200 LF trans leaching cracks. [1999] 30 SF delam along cracks.

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
360	SETTLEMENT	0	2	05-19-2005	1 EA	0	1	0	N/A	N/A
				09-16-2004	1 EA	0	1	0	N/A	N/A

Notes: [1992/98] NE retaining wall (along N abut appr) is tipping outward 2-1/2" (lower portion of the wall is original 1917 construction) - should be monitored (offset along sidewalk & railing above). The NW retaining wall is also tipped out slightly (1/2" gap offset at coping).

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
361	SCOUR	0	2	05-19-2005	1 EA	0	1	0	N/A	N/A
				09-16-2004	1 EA	0	1	0	N/A	N/A

Notes: [1996] Underwater inspection found portions of footings exposed on arch piers 2, 5, 6, & 7. [2004] Underwater Inspection by "Ayres Associates" found at pier #1 undermining of 18" to 24" deep by 6" high by 12 FT long along W side near the upstream nose & undermining of 18" to 24" deep by 6" to 24" high by 17.5 FT long along W side near the downstream nose. Pier #3 was only inspected at the downstream nose. High water velocity prohibited safe access to the upstream nose. No significant changes to structure condition. Pier #5 has undermining 3 FT high by 6 FT long by 18" deep on W side near the upstream nose. Upstream nose has undermining 6" by 6" by 18" deep. Pier #6 has numerous small undermines at the upstream nose. Pier #7 has undermining 2 FT deep by 30 FT long along it's side.

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
964	CRITICAL FINDING	0	2	05-19-2005	1 EA	1	0	N/A	N/A	N/A
				09-16-2004	1 EA	1	0	N/A	N/A	N/A

Notes: 964) Do not delete this critical finding smart flag.

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
981	SIGNING	0	2	05-19-2005	1 EA	1	0	0	N/A	N/A
				09-16-2004	1 EA	1	0	0	N/A	N/A

Notes: < none >

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
983	PLOWSTRAPS	0	2	05-19-2005	1 EA	1	0	0	N/A	N/A
				09-16-2004	1 EA	1	0	0	N/A	N/A

Notes: < none >

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
984	DRAINAGE	0	2	05-19-2005	1 EA	0	1	0	N/A	N/A
				09-16-2004	1 EA	0	1	0	N/A	N/A

Notes: 984) Dec k drains directly into river. [1984] Deck drains are eroding pier footings. [1998] Pier 8: water ponding inside hollow pier wall (west end).

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
985	SLOPES	0	2	05-19-2005	1 EA	0	1	0	N/A	N/A
				09-16-2004	1 EA	0	1	0	N/A	N/A

Notes: 985) [1998] Pier 8: bituminous slopes along pier base are undermined by erosion.

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
986	CURB & SIDEWALK	0	2	05-19-2005	1 EA	0	1	0	N/A	N/A
				09-16-2004	1 EA	0	1	0	N/A	N/A

Notes: 986) [92/1998] Sidewalks have 780 LF of cracks, with patching & spalling along the poured deck joints (arch spans).

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5
988	MISCELLANEOUS	0	2	05-19-2005	1 EA	0	0	1	N/A	N/A
				09-16-2004	1 EA	0	0	1	N/A	N/A

Notes: Catwalk, 36" watermain & phone conduits running below bridge. [1998] Utility supports have corrosion below poured deck jts. Deck lighting mounted on ext railings. [1990] Light pole blown into river during high wind - severe section loss found on light pole bases (under anchor bolt covers). 3 poles were replaced - the anchor bolt covers were removed, and light pole bases repainted. [2000] Graffiti "artists" are accessing catwalk from the arched openings on pier #8 (facing SE Main St.) - there is extensive graffiti throughout the arch superstructure.

General Notes: Bridge #2440 Year 2005
See previous year notes. These had to be deleted in order to enter new report for 2005. No new notes for 2005.
2005 Inspector: Palmer/Bergmann

Crew Number: 7627
Inspector: METRO

Mn/DOT BRIDGE INSPECTION REPORT

BRIDGE 2440 **TH 65 (3RD AVE S) OVER MISS R, BN RR& CITY STS** **INSP. DATE: 05-19-2005**

STRUCTURE UNIT: 0

ELEM NBR	ELEMENT NAME	STR UNIT	ENV	INSP. DATE	QUANTITY	QTY CS 1	QTY CS 2	QTY CS 3	QTY CS 4	QTY CS 5

Inspector's Signature

Reviewer's Signature / Date

Appendix D. Cost Detail

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 2440 MAINTENANCE/STABILIZATION/PRESERVATION (M/S/P) Activity Listing and Costs

Notes:
1 *Costs are presented in 2006 dollars.*
2 *Unit costs are presented to the dollar or cent depending on the precision of the specific value.*

STABILIZATION COST SUMMARY

	ITEM	COSTS
1.00	SUPERSTRUCTURE	$ -
2.00	SUBSTRUCTURE	$ 400,000
3.00	RAILINGS	$ -
4.00	DECK	$ 40,000
5.00	OTHER	$ 75,000
		$ 515,000

1.00 SUPERSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
1.05					$ -	$ -
1.10					$ -	$ -
1.15					$ -	$ -
1.20					$ -	$ -
1.25					$ -	$ -
1.30					$ -	$ -
1.35					$ -	$ -
1.40					$ -	$ -
1.45					$ -	$ -
1.50					$ -	$ -
						$ -

2.00 SUBSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
2.05	Repair exposed and undermined foundations	50	1	LS	$ 400,000	$ 400,000
2.10					$ -	$ -
2.15					$ -	$ -
2.20					$ -	$ -
2.25					$ -	$ -
2.30					$ -	$ -
2.35					$ -	$ -
2.40					$ -	$ -
2.45					$ -	$ -
2.50					$ -	$ -
						$ 400,000

3.00 RAILINGS

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
3.05					$ -	$ -
3.10					$ -	$ -
3.15					$ -	$ -
3.20					$ -	$ -
3.25					$ -	$ -
3.30					$ -	$ -
3.35					$ -	$ -
3.40					$ -	$ -
3.45					$ -	$ -
3.50					$ -	$ -
						$ -

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
4.05	Inspect and test drainage features	N.A.	1	LS	$ 40,000.00	$ 40,000
4.10					$ -	$ -
4.15					$ -	$ -
4.20					$ -	$ -
4.25					$ -	$ -
4.30					$ -	$ -
4.35					$ -	$ -
4.40					$ -	$ -
4.45					$ -	$ -
4.50					$ -	$ -
						$ 40,000

5.00 OTHER

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
5.05	Superstructure and Substructure Survey	N.A.	1	LS	$ 75,000.00	$ 75,000
5.10					$ -	$ -
5.15					$ -	$ -
5.20					$ -	$ -
5.25					$ -	$ -
5.30					$ -	$ -
5.35					$ -	$ -
						$ 75,000

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 2440 MAINTENANCE/STABILIZATION/PRESERVATION (M/S/P) Activity Listing and Costs

Notes:
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2. *Unit costs are presented to the dollar or cent depending on the precision of the specific value.*

PRESERVATION COST SUMMARY

	ITEM	COSTS
1.00	SUPERSTRUCTURE	$ 2,000,000
2.00	SUBSTRUCTURE	$ 8,000,000
3.00	RAILINGS	$ 250,000
4.00	DECK	$ 180,000
5.00	OTHER	$ 1,667,000
		$ 12,097,000
	Mobilization @ 5% and 20% Contingency:	$ 2,608,000
		$ 14,705,000

1.00 SUPERSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
1.05	Concrete repairs	50	1	LS	$ 2,000,000	$ 2,000,000
1.10					$ -	$ -
1.15					$ -	$ -
1.20					$ -	$ -
1.25					$ -	$ -
1.30					$ -	$ -
1.35					$ -	$ -
1.40					$ -	$ -
1.45					$ -	$ -
1.50					$ -	$ -
1.55					$ -	$ -
1.60					$ -	$ -
1.65					$ -	$ -
						$ 2,000,000

2.00 SUBSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
2.05	Remove and rework abutment backfills	75	1	LS	$ 1,000,000	$ 1,000,000
2.10	Concrete repairs	50	1	LS	$ 7,000,000	$ 7,000,000
2.15					$ -	$ -
2.20					$ -	$ -
2.25					$ -	$ -
2.30					$ -	$ -
2.35					$ -	$ -
2.40					$ -	$ -
2.45					$ -	$ -
2.50					$ -	$ -
						$ 8,000,000

3.00 RAILINGS

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
3.05	Paint railings	40	1	LS	$ 250,000	$ 250,000
3.10					$ -	$ -
3.15					$ -	$ -
3.20					$ -	$ -
3.25					$ -	$ -
3.30					$ -	$ -
3.35					$ -	$ -
3.40					$ -	$ -
3.45					$ -	$ -
3.50					$ -	$ -
3.55					$ -	$ -
3.60					$ -	$ -
3.65					$ -	$ -
3.70					$ -	$ -
						$ 250,000

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
4.05	Seal cracks in the deck and sidewalks	5	1	LS	$ 100,000	$ 100,000
4.10	Install concrete approach panels	75	1	LS	$ 75,000	$ 75,000
4.15	Remove vegetation	5	1	LS	$ 5,000	$ 5,000
4.20					$ -	$ -
4.25					$ -	$ -
4.30					$ -	$ -
4.35					$ -	$ -
4.40					$ -	$ -
4.45					$ -	$ -
4.50					$ -	$ -
						$ 180,000

5.00 OTHER

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL
5.05	Concrete testing and mapping program	N.A.	1	LS	$ 250,000	$ 250,000
5.10	3D model and load rating	N.A.	1	LS	$ 125,000	$ 125,000
5.15	Replace missing light fixtures	N.A.	1	LS	$ 40,000	$ 40,000
5.20	Repair signage	N.A.	1	LS	$ 2,000	$ 2,000
5.25	Field work for rehabilitation project	N.A.	1	LS	$ 250,000	$ 250,000
5.30	Contract document preparation	N.A.	1	LS	$ 1,000,000	$ 1,000,000
5.35					$ -	$ -
						$ 1,667,000

Mn/DOT Historic Bridge Management Plan

BRIDGE No. 2440 MAINTENANCE/STABILIZATION/PRESERVATION (M/S/P) Activity Listing and Costs

Notes:

1. *Costs are presented in 2006 dollars.*
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MAINTENANCE COST SUMMARY

	ITEM	ANNUAL COSTS
1.00	SUPERSTRUCTURE	$ 3,000
2.00	SUBSTRUCTURE	$ 5,000
3.00	RAILINGS	$ 14,300
4.00	DECK	$ 6,000
5.00	OTHER	$ 17,000
		$ 45,300

1.00 SUPERSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
1.05	Flush fascia beams and arches w water	1	1	LS	$ 3,000	$ 3,000	$ 3,000
1.10					$ -	$ -	$ -
1.15					$ -	$ -	$ -
1.20					$ -	$ -	$ -
1.25					$ -	$ -	$ -
1.30					$ -	$ -	$ -
1.35					$ -	$ -	$ -
1.40					$ -	$ -	$ -
1.45					$ -	$ -	$ -
1.50					$ -	$ -	$ -
						$ 3,000	$ 3,000

2.00 SUBSTRUCTURE

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
2.05	Flush fascia faces of piers w water	1	1	LS	$ 5,000	$ 5,000	$ 5,000
2.10					$ -	$ -	$ -
2.15					$ -	$ -	$ -
2.20					$ -	$ -	$ -
2.25					$ -	$ -	$ -
2.30					$ -	$ -	$ -
2.35					$ -	$ -	$ -
2.40					$ -	$ -	$ -
2.45					$ -	$ -	$ -
2.50					$ -	$ -	$ -
						$ 5,000	$ 5,000

3.00 RAILINGS

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
3.05	Flush railings with water	1	1	LS	$ 3,000	$ 3,000	$ 3,000
3.10	Spot paint railings	5	1	LS	$ 25,000	$ 25,000	$ 5,000
3.15	Repaint railings	40	1	LS	$ 250,000	$ 250,000	$ 6,250
3.20					$ -	$ -	$ -
3.25					$ -	$ -	$ -
3.30					$ -	$ -	$ -
3.35					$ -	$ -	$ -
3.40					$ -	$ -	$ -
3.45					$ -	$ -	$ -
3.50					$ -	$ -	$ -
						$ 278,000	$ 14,250

4.00 DECK

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
4.05	Flush deck and sidewalks with water	1	1	LS	$ 6,000	$ 6,000	$ 6,000
4.10					$ -	$ -	$ -
4.15					$ -	$ -	$ -
4.20					$ -	$ -	$ -
4.25					$ -	$ -	$ -
4.30					$ -	$ -	$ -
4.35					$ -	$ -	$ -
4.40					$ -	$ -	$ -
4.45					$ -	$ -	$ -
4.50					$ -	$ -	$ -
						$ 6,000	$ 6,000

5.00 OTHER

REF. No.	ITEM / DESCRIPTION OF WORK	EXPECTED LIFE CYCLE - YEARS	ITEM QTY	QTY UNIT	UNIT COST	ITEM TOTAL	ANNUAL COST
5.05	Routine inspection	1	1	LS	$ 5,000	$ 5,000	$ 5,000
5.10	Arm's length inspection	4	1	LS	$ 32,000	$ 32,000	$ 8,000
5.15	Underwater inspection	5	1	LS	$ 20,000	$ 20,000	$ 4,000
5.20					$ -	$ -	$ -
5.25					$ -	$ -	$ -
5.30					$ -	$ -	$ -
5.35					$ -	$ -	$ -
						$ 57,000	$ 17,000

Bridge Number: 2440

Bridge 2440, an open spandrel concrete arch, carries Trunk Highway 65 (3rd Avenue South) over the Mississippi River in Hennepin County. The Minnesota Department of Transportation (MnDOT) has committed to preserve certain state-owned historic bridges, including Bridge 2440. As part of this commitment, MnDOT prepared a Historic Bridge Management Plan (Management Plan) for each of the bridges. These plans for state-owned bridges were prepared between 2006 and 2009, and can be found on the MnDOT website (see http://www.dot.state.mn.us/historicbridges/about.html). The 2006 Management Plan for Bridge 2440 describes the character-defining features of the bridge and recommends maintenance, stabilization, and preservation efforts for its ongoing use.

On behalf of MnDOT, Mead & Hunt conducted a review of correspondence files, bridge plans, and engineering records for Bridge 2440 in 2014. This review found no changes, alterations, or major repairs since the completion of the original management plan. As such, the condition findings and engineering recommendations outlined in the original management plan are still applicable.

Cost estimates provided in the original Management Plan reflect 2006 costs. Those costs were not updated as part of this study. Prior to any planned work, new cost estimates should be prepared for the proposed project. Funding for this bridge in the Management Plan previously identified the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) as a source for rehabilitation funds. Since the creation of the original management plans in 2006, federal transportation funding was reauthorized under a program known as MAP-21, which replaced SAFETEA-LU. The MAP-21 program is in place until September 30, 2014, at which time it is expected to be replaced by another federal transportation reauthorization bill expected to authorize federal funds for transportation projects.

Appendix B – Historic Property Record

MINNESOTA HISTORIC PROPERTY RECORD

PART I. PROPERTY IDENTIFICATION AND GENERAL INFORMATION

Common Name: Third Avenue Bridge

Bridge Number: 2440

Identification Number: HE-MPC-0165

Location:

Feature Carried: TH 65 (Third Avenue S.)

Feature Crossed: Mississippi River, railroad, and city streets

Descriptive Location: 0.3 Miles Northeast of Jct. TH 952A

Town, Range, Section: 29N-24W-23

Town or City: Minneapolis

County: Hennepin

UTM:

Zone: 15

Easting: 4981072

Northing: 479448

Quad:

Minneapolis
7.5 Minute Series
1983

Present Owner:

State

Present Use:

Mainline

Significance Statement:

The Third Avenue Bridge is individually eligible under Criterion C for its engineering significance and under Criterion A as a contributing element to the St. Anthony Falls Industrial Historic District.

The Third Avenue Bridge is an example of Melan arch construction. In 1894, Viennese engineer Josef Melan received an American patent for his innovative reinforcing system. It consisted "of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose" (Frame 1988:3). The first American bridge to embody the Melan system reportedly was a small highway span designed by German-born engineer Fritz von Emperger and built by William S. Hewett at Rock Rapids, Iowa, the same year as the patent. Several small but early Melan bridges were built and designed by Hewett in Minneapolis and Saint Paul for the Twin Cities Rapid Transit and survive today as park structures (Frame 1988:3). The

Third Avenue Bridge is significant because it reflects the design and engineering of Josef Melan's reinforcing system.

In 1912, Minneapolis planners solicited designs for a concrete-arch bridge from a New York-based company, the Concrete-Steel Engineering Co. The Third Avenue Bridge was to be constructed just above the St. Anthony Falls, originally planned to be to the north of the final location. The proposal, which called for sinking piers into the weak stratum that had caused the collapse of the Eastman Tunnel in the 1860s, was not well received by the public or the power companies (since a collapse of the falls would impact its power capabilities).

Frederick W. Capellen, Minneapolis city engineer, devised a solution by altering the bridge location and leapfrogging the bridge arches over the dangerous limestone breaks (Westbrook 1983:18). As described by A. M. Richter in an Engineering News article from 1915 (pp. 1269-1270):

"While bridge engineer for the city in previous years, Capellen had built six bridges across the Mississippi River and acquired a thorough knowledge of river conditions. He refused to approve the proposed location. The City Council then rejected the plans and instructed him to design a steel bridge that could be constructed without endangering the falls or affecting water-power-rights.

"His proposed location is shown on the plan, and his design included one span of 434 feet to clear entirely the area of the limestone breaks. The trusses were to be of the parabolic through-truss type. In the face of many objections (based mainly on aesthetic considerations), the City Council approved the plans and directed the engineer to proceed with construction."

At this time, however, Mr. Cappelen conceived the idea that by adopting a curved location for the line of the bridge, a design satisfactory to all parties might be worked out. On investigation it was found that at one point the limestone break could be spanned by a concrete arch of 211-foot clear-span. A revised plan for the desired ornamental structure was then presented. This proved satisfactory to all parties and was finally adopted."

Construction began on the Third Avenue Bridge in 1914, and the total project cost was $862,254.00.

PART II. HISTORICAL INFORMATION

Date of Construction:

1917

Contractor and/or Designer (if known):

Contractor: Unknown

Designer: Frederick W. Capellen

Historic Context:

Reinforced-Concrete Highway Bridges in Minnesota, 1900-1945

National Register Criterion:

A, C

PART III. DESCRIPTIVE INFORMATION

Descriptive Information:

The Third Avenue Bridge is the last major reinforced-concrete bridge constructed in the Twin Cities using Melan ribs (Westbrook 1983:18). As explained by Condit (1982:174-175):

"In the Melan system, the reinforcing consisted of a number of steel I-beams bent approximately to the shape of the arch axis and laid in a parallel series near the undersurface of the arch. The resulting structure might be regarded as a combination of the steel-rib arch and the concrete barrel, the concrete serving a protective as much as a structural purpose."

A detailed bridge description was presented in a 1915 article in Engineering News:

"There are five 211-ft. concrete arch spans with piers 20-ft. wide at the springing line and two 131-ft. spans with an intermediate pier 13.79-ft. wide. The two end, or abutment, piers and the pier between the 211-ft. and 134-ft. spans are 30-ft. wide. The approaches are steel girder spans on thin piers. All the river piers are skew to the center line. The 211-ft. spans are on the tangent of the 4? curves and the 134-ft. spans are on the 10? curves.

"Each of the 211-ft. spans is carried by three arched ribs of 36-ft. rise. The outside ribs are 12-ft. wide in the two end spans and 10 ft. in the intermediate spans, while all center ribs are 16 ft. wide. The reinforcing is of the Melan type, consisting of ribs of 4 x 4 x ½-in. angles laced with 3 x 3 x 5/16-in. angles (at haunches) and 2½ x -in. bars. There are six of these ribs in each 16-ft. arch rib, five in the 12-ft. and four in the 10-ft. ribs. They are braced every 30 ft. with 3 x 3 x 5/16-in. angles.

"The two 134-ft. spans over the east channel are full-barrel arches with Melan ribs of 3 x 3 x 5/16-in. angles laced with 2½ x ¼-in. bars. These are spaced 34 in. center to center and cross-braced every 30 ft. with 3 x 3 x 3/8-in. angles.

"Carrying the floor system from the ribs are transverse walls and girders supporting the floor slab and brackets supporting the sidewalk slabs and parapet-wall beam.

"The piers were constructed in open coffer-dams of Lackawanna steel sheeting, some of the sheeting being used three and four times. The coffer-dam dimensions were as follows: Pier No. 2, 46 x 121-ft.; Nos. 3 to 6, inclusive, 37 x 113-ft.; No. 8, 24 x 101.5-ft.; No. 7 (between the larger and smaller arches), 46 x 131-ft.; east abutment pier, 42 x 110-ft.

"The construction of pier No. 2 is described in what follows and is typical of all the work. After placing the underbracing for the coffer-dam, the sheetpiling was driven. On this pier (also No. 3) it was necessary at the upstream end of the coffer-dam, because of the strong current, to anchor 15-in. I-beam sills to the rock bottom with 2-in. rods to hold the lower end of the sheeting in place.

"The steel sheeting was very tight and was made entirely water-tight by a filling of coal dust and fine cinders. Sandbags were placed around the bottom of the sheeting and then pumping was started. If water came in through fissures in the rock, pumping was stopped and the bottom curse of the concrete, 5 to 6 ft. think, was placed under water. After this had set, the coffer-dam was pumped out and the remainder of the work placed dry. This was done on piers Nos. 2, 6 and 8 and partly on No. 3. Excavating for piers Nos. 6 and 8 was done entirely with orange-peel buckets. The rock in those coffer-dams was cleaned by divers with water jets. The other foundations were place dry, but always in sections, and generally four sections to each coffer-dam.

"After the footings were completed, the piers were concreted in forms which were used over and over again. The first section above the footing was carried above water level, generally leaving a center space considerable below water level to receive the ends of the steel ribs. Finally this part of the pier containing the ribs was cast in one continuous pouring. This amounted to about 7,000 yd. on piers Nos. 3, 4, 5, and 6; 1,266 yd. on Nos. 7 and 9; and 750 yd. on pier No. 8. The record run was 1,000 yd. in 22 hr.

"Pier construction was carried on through the winter except when the temperature was below zero, special precautions being taken against freezing. The forms were entirely inclosed [sic] with tarpaulins and heated with coke stoves. The sand and rock bins were supplied with heaters, and when necessary the cableway buckets for handling concrete were dipped in hot-water tanks on shore. Careful records were kept of temperatures of materials at deposit points. As a result, there was no trouble from frozen concrete.

"Concrete deposited under the water was 1:2:4 mixture. All other concrete in the piers was 1:3:6. It was mixed in batches of about 1yd. (24 ft. of stone, 12 of sand and 4 sacks of cement), two batches to each bucket. The stone was mostly traprock from Dresser Junction, Wis., crushed to a maximum size of 3 ½ in. The sand was a Minnesota product. A timber tower about 50 ft. high, with crib bottom for anchorage, was placed adjacent to the pier, standing on the river bottom. The tower had a hopper near the top, with a chute to the forms. The cableway buckets delivered concrete to the hopper, where a man regulated the discharge to the chute. The towers were picked up bodily by the cableway and moved from place to place.

"The first coffer-dam (pier No. 2) was begun Aug. 2, 1914, and the pier work was finished June 28, 1915. The river froze solid early in December, and the ice left the west channel in March and the east channel in April. Between the dates mention, 27,000 yd. of concrete was laid in pier construction.

"Falsework for the arches was begun Apr. 19, after the ice was out. One set of falsework was designed for the center ribs for the five 211-ft. spans. It was made in seven sections per span, supported by 24-in. 70-lb. I-beams, 28 ft. long on the inside sections and 26 ft. on the two end sections. The I-beams were supported on cribs made of eight 10 x 10-in. posts braced and capped and having open plank bottoms for loading with sandbags to sink them into place. These cribs were placed 28 ft. 11 in. c. to c.

"The falsework to carry the ribs was of 8 x 8-in. posts braced with 2 x 10-in. planks. The bents were capped and furnished with wedges under caps supporting the joists which carried the lagging and the framework for the rib. The lagging and side forms were 1-in. tongued-and-grooved plank, the forms being supported by 4 x 4-in. posts and 4 x 6-in. longitudinal timbers.

"The I-beams rested on 8-in. blocking, so that when the centering had been used for one rib, the entire falsework could be moved into place for the next rib by replacing the blocking with rollers. This falsework was placed in position for the upstream rib first and cribs were place also for the center ribs at the same time. Trouble was experienced in placing them because of high water and because several cribs were located on the roll dams and aprons. The use of the 24-in. I-beams of 26- and 28-ft. length was decided upon in order to utilize the material for the floor spans of the approaches.

"The first arch rib, between piers Nos. 2 and 3, was poured July 8, 1915; 240 yd. of concrete was handled on one cableway in 11 hr. over the center section of the rib. The steel ribs were then riveted at the haunches during the next night and the two end sections poured simultaneously the following day, both cableways being used for 9 hr. to handle 340 yd. of concrete. The last upstream rib was poured Aug. 5. Two days later the centering was struck under the first rib and the falsework rolled over by means of a crab on pier No. 2, with block and tackle hitched to each section. The whole centering for one span was thus moved in one day.

"On Aug. 16 the centering for the next span was moved into position and on Aug. 19 and 21 the center rib was poured – 768 yd. in 24 hr. A record run was made on the center rib finished Aug. 28, when 450 yd. was poured in 7½ hr. with both cableways, or one bucket every 2 min., at a distance of 1,600 ft. from the mixers. The concrete for the ribs is a 1:2:4 mix, using ¼ to 1½-in. stone.

"The program for the rest of the work provided for pouring one rib a week until all 15 were completed. The cribs for the upstream ribs were moved and used again for the third ribs on the downstream side. The centering of the last rib was moved over into place in 2 hr. 40 min.

"In October, 1915, the timber for the first three 211-ft. spans was moved over to the 134-ft. spans in order to finished the arches before cold weather sets in. The transverse walls are being put in, and only the floor proper will remain to be put in next spring. It is expected that the new bridge will be opened to travel not later than June1, 1916.

"The alignment of the bridge and skew of the piers necessitated an elaborate system of location. The triangulation had for its base the center tangent line of the bridge. A series of large triangles was laid out on either side of this base line, regard being given to prominent points as targets for the apices of the triangles.

"A secondary triangulation system was calculated, with proper attention to balancing errors for the location of the instrument platforms. Upon this the intersection points of pier, transverse center lines and base line of platforms were accurately established. These intersections were established with ordinary transits reading to 30 sec. Seconds were interpolated on the platforms by means of thread intersections; the minute next great and that next smaller to the actual triangle calculated to the nearest second were ready by the instrument man and recorded on the platform. Actual measurements show a maximum error of ¼-in. in 211 ft."

The bridge had ornamental railing installed in 1939, and was remodeled in 1979-1980. The rehabilitation consisted of complete deck removal; new light standards; raising of the spandrel columns; raising of the roadway grade by 5 feet; new approach pads; removal, cleaning and reinstallation of the 1939 railing; and pier repair.

PART IV. SOURCES OF INFORMATION

References:

Bridge Inventory Files, Bridge no. 2440, Minnesota Department of Transportation Office; Condit, C.W. “Reinforced Concrete: Buildings and Bridges,” in American Building: Materials and Techniques from the First Colonial Settlements to the Present, 2d ed. Chicago and London: University of Chicago Press, 1982; Frame, Robert M. “Reinforced-Concrete Highway Bridges of Minnesota,” National Register of Historic Places Multiple Property Documentation Form, Sec. F, 8, 1988, in files of State Historic Preservation Office, Minnesota Historical Society, St. Paul, Minnesota; Richter, A.M. “A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve,” Engineering News 74, no. 27 (1915):1268-1273, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota; Westbrook, N., ed. A Guide to the Industrial Archaeology of the Twin Cities. 1982, prepared for the Twelfth Annual Conference of the Society for Industrial Archaeology, on file at the State Historic Preservation Office, Bridge no. 2440 property file, Minnesota Historical Society, St. Paul, Minnesota.

PART V. PROJECT INFORMATION

Historians:

Kristen Zschomler

Form Preparer:

Mead & Hunt, 2006

MHPR NO. HE-MPC-0165

Appendix C – Bridge 2440 Engineering Summary 2015

Appendix D – *Engineering News* article, December 30, 1915

"A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve"

A 2,223-Ft. Concrete-Arch Bridge Built on Reverse Curve

By A. M. Richter*

SYNOPSIS—*A long bridge, curved in plan, with arches of two types; 211-ft. spans, with three arch ribs carrying crosswalls, and 124-ft. spans, with barrel arches. All are reinforced by steel truss ribs. Concrete was placed by a cableway of 2,223-ft. span, handling drop-bottom buckets. The entire construction is being done by the city on the day-labor system.*

The construction of the Third Ave. reinforced-concrete arch bridge across the Mississippi River at Minneapolis, Minn., has involved unusual engineering difficulties and presents features of interest in both design and construction. The bridge is notable for its size, because it is curved in plan and because it is being built on the day-labor system, which has been employed for some time in the city engineering department. Some stages of the work under construction are shown in Fig. 1, and the general plan is shown in Fig. 2.

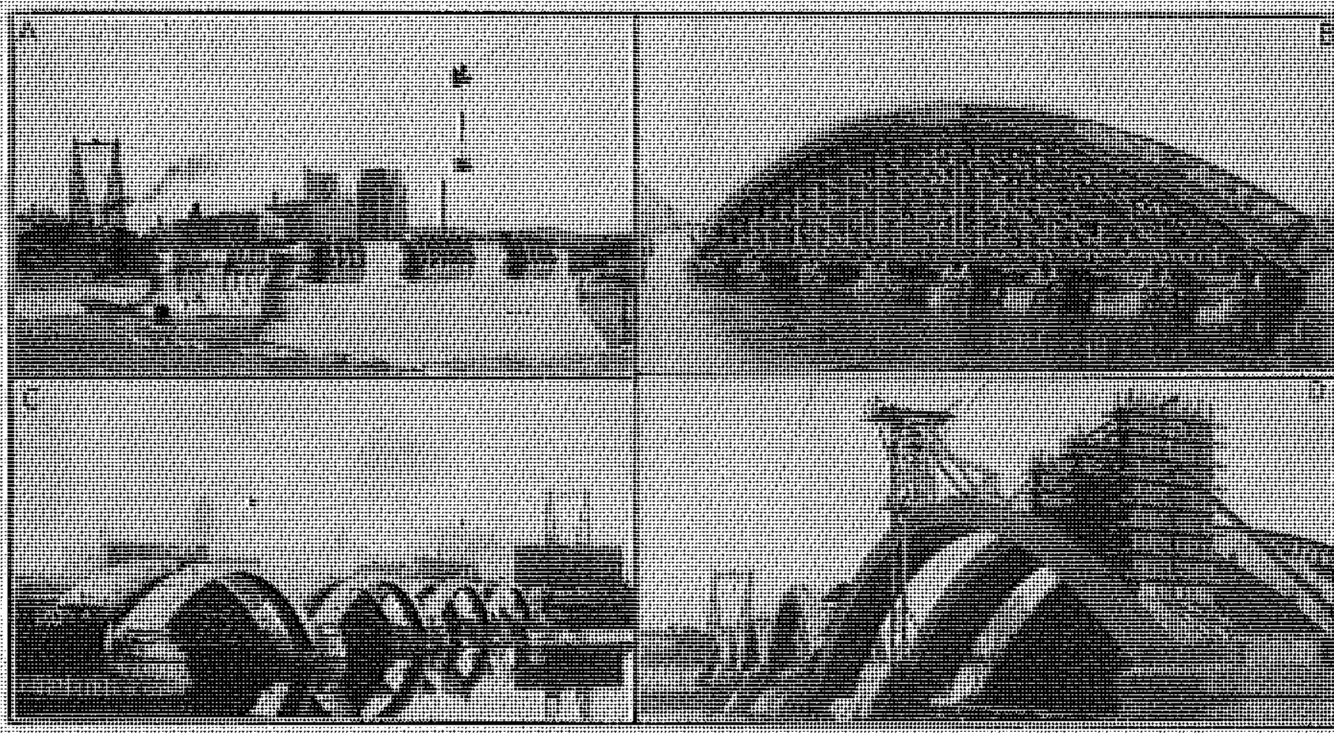

FIG. 1. CONSTRUCTION OF REINFORCED-CONCRETE ARCH BRIDGE OVER MISSISSIPPI RIVER AT THIRD AVE., MINNEAPOLIS, MINN.

A—Piers 4 and 5, showing ends of steel arch ribs and east tower of the cableway [illegible]. B—Falsework and steel reinforcing ribs for [illegible]. C—[illegible]. D—Fifth 211-ft. span, with two ribs completed and falsework and steel reinforcement in place for third rib. On the center rib are forms for the cross walls, and [illegible]

Troublesome Geological Conditions

Of special interest are the geological conditions which affect the foundation work and which account for the curved line of the bridge. The geological formation of the river bottom at the bridge site consists of a limestone bed about 15 ft. thick, which is practically bare in the west channel and covered only by a few feet of silt and sand in the east channel. The limestone ledge rests on the St. Peter sandstone, which is about 400 ft. in depth. This sandstone is readily excavated with picks and is easily eroded by the action of water, especially when under a head. The limestone extends upstream about 500 ft. from the bridge and downstream about 700 ft. to the crest of St. Anthony Falls.

In the early construction of works to utilize the power from St. Anthony Falls a peculiar advantage was afforded by the facility with which tunnels could be excavated in the soft sandstone. The water was led from the mill pond in a canal above the limestone, and the tunnels served as tailraces. In 1869, however, one of these tunnels had reached a point near the foot of Nicollet Island (2,000 ft. from the point of beginning), when water poured in from a break in the overlying bed of limestone. The project had to be abandoned, and the United States Government made extensive repairs to close the break in order to insure continuance of the water-power and restore the original conditions as far as possible. Another break occurred in 1870. The locations of these breaks in the river bed and their relation to the bridge projects are shown on the plan.

With the growth of the city, there has been strong demand for a bridge in the neighborhood of Third Ave. South. It was desired that this should be of handsome appearance, and a concrete arch structure was considered

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the best to meet the requirements of the situation. In 1912 the City Council commissioned the Concrete-Steel Engineering Co., of New York, to prepare designs for a reinforced-concrete arch bridge between Third Ave. South and First Ave. Southeast. The location is indicated by a dotted line on the plan.

The design was subjected to a public hearing before the engineers of the United States War Department in 1913. The water-power companies had not favored any bridge project and announced that, if necessary, they would resort to litigation to oppose any work threatening danger to the falls.

Shortly after affairs had reached this stage, Frederick W. Cappelen was elected city engineer. While bridge engineer for the city in previous years he had built six bridges across the Mississippi River and acquired a thorough knowledge of river conditions. He refused to approve the proposed location. The City Council then rejected the plans and instructed him to design a steel bridge that could be constructed without endangering the falls or affecting water-power rights.

His proposed location is shown on the plan, and his design included one span of 434 ft. to clear entirely the area of the limestone breaks. The trusses were to be of the parabolic through-truss type. In the face of objections (based mainly on æsthetic considerations) the City Council approved the plans and directed the engineer to proceed with construction.

At this time, however, Mr. Cappelen conceived the idea that by adopting a curved location for the line of the bridge, a design satisfactory to all parties might be worked out. On investigation it was found that at one point the limestone break could be cleared by a concrete arch of 211-ft. clear span. A revised

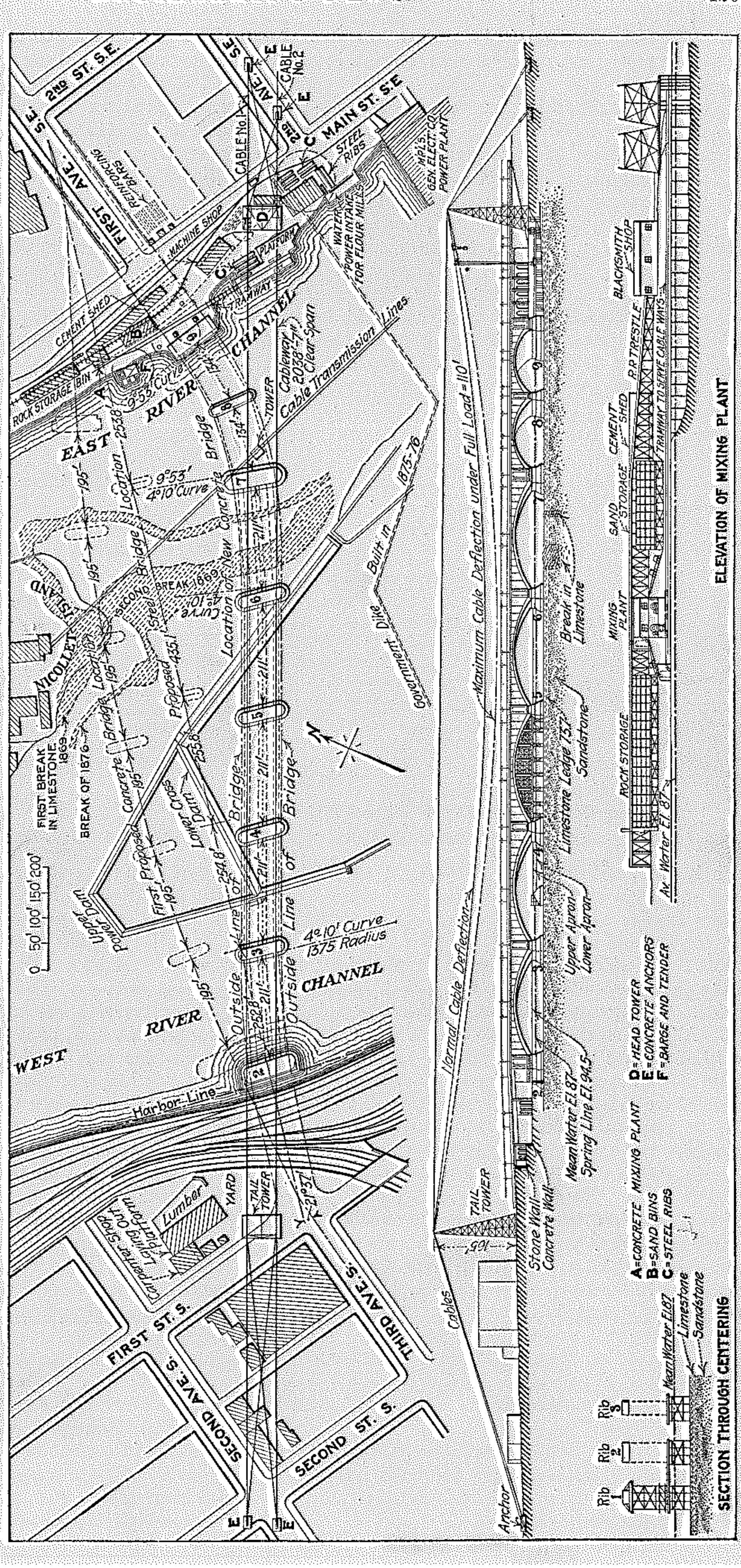

FIG. 2. PLAN AND ELEVATION OF THE THIRD AVE. REINFORCED-CONCRETE ARCH BRIDGE OVER THE MISSISSIPPI RIVER AT MINNEAPOLIS, MINN.

plan for the desired ornamental structure was then prepared. This proved satisfactory to all parties and was finally adopted.

The bridge is 2,223 ft. long and consists of seven main river spans. It has a 54-ft. roadway (with double-track street railway) and two 12-ft. sidewalks. The loading provides for two 40-ton cars and 100 lb. per sq.ft. uniform load. The floor system is designed to carry a 24-ton road roller on a space of 12x18½ ft. The center line starts at the intersection of Third Ave. South and First St. at an angle of 21° 39′, and is on a tangent for 151 ft. to a 4° curve 330.2 ft. long. A tangent 719 ft. long continues to a curve consisting of a 4° compounded into a 10° curve in a distance of 526.83 ft., bringing the center line of the bridge to that of First Ave. Southeast. The bridge is level, with a grade of 0.9% on the east approach and 3.4% on the west approach.

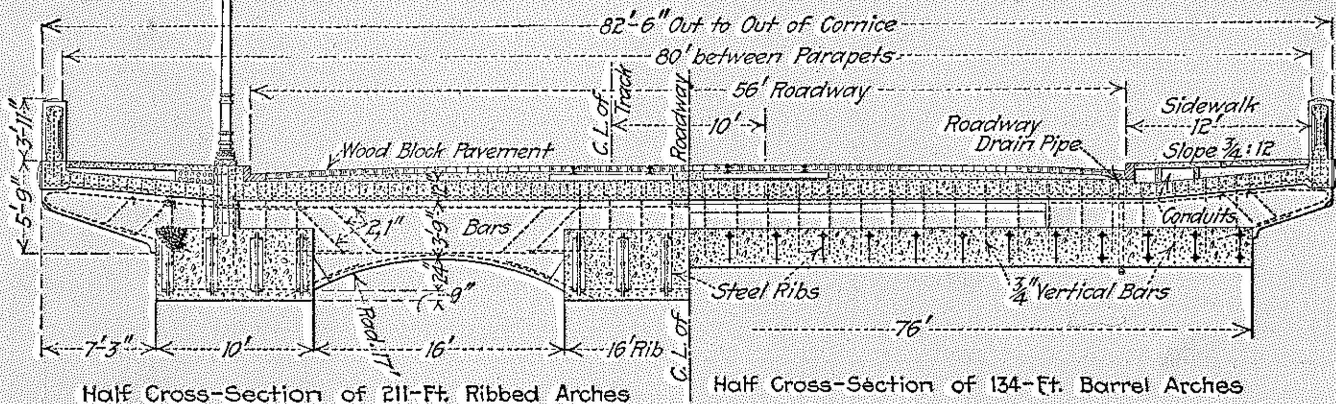

FIG. 3. CROSS-SECTION OF THE CONCRETE ARCH BRIDGE AT THIRD AVE., MINNEAPOLIS, MINN.

There are five 211-ft. spans with piers 20 ft. wide at springing line and two 134-ft. spans with an intermediate pier 13.79 ft. wide. The two end, or abutment, piers and the pier between the 211-ft. and 134-ft. spans are 30 ft. wide. The approaches are steel girder spans on thin piers. All the river piers are skew to the center line. The 211-ft. spans are on the tangent of the 4° curves and the 134-ft. spans are on the 10° curves.

Each of the 211-ft. spans is carried by three arched ribs of 36-ft. rise, as shown in the cross-section, Fig. 3. The outside ribs are 12 ft. wide in the two end spans and 10 ft. in the intermediate spans, while all center ribs are 16 ft. wide. The reinforcing is of the Melan type, consisting of ribs of 4x4x½-in. angles laced with 3x3x$\frac{5}{16}$-in. angles (at haunches) and 2½x⅜-in. bars. There are six of these ribs in each 16-ft. arch rib, five in the 12-ft. and four in the 10-ft. ribs. They are braced every 30 ft. with 3x3x$\frac{5}{16}$-in. angles.

The two 134-ft. spans over the east channel are full-barrel arches (Fig. 3) with Melan ribs of 3x3x$\frac{5}{16}$-in. angles laced with 2½x¼-in. bars. These are spaced 34 in. c. to c. and cross-braced every 30 ft. with 3x3x⅜-in. angles.

Carrying the floor system from the ribs are transverse walls and girders supporting the floor slab and brackets supporting the sidewalk slabs and parapet-wall beam. These are shown in Figs. 3 and 4.

The piers were constructed in open coffer-dams of Lackawanna steel sheeting, some of the sheeting being used three and four times. The coffer-dam dimensions were as follows: Pier No. 2, 46x121 ft.; Nos. 3 to 6, inclusive, 37x113 ft.; No. 8, 24x101.5 ft.; No. 7 (between the larger and smaller arches), 46x131 ft.; east abutment pier, 42x110 ft.

Practically no silt was found on top of the ledge at piers Nos. 2, 4 and 5, but there were from 6 to 12 in. at No. 3, 5 ft. at the downstream and 7 ft. at the upstream ends of No. 6, 9 and 10 ft. at No. 7, 8 ft. originally and scouring out to 3 ft. minimum at No. 8 and 8 ft. at pier No. 9. The depth of water was 16 ft. at piers Nos. 7, 8 and 9, 12 ft. at Nos. 2, 3, 6 and 12 and 5 ft. at Nos. 4 and 5.

The construction of pier No. 2 is described in what follows and is typical of all the work. After placing the underbracing for the coffer-dam, the sheetpiling was driven. On this pier (also No. 3) it was necessary at the upstream end of the coffer-dam, because of the strong current, to anchor 15-in. I-beam sills to the rock bottom with 2-in. rods to hold the lower end of the sheeting in place. This is shown in Fig. 5.

The steel sheeting was very tight and was made entirely water-tight by a filling of coal dust and fine cinders. Sandbags were placed around the bottom of the sheeting and then pumping was started. If water came in through fissures in the rock, pumping was stopped and the bottom course of concrete, 5 to 6 ft. thick, was placed under water. After this had set, the coffer-dam was pumped out and the remainder of the work placed dry. This was done on piers Nos. 2, 6 and 8 and partly on No. 3. Excavating for piers Nos. 6 and 8 was done entirely with orange-peel buckets. The rock in these coffer-dams was cleaned by divers with water jets. The other foundations were placed dry, but always in sections, and generally four sections to each coffer-dam.

The silt on top of the bedrock was full of old water-soaked logs that caused trouble in the excavation. Two slight breaks occurred in coffer-dam No. 3. Both occurred during night shifts, and might have been prevented had there been an intimation of a break during the day.

Construction of the Piers

After the footings were completed, the piers were concreted in forms which were used over and over again (Fig. 6). The first section above the footing was carried above water level, generally leaving a center space considerably below water level to receive the ends of the steel ribs. Finally this part of the pier containing the ribs was cast in one continuous pouring. This amounted to about 1,000 yd. on piers Nos. 3, 4, 5 and 6, 1,266 yd. on Nos. 7 and 9 and 750 yd. on pier No. 8. The record run was 1,000 yd. in 22 hr.

Pier construction was carried on through the winter except when the temperature was below zero, special precautions being taken against freezing. The forms were entirely inclosed with tarpaulins (Fig. 6) and heated with coke stoves. The sand and rock bins were supplied with heaters, and when necessary the cableway buckets for handling concrete were dipped in hot-water tanks on shore. Careful records were kept of temperatures of materials at deposit points. As a result, there was no trouble from frozen concrete.

Concrete deposited under water was a 1 : 2 : 4 mixture. All other concrete in the piers was 1 : 3 : 6. It was mixed in batches of about 1 yd. (24 ft. of stone, 12 of sand and 4 sacks of cement), two batches to each bucket. The stone was mostly traprock from Dresser Junction, Wis., crushed to a maximum size of 3½ in. The sand was a Minnesota product. A timber tower about 50 ft. high, with crib bottom for anchorage, was placed adjacent to the pier, standing on the river bottom. The tower had a hopper near the top, with a chute to the forms. The cableway buckets delivered concrete to the hopper, where a man regulated the discharge to the chute. The towers were picked up bodily by the cableway and moved from place to place.

The first coffer-dam (pier No. 2) was begun Aug. 2, 1914, and the pier work was finished June 28, 1915. The river froze solid early in December, and the ice left the west channel in March and the east channel in April. Between the dates mentioned, 27,000 yd. of concrete was laid in pier construction.

Falsework for the Arch Spans

Falsework for the arches was begun Apr. 19, after the ice was out. One set of falsework was designed for the center ribs for the five 211-ft. spans. It was made in seven sections per span, supported by 24-in. 70-lb. I-

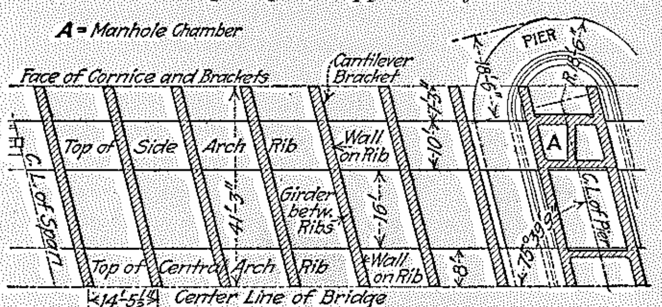

FIG. 4. PART PLAN OF 211-FT. ARCH SPAN
Showing the arch ribs and cross walls

beams, 28 ft. long on the inside sections and 26 ft. on the two end sections. The I-beams were supported on cribs made of eight 10x10-in. posts braced and capped and having open plank bottoms for loading with sandbags to sink them into place. These cribs were placed 28 ft. 11 in. c. to c. (Fig. 1).

The falsework to carry the ribs was of 8x8-in. posts braced with 2x10-in. planks. The bents were capped and furnished with wedges under caps supporting the joists which carried the lagging and the framework for the rib. The lagging and side forms were of 1-in. tongued-and-grooved plank, the forms being supported by 4x4-in. posts and 4x6-in. longitudinal timbers.

The I-beams rested on 8-in. blocking, so that when the centering had been used for one rib, the entire falsework could be moved into place for the next rib by replacing the blocking with rollers. This falsework was placed in position for the upstream rib first and cribs were placed also for the center ribs at the same time. Trouble was experienced in placing them because of high water and

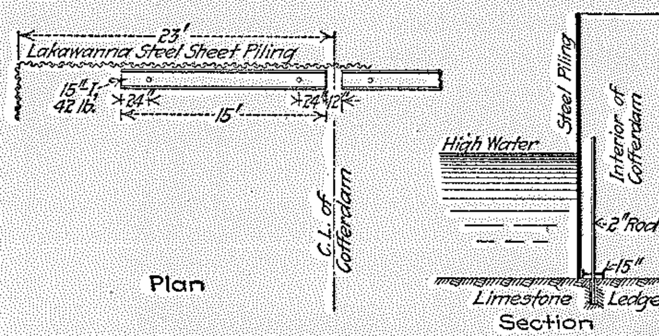

FIG. 5. SUPPORT FOR BOTTOM OF STEEL SHEETING FOR COFFER-DAM

because several cribs were located on the roll dams and aprons. The use of the 24-in. I-beams of 26- and 28-ft. length was decided upon in order to utilize the material for the floor spans of the approaches.

Concreting the Arches of the Bridge

The first arch rib, between piers Nos. 2 and 3, was poured July 8, 1915; 240 yd. of concrete was handled on one cableway in 11 hr. over the center section of the rib. The steel ribs were then riveted at the haunches during the next night and the two end sections poured simultaneously the following day, both cableways being used for 9 hr. to handle 340 yd. of concrete. The last upstream rib was poured Aug. 5. Two days later the centering was struck under the first rib and the falsework rolled over by means of a crab on pier No. 2, with block and tackle hitched to each section. The whole centering for one span was thus moved in one day.

On Aug. 16 the centering for the next span was moved into position and on Aug. 19 and 21 the center rib was poured—768 yd. in 24 hr. A record run was made on the center rib finished Aug. 28, when 450 yd. was poured in 7½ hr. with both cableways, or one bucket every 2 min., at a distance of 1,600 ft. from the mixers. The concrete for the ribs is a 1 : 2 : 4 mix, using ¼- to 1½-in. stone.

The program for the rest of the work provided for pouring one rib a week until all 15 were completed. The cribs for the upstream ribs were moved and used again for the third ribs on the downstream side. The centering for the last rib was moved over into place in 2 hr. 40 min.

In October, 1915, the timber for the first three 211-ft. spans was moved over to the 134-ft. spans in order to finish the arches before cold weather sets in. The transverse walls are being put in, and only the floor proper will remain to be put in next spring. It is expected that the new bridge will be opened to travel not later than June 1, 1916.

The alignment of the bridge and skew of the piers necessitated an elaborate system of location. The triangulation had for its base the center tangent line of the bridge.

A series of large triangles was laid out on either side of this base line, regard being given to prominent points as targets for the apices of the triangles.

A secondary triangulation system was calculated, with proper attention to balancing errors for the location of the instrument platforms. Upon this the intersection points of pier, transverse center lines and base line of platforms were accurately established. These intersections were established with ordinary transits reading to 30 sec. Seconds were interpolated on the platforms by means of thread intersections; the minute next greater and that next smaller to the actual triangle calculated to the nearest second were read by the instrument man and recorded on the platform. Actual measurements show a maximum error of 1/4 in. in 211 ft.

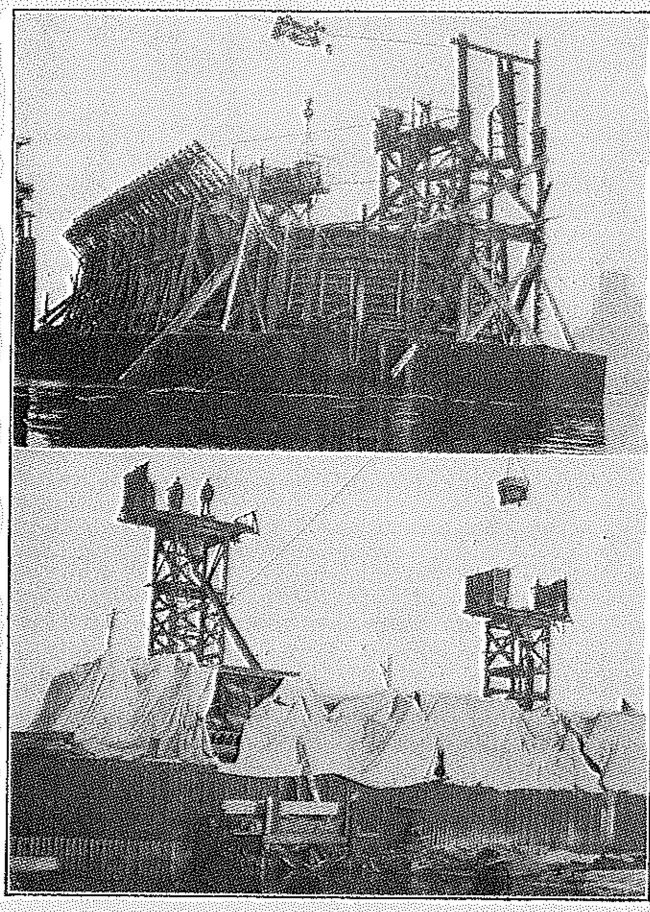

FIG. 6. CONCRETING THE PIERS FOR THE THIRD AVE. BRIDGE

Upper View—Work at pier No. 7 in April, 1915. Lower View—Concreting pier No. 3 during freezing weather in December, 1914

Handling Material by Cableways

The river conditions, as well as railway operations at the site of the bridge, led to the use of a Lidgerwood double cableway to handle the work. This has two 2½-in. steel main cables and is operated by two 75-hp. engines and a 150-hp. tubular boiler. The cables have a working span of 2,020 ft., giving a capacity of 6 tons each at a speed of 1,200 ft. per min. constant work and 10 tons for occasional demand. Fig. 2 shows the location of the cableway and the bridge.

The towers had to be 165 ft. high to insure clearance. The location of the anchors was a difficult problem, which was finally solved by utilizing space in the streets in such a way as to interfere but little with traffic. The towers are 39x76½ ft. at the base. They are built of Douglas-fir timbers, 12x14 to 10x10 in., and capped with oak headblocks, 20x20 in. and 7 ft. long.

The anchors of the head tower (east side) contain 122 yd. of concrete each and weigh 237 tons. They are 27x12½x10 ft. and entirely under the ground. The tail-tower anchors are 22x15x10 ft. each, containing 120 cu.yd. and weighing 230 tons. They are half buried in the street. Each tower is guyed by two 1½-in. lines. Difficulty was met in carrying one of the cable lines over a seven-story building about 100 ft. from the tail tower and in supporting the same line to afford clearance on the street at the anchor, as indicated in Fig. 2. High-water conditions, inability to get near the dam in rowboats and the necessity of precaution against dropping the heavy cable and cutting a power-transmission line, as well as danger of interference with trains on several tracks, were among the complications involved. The task was finally accomplished by using a rope line and then a 1⅛-in. messenger cable to trolley across the 2½-in. cables.

The cableways are located to serve all piers except No. 9, the abutment pier on the east side. This is near the mixing plant and was served direct with towers, elevators and derricks.

The towers were framed on the ground and then erected. The framing began Apr. 1, 1914, and was completed Aug. 1. It was done on the day-labor system, with a crew of 7 ironworkers, 20 carpenters and 15 laborers. The erection cost is estimated at $5,000 and the machinery and special equipment cost approximately $21,000.

Concrete-Mixing and Handling Plant

A difficult part of the work was that of arranging the working plant. There was no room except on Main St. (on the east side), and here some travel had to be provided for. The Great Northern R.R. maintains two industrial tracks on the street and owns the land to the river, which is leased to various concerns. The railway company, however, cancelled the leases and made it possible to establish the mixing plant at that point. Concrete, steel and machinery were located on the east side and lumber on the west side. The layout of the construction plant and supply yards is shown in Fig. 2.

The concrete-mixing plant has a capacity of 400 yd. in 8 hr. There is a 2,000-yd. rock-storage bin 125 ft. long and an 800-yd. sand bin 74 ft. long. The bins are 27½ ft. wide and 12 ft. deep, and are provided with boilers for heating. The material track reaches the top of the bins by a trestle 460 ft. long, with a grade of 4%. Stone and sand are delivered through bottom openings into cars of 24-cu.ft. capacity, which serve the mixing platform by a cable incline operated by hoisting engines. The cement shed, 20x200 ft., of 5,000 bbl. capacity, is served by a sidetrack.

There are two cube-type mixers, each of 1-yd. capacity. They are equipped with steam lines, and in freezing weather the water is run through a reheater. The water tanks are fitted with gages for measuring the supply to each batch. The sand and stone are dumped into the hopper at one level and the cement from a higher level, and the entire charge then spouted into the mixer.

The concrete is discharged into 2-yd. drop-bottom buckets. These are circular in shape, with conical bottoms, and have legs so that they stand upright on flat cars. These cars are hauled between the mixer plant and the cableway on a double-track cable tramway operated by American reversible hoisting engines.

At the city workhouse prisoners are making the ornamental concrete railing shown in Fig. 7. The concrete is made with mica-spar crystals (from Crown Point, N. Y.) and is cast in steel molds to obtain a smooth finish and polish. The cement workers' union protested against this plan, but finally withdrew its objections. This railing is estimated to cost $20,000.

Other Construction Plant

Space and trackage were very limited on the west side, but three lots at the street level were loaned by the Rock Island Lines. Here was erected a 48x135-ft. platform for framing timber and laying out the centering; also a small planing and ripping mill, tool house, men's house and engineers' field office. The timber is piled high on account of limited space. It is handled by a derrick with a 47-ft. boom and a 17-ft. mast.

The machine shop, 30x60 ft., is also on the east side. It has a blacksmith forge, bolt-threading machine, emery

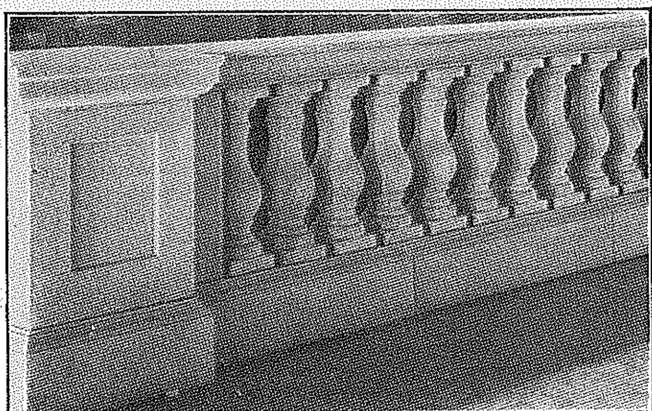

FIG. 7. CONCRETE RAILING FOR THE THIRD AVE. BRIDGE

grinder, miscellaneous tools and one 4-ton and two 2-ton chain blocks. A track runs under the shop from the cableway tower, so that equipment may be run in for repairs. Two movable derricks in the same location have 65-ft. masts and 50-ft. booms. Completing the east-side layout are the steel storage yards, served by a derrick with 65-ft. mast and 75-ft. boom. Each Melan rib is in its own common pile, some running 35 sections high. The reinforcing steel and bar iron are in separate places bundled and labeled for length and location.

Electric motors are used in the mill and machine shop and for operating the concrete mixers. Electric drills are employed in timber framing. All pumping was done with electric belt-driven centrifugal pumps. Compressed air was used for riveting.

The total cost was estimated at $650,000. The bridge will require 53,000 cu.yd. of concrete, 963 tons of structural steel for the arch ribs, 800 tons of reinforcing bars for piers and 1,500,000 ft. of lumber for centering. The prices for materials delivered at the site were as follows: Crushed traprock, $1.45 per cu.yd.; washed sand, 75c.; cement, $1.20 per bbl.; structural steel (including erection bolts and nuts), $53.50 per ton; reinforcing bars, $1.429 per 100 lb.; Lackawanna 7-in. steel sheetpiling, $1.63¾ per 100 lb.; coal (lump), $4.15 to $4.25 per ton; electric current for light and power, 2.9c. per kw.-hr.

The wages paid by the city (for an 8-hr. day) were as follows: Foremen, $4.50 to $6; ironworkers, $5; carpenters, hoisting enginemen and electricians, $4; handymen, $2.65; laborers, $2.50; water boys, $1.40; teams, $5.

The location was determined and the general design made by Frederick W. Cappelen, City Engineer (with whose aid and approval these notes were prepared). All construction was done under his direct supervision. He also designed the methods of construction, the working plant, falsework, etc. The assistant engineers, all employed in the city eigineering department, were as follows: K. Oustad, Bridge Engineer; William Elsberg, Superintendent of Construction; and John E. Lawton, Junior Engineer.

The construction foremen were N. Linstrom, for the forms, concreting and falsework, and J. F. McAuley, for the mechanical equipment. The Concrete-Steel Engineering Co. furnished the detail plans under its original commission of 1912. Its resident engineer on the work was Charles F. Bornefeld.

Large Water-Works Figures

Municipal ownership of water-works prevails in 155 of the 204 cities of the United States having an estimated population of 30,000 or more in 1915, according to a statement just issued by the United States Bureau of the Census. The total estimated value of these municipally owned works is $1,071,000,000. The distribution systems in the 155 cities comprise a total of 36,936 mi. of mains, 330,593 fire hydrants and 1,787,448 meters. The total water consumption in the 155 cities for the year covered by the report was 1,326,028,000,000 gal., supplied to 26,200,000 people, giving an average daily per capita consumption of 139 gal. On the range of water consumption and the effect of meters, the Bureau of the Census says:

> The greatest daily consumption of water per inhabitant, 430 gal., is reported for Tacoma, Wash., and the smallest, 34 gal., for Woonsocket, R. I. In the former city 8% of the water is metered and in the latter 98%. The tendency of meters to curtail greatly the use of water is strikingly shown by a comparison of the figures for the 26 cities in which the entire water-supply is metered with those for the 26 cities in which not more than 25% is metered. In the former group the average daily consumption per inhabitant ranges from 42 gal. in Brockton, Mass., to 179 gal. in Columbia, S. C., and in only 7 cities does it exceed 100 gal. In the latter group it varies from 43 gal. in Savannah, Ga., to 430 gal. in Tacoma, Wash., and in only 3 cities does it fall below 100 gal.

The number of cities with water-purification plants is not given. Instead the statement is made that in the 155 cities of over 30,000 population having municipal ownership there are in operation a total of 87 settling reservoirs, in which are treated 958,600,000 gal. a day; 54 coagulation plants, treating 492,100,000 gal.; 527 sand filters, treating 598,700,000 gal.; and 427 mechanical filters with a daily output of 468,200,000 gal. The surprising total of 1,972,900,000 gal. of water per day is treated by some disinfection process.

The range of cost of water treatment per 1,000,000 gal. is reported as from 4c. per 1,000,000 gal. in Chicago, Ill., for disinfection, to $17.46 in Columbus, Ohio, for "mechanical filtration and chemical sterilization."

More detailed information regarding both municipally owned water-works and various other works and operations of the larger cities of the United States will be published later on under the title "General Statistics of Cities, 1915," compiled under the direction of Starke M. Grogan, Chief Statistician for Statistics of Cities. Sam L. Rogers is Director of the Bureau of the Census.